THE PADUCAH GASEOUS DIFFUSION PLANT: AN ASSESSMENT OF WORKER SAFETY AND ENVIRONMENTAL CONTAMINATION

HEARING

BEFORE THE

SUBCOMMITTEE ON
OVERSIGHT AND INVESTIGATIONS

OF THE

COMMITTEE ON COMMERCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED SIXTH CONGRESS

FIRST SESSION

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THE PADUCAH GASEOUS DIFFUSION PLANT: AN ASSESSMENT OF WORKER SAFETY AND ENVIRONMENTAL CONTAMINATION

WEDNESDAY, SEPTEMBER 22, 1999

HOUSE OF REPRESENTATIVES,
COMMITTEE ON COMMERCE,
SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m., in room 2322, Rayburn House Office Building, Hon. Fred Upton (chairman) presiding.

Members present: Representatives Upton, Burr, Bilbray, Whitfield, Bryant, Bliley (ex officio), Klink, Stupak, Green, Strickland, DeGette, and Dingell (ex officio).

Staff present: Dwight Cates, majority investigator; Amy Davidge, legislative clerk; and Edith Holleman, minority counsel.

Mr. UPTON. Good morning. Today the subcommittee will review worker safety and environmental contamination at the Paducah Gaseous Diffusion Plant located in the congressional district of Congressman Ed Whitfield. This hearing follows a recent June hearing where this subcommittee reviewed the Department of Energy's nuclear safety program for protecting workers engaged in nuclear activities at DOE facilities as required by the Price Anderson Amendments Act of 1998. At that hearing, the subcommittee learned that DOE has not been aggressive in issuing nuclear safety rules or in holding its contractors accountable for complying with nuclear safety requirements. Today, at the urging of Congressman Whitfield, the subcommittee will assess DOE's effectiveness in enforcing worker safety at the Paducah site, as well as the Department's current and past efforts to deal with the enormous wastes that have accumulated in the course of nearly 50 years of uranium enrichment at Paducah.

The Paducah site was built in the early 1950's to increase the government's production of enriched uranium for defense and nondefense needs. The plant is surrounded by the West Kentucky Wildlife Management Area which, I am told, is a significant recreational resource to the Paducah community. Paducah is one of three gaseous diffusion plants, including the K-25 plant and the Portsmouth plant built by the Department of Energy's predecessor agency, the Atomic Energy Commission. The government ceased uranium production for weapons purposes in 1964. However, Paducah's enriched uranium output was actually increased in the late 1960's to meet the growing demands of the U.S. Naval Nuclear

Program and the nuclear power industry. The plant was operated for AEC and DOE under contract by Union Carbide between 1951 and 1986, and then by Martin Marietta which became Lockheed Martin between 1984 and 1996. Pursuant to the Energy Policy Act of 1992, the newly created government corporation USEC assumed uranium enrichment responsibility in 1993 at the Paducah and Portsmouth plants with Lockheed Martin continuing as contractor. USEC was privatized last year, and has assumed control of the plants from Lockheed Martin. The Paducah and Portsmouth plants are still owned by DOE, and are leased to USEC, which uses the plants to produce low-enriched uranium for sale as commercial power reactor fuel.

The DOE retains responsibility for remedial action of past environmental releases, or legacy wastes at the site, including nearly 37,000 canisters of depleted uranium. Contaminants found in groundwater wells around Paducah in 1988 eventually led to a Superfund site designation for Paducah in 1994. Several Superfund studies and cleanup actions to contain the spread of contaminants in groundwater and soil are already underway. Since October 1998, environmental responsibilities at Paducah have been managed by DOE's contractor, Bechtel Jacobs Corporation. USEC employs approximately 1,500 people, and Bechtel Jacobs employs 400 at Paducah.

There are many issues that we will cover today and they all stem from the committee's interest in ensuring that the workers and the surrounding community are safe. On today's first panel we will hear from three workers currently employed at Paducah—Mr. Jim Key, Mr. Garland Jenkins, and Mr. Ronald Fowler—and one Lockheed Martin employee who has worked at Paducah, Mr. Brad Graves.

I want to express my thanks to each of you and commend you for your bravery in coming forward to relate your experiences at this site. I realize that your efforts to reveal the truth at Paducah have introduced uncertain risks and complications in your lives but your efforts are truly appreciated. In the past 3 months, the country has learned more about Paducah than the DOE would have revealed in a period of years. You should also know if you experience any act of retaliation following your testimony before this subcommittee, you should notify us immediately.

Because of your efforts, and the front page press attention you have generated, the Secretary of Energy is now focused on worker safety and environmental issues at the Paducah site. Mr. Richardson visited the Paducah site on October 23, 1998, and met with the members of the Paducah Site Specific Advisory Board. According to the minutes of this meeting, board members expressed serious concerns regarding plutonium emissions from the site, the health impacts of legacy wastes at the site, and the fear of being forgotten within the Department's large Oak Ridge complex. The board's requests were not enough to attract the necessary attention to these issues.

Nonetheless, the two-phased investigation the Secretary recently initiated may answer many of the questions the board sought answers to last year. However, I still remain concerned that the first phase of DOE's investigation, covering the period from 1990 to present, is insufficient. Preliminary findings of the Department's 2-week onsite review of worker safety and environmental issues at Paducah were released last Tuesday. Findings include: 1, a failure of DOE to perform adequate health and safety oversight at Paducah; 2, a lack of discipline, formality and oversight with respect to Bechtel Jacobs' radiation protection program; and, 3, significant onsite hazards from legacy wastes stored onsite. But 2 weeks is not enough time to get your hands around 10 years of mismanagement. These preliminary findings do not include environmental sampling data DOE has collected on and offsite. The Department has told committee staff that radiation readings at one offsite stream are high enough to require technicians to wear protective clothing while taking samples. This contaminated stream is fully accessible to the public, but there are no warning signs.

In light of these findings, I should point out that several State and Federal studies around Paducah indicate that there is contamination offsite, but not at levels of current health hazard to the public. However, data recently obtained by the committee indicate that the levels of plutonium in offsite soil are higher than what the State, EPA, DOE and DOE's contractors have been telling the public.

I want to make it clear that this information needs to be verified and any health issues resolved quickly. This committee will give close scrutiny to any government agency or contractor who may have misled the Paducah community regarding offsite contamination.

It is also important to point out another issue that the Department's investigation of Paducah has not reviewed. Radiation protection in areas currently controlled by the United States Enrichment Corporation is regulated by the NRC. The NRC has informed the committee that the company is in compliance with nuclear safety requirements and that workers at the site are adequately protected from radiation. However, plant upgrades to protect workers in the event of an earthquake are still not complete. When the United States Enrichment Corporation was privatized last year, DOE transferred more than $200 million worth of uranium to the company to pay for these NRC upgrades which were supposed to be completed in 1997. This is a significant safety issue that will be thoroughly investigated as part the committee's review of the privatization of the United States Enrichment Corporation.

Clearly there are many issues that need to be closely evaluated at Paducah. There seem to be new revelations coming forth every day. The Department's Phase II investigation covering the period before 1990 has not even started. I expect that the Phase II effort will take months. It is unreasonable to believe that we will have all the answers today. However, I do expect candid answers regarding the Department's surprising lack of safety oversight and the mistakes made by DOE's contractors and the management changes that must occur to raise the level of worker safety and environmental cleanup performance at Paducah.

I also appreciate and thank the staff for working so hard on this hearing. I know that it was rather quickly set up and particularly with the delay last week because of the hurricane threat to Washington. We appreciate on both sides the good staff work done by both the Democratic and Republican members of the staff.

At this point, I would like to make a unanimous consent request that a number of documents that have been circulated on both sides be made a part of the record. Without objection, so ordered.

[The information referred to follows:]

Document #	Date	Description
1a	August 27, 1999	Letter from Jim Miller of USEC to Ms. Leah Denver of DOE. regarding the relocation of DOE Material Storage Areas
1b	September 15, 1999	Letter from Steve Toelle of USEC to Mr. Robert Pierson of the NRC regarding the progress of seismic upgrade modifications to buldings C-331 and C-335
2	October 23, 1998	Paducah Gaseous Diffusion Plant Site Specific Advisory Board Special Meeting Minutes
3	September 27, 1999	Executive summary from the Public Health Assessment: U.S. DOE Paducah Gas Diffusion Plant. Prepared by the Agency for Toxic Substances and Disease Registry
4	July 1990	Executive summary of U.S. DOE Tiger Team Assessment of the Paducah Gaseous Diffusion Plant
5a	March 27, 1990 (4 pages, various dates)	Exerts from the corporate Audit Records for Martin Marietta regarding worker safety
5b	May 1991	Exerts from the Martin Marietta Action Plant Response to Corporate Technical Audit of Paducah Gaseous Diffusion Plant
5c	August 19, 1992	Exerts from the Audit of Health, Safety and QA Management Systems for Martin Marietta
6	September 15, 1999	Fax from Jennifer Davis of OSHA to Committee staff regarding Paducah Gaseous Diffusion Plant Whistle Blower Complainants
7a	December 10-14, 1990	Exerts from the Martin Marietta Summary Report, Paducah Gaseous Diffusion Plant Environmental Compliance Review
7b	September 1991	Exerts from the Martin Marietta Paducah Gaseous Diffusion Plant Environmental Report for 1990
7c	October 23, 1992	Exerts from the Martin Marietta Environmental Compliance Report for Paducah Gaseous Diffusion Plant
7d	September 1993	Excerpts from Paducah Gaseous Diffusion Plant Environmental Report for 1992, prepared by Martin Marietta Energy Systems, Inc. for the U.S. DOE

8a	March 22, 1991	Results of the Site Investigation, Phase I at the Paducah Gaseous Diffusion Plant
8b	No date	"To come: Appendix 2B-17, Radiological Walkover Survey of Little Bayou Creek, Big Bayou Creek, and Plant Ditches
8c	January 4, 1991	Technical Memorandum prepared by Pat Schofield/ORO for Paducah Gaseous Diffusion Plant Phase I Site Investigation, Results of the radiological walkover survey of Little Bayou Creek, Big Bayou Creek, and Plant Ditches
8d	May 19, 1999	Page 16 from the Disclosure Statement of Thomas B. Cochran of the Natural Resources Defense Counsel regarding United States of America v. Lockheed Martin Corporation
8e	October 1992	Exerts from the Paducah Gaseous Diffusion Plant Environmental Report for 1991 prepared by Martin Marietta Energy Systems, Inc. for the U.S. DOE
9	September 8, 1999	Email from Jimmy C. Massey to Paducah BJC Personnel regarding a DOE safety stand down for the Paducah Gaseous Diffusion Plant
10	January 31, 1992	Martin Marietta interoffice memorandum from J.L. Walker, regarding potential questions for a February 4 pubic briefing
11	March 16, 1992	Article from the publication *Nuclear Fuel* entitled "Decision to Feed Reprocessed U to GDPs will complicate D&D"

USEC
A Global Energy Company

James H. Miller
Executive Vice President

301/564-3309/ *phone*
301/564-3205/ *fax*

August 27, 1999

Ms. G. Leah Dever
Manager, Oak Ridge Operations Office
U.S. Department of Energy
200 Administration Road
Oak Ridge, TN 37831

Paducah Gaseous Diffusion Plant (PGDP)
Relocation of DOE Material Storage Areas

Dear Ms. Dever:

Issue 36 of DOE/OR-2026, "Plan for Achieving Compliance with NRC Regulations at the Paducah Gaseous Diffusion Plant" (Compliance Plan), required USEC to complete the seismic upgrade modifications to the C-331 and C-335 process buildings. This project was identified by DOE as important to protect the public health and safety. The Nuclear Regulatory Commission (NRC) also considers this a high priority project for the Paducah Gaseous Diffusion Plant.

DOE's relocation of DOE Material Storage Areas (DMSAs) containing fissile or potentially fissile material within these two process buildings has adversely impacted the schedule for completion of USEC's seismic modification work by causing us to bypass these DMSAs and to restage equipment over longer distances. DOE's activities related to these DMSAs have now become a critical path item in the schedule to complete these modifications. DOE has committed to USEC and the NRC to begin relocation of the material in these DMSAs by September 22, 1999. In a recent meeting between NRC and USEC executive management, the NRC requested USEC to inform them immediately of any concerns about DOE's ability to meet this commitment. I must emphasize the importance of meeting this date to the successful completion of the seismic upgrade project and USEC's commitments to the NRC.

I am requesting your involvement and support to assure that DOE will meet its commitment to begin relocation of the material in these DMSAs by September 22, 1999. Please contact me immediately if you believe this date is in jeopardy.

Sincerely,

James H. Miller

James H. Miller
Executive Vice President

cc: G. Benedict (DOE)
J. Hodges (DOE)
J. Massey (Bechtel Jacobs)
L. Price (DOE)
J. Thiesing (Bechtel Jacobs)

USEC
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September 15, 1999
GDP 99-0168

Mr. Robert C. Pierson
Chief, Special Projects Branch
Division of Fuel Cycle Safety and Safeguards, NMSS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Paducah Gaseous Diffusion Plant (PGDP)
Docket No. 70-7001
Monthly Update on Progress of Seismic Upgrades to Buildings C-331 and C-335

Dear Mr. Pierson:

In accordance with USEC's commitments in our April 15, 1998 letter (Reference 1), the purpose of this letter is to provide the monthly update on the progress of the installation of the seismic upgrade modifications to Buildings C-331 and C-335.

Issue 36 of DOE/ORO-2026, "Plan for Achieving Compliance With NRC Regulations at the Paducah Gaseous Diffusion Plant" (the Compliance Plan) requires that the modifications to increase the seismic capacity of Buildings C-331 and C-335 be completed by June 30, 1999. As identified in our previous monthly status reports (Reference 2), USEC had anticipated that an additional 12 months would be required to complete the seismic upgrades to account for unanticipated construction difficulties and reduced worker productivity due to high temperatures. A Certificate Amendment Request (CAR) was submitted on January 12, 1999 (Reference 3) to request NRC review and approval of a change in the schedule for completing these upgrades to June 30, 2000. On June 30, 1999, NRC issued a Notice of Enforcement Discretion to allow USEC to continue plant operations until the NRC can issue the amended Certificate of Compliance for the this CAR.

During recent discussions with the NRC staff, USEC identified that additional time may be required to complete this project due to delays in relocating fissile/potentially fissile materials stored in DOE Material Storage Areas (DMSAs) in areas of the two buildings in which steel removal and/or installation must occur. DOE questions about the handling of fissile/potentially fissile material in the DMSA's from a nuclear criticality safety standpoint have delayed the movement of these materials from areas affecting construction. There are 46 work locations which remain inside DMSAs from which these materials must be relocated prior to beginning construction activities. USEC is in the process of preparing a CAR to request an additional extension to September 30, 2000. This request will be submitted to DOE by October 1, 1999 for their concurrence. The CAR will then be submitted to NRC within one week of obtaining DOE concurrence.

Mr. Robert C. Pierson
September 15, 1999
GDP 99-0168, Page 2

During August, 47 locations were completed. A total of 357 out of 723 locations have been completed. An average completion rate of 29 locations per month is necessary to support the proposed September 30, 2000, completion date. However, the current monthly completion targets are higher than the required average because some locations scheduled to be worked near the end of the project are expected to be more difficult to complete. The goal for September is 50 locations. USEC has authorized the construction contractor to add two additional crews (21 additional workers) to assist in meeting the proposed schedule. A revised schedule, showing the proposed new completion date of September 30, 2000 will be included in the next monthly status report.

The enclosure to this letter provides a list of new commitments contained in this submittal. Should you have any questions related to this subject, please contact me at (301) 564-3250.

Sincerely,

S. A. Toelle

Steven A. Toelle
Nuclear Regulatory Assurance and Policy Manager

References:
1. Letter from Steven A. Toelle (USEC) to Robert C. Pierson (NRC), "Schedule for Seismic Upgrades to Buildings C-331 and C-335," Letter No. GDP 98-0082, April 15, 1998.
2. Letters from Steven A. Toelle (USEC) to Mr. Robert C. Pierson (NRC); "Paducah Gaseous Diffusion Plant, Docket No. 70-7001, Monthly Update on Progress of Seismic Upgrades to Buildings C-331 and C-335;" Letter Nos. GDP 98-0217 dated November 16, 1998; GDP 98-0269 dated December 15, 1998; GDP 99-0019 dated January 15, 1999; GDP 99-0037 dated February 16, 1999; GDP 99-0051 dated March 15, 1999; GDP 99-0068 dated April 15, 1999; GDP 99-0085 dated May 14, 1999; GDP 99-0107 dated June 15, 1999; GDP 99-0128 dated July 15, 1999; and GDP 99-0150 dated August 16, 1999.
3. Letter from Steven A. Toelle (USEC) to Dr. Carl J. Paperiello (NRC), "Certificate Amendment Request - Buildings C-331 and C-335 Seismic Upgrades," Letter No. GDP 99-0012, dated January 12, 1999.

Enclosure: New Commitments Contained in This Submittal

cc: Mr. Patrick L. Hiland - NRC Region III
NRC Resident Inspector - PGDP
Mr. Randall M. DeVault - DOE

New Commitments Contained in This Submittal

1. USEC will prepare a certificate amendment request (CAR) to request an extension of the scheduled completion date for Compliance Plan Issue 36 to September 30, 2000. This CAR will be submitted to DOE by October 1, 1999 for their concurrence.

2. The CAR requesting an extension of the scheduled completion date for Compliance Plan Issue 36 to September 30, 2000 will be submitted to NRC within one week of obtaining DOE concurrence.

Paducah Gaseous Diffusion Plant
Site Specific Advisory Board
Special Meeting Minutes

October 23, 1998

Members of the Site Specific Advisory Board (SSAB) met with Energy Secretary Bill Richardson October 23, 1998, at 3:30 p.m. at the United States Department of Energy (DOE) Site Office.

The following board members were present: Nola Courtney, Mark Donham, David Fuller, Vicki Jones, Ronald Lamb, Ray McLennan, Bill Tanner, and Gregory Waldrop. Energy Secretary Bill Richardson was present. The ex officio member present was Jimmie Hodges. The DOE federal coordinator present was John Sheppard. Also present was Shelley Hawkins.

Jimmie Hodges introduced Energy Secretary Bill Richardson to the members of the SSAB and explained to the Secretary that the SSAB has been functioning for two years in Paducah. Hodges said the SSAB has made significant contributions to the program. He said it provides a cross-representation of the community and has helped in developing an understanding of the public's perspectives on cleanup.

Secretary Richardson gave the SSAB members a chance to voice their concerns to him.

Vicki Jones said her main concern was over the budget and in making sure Paducah does not get lost in the Oak Ridge Operations area of the budget. She said she would like to see Paducah get a fair share of the budget to fund cleanup.

Secretary Richardson said the work on the design of the uranium recycling plant will start in 1999. He said he had just announced a $6 million grant for worker retraining and regional economic development for Paducah. Richardson said the DOE cares about issues related to health and safety and is not going to forget about Paducah.

David Fuller said he appreciated hearing the news about the uranium plant. He said he was concerned about autonomy and coordinating better between events. Fuller said Paducah and Portsmouth were unique examples in the complex and it was difficult to blend all the operations of Paducah with others that do not exist elsewhere. Fuller said he would like to see some measure of autonomy for unique sites because things sometimes get lost in the translation. He said it might be helpful for Paducah to deal with some things on its own such as labor/worker issues. Fuller said Oak Ridge is nothing like Paducah and he would like to see better coordination between DOE Headquarters and Paducah.

Hodges explained to Richardson that Paducah money comes out of a decontamination and decommissioning fund and Paducah must compete with Oak Ridge and Portsmouth for funding. He said he thought Fuller desired better local control because our contract is the same as the one in Oak Ridge.

Ronald Lamb said his main concern was the cleanup and funding of the plant because he is a neighbor of the plant. Lamb said he was afraid the Accelerating Cleanup Plan would not allow enough funding for the cleanup to be thorough. He said he worried that there was too little time and money allocated for cleanup. Lamb said he would like the DOE to be more concerned with the people in relation to the sites.

Mark Donham said he lived approximately 15 miles downwind of the plant and his main concern was about air emissions and groundwater contamination. He said he was concerned about plutonium and neptunium emissions from the plant and that there was no pollution control on trichloroethene. He said higher levels were allowed to be emitted at Paducah than at other DOE sites. Donham said there needs to be more emphasis on cleaning the source of groundwater contamination rather than on the pump and treat facilities.

Bill Tanner said his main concern was that there were too many players in the funding and approval process. He said he would like to see things controlled at Paducah to accelerate cleanup. Tanner said he would also like to see more progress on stopping the sources of groundwater contamination.

Nola Courtney said she was concerned with how things were prioritized. She said sometimes when something could be done to save money down the road, it does not always correlate with what is best for human health and the environment. Courtney said legacy waste was a concern for her and she wanted the DOE to consider the best route for human health and the environment in cleanup. She said groundwater contamination and air emissions also were concerns for her.

Gregory Waldrop said he was apprehensive about the Accelerating Cleanup Plan. He said he would like to see Paducah have more local control. He said he was pleased with the cooperation and good relations with the local DOE. Waldrop said he would like to see more focus finance-wise.

Ray McLennan said his main concern was funding. He said he was not sure Paducah was getting its fair share of the budget since it is mixed in with Oak Ridge. McLennan said he would like to see the prioritization list changed. He said he would like to see more progress toward a safe environment now and, in the future, and would like to see more SSAB and DOE involvement in the end use of the plant. McLennan said he would also like to see more of the money being spent on cleanup instead of administration.

After all the members spoke, Richardson asked the members how the DOE could be a better neighbor in improving quality of life. Courtney said there seems to be a lack of pervasive concern about the plant in this region. She said she is amazed at how little people in this region know and that the SSAB may be obliged to let the public know. Courtney said the public seems to think there is no depletion of natural resources.

Richardson then asked the SSAB about their environmental concerns and members responded that their main concerns were groundwater contamination, legacy waste, and methodology for cleanup. Richardson asked Hodges what was being done onsite for groundwater remediation. Hodges said remediation is done on a solid waste management unit (SWMU)-by-SWMU basis. He said the DOE is looking at sources onsite. He said the C-400 Building now has ongoing characterization. Hodges said new technologies are being considered in dealing with the contamination onsite. He said the concerns are very valid and it has been a source of frustration in how quickly the problems are being handled. Hodges said air emissions are relatively small in terms of radiation dose and groundwater is the much bigger risk to the population.

Richardson asked what could be done about air emissions. Hodges said it would be helpful to gain the confidence of the public and assure the public that Paducah has acceptable emissions.

Richardson also asked the members about their feelings on community input. Courtney said there is a lack of concern with the public because some of the threats may not have immediate effects. She said many people in this area are concerned about the economic impact of the plant and see job preservation as the priority. Courtney said she did not think the DOE was the sole owner of this issue. Hodges said the DOE is part of the issue in terms of its secrecy in the past. McLennan said he thought the local media were afraid to report any negative news on the plant.

Lamb said he is concerned with health issues because he has seen lots of neighbors sick and wondered what the relation of the illness was to the plant. Hodges said the Agency for Toxic Substances and Disease Registry has conducted a health assessment on Paducah that is due after the first of the year. Hodges said the DOE has allocated $30 million for health studies around its complexes, and there are ongoing studies on the environment and former employee health.

Richardson said he knew the plant was located next to the West Kentucky Wildlife Management Area and asked if the plant and wildlife coexist well. Waldrop said recent studies have found polychlorinated biphenyls in the wildlife and this has alerted ongoing studies. Donham said he would like to see more research on the wildlife and environment and to see if bioaccumulation was occurring and Courtney agreed. Hodges said a biological program has been funded at Paducah. Waldrop said the SSAB once tried to connect with the hunter population through a survey. He said there has been some recent alarm, however, as some of the wildlife has been dying.

Richardson said he was very interested in these concerns and considered public input important. He said the DOE would try to do better with the concerns that had been presented. He said the DOE would regrettably not be able to make the decision on the Atomic Vapor Laser Isotope Separation (AVLIS) plant at Paducah since this was the United States Enrichment Corporation's decision. Richardson said he appreciated the efforts of the SSAB and also appreciated the members taking time from their day to come speak with him.

PUBLIC HEALTH ASSESSMENT

US DOE PADUCAH GAS DIFFUSION PLANT

PADUCAH, MCCRACKEN COUNTY, KENTUCKY

CERCLIS NO. KY8890008982

EMBARGOED

NOT FOR PUBLIC RELEASE

Prepared by:

Energy Section
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE)'s Paducah Gaseous Diffusion Plant (PGDP) was added to the U.S. Environmental Protection Agency's Superfund National Priorities List (NPL) on May 31, 1994, due to elevated concentrations of trichloroethylene (TCE) and technetium 99 (Tc-99) found in offsite groundwater (residential wells). The plant was primarily designed for enriching uranium in the isotope uranium 235 and began operation in 1952. It is located about 16 kilometers (10 miles) west of Paducah, Kentucky. TCE was used as a solvent to clean metal parts. Tc-99 is a radioactive contaminant introduced at the site when uranium used in a reactor was reprocessed. In this public health assessment, ATSDR scientists evaluated these contaminants plus other potential chemical and radioactive contaminants in human exposure pathways. The findings of our analysis are presented below. In addition, we considered other hazards such as accidents involving the depleted uranium cylinders stored at and transported to and from this site.

Conclusion Category	Human Exposure Pathway
Public Health Hazard	Groundwater: Past - trichloroethylene (TCE) and lead Potential Future - TCE and lead
Indeterminate Public Health Hazard	Groundwater: Past - vinyl chloride Potential Future - vinyl chloride
No Apparent Public Health Hazard	Groundwater: Current Surface Water: Current Soil and Sediment: Current Biota: Current
No Public Health Hazard	Air: Current and Past (Releases from operating plant)

As presented in the table (above), based on the data reviewed and under normal site operating conditions, *the Paducah Gaseous Diffusion Plant does not currently pose a health hazard to offsite populations*. This means that, although members of the public near the site may be exposed to low levels of contamination in the environment from the Paducah Gaseous Diffusion Plant facilities, the concentrations are not at a level that would cause harm to humans. We define "current" as beginning in 1990 to the present. This conclusion takes into account access restrictions to Little Bayou Creek, the North-South diversion ditch, and the area around the southwest inactive landfill, and the fish advisories issued for Little Bayou Creek and some of the ponds in the Western Kentucky Wildlife Management Area by the Commonwealth of Kentucky.

Historic releases of materials from the Paducah Gaseous Diffusion Plant were considered, and *one pathway (groundwater) was identified where past exposures to environmental contamination (e.g., TCE and lead) posed a public health hazard for children.* For the types of onsite processes currently in operation, a future groundwater pathway could exist if new wells are drilled into the

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northwest or northeast plumes. The agreement (between DOE and the current residents that have been connected to municipal water) restricts future use of wells on the resident's property but does not restrict the drilling of new wells by future owners of this land. Therefore, potential future exposures may occur if new wells are drilled into these plumes. Vinyl chloride (a degradation product of TCE) was not identified as a past or a potential future health hazard since the detection limits in the analysis of samples from residential wells tested were well above the levels of concern. Also, not all residential wells in or near the plume were tested for vinyl chloride. Therefore, vinyl chloride is an indeterminate public health hazard for past and potential future exposures.

Under abnormal conditions such as transportation accidents involving a fire and the rupture of depleted uranium cylinders, *an urgent public health hazard would exist for the general population in the proximity of the accident.* This distance from the accident varies based on weather conditions and length of exposure time; however, the maximally exposed individual is predicted to be at or within 30 meters of the accident and an urgent public health hazard could exist out to 70 meters from the accident. Less severe health effects could be experienced by individuals within several thousand meters from the accident. *However, the likelihood of this type of accident occurring is very low.*

For other accident scenarios such as a plane crash, severe weather or natural disasters involving the onsite depleted uranium cylinders, *a temporary public health hazard could exists offsite from the hydrogen fluoride but the exposure would not cause permanent harm or would not be fatal.*

The probability of occurrence of these scenarios is extremely low; however, ATSDR recommends that appropriate emergency preparedness plans be implemented.

There are no existing health data that apply specifically to the population that could have been exposed to contaminants from the Paducah Gaseous Diffusion Plant. The populations of concern for the potential pathways of exposure in the area around the diffusion plant are extremely small. Most of the health outcome data are recorded for the population of a census tract or county, which would include many people with no exposures to contaminants from the site. By using the larger population group, any association between potential exposures and adverse health effects would be obscured or distorted. Also, with a small group of households potentially exposed, very few specific diseases occur over time making it difficult to estimate how many excess cases a group experienced.

Over several years ATSDR representatives collected people's concerns from the communities near the Paducah Gaseous Diffusion Plant for this public health assessment. Many people expressed concerns related to the incidence of cancer and other illnesses reported by residents in the area and the possibility of exposure to contaminants through a variety of media. Community concerns and our responses are presented in the main part of this document.

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Based on the data and information reviewed for this public health assessment, ATSDR recommends the following: (1) ship depleted uranium to and from PGDP in new DOT-approved transport cylinders; (2) write and implement emergency plans for the transport (by rail or truck) of uranium hexafluoride (and hydrogen fluoride) cylinders; (3) prevent the future use of new wells in the contaminated plume areas by institutional controls; (4) prevent the future reuse of contaminated wells by disconnecting water pipes to homes or businesses and plugging or dismantling the wells; (5) parents of children who may have ingested over 100 µg/L of lead in their drinking water should alert the children's pediatricians; (6) continue monitoring contaminants in the northwest and northeast groundwater plumes; (7) include degradation products of TCE, such as vinyl chloride, in the groundwater analysis and assure that the detection limits are low enough to determine whether concentrations exceed a level of health concern; (8) monitor the McNairy Aquifer to detect possible migration of contaminants from the Regional Gravel Aquifer; (9) continue monitoring residential wells for those residences possibly affected by the plumes and those located near Little Bayou Creek, Big Bayou Creek, and the North-South Drainage Ditch; (10) continue access restrictions to Little Bayou Creek, the North-South Drainage Ditch, and the southwest inactive landfill; (11) continue monitoring biota to ensure no human exposure to contaminants; (12) advise new landowners in the areas of the groundwater plumes of the groundwater contaminants; and (13) encourage residents near PGDP who are concerned about lead in their well water to have their wells tested. (Lead did not appear to be related to the groundwater plumes.)

ATSDR staff will continue to monitor environmental issues and remedial activities at the Paducah Gaseous Diffusion Plant as well as proposals for resolution of the depleted uranium cylinder storage dilemma.

The interpretation, conclusions, and recommendations provided in this public health assessment are based on the data and information referenced. Additional data could alter those conditions and recommendations. The conclusions and recommendations are site specific and should not be considered applicable to any other situation.

DOE/EH-014
Volume 1 of 2 Volume

U.S. Department of Energy
Environment, Safety and Health

Tiger Team Assessment of the Paducah Gaseous Diffusion Plant

July 1990

U.S. Department of Energy
Washington, DC 20585

EXECUTIVE SUMMARY

This report documents the results of the Tiger Team Assessment of the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, conducted from June 18 to July 20, 1990. The purpose of the assessment was to provide the Secretary of Energy with the status of Environment, Safety and Health (ES&H) Programs at the Plant. The Plant, operated by Martin Marietta Energy Systems, Inc. (MMES) for the Department of Energy (DOE), provides up to 2 percent uranium enrichment services for government purposes and for commercial nuclear reactors in the U.S. and abroad.

The assessment was conducted by a team of professionals from DOE, contractors and consultants.

The Assessment Team concluded that curtailment or cessation of any operations at PGDP is not warranted. Compliance issues identified by the Assessment Team are known to Federal and state permitting agencies. Nevertheless, there are a significant number of ES&H findings and concerns identified in the report that require prompt management attention.

PGDP management and staff are committed to full implementation of the Secretary's ES&H initiatives and acknowledge the imperative for action. However, compliance with DOE Orders and mandatory standards is deficient in a wide variety of activities. Furthermore, inadequate ES&H support and guidance to PGDP by MMES provides barriers to ES&H excellence at PGDP.

MMES and PGDP management have expended significant effort to improve their existing management systems. Nevertheless, deficiencies were noted in management control systems such as Quality Assurance (QA), compliance management, human resource management, and operating practices and procedures. Furthermore, there is no integrated site-wide corrective action tracking system for tracking identified deficiencies.

PGDP staffing levels and skill mixes are inadequate throughout the Plant, although some progress is being made in filling staff needs. Training deficiencies have been identified as being significant, contributing factors to environmental compliance findings.

The DOE Site Office is responsible for day-to-day oversight, but it is not adequately staffed to perform this critical function. In addition, the roles and responsibilities of the other involved DOE parties, NE, EM, and OR, are not well defined, documented, or communicated throughout DOE and the contractor organizations. Furthermore, DOE is not providing timely and clear ES&H guidance to MMES and PGDP.

The Plant enjoys a sound and credible relationship with the surrounding community and conducts programs of outreach in which the general public and potentially interested parties are encouraged to become involved in ES&H concerns and issues related to site activities.

Recent assessments, including the PGDP Self-Assessment, identified areas in which improvements are needed to meet the Secretary's ES&H initiatives. PGDP personnel demonstrated a positive attitude and willingness to discuss deficiencies with the Assessment Team and are eager to rectify existing problems. The high morale, "can-do" attitude, and dedication of site personnel, coupled with plant management's obvious commitment to cultural change, provide a sound foundation for success in meeting those initiatives.

Summary of Key Findings, Root Causes and Noteworthy Practices

Environmental

The Environmental Subteam identified findings of noncompliance with Federal and state regulations and DOE Orders, and nonattainment of acceptable best management practices. However, none of these deficiencies present an immediate threat to public health or the environment.

Environmental findings, associated root causes, and observations of PGDP operations illustrate a workforce that is generally committed to the Secretary's ES&H initiatives; however, a lack of technical expertise and experience in the environmental field at PGDP is hampering the development and implementation of a comprehensive environmental protection program. The key areas of concern are: environmental monitoring and evaluation programs are not being effectively implemented because of a lack of key programmatic elements; formal procedures have not been developed for the effective implementation of environmental protection activities; and quality assurance programs have not been developed or implemented for many environmental activities.

In characterizing potential root causes, the Environmental Subteam constructed a three-tier system to define the relationship between the findings and root causes. The programmatic nature of many of the findings is such that the findings themselves are often root causes of other more specific findings. Although PGDP management shows evidence of commitment to environmental protection as a top priority, environmental concerns have yet to become an integral part of PGDP operations.

Safety and Health

The PGDP organization is in transition to bring the site into compliance with the new safety and health requirements of DOE. Strengths were noted in the supportive attitude of plant management toward making the changes necessary to meet these requirements, in the recent performance of a self-assessment by Energy Systems, and in the Uranium Enrichment Performance Improvement Program.

Safety concerns were expressed in all technical areas examined, except Experimental Activities. The appraisal revealed deficiencies in compliance with DOE Orders, and mandatory standards in the safety program requirements for document reviews, inspections, emergency planning, fire protection engineering, radiological protection, and quality assurance. The system of preparing and revising, reviewing, and approving administrative control documents is inadequate. Training and certification programs and practices do not satisfy site needs. There is no overall plan for safe, long-term storage of depleted uranium. No integrated sitewide management system to track and correct identified deficiencies has been developed.

An inspection of about 85 percent of the work area revealed 237 noncompliances with OSHA standards, 90 percent of which would be classified as "serious" by OSHA. The noncompliances generally related to electrical hazards, fire protection, machine guarding, and hazard communication.

The principal concerns in Fire Protection, Worker Safety, and Medical Services are direct results of insufficient management commitment to full compliance with safety requirements, and inadequate resources for timely implementation. Other concerns are related to the lack of an integrated approach to development and implementation of site-wide management initiatives, such as procedures, document control, training, quality assurance, and corrective action tracking. Deficiencies in site operations were related to lack of rigor, formality, and discipline in the areas of concern.

Management

Key management findings are supported by the Environmental and Safety and Health Assessments, especially with respect to PGDP policies and procedures, formality in operations, management control systems, employee performance evaluation, self-assessment, and DOE oversight. Inadequate staffing and training was encountered at all levels of the plant. MMES does not have a corporate-wide strategic plan, and subordinate implementation plans, to define and accomplish ES&H objectives on a prioritized basis. DOE oversight roles and responsibilities have not been well defined, documented or communicated. Interfaces among the involved DOE offices have not been established and there is little guidance provided to MMES and PGDP by DOE.

The Management Subteam identified two root causes for the findings and concerns identified in the Assessment. First, DOE is precluded from effectively performing its oversight responsibilities due to rapidly growing ES&H requirements, inadequate staffing and institutional inertia within DOE. Furthermore, the low profile of PGDP has hindered resolution of this problem. Second, MMES does not have sufficient incentives to ensure full support of ES&H excellence at PGDP due to the necessity of PGDP to compete with other MMES sites for scarce ES&H resources.

Unclassified

MARTIN MARIETTA | CORPORATE AUDIT RECORD (CA

Corporate Team Auditor L.R. MCKAY		Control Number 13-[illegible] 2C	
Company Counterpart/Escort A.H. JEFFERIES/M.B. GRAVES	Initials: AHJ	Date 3/27/90	
Area Contact M.B. GRAVES		Location/Program HP	

SUBJECT: CORPORATE HEALTH PHYSICIST ROLE

REQUIREMENTS:
TSA Performance Objective OA.4, "Corporate Support," Criterion 4.

COMPLIANCE ASSESSMENT REPORT REF.:

☐ FINDING: ☒ OBSERVATION:

A Corporate Health Physicist position, staffed with an individual of substantial operating HP experience, does not appear to exist for MMES.

RECOMMENDATION:

Audit Team Leader	Corporate Leader	Counterpart Leader
[signature]	[signature]	

Unclassified

Unclassified

MARTIN MARIETTA | **CORPORATE AUDIT RECORD (CA**

Corporate Team Auditor: S.W. JOHNSON		Control Number: 2-014
Company Counterpart/Escort: JAY COLLINS / B. Holick;	Initials: JMC	Date: 3/26-29/90
Area Contact		Location/Program: RDP

SUBJECT: Maintenance

REQUIREMENTS:
MA.1 Maintenance organization and administrative should ensure effective implementation and control of Maintenance activities.

Criteria - 3, 2, 6, 8, 12

COMPLIANCE ASSESSMENT REPORT REF.:

☒ FINDING: ☐ OBSERVATION:

Supervisors and managers often do not hold maintenance personnel accountable for the performance of good work practices. Examples include work in radiological areas; foreign material exclusion in open systems; cleanliness and housekeeping, especially in the maintenance and stores buildings; welding without proper shielding for observers; good practices with lifting devices; improper wearing of dosimetry; and proper use of tools.

RECOMMENDATION:

~~Corporate~~ EXEC Management should hold maintenance personnel, supervisors, and plant management accountable and responsible to implement high standards in the conduct of maintenance.

Audit Team Leader	Corporate Leader	Counterpart Leader
[signature]	[signature]	

Unclassified

Unclassified

MARTIN MARIETTA | CORPORATE AUDIT RECORD (CA

Corporate Team Auditor: L.R. McKAY	Control Number: [illegible]
Company Counterpart/Escort: A.H. JEFFERIES / M. B. GRAVES — Initials: AHJ	Date: 3/27/90
Area Contact: M. B. GRAVES	Location/Program: HP

SUBJECT: AIR MONITORING

REQUIREMENTS:
DOE ORDER 5480.11, Section 9.g.(3)(a), "Air MONITORING"; TSA Performance Objective RP.9, "AIR MONITORING", Criterion 4

COMPLIANCE ASSESSMENT REPORT REF.:

[X] FINDING: [ ] OBSERVATION:

1. The current air monitoring system has too few locations to characterize work location airborne concentrations of radioactivity.
2. The air sampling and monitoring program is not adequately supported by air flow studies.
3. Air sample concentrations can not be determined locally (samples must be counted in laborato

RECOMMENDATION:
1. Evaluate, procure additional air monitor
2. Conduct an air flow study to characterize workplace conditions.
3. Evaluate possible methods for field determination of airborne concentratio

Audit Team Leader	Corporate Leader	Counterpart Leader
[signature]	[signature]	

Unclassified

Unclassified

MARTIN MARIETTA | **CORPORATE AUDIT RECORD (CA**

Corporate Team Auditor: L.R. MCKAY		Control Number: 13-[illegible]	
Company Counterpart/Escort: A.H. JEFFERIES/M.B. GRAVES	Initials: AHJ	Date: 3/27/90	
Area Contact: M.B. GRAVES		Location/Program: HP	

SUBJECT: HP TECHNICIAN STAFFING LEVEL

REQUIREMENTS: TSA Performance Objective RP.1, "Organization and Administration, Criterion 3.

COMPLIANCE ASSESSMENT REPORT REF.: PORTS 4.5.7.3.4

☒ FINDING: ☐ OBSERVATION:

The current Health Physics Technician staffing level is inadequate to support job coverage, an assigned HP responsibility (salaries are not competitive).

RECOMMENDATION:

1. Perform a comparative salary survey of 5 midwestern nuclear utilities.
2. Submit a request to Human Resources to adjust HP Technician pay to at least the average of the 5 utilities
3. Detail a Personnel Specialist to PGDP until the technician staffing levels are adequate

Audit Team Leader	Corporate Leader	Counterpart Leader
[signature]	[signature]	

Unclassified

MARTIN MARIETTA | **CORPORATE AUDIT RECORD (CAF**

Corporate Team Auditor: L.R. McKAY	Control Number: 13-...
Company Counterpart/Escort: A.H. JEFFERIES/M.B. GRAVES — Initials: AHJ	Date: 3/27/90
Area Contact: M.B. GRAVES	Location/Program: HP

SUBJECT: RAD. AREA POSTINGS: DOSE RATE INFORMATIO

REQUIREMENTS:
TSA Performance Objective RP.10, "Radiation Monitoring/Contamination Control," Criterion 4.

COMPLIANCE ASSESSMENT REPORT REF.: PORTS 4.5.7.3.5

[X] FINDING: [ ] OBSERVATION:

Radiation Area postings do not bear approximate dose rates.

RECOMMENDATION:
1. Train HP technicians to post approximate dose rates on Radiation Area postings.
2. Perform supervisory verification tours.

Audit Team Leader	Corporate Leader	Counterpart Leader
[signature]	[signature]	

Unclassified

MARTIN MARIETTA USE ONLY

KY/A-556

PGDP

PADUCAH GASEOUS DIFFUSION PLANT

MARTIN MARIETTA

ACTION PLAN RESPONSE TO

CORPORATE TECHNICAL AUDIT

OF

PADUCAH GASEOUS DIFFUSION PLANT

May 1991

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

MARTIN MARIETTA USE ONLY

MARTIN MARIETTA

CORPORATE AUDIT RECORD (CAR)

CONTROL NUMBER: RAD-11 RESPONSIBLE MANAGER: J. C. Massey

SUBJECT:

Failure to use Radiation Work Permit (RWP)

FINDING:

Work was performed on a converter without a Radiation Work Permit. [The job was addressed on a Hazardous Work Permit; however, this document does not include the detail addressed in ANSI N13.6-1966 (R1972)].

REQUIREMENT(S):

TSA RP.3 Radiological Protection Procedures and Posting Criteria 4, 5

TSA RP.6 Internal Radiation Exposure Control Program Criteria 5

RECOMMENDATION(S):

The Radiation Work Permit system should be implemented for all radiological work.

PLANNED ACTION(S):

	PLANNED ACTION	COMPLETION DATE	PERSON ACCOUNT
1.	Draft procedure on RWP and use as pilot in C-360. (CAR 3-16, Step 1)	Complete	M. B. Graves
2.	Get management concurrence on use of RWP. (CAR 3-16, Step 2)	Complete	P. A. Gourieux
3.	Issue an SPP for the RWP system. (TT RP.3-1, Step 1)	06/91	M. B. Graves
4.	Develop and implement RWP training for Health Physics staff and occupational workers. (TT RP.3-1, Step 3)	06/91	M. B. Graves

Energy Systems Validator

PGDP Validator

(for) JCMassey

Division Manager

MARTIN MARIETTA

CORPORATE AUDIT RECORD (CAR)

CONTROL NUMBER: RAD-22 **RESPONSIBLE MANAGER: J. C. Massey**

SUBJECT:

Inadequate Health Physics Procedures

FINDING:

The Health Physics Program is not effectively defined and controlled by current procedures.

REQUIREMENT(S):

TSA RP.1 Criteria 11

RECOMMENDATION(S):

Expedite the development and revision of administrative and operating Health Physics Procedures.

RESPONSE:

Development of specific Health Physics administrative/operating procedures are delineated in Tiger Team Assessment Findings RP.1-1, Steps 3, 5, 7, 8, 9, 10; RP.1-2, Steps 2, 4; RP.1-3, Steps 3, 4; RP.3-1, Steps 2, 4, 5; RP.3-3, Steps 3, 4; RP.6-1, Steps 2, 7; RP.7-1, Steps 1, 4; RP.9-1, Step 7; RP.10-1, Steps 3, 7; and RP.11-1, Step 4.

PLANNED ACTION(S):

	PLANNED ACTION	COMPLETION DATE	PERSON ACCOUNT
1.	Issue standard practice procedures (SPPs) detailing responsibilities in contamination control, radiological job coverage requirements, and health physics requirements including implementation of a Radiation Work Permit Program. SPPs will address interfaces between Health Physics Department and plant personnel. (TT RP.1-1, Step 5)	06/91	M. B. Graves
2.	Issue Martin Marietta Energy Systems Central Staff final Health Physics standards and procedures. (TT RP.1-1, Step 8)	11/91	S. E. Meiners

Energy Systems Validator

PGDP Validator

DC Division Manager

MARTIN MARIE

Internal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

August 19, 1992

J. M. Collins
J. C. Massey
H. Pulley
L. O. Ramsett
A. E. Williams

QAU:48-92-1052, Audit of the Paducah Health,
Safety, and Quality Assurance Management Systems

The subject audit (attached) was conducted July 13-17, 1992, to evaluate the adequacy and effectiveness of health and safety and plant management as they relate to procedures, systems, and management controls for the protection of personnel and the environment during the achievement of plant mission objectives. Issue Response Sheets for deficiencies noted in your area are attached. Each division should evaluate the deficiencies and determine the type of response required in accordance with P-GP-36. Finding FM-92-6-4 will require a response from J. C. Massey and L. O. Ramsett since it pertains to both areas.

The Issue Response Sheets may be used to prepare your corrective action contract; please note the Documentation of Root Cause is copied on the reverse.

Your response should be sent to Corrective Actions by September 21, 1992. If you have questions, please call.

B. C. Lichtenberg, C-720, PGDP (6055) - NoRC

/bcl

Attachments
1. Audit Report
2. Issue Response Sheets

cc/att1: T. M. Hines, D. M. Massey, S. A. Polston, S. L. Shell, W. E. Sykes, W. E. Thompson, C. W. Walter, P. D. Wooldridge

ISSUE RESPONSE SHEET
PGDP IRMS Centralized Tracking System

UC92A0271 **AUDIT OF HEALTH, SAFETY AND QA MANAGEMENT SYSTEMS**

ISSUE TITLE: RESOURCE NEED, ITS QUALITY AND ITS CONTROL

IRMS ID:	UC9211981	**MANAGER:**	J.C.Massey/L.O.Ramset
FINDING NO:	FM-92-6-4	**REQUIREMENT:**	DOE PROCEDURE
SOURCE:	QAU:48-92-1052	**QUICK FIX:**	F (T = YES; F = NO)
STATUS:	OPEN	**PEG SCORE:**	5

RELATED PROJECTS (WHERE AVAILABLE)

DESCRIPTION

Upper management feels there are adequate resources, but they need better control. This audit indicates examples of both in resources and insufficiently qualified resources. For example:

1. The independent review committee for safety-related issues appear to lack the qualifications and full-time independence r for such a group. Contrary to what is indicated in procedure P-eSH-34, paragraph VI.A. This type of committee is not a "v body. Qualified, professional engineers should review, and any noted technical deficiency is sufficient to require rejection o submittal.

2. Quality Assurance has insufficient auditing resources.

3. Nuclear Safety does not have resources to be in full compliance.

4. Health Physics appears not to have sufficient resources to the new DOE N 5480.6.

5. Safety needs additional resources which have been requested.

6. Safety Department does not have a procedure writer as needed.

Requirements: "DOE Procedure for Conduct of Management Appraisals of ESH and QA Activities." Appendix B, paragraph "Are you and your line managers satisfied that you have the resources under your control to accept this responsibility?")

Recommendations: Develop needed resources.

APPRAISAL

ACTION PLAN(S)	SCHEDULED COMPLETION DATE	RESPONSIBLE PERSON

SUMMARY REPORT

PADUCAH GASEOUS DIFFUSION PLANT

ENVIRONMENTAL COMPLIANCE REVIEW

DECEMBER 10-14, 1990

MARTIN MARIETTA ENERGY SYSTEMS, INC.	Environmental Compliance Review (ECR) Record
Review Team Member: H. M. Braunstein and A. B. Johnson	Control Number: PGDP-NEPA-2
Counterpart/Escort: V. W. Jones	Date: 12/10/90
Subject/Compliance Review Area: National Environmental Policy Act (NEPA)	
Non-Compliance Identified: No system is in place to ensure that environmental impact assessments prepared in compliance with NEPA are honored by plant management. Under the current reporting structure, NEPA assessment documents can be altered by plant management under a conflict-of-interest situation. Alteration could result in an environmental impact analysis that differs significantly from the original. No independent system is in place for resolution of controversial issues to prevent possible abuse of management authority over the NEPA process.	
Regulation/Requirement/Law Violated: NEPA, CEQ regulations at 40 CFR 1502, DOE Order 5440.1C, and SEN-15-90. All require proper assessment of actions to evaluate the potential for impacting the environment.	
Recommended Action: A system should be established and implemented to ensure (1) preparation of adequate NEPA assessments, (2) implementation of an issue-resolution system independent of conflict-of-interest resolutions, and (3) proper management of NEPA-related compliance issued.	
Energy Systems ECR Team Member: Helen Braunstein	Energy Systems ECR Leader: Carl L Stein

ES/ESH-18/V3

PADUCAH GASEOUS DIFFUSION PLANT
ENVIRONMENTAL REPORT FOR 1990

Project director
F. C. Kornegay

Project coordinator
D. C. West

Technical coordinator
T. G. Jett

Coordinating editor
Deborah Counce-Brown

Date published: September 1991

Prepared by
Environmental, Safety, and Health Compliance
and Environmental Management Staff
MARTIN MARIETTA ENERGY SYSTEMS, INC.
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and the
Environmental Compliance Department
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MARTIN MARIETTA ENERGY SYSTEMS, INC.
P.O. Box 1410
Paducah, Kentucky 42001
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-76OR00001

PGDP, and technetium-99 (^{99}Tc), a man-made radionuclide developed during the fission of uranium. The source of ^{99}Tc at PGDP was the enrichment of reprocessed uranium from government reactors at other DOE facilities. The major requirements of the ACO include monitoring of residential wells potentially affected by the contamination, provision of alternative drinking water supplies to residents with contaminated wells, and investigation of the nature, extent, and source of the contamination to develop a plan for remediation.

National Environmental Policy Act (NEPA)

NEPA Compliance personnel review all Engineering Service Orders and submit appropriate NEPA documentation to DOE for project approval. Activities that do not require engineering involvement are handled via a Work Order system. Compliance with NEPA is maintained by following the guidelines set forth by CEQ, DOE, and Martin Marietta Energy Systems, Inc.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

No restricted-use pesticides are used by PGDP personnel. If application of a restricted-use pesticide at the plant is necessary, a certified contractor will be used to make the application. General-use pesticides used at the plant by plant personnel are used in a manner consistent with the product labeling. All product warnings and cautions are strictly adhered to. Applications of pesticides by plant and contractor personnel must be approved by the Plant Pesticide Coordinator. The Waste Management Department at PGDP currently is seeking a vendor that will dispose of the Napchlor-G fungicide being held on-site.

Safe Drinking Water Act (SDWA)

PGDP operates a "nontransient, noncommunity" public water system subject to regulation by KDOW. The PGDP water treatment facility is a Class II facility. There are ten operators on-site with the Class II certification or above. Monthly operational reports are provided to the state describing operational activity for the facility. The ongoing training required to maintain certification is provided by a program developed in-house. The state of Kentucky has approved the program as meeting state requirements.

Surveys of the sanitary water supply system indicate that the plant's drinking water meets all state and federal regulations for maximum contaminant levels. In 1989 KDOW completed a quarterly survey of PGDP's sanitary water system for 8 regulated and 51 unregulated volatile organic compounds (VOCs). None of the regulated VOCs was detected in the system, but 3 of the unregulated VOCs were detected. Because of the detection of the three unregulated VOCs, PGDP will monitor for all 59 VOCs annually, starting in 1991.

CURRENT ISSUES AND ACTIONS

NESHAP Compliance

The NESHAP regulation, promulgated in December 1989, pertains to DOE facilities emitting radionuclides other than radon. It requires documentation of compliance by March 15, 1990. It requires extensive evaluation of each potential radionuclide air emission point and either continuous measurements of each emission point (stack sampling), or documentation that emissions from each point are below a level that would cause the most affected individual to receive an annual effective dose equivalent of 0.1 mrem.

PGDP, in conjunction with DOE/ORO and the three Oak Ridge facilities, submitted a compliance plan to EPA Region IV in March 1990. Due to the enormous number of potential radiological air emission points (albeit small ones) and the difficulty of initially evaluating each point and periodically confirming the insignificant emissions, the plan requested approval to use ambient air samplers to collect data and demonstrate compliance with the 10-mrem standard established in the regulation. On February 8, 1991, DOE/ORO received correspondence from EPA stating that ambient air sampling could not be used to demonstrate compliance with any portion of the regulation except computation of dose. Therefore, PGDP and the Oak Ridge facilities will still be required to perform the stack sampling on each emission point or submit evidence that the emissions from each stack result in a dose less than 0.1 mrem. A revised compliance plan is scheduled for submittal to EPA Region IV by May 1. It is anticipated that an FFCA based on the compliance plan will be negotiated.

Internal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

October 23, 1992

S. A. Polston

Environmental Compliance Audit Report for Paducah Gaseous Diffusion Plant (PGDP) - October 5-9, 1992

Since the audit closeout on October 9, 1992, Gail Giltner of your staff has provided our organization with supplemental information regarding 14 Corporate Audit Reports (CARs) with which there is disagreement regarding categorization. After thorough review by our compliance personnel and legal counsel, determinations have been made and verbally communicated to Gail (written response to follow). He and Tracey Feldhaus are working closely with my staff to assure that these are reported and tracked in the Corporate Compliance Report as appropriate.

After carefully reviewing all of the remaining uncontested CARs which were generated during the audit, the validation process is now complete and the final report is provided for your use in enhancing the Environmental and Waste Management Programs at Paducah. As you will note 62 of the 81 CARs written were related to some aspect of waste management (Toxic Substances Control Act (TSCA)/Resource Conservation and Recovery Act (RCRA)) and that 52 of these 62 are findings or negative observations, indicating the need for additional emphases in this area.

Recognizing that this audit comprises one segment of the technical audits conducted by Dale Bewley in March, we are transmitting the original CARs and a copy of the final report to Dale for incorporation into the audit record.

The cooperation and support provided by your staff was outstanding and certainly enhanced the productivity, quality, and value gained from the activity. If we can be of further assistance, please contact C. L. Stair at 615-576-5586 or myself.

M. E. Mitchell

M. E. Mitchell, K1001, MS-7155 (6-8006)

MEM:CLS:efi

cc:

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MARTIN MARIETTA

CORPORATE AUDIT RECORD (CAR)

Corporate Team Member: MIKE AMBROSE	Audit: MKA	Control Number: ENV - 17
Company Counterpart/Escort: MARK WALTER	Initials:	Date: 10/7/92
Area Contact: MARK WALTER	Location/Program: NEPA	

SUBJECT:

NEPA

REQUIREMENTS:

☐ FINDING: ☑ NEGATIVE OBSERVATION: ☐ POSITIVE OBSERVATION:

The NEPA program is heading in the right direction, but all programs have not been implemented to keep projects/activities from not getting proper NEPA review. Environmental Compliance has a NEPA procedure, but Engineering needs to have NEPA be a

DISCUSSIONS: part of every ESO by way of a procedure. Some projects have been ~~[illegible]~~ initiated without NEPA review. Proper training of all personnel involved (such as Engineering, Maintenance, ER) would

RECOMMENDATIONS: help to close the loop holes. A training program is in planning, but has not been ~~[illegible]~~ implemented.

Audit Team Leader	Corporate Leader	Counterpart Leader
RHK		

ES/ESH-36
KY/E-164

PADUCAH GASEOUS DIFFUSION PLANT ENVIRONMENTAL REPORT FOR 1992

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U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-76OR00001

contaminated wells; and investigation of the nature, extent, and source of the contamination. Residential wells are sampled on a weekly, monthly, or bimonthly basis for TCE and ^{99}Tc; wells potentially affected by the contamination are also sampled monthly for gross alpha and gross beta contamination. Samples are analyzed by the on-site laboratory, and the results are reported to the well-owners. In the event that contamination that originated at PGDP is detected above plant action levels, which are established at the analytical laboratory detection limits of 25 pCi/L or 1 mg/L of ^{99}Tc, a response is initiated by PGDP. Residents are notified immediately; state and EPA officials are also notified. Alternative water supplies are provided through connections to municipal water systems, or in the event that there is a time lag between discovery and the ability to complete connections, bottled water is made available. DOE pays the cost of installation of water systems and the monthly charges for water service to residents with contaminated wells. The plant has several programs proceeding to investigate the nature and extent of contamination. These include the investigation of solid waste management units under the Hazardous and Solid Waste Amendments Permit; the characterization of the northwest plume using direct push sampling technologies to provide data needed to select the locations for the hydraulic containment system; and investigations of the northeast plume as a part of the Groundwater Monitoring Phase IV Study. More information on environmental restoration CERCLA activities may be found in the "Current Issues" section of this summary and in Part 1, Sects. 5 and 8, particularly Sects. 5.5.13, 5.6.7.1, and 8.2.1 of the 1992 PGDP Environmental Report.

CERCLA Section 103(a)

On October 21, 1991, a request was issued to EPA Region IV and to the KDOW seeking concurrence on the reporting mechanism for oil sheens on KPDES outfall ditches and on Big and Little Bayou creeks. To date no response has been received. PGDP submitted the Spill Prevention and Control Countermeasures Plan to EPA Region IV and to the KDEP. Three releases were reportable to the National Response Center because reportable quantities were exceeded.

Emergency Planning and Community Right-To-Know Act (EPCRA)

The EPCRA [also referred to as the Superfund Amendments and Reauthorization Act Title III] requires that inventory and environmental release information of certain chemicals at a facility be reported to federal, state, and local authorities. This information is used for emergency planning and to provide information to the public. EPCRA requires that local and state emergency planning commissions be informed of the amount of hazardous and extremely hazardous substances that are present at PGDP and that a material safety data sheet (MSDS) be available for each chemical upon request. The regulation also requires that releases of toxic chemicals to the environment be reported each calendar year if chemical threshold limits are met. Two releases were reported under EPCRA Sect. 304 during 1992.

The *Emergency and Hazardous Chemical Inventory Report* was submitted to the state and local emergency planning commissions in March 1993. MSDSs are kept on site and are available upon request through the PGDP Hazard Communication Program. Detailed information on the *Toxic Chemical Release Report for 1992* is presented in Appendix A of the *Paducah Gaseous Diffusion Plant Environmental Report for 1992*.

National Environmental Policy Act (NEPA)

NEPA implementation is a decision making process that considers the need for a proposed action and an alternative action with emphasis on minimizing environmental impacts. It establishes policy, sets goals, and provides means for carrying out the policy. NEPA contains "action forcing" provisions to ensure that federal agencies act according to the letter and spirit of the act.

Through the implementation of NEPA, the plant has a practicable means (consistent with the requirements of the act and other essential considerations of national policy) to restore and enhance the quality of the human environment and to avoid or minimize any possible effects of its actions upon the quality of the human environment.

NEPA compliance personnel review all engineering service orders, engineering service requests, and work orders and submit appropriate NEPA documentation to DOE for project approval. Compliance with NEPA is maintained by following the guidelines set forth by the Council on Environmental Quality, DOE, and Energy Systems.

During 1992, NEPA compliance personnel completed 95 NEPA review checklists. Categorical exclusion (CX) determinations were issued in 110 cases, and 96 CX approvals were received. Five environmental assessment (EA) determinations were submitted to DOE for review and approval: Plant Laboratory Facility—ESO 17846, CFC-114 Replacement—ESO 17977, Groundwater Pump and Treat Demonstration—18045-RA, Uranium Enrichment (UE) Waste Storage Facilities—NEPA No. 92-011, and Environmental Restoration (ER) Waste Storage Facilities—NEPA No. 92-012. One environmental impact statement determination was submitted to DOE for review and approval: CFC-114 Replacement—ESO 17977. Three EA determinations were approved by DOE: UF_6 Cylinder and Storage Yards—ESO 17628, UE Waste Storage Facilities—NEPA No. 92-011, and ER Waste Storage Facilities—NEPA No. 92-012. Four EAs were presented to DOE during the year: Solid Waste Landfill—ESO 18007, Groundwater Pump and Treat Demonstration—18045-RA, UE Waste Storage Facilities—NEPA No. 92-011, and ER Waste Storage Facilities—NEPA No. 92-012.

Federal Insecticide, Fungicide, and Rodenticide Act

No restricted-use pesticides are used by PGDP personnel. If application of a restricted-use pesticide at the plant is necessary, a certified contractor will be used to make the application. General-use pesticides applied by plant personnel are applied in a manner consistent with the product labeling. All product warnings and cautions are strictly adhered to. Applications of pesticides by plant and contractor personnel must be approved by the plant pesticide coordinator. Napchlor-G is a fungicide that was used at PGDP as a wood preservative for cooling towers. The Waste Management Operations Department at PGDP is seeking a vendor that will dispose of the Napchlor-G being held on-site.

Safe Drinking Water Act

PGDP operates a "nontransient, noncommunity" public water system subject to regulation by the KDOW. The PGDP water treatment facility is a Class II facility. Ten on-site operators have Class II or higher certification. Monthly operational reports are provided to the KDOW describing operational activity for the facility. The ongoing training required to maintain certification is provided by a program developed in-house. The state of Kentucky has approved the program as meeting KDOW requirements.

In 1992, surveys of the sanitary water supply system indicate that the plant's drinking water meets all state and federal regulations for maximum contaminant levels for the required inorganic parameters. In 1992, PGDP completed a quarterly survey of the sanitary water system for eight regulated volatile organic compounds (VOCs). In one quarter of sampling, 1,2-dichloroethane was detected, but the concentration was below the maximum contaminant limit set by drinking water regulations. Because the VOC was detected in a sample, PGDP will continue quarterly sampling of VOCs for at least three consecutive years in accordance with KDOW drinking water regulations.

Current Issues

CAA Compliance

PGDP, in conjunction with the DOE Oak Ridge Field Office (DOE-OR) and the three Oak Ridge facilities, submitted a radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAP) compliance plan to EPA Region IV in March 1990. Because of the enormous number of potential radiological air emission points (albeit small ones) and the difficulty of initially evaluating each point and periodically confirming the insignificant emissions, the plan requested approval to use ambient air samplers to collect data and demonstrate compliance with the 10-millirem (mrem) standard established in the regulation. On February 8, 1991, DOE-OR received correspondence from the EPA stating that ambient air sampling could not be used to demonstrate compliance with any portion of the regulation except computation of dose. Therefore, PGDP and the Oak Ridge facilities are required to

RESULTS OF THE SITE INVESTIGATION, PHASE I

at the
PADUCAH GASEOUS DIFFUSION PLANT
Paducah, Kentucky

owned and operated by the
U.S. DEPARTMENT OF ENERGY

and managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.

March 22, 1991

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1.0 NATURE AND EXTENT OF CONTAMINATION

1.1 Background

The Paducah Gaseous Diffusion Plant (PGDP) is an uranium-enrichment facility consisting of a diffusion cascade and extensive support facilities. Construction at the plant began in 1951, and by 1952 the plant was operating. The PGDP is owned and operated by the United States Department of Energy (DOE) and is managed by Martin Marietta Energy Systems (Energy Systems).

The plant is located on a reservation of about 1,350 acres in western McCracken County, about 10 miles west of Paducah, Kentucky, and about 3 miles south of the Ohio River. Approximately 740 acres of the reservation are within a fenced security area. The raw-water treatment plant, the residential landfill, and the inert landfill are the only operating areas outside of the security area. An uninhabited buffer zone surrounds the fenced area.

Beyond the DOE-owned buffer zone is an extensive wildlife management area of 2,100 acres deeded or leased to the Commonwealth of Kentucky. During World War II, the Kentucky Ordnance Works, a trinitrotoluene (TNT) production facility, operated in an area southwest of the plant on what is now part of the West Kentucky Wildlife Management Area.

The PGDP performs the first step in the uranium-enrichment process. The product from the PGDP must be further enriched before being used as a nuclear fuel. The plant provides an enriched feed stream to the gaseous diffusion plant in Portsmouth, Ohio. It also provided a similar feed stream to the Oak Ridge Gaseous Diffusion Plant in Oak Ridge, Tennessee, before that plant closed.

The PGDP enriches the uranium-235 (U-235) radionuclide in a physical separation process. The separation is based on the faster rate at which U-235 diffuses through a barrier in comparison to the heavier U-238. Extensive support facilities are required for maintaining the diffusion process. Some of the major support facilities include a steam plant, four major electrical switchyards, four sets of cooling towers, a building for chemical cleaning and decontamination, a water treatment plant, maintenance facilities, laboratory facilities, and two active landfills. Several inactive facilities are also located on the plant site.

Hazardous, nonhazardous, and radioactive wastes have been generated and disposed of as a result of PGDP operations. In August 1988, contamination was found in an offsite drinking water well north of the PGDP. The contaminant is technetium-99 (Tc-99), which is a man-made radionuclide created as a by-product of the fission of uranium. Tc-99 was introduced to the PGDP in 1953 as a contaminant in feed material during a program in which spent nuclear reactor fuel was fed into the cascade. Further sampling showed that a commonly used solvent, trichloroethene (TCE), is in offsite wells. At DOE's expense, a community water line was extended as an alternative water supply to residences with contaminated wells. DOE is also paying for the water.

To establish a schedule for investigating and remediating the offsite groundwater contamination, the United States Environmental Protection Agency (EPA) and DOE developed an Administrative Order by Consent (Consent Order) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 104 and Section 106. DOE and EPA agreed to the Consent Order, and the United States Department of Justice approved it. The effective date of the Consent Order is November 23, 1988. The intent of the Consent Order is outlined in four major objectives:

- To determine the nature and extent of the threat to human health and welfare and to the environment from the offsite contamination of groundwater and surface water

- To ensure that the environmental effects of the releases and threatened releases are thoroughly investigated and that appropriate actions are taken to protect the public health and welfare and the environment

- To establish a schedule and a work plan for developing, implementing, and monitoring necessary response actions at the site

- To promote cooperation (exchange of information among, and participation of, DOE, EPA, and the Commonwealth of Kentucky) in achieving the first three objectives

The Consent Order defined the work to be performed by DOE/Energy Systems in response to the discovery of groundwater and surface water contamination and established the schedule for completing certain elements of the work.

DOE/Energy Systems contracted with CH2M HILL, an environmental engineering firm, to develop and implement Phase I of the work plan for the site investigation of the PGDP (*Phase I Site Implementation Work Plan for Paducah Gaseous Diffusion Plant*, CH2M HILL, 1989). The initial draft of the work plan was submitted to EPA and the Commonwealth of Kentucky on January 23, 1989. The plan included information on the identified potential sources, pathways, and receptors; a field sampling and analysis plan; a quality assurance and quality control plan; a health and safety plan; and a schedule for completing the investigation.

The plan also contained work elements designed to determine the characteristics of sources at the site that have contributed or are contributing to the contamination found off the site. The characterization is necessary for establishing a baseline risk assessment and for determining implementable, cost-effective remedies. In accordance with the Consent Order, however, the Phase I work plan focused primarily on the nature and extent of contamination off the site.

The following work was accomplished in Phase I of the investigation:

- Installed 35 new water-quality monitoring wells in clusters upgradient and downgradient of the plant.
- Inspected and evaluated 80 monitoring wells previously installed by DOE/Energy Systems as part of the Remedial Action Program and environmental surveillance activities and selected about 40 wells for periodic water-quality monitoring during the investigation.
- Conducted up to four rounds of sampling of each of the selected wells.
- Conducted two rounds of aquifer slug tests in selected wells to determine hydraulic conductivity.
- Measured water levels simultaneously over several days in wells and creeks to determine interconnectivity.
- Measured water levels in wells on four occasions to determine gradients.
- Collected soil samples from borings for the 13 new well clusters off the site, from 12 deep borings on the site, and from over 50 shallow borings on and off the site.
- Conducted radiation walkover surveys of Big Bayou Creek, Little Bayou Creek, and the North-South Diversion Ditch.
- Obtained creek-bank sediment samples on the basis of the results of the walkover survey to characterize a zone of elevated radiation dubbed the "bathtub ring effect."
- Obtained surface water and sediment samples from the 2 creeks, about 20 ponds, the marshes, and Metropolis Lake.
- Obtained fish and macroinvertebrates from the same lakes and creeks that were sampled for water and sediment. Crops and vegetables were collected from gardens or donated by neighbors of the plant. Deer and various road kills were collected, and samples were taken for analysis.
- Conducted a survey of well users within 5 miles of the PGDP and of surface water users for 15 miles downstream of the plant on the Ohio River.

- Mapped the 64,000-acre study area at 1" = 50′ and 1" = 100′, using aerial photography and extensive civil surveys.

- Implemented the DOE/Energy Systems community relations plan with fact sheets and public briefings.

- Submitted several thousand environmental samples for analyses, validated the data, and entered the information (over 300,000 "bits") in an electronic data management system developed for the project.

- Prepared 28 technical memoranda and a preliminary report that includes an assessment of offsite receptors. The report was issued to the Commonwealth of Kentucky and EPA, and copies are available for the public. The report is summarized in this executive summary.

The result of this work is a clearer understanding of the pattern of offsite groundwater and surface water contamination that has resulted from the PGDP's activities; a better concept of contamination patterns on the plant and of the contribution of plant contamination to the offsite contamination; a basic sense of the risks to offsite receptors from the contamination; and a detailed plan for protecting PGDP neighbors by completing the groundwater investigation and other environmental restoration projects.

Table ES-1 lists the chemical contamination found off the site in all media. The remainder of this section presents findings and conclusions, by media.

1.2 Offsite

Groundwater

Offsite contamination in groundwater could occur in any or all of three systems: shallow groundwater system, regional gravel aquifer, and deep groundwater system. The shallow groundwater system is used for obtaining a water supply through hand-dug large-diameter wells, primarily in residences north and east of the plant. Lenses of sand and clay in the shallow system laterally direct rainwater percolating through the system. Interconnections between lenses allows vertical migration to the confining layer immediately above the regional gravel aquifer. In the confining layer, "windows" to the regional gravel aquifer would allow unretarded migration of contaminants to the aquifer from the surface or from near-surface disposal areas.

The regional gravel aquifer is the primary groundwater supply for this area. Water-supply wells completed in the regional gravel aquifer may also draw water from the shallow groundwater system. The regional gravel aquifer is nonhomogeneous. Preferential pathways for more-rapid movement of groundwater apparently are located where river channels once were. The regional gravel aquifer appears to be a major transport pathway for contamination. The deep groundwater system is not typically used as a water supply in this area, but contamination in this system would be an indicator of continuing contaminant migration.

Table ES-1
CONTAMINANTS FOUND OFF THE SITE, ALL MEDIA

(page 1 of 2)

Analyte	Compound	Assessed Media: Groundwater	Surface Water	Sediment	Fish	Deer	Crops
Pesticide, PCB	Aroclor-1260			X	a	b	
Base/Neutrals	4-Nitrophenol	X					
	Bis(2-ethylhexyl)phthalate	X	X	X	X		
	Di-n-butyl phthalate	X					X
	Di-n-octyl phthalate	X					
	Diethyl phthalate	X					
Volatiles	1,2-Dichloroethane	X					
	1,2-Dichloroethene (total)	X					
	2-Butanone	X		X			
	Benzene	X					
	Carbon Disulfide	X	X	X			
	Carbon Tetrachloride	X	X				
	Chloroform	X					
	Tetrachloroethene	X		X			
	Toluene	X					
	Trichloroethene	X		X			
	Xylene	X					

Table ES-1
CONTAMINANTS FOUND OFF THE SITE, ALL MEDIA

(page 2 of 2)

Analyte	Compound	Assessed Media					
		Groundwater	Surface Water	Sediment	Fish	Deer	Crops
Inorganic	Aluminum	X	X	X	X	X	X
	Arsenic	X	X	X	X	X	X
	Barium	X	X	X	X	X	X
	Beryllium	X	X	X	X	X	
	Cadmium	X	X	X	X	X	X
	Chromium	X	X	X	X	X	X
	Copper	X	X	X	X	X	X
	Iron	X	X	X			
	Lead	X	X	X	X	X	X
	Magnesium	X	X	X	X	X	X
	Mercury	X			X		
	Nickel	X		X	X	X	X
	Selenium	X	X		X		
	Silver						
	Zinc		X	X	X		
Radiation	Radionuclide						
	Technetium-99	X	X	X	X	X	X
	Uranium-238	X	X	X	c	X	d
	Uranium-235	X	X	X	c		d
	Uranium-234	X	X		c	X	d
	Plutonium-239	X			c		d
	Neptunium-237			X	c		d
	Thorium-230	X	X	X	c	X	X

a: PCBs were not found in fish during this investigation, but the Biological Monitoring Program has found PCBs in fish.
b: Oak Ridge National Laboratory found PCBs at significant levels in a deer taken for background comparison from The Land Between the Lakes Recreation Area.
c: not analyzed
d: natural background only

The movement of groundwater is generally from the plant to the Ohio River, which is to the northeast, north, and northwest of the plant on a large bend. The pattern of groundwater flow is influenced by an underground terrace immediately south of the plant. The regional gravel aquifer beneath the plant apparently receives recharge from the shallow groundwater system, which is "perched" on the terrace. Movement of the groundwater to the south, east, and west beneath the plant should be limited by the terrace and influenced by the preferential pathways in the regional gravel aquifer.

Deep Groundwater System

The primary contaminants found in the deep groundwater system were BTEX compounds (constituents of petroleum--benzene, toluene, ethylbenzene, xylenes) and the radionuclides Tc-99, U-234, and U-238.

Shallow Groundwater System

The offsite contamination in the shallow groundwater system is either adjacent to streams or in cultivated fields. Contaminants found in Little Bayou Creek may affect these wells through bank storage and later release. The primary contaminants found in the shallow groundwater system are toluene and Tc-99, both at low levels.

Regional Gravel Aquifer

Off the site, the regional gravel aquifer is primarily contaminated by the organic compounds TCE and bis(2-ethylhexyl)phthalate and by the radionuclide Tc-99. Concentrations are variable. Several wells consistently show concentrations indicative of plumes. Other wells show "fringe" or "leading edge" effects. Locations where contaminants were found in the regional gravel aquifer are generally between Big Bayou Creek and Little Bayou Creek, with plumes reaching north and northeast of the plant.

A preliminary delineation of Tc-99 and TCE contaminant plumes in the regional gravel aquifer is shown in Figure ES-1 and Figure ES-2.

Surface Water and Sediment

Chemical contamination associated with the PGDP was found in Little Bayou Creek and in the North-South Diversion Ditch in both sediment and surface water. Chemical contamination found in the ponds, Metropolis Lake, and the marshes could not be directly attributed to the plant.

Radiological contamination was found in the creeks and can be attributed to the plant. Lower levels were found in the ponds, Metropolis Lake, and the marshes near the Ohio River. Radiological contamination of sediment in the creeks is evident, particularly in the North-South Diversion Ditch. Metropolis Lake sediment shows low levels of radiological contamination, probably caused by flooding from the Ohio River and not related to PGDP activities.

Creek Banks

Through bank storage, creek banks may account for both the chemical and the radiological contamination found at wells on Tennessee Valley Authority (TVA) property (WC-5 and TVA-27). The bathtub ring effect in Little Bayou Creek south of Ogden Landing Road and in the North-South Diversion Ditch presents significant exposure risks.

Most wells at the TVA containing TCE are in proximity to Little Bayou Creek, which suggests that the contamination may be associated with flooding in the creek and subsequent contamination of the underlying groundwater. Organics in TVA wells are very low (less than 3 $\mu g/l$), as would be expected for a volatile organic being transported by a creek.

Biota

Low levels of contaminants were found in fish from both flowing and nonflowing water bodies. Only 1 fish of the over 30 that were sampled had radionuclides above reporting levels; that fish had an estimated 5.95 pCi/g of Tc-99. The Biological Monitoring Program conducted by the University of Kentucky for the PGDP has found PCBs in fish at levels above 2 ppm, the allowable level established by the United States Food and Drug Administration (FDA). Phase I of the investigation did not find fish containing PCBs.

Analysis of radionuclides in edible parts of deer by both Oak Ridge National Laboratory and subcontracted laboratories did not find levels of radionuclides above background levels. Arsenic was found below FDA allowable levels for arsenical compounds in meat meant for human consumption. The FDA levels are for residues of growth additives fed to beef and poultry.

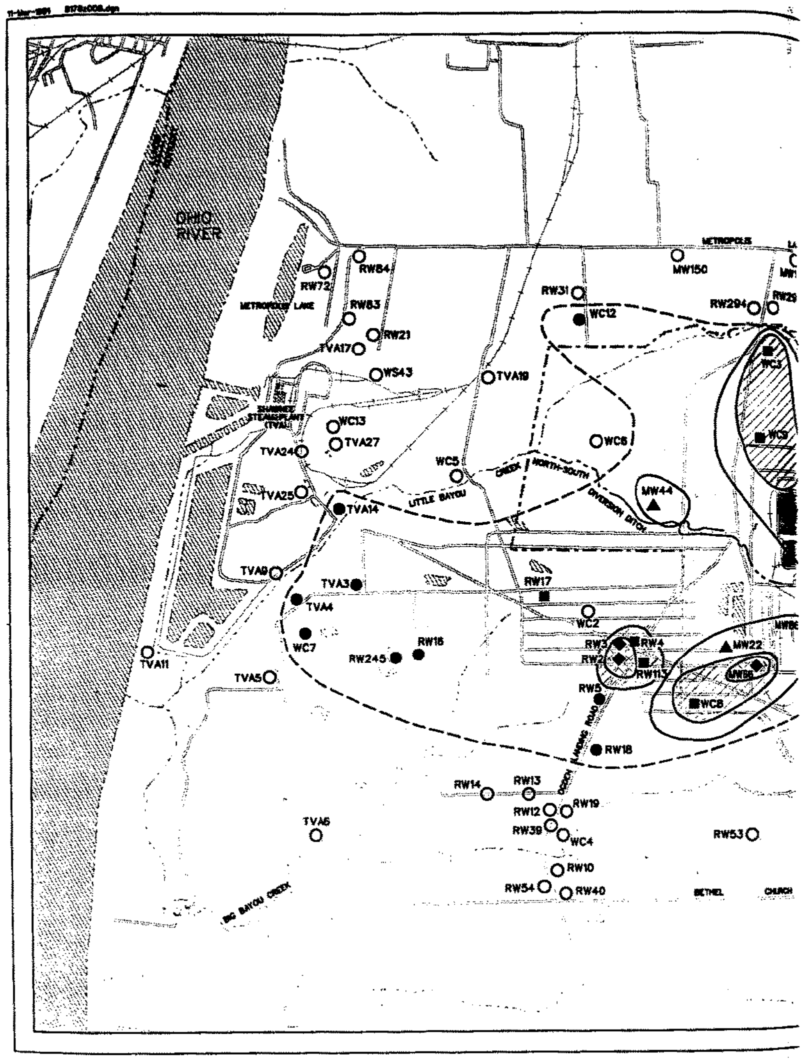
The only crops found with radionuclides above reporting levels were some composite samples from whole soybean plants.

Soil

No pattern of contamination associated with the PGDP, including air dispersion, was found in offsite soil. However, levels of arsenic found in shallow soil pose risks, particularly to children, in some exposure situations.

1.3 Onsite

Varying levels and types of contamination were found on the site in all sampled media. The shallow groundwater system, the regional gravel aquifer, and the deep groundwater system contain contamination. The deep groundwater system (the Clayton and McNairy formations) does not, however, seem to be significantly contaminated. No evidence of dense nonaqueous-phase liquids was found, but not all source areas have been adequately characterized.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METROPOLIS LAKE
METROPOLIS
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RW84
RW83
RW21
TVA17
WS43
TVA19
RW31
WC12
MW150
RW294
SHAWNEE STEAM PLANT (TVA)
WC13
TVA27
TVA24
WC5
WC6
LITTLE BAYOU
CREEK
NORTH-SOUTH DIVERSION DITCH
MW44
TVA25
TVA14
TVA9
TVA3
TVA4
RW17
WC2
WC7
RW245
RW16
RW3
RW4
RW2
RW11
MW22
WC8
TVA11
TVA5
RW5
RW18
LANDING ROAD
RW14
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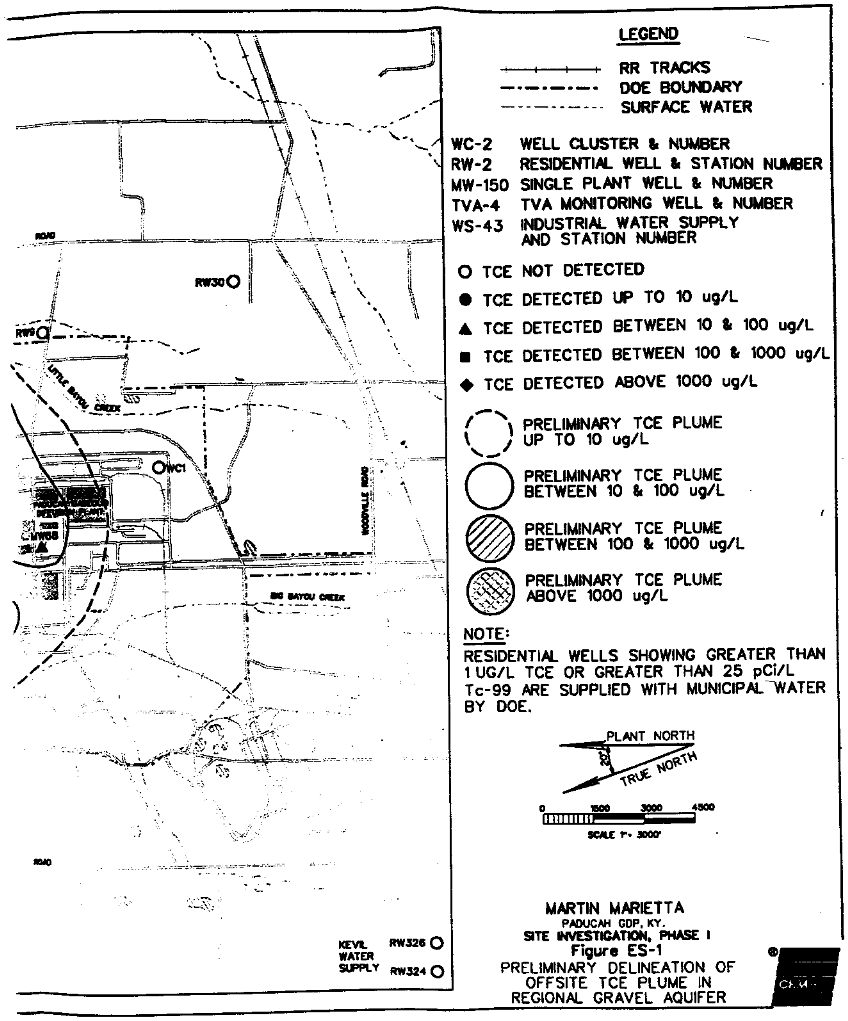
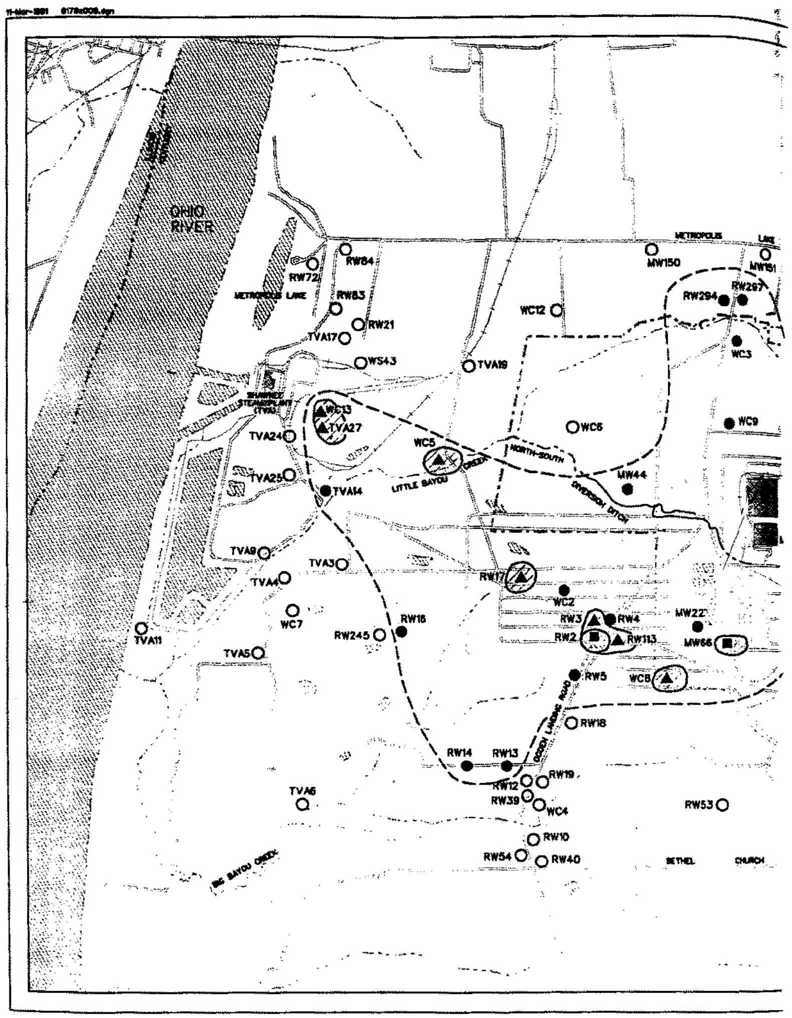
BIG BAYOU CREEK
BETHEL
CHURCH



MARTIN MARIETTA
PADUCAH GDP, KY.
SITE INVESTIGATION, PHASE I
Figure ES-1
PRELIMINARY DELINEATION OF OFFSITE TCE PLUME IN REGIONAL GRAVEL AQUIFER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WC13
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TVA24
WC5
WC6
WC9
TVA25
TVA14
LITTLE BAYOU CREEK
NORTH-SOUTH DIVERSION DITCH
MW44
TVA9
TVA3
TVA4
RW17
WC2
WC7
RW16
RW245
TVA11
RW3
RW4
RW2
RW113
MW22
MW66
TVA5
RW5
WC8
RW18
RW14
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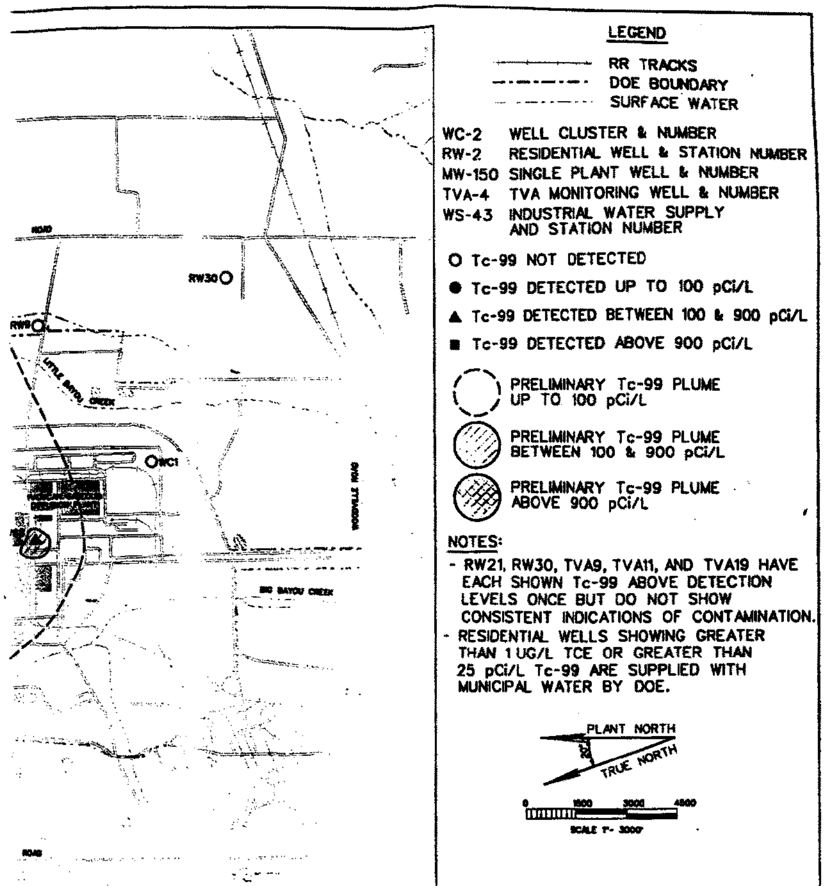
RW10
RW54
RW40
BETHEL CHURCH
BIG BAYOU CREEK



MARTIN MARIETTA
PADUCAH GDP, KY.
SITE INVESTIGATION, PHASE I
Figure ES-2
PRELIMINARY DELINEATION OF OFFSITE Tc-99 PLUME IN REGIONAL GRAVEL AQUIFER

Contamination above reporting levels was found in soil near the waste management units (WMUs). Sediment in the outfall ditches contains both radiological and chemical contamination, but the contaminated sediment is located behind overflow dams.

2.0 FATE AND TRANSPORT

2.1 Offsite Groundwater

The regional gravel aquifer appears to be the primary transport route for contaminants found in offsite groundwater. The gravel deposits of the reentrant river channel may have rates of migration of up to 300 feet/year (Energy Systems, 1990). In the lower reaches of Little Bayou Creek, the regional gravel aquifer may contribute to contamination found in the creek. The shallow groundwater system does not seem to be a major transport route for contamination from on the site to off the site, but the occurrence of some transport off the site can be inferred near the northwest corner of the plant (Figure ES-1 and Figure ES-2). In addition, in conjunction with bank storage in the creek banks, the shallow groundwater system may transport contamination from the creeks to wells near the creeks (MW-138, for example).

2.2 Creek Banks and Sediment

Little Bayou Creek and the North-South Diversion Ditch are major transport pathways for contaminated sediment and pose major risks of exposure.

2.3 Biota

Fish caught in the ponds, Metropolis Lake, and the marshes and, to a lesser degree, in Big Bayou Creek offer a route for exposure to chemical and radiological contamination. Little Bayou Creek has been posted by the Commonwealth of Kentucky warning people to limit consumption of fish from the creek because the fish may contain PCBs.

3.0 ASSESSMENT OF OFFSITE RECEPTORS

The purpose of the offsite-receptor assessment was to develop a preliminary evaluation of the risk to the neighbors of the PGDP much earlier than would be normal in an investigation of this type. The assessment, unlike the baseline risk assessments commonly conducted, has not thoroughly evaluated the effect of naturally occurring risks. The risks presented here therefore combine "normal," or background, risks with risks from contamination from the PGDP. This approach provides a conservative evaluation of risk and thereby focuses attention on a range of possible sources of risk. Thus, the continuing efforts of DOE/Energy Systems can be focused on "contaminants of concern" during Phase II of this investigation and through the continuing environmental compliance and restoration programs. The future effort will further define the nature and extent of contamination identified in Phase I work. Some contaminants will probably be discounted as further information confirms that they occur naturally or are not related to the plant. Contaminants that have not migrated off the plant will probably be found.

In the calculation of the risk to offsite receptors, the pathways of exposure were evaluated. The pathways and the primary risk-causing substances may be ranked by significance as follows, from highest to lowest:

1. Ingestion of Groundwater: TCE, arsenic, bis(2-ethylhexyl)phthalate, Tc-99, U-238, U-234.

2. Ingestion of Food: arsenic, mercury, Tc-99

3. Ingestion of Soil or Sediment: arsenic, U-238, U-234, Np-237.

4. External Exposure to Little Bayou Creek: direct gamma radiation.

The risks from the various exposure situations are summarized in Table ES-2.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Although there are some limitations on the data gathered during Phase I (for example, the monitoring wells were not all ideally situated, and only one round of surface water sampling was conducted), the limitations do not adversely affect the validity of the conclusions. Contamination at levels potentially harmful to human health is present in wells, fish, creek banks, and shallow soil off the site. The contamination can be linked to past practices at the PGDP.

Independent medical studies performed to date have not found a correlation between possible exposure and the health of the affected residents. The possibility of continued exposure to the contaminated groundwater in wells has been reduced by providing an alternative water supply to the affected residents. Some exposure situations present risks that may be caused by naturally occurring levels of common constituents of the earth, such as arsenic. Also apparent, however, is that other situations (for example, the risks from exposure to external gamma radiation along the south end of Little Bayou Creek) require further action by DOE/Energy Systems. The actions can be taken through a series of continuing programs, culminating in remediation of the contamination.

4.2 Potential Remedial Actions

This section discusses possible activities for remediating the offsite contamination. Identifying reasonable response actions helps focus the efforts of DOE/Energy Systems.

General Response Actions for Groundwater

Possible institutional actions include establishing access restrictions, arranging alternative water supplies, and long-term monitoring. These actions are similar to those already implemented by DOE/Energy Systems.

Table ES-2
SUMMATION OF RISK

Pathway	Excess Lifetime Cancer Risk[a]	Fatal Cancer Risk (Rad)[a,b]	Systemic Risk[c]
1. Residential Use of Ground-water: Residential Wells	6×10^{-4} (Chemical) 5×10^{-5} (Rad)	2×10^{-5}	--
2. Residential Use of Ground-water: Monitoring Wells	2×10^{-4} (Chemical) 5×10^{-5} (Rad)	-- 2×10^{-5}	--
3. Ingestion of Fish: From Ponds From Big Bayou Creek From All Water (Rad)	3×10^{-4} (Chemical)[d] 1×10^{-4} (Chemical)[d] 3×10^{-6} (Rad)	3×10^{-6} $1 \times ^{-6}$	20
4. Direct Gamma Exposure, Little Bayou, South	1×10^{-4} (Rad)	9×10^{-5}	--
5. Sediment or Soil Ingestion	1×10^{-4} (Chemical) 3×10^{-5} (Rad)	-- 2×10^{-5}	--
6. Residential Use of Groundwater: TVA Wells	3×10^{-5} (Chemical) 3×10^{-4} (Rad)	-- 1×10^{-4}	--
7. Ingestion of Food: Apples Deer	6×10^{-5} (Chemical) 4×10^{-5} (Chemical) 5×10^{-5} (Rad)	-- 1×10^{-5}	--

[a]The methods and assumptions used in calculating cancer risk are very conservative and represent a "worst case" situation.
[b]Rad = radiation risk
[c]Expresses noncarcinogenic risk; anything greater than 1 represents a significant risk.
[d]Does not include PCBs, which were not found in fish during this study.

NOTE TO READERS

This table presents the results of an "offsite-receptor assessment," which is a type of risk assessment. A risk assessment determines potential health effects on the basis of studies and mathematical models. How the study is done is determined by EPA; some modifications are made to account for risk from radiological exposure.

A risk assessment is based on the amount of contamination; how much contamination might be consumed, how often, and for how long; and how much the person who ingests the contamination weighs. Typically, a risk assessment is based on a 170-pound man consuming a fixed amount (for example, eating 3 contaminated fish per week) over a "lifetime," which is defined as 70 years.

The results of a risk assessment are reported as the number of people out of one million who would be likely to develop cancer from exposure to the contamination for a set period of time, (such as a "lifetime"). The results of a risk assessment determine the "excessive lifetime cancer risk," or the risk of developing contamination-caused cancer that is above the risk of getting cancer anyway, which is about a 1 in 4 (or a 250,000 in 1 million) chance. The way the study is done is very conservative, so the predictions are almost certainly higher than the actual occurrence of health effects.

- Containment systems, including capping, lining, and vertical barriers, may be considered for several onsite WMUs.

- Groundwater-recovery systems are likely to be effective in intercepting or removing contaminated groundwater.

General Response Actions for Soil

General response actions for remediating soil contamination include institutional controls, containment, excavation, and in situ treatment technologies.

- Institutional controls, including security fences, warning signs, and roped-off areas, have been implemented by DOE/Energy Systems in some areas of the plant.

- Containment (capping, slurry walls) is potentially applicable to several onsite WMUs

- Excavation at the plant is potentially applicable to several onsite WMUs.

- In situ treatment technologies that may be feasible at the PGDP include soil washing, soil-vapor extraction, in situ stabilization and solidification, vitrification, and bioremediation.

General Response Actions for Sediment

General response actions for remediating contaminated sediment in ditches and creeks include institutional controls, excavation, in situ solidification and stabilization, and drainage-channel modifications.

- Institutional controls have already been implemented in some areas, such as posting of signs along Little Bayou Creek warning against consumption of fish, "No Trespassing" signs installed on Little Bayou Creek south of Odgen Landing Road and the North-South Diversion Ditch, and continued monitoring of water quality. Additional controls, such as access restrictions on other parts of Little Bayou Creek, can be implemented rapidly.

- Excavation of contaminated sediment is likely to be effective in removing uranium contamination. Once excavated, sediment could be dewatered and treated using technologies similar to those for soil.

- In situ solidification and stabilization may be potentially applicable in some reaches, particularly during periods of low flow. The effectiveness of solidification could be determined by conducting bench-scale treatability tests.

- Channel modifications may include installing sediment traps, lining the channel, or relocating the channel. Soil type should be determined for use in conjunction with hydrologic calculations in assessing these remedial actions.

4.3 Means of Accomplishing Work

Several means are available to DOE/Energy Systems for accomplishing the described work, including the following.

ERP Groundwater Monitoring: Phase 3 and Phase 4

These projects are a continuation of the Environmental Restoration Program (ERP). The ERP Phase 3 and Phase 4 groundwater monitoring is intended to further characterize the PGDP's subsurface hydrology and geology.

ERP UST Characterization and Remediation

As a result of a well evaluation performed during Phase I of the site investigation, underground storage tanks (USTs) were found to be leaking. Removal of the leaking tanks is planned to begin in early 1991.

ERP Outfall Ditch Characterization Study

The purpose of this investigation was to identify the contaminants in the plant outfall ditches. In addition, water samples were taken from each ditch and were analyzed for PCBs. The results of the investigation indicate that chemical and radiological contaminants are present in the outfall ditches. Continuing work will evaluate the risks inherent in the material and will determine the need for remediation.

Corps of Engineers Program at Kentucky Ordnance Works

The Corps of Engineers has undertaken an evaluation program at the Kentucky Ordnance Works. The activities are based in part on the findings of an earlier environmental survey performed by an environmental consultant under contract to DOE Headquarters.

ERP HSWA Work

The Hazardous and Solid Waste Act (HSWA) draft permit, to be issued under Section 3004(u) of the Resource Conservation and Recovery Act (RCRA) as amended, will result in investigations of WMUs and spill sites not addressed under Phase I or Phase II of the site investigation. The HSWA permit for the PGDP will be issued either with the facility RCRA Part B permit for treatment and storage units or with the postclosure permit for the C-404 landfill, whichever is issued first. The earliest expected issue date for the HWSA permit is the second quarter of 1991.

FUSRAP

The Formerly Used Sites Remedial Action Program (FUSRAP) evaluates the potential for contamination at property formerly owned or used by DOE and its predecessors. These sites were used primarily for producing materials for the Manhattan Project. The PGDP is not a FUSRAP site, but FUSRAP will provide a contracting mechanism for supporting the environmental restoration programs at the PGDP and at the Portsmouth, Ohio, plant, beginning in 1991.

Phase II of Site Investigation

A work plan for Phase II of the site investigation was developed on the basis of the results of Phase I. Phase II will characterize the unit or units that are releasing TCE, Tc-99, and other contaminants to groundwater and surface water and will identify possible sources of arsenic and phthalate. The purpose of Phase II is to gather additional data for each unit and to select a corrective action to stop contaminant releases.

DOE/Energy Systems has hired outside consultants under the Hazardous Waste Remedial Action Program (HAZWRAP) subcontract to perform Phase II of the site investigation and the characterization of individual WMUs and spill sites. The HAZWRAP subcontractor (CH2M HILL) and their lower-tier subcontractors will be responsible for developing investigation plans and for performing the investigations. For the development and compilation of the results into an evaluation of alternatives for selecting the most appropriate corrective actions at each WMU, DOE may need to hire a second subcontractor to prevent conflicts of interest. Work on Phase II has begun. The scope of work for each of the various stages is summarized below.

Stage A Source Characterization. The scope of work for Stage A includes surface reconnaissance surveys, installation of new wells, groundwater sampling, aquifer testing, soil sampling, test-pit sampling, sediment sampling, and surface water sampling.

The results of the Stage A investigation will be summarized in a supplemental report on the site investigation that will augment the Phase I report.

Stage B Offsite Investigation. Stage B consists of additional investigations of the extent of offsite contamination, including refining the offsite-plume configuration or aquifer characteristics.

Up to 16 new wells at 7 cluster locations may be installed to refine the estimate of conditions upgradient of the site, within the Ohio River floodplain, near Metropolis Lake, and east of the plant near Metropolis Lake Road. Wells may also be useful between existing clusters for clarifying complex patterns of groundwater flow or for bracketing the estimated size of well-pumping influence zones for the evaluation of alternatives.

The results of the Stage B investigation will be summarized in a supplemental report on the site investigation that will augment the Phase I report.

Stage C Alternatives Evaluation. Stage C consists of evaluating alternatives for remediating offsite contamination, including screening remedial technologies, developing alternatives, performing a detailed evaluation of alternatives, preparing a risk assessment, and estimating a schedule for implementing the proposed remediation. The evaluation will be performed in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, October 1988).

Each alternative will also be compared against CERCLA criteria and one another to identify relative strengths and weaknesses in satisfying the remedial action objectives and the evaluation criteria. Estimates of the cost and the schedule for implementing each alternative will be prepared. A detailed risk assessment will be prepared to assess the potential human health and environmental risks posed by the PGDP in the absence of a remedial action and to assess each alternative for how well it protects public health and the environment.

The results of the alternatives evaluation will be presented in a final report to EPA and the public. The report will include (1) data summaries from the investigation; (2) interpretations of the collected data; (3) a summary of alternatives for remediating offsite contamination, together with the probable cost and schedule for implementing the remediation; and (4) the results of the detailed risk assessment. Comments from the public and regulatory agencies will be received and addressed.

After the final report is approved, DOE and EPA will amend the Consent Order to include actions to carry the program to completion, and the remedial design will begin.

The design and implementation of remedial alternatives typically results in remediation of different areas at different times over a period of years. If at any point during Phase II, an imminent threat to public health or to the environment is found, implementation of corrective measures will be expedited by DOE/Energy Systems.

4.4 Continuing Activities

In addition to the projected work, several measures should be continued or implemented soon, including the following:

- Continue supplying water to residents (high priority).
- Post Little Bayou Creek, the North-South Diversion Ditch, and possibly Big Bayou Creek (within the DOE boundary) against all use. Notify the Commonwealth of Kentucky about actions (high priority). The DOE-owned parts of Little Bayou Creek and the North-South Diversion Ditch have been posted.
- In conjunction with the Commonwealth of Kentucky and EPA, reach a consensus on "background" or "normal" concentrations of radionuclides and chemicals (arsenic and phthalates) in surface water, sediment, groundwater, and biota (high priority).

- Plug and abandon onsite wells (high priority); this project is under way.
- Continue yearly harvest of deer before the hunting season opens to confirm findings of low risk. Plans are now for eight deer to be taken yearly from plant A-Areas (high priority).
- Complete a more extensive survey of radiologically contaminated rubble piles (medium priority).
- Complete the pH, chlorine, and temperature control project, which will allow flow diversion from Ditch 011 (medium priority).
- Conduct a complete radiation walkover of the plant property (low priority).
- Undertake a historical evaluation using records, interviews, reviews of processes, etc., for all chemical and radiological uses and releases on the PGDP to determine possible future contributions to onsite or offsite contamination (low priority).
- Coordinate with the Commonwealth and Oak Ridge National Laboratory on contingency plans for radiological screening of deer and other game if results of the yearly deer evaluation indicate the presence of radioactive contaminants (low priority).

The planned and continuing activities discussed above represent DOE/Energy System's response to the findings of Phase I of the site investigation. When completed, the proposed work will fully satisfy the Consent Order.

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TO COME

Appendix 2B-17

Radiological Walkover Survey of

Little Bayou Creek, Big Bayou Creek,

and Plant Ditches

TO COME

TECHNICAL MEMORANDUM NO. 17 CH2M HILL

PREPARED FOR: PGDP Phase I Site Investigation

PREPARED BY: Pat Scofield/ORO

08 - 37 - - 930405581

DATE: January 4, 1991

SUBJECT: Results of Radiological Walkover Survey of Little Bayou Creek, Big Bayou Creek, and Plant Ditches

PROJECT: ORO28178.TM

INTRODUCTION

A surface radiation survey was conducted from March through September 1990 of sections of Little Bayou Creek, the North-South Diversion Ditch, the North Perimeter Ditch, certain Kentucky Pollution Discharge Elimination System (KPDES) ditches, and sections of Big Bayou Creek. The surveyed sections are highlighted in Figure 1. In addition, samples of creek and ditch sediment and bank samples were collected. The locations of the bank sampling locations are shown in Figure 2.

The purpose of the surveys was to determine the level of radioactive contamination in the stream beds and to characterize the relative amounts and types of radioactive contamination. The results of the survey will be used to help determine the influence of the creeks on the shallow groundwater system and to assess the risks from offsite radioactive contamination.

SURVEY METHODOLOGY

SURVEY AREA AND COVERAGE

Initially, the radiological survey focused on the North-South Diversion Ditch and Little Bayou Creek and was to be conducted in three phases. The first phase covered the North-South Diversion Ditch from the Paducah Gaseous Diffusion Plant (PGDP) fence to Little Bayou Creek. The second phase covered the section of Little Bayou Creek where the North-South Diversion Ditch converges with the creek and extends to approximately Station No. SB5. The third phase covered from Station No. SB5 to the Ohio River.

As contamination was detected, the survey plan was extended to include other areas. The areas were a section of the North Perimeter Ditch, which runs from the convergence of the North-South Diversion Ditch to outside the westernmost plant location, the KPDES ditches, and Big Bayou Creek.

Coordinate systems were established to mark survey and sampling locations along the creeks and ditches. For example, the 0 coordinate for Little Bayou Creek was located approximately at Station No. RS3. The southern section of the Little Bayou Creek survey extended into the West Kentucky Wildlife Management Area (Wildlife Management Area) to approximately 19000-South, and the northern survey essentially extended to the Ohio River (approximately 18900-North). The coordinate systems established for Big Bayou Creek and the ditches are described in the following sections.

This technical memorandum (TM) presents data gathered in areas that were accessible between March and September 1990. Areas of dense undergrowth, stream-bed contours, and the beaver dam limited the survey coverage.

LOW-LEVEL-GAMMA WALKOVER

The low-level-gamma survey was conducted using Eberline SPA-3 2 inch × 2 inch NaI detectors (sensitivity of approximately 1,200 cpm per microRoentgens per hour [uR/hr] Ra-226) and either Eberline ESP-1 or PRS-1 count-rate meters. The banks of the streams between the water line and the estimated high-water line were scanned with SPA-3 detectors to determine the location of the highest count rate. The stream bed was surveyed by walking with the low-level-gamma detector held approximately 6 inches off the ground. In areas that were too steep for scanning the area between the high- and low-water lines, either the top of the bank or the area from the creek bed up, whichever was more accessible, was scanned. Areas of elevated count rates (approximately 3 times background) were marked with pin flags, and shielded and unshielded G.M. detector readings were taken. In areas of elevated readings, surface-contact and 1-meter readings were taken.

G.M. DETECTOR MEASUREMENTS

The shielded and unshielded G.M. detector measurements were taken at discrete 500-foot intervals along both banks of Little Bayou Creek, the North-South Diversion Ditch, Big Bayou Creek, the North Perimeter Ditch, KPDES 001, and KPDES 011. The measurements were staggered so that no more than 250 feet separated two measurement locations on opposite sides of the stream bed. In addition, the G.M. measurements were taken at "hot spots" (less than three times background) that were detected during the gamma walkover survey.

The measurements were conducted with thin-window (<2 mg/cm^2 HP-210 and HP-260) G.M. detectors and portable Eberline ESP-1 and PRS-1 count-rate meters. The instruments were used to obtain surface measurements of total beta and gamma radiation levels at each location. The measurements were also taken with the detector shielded to evaluate contributions of nonpenetrating beta and low-energy gamma radiation (approximately 400 mg/cm^2 aluminum foil). The detectors are shielded with either tungsten (HP210T) or lead (HP210L) to reduce background radiation, particularly cosmic radiation. The HP210T and the HP210L have the same shielding specifications, so the results are directly comparable.

SEDIMENT SAMPLES

Initially, sediment samples were to be collected at 4 locations on the North-South Diversion Ditch and up to 20 locations along Little Bayou Creek. As the survey began and information was received, sample collection expanded into other areas. Additional sediment samples were collected from Little Bayou Creek and the North-South Diversion Ditch, and sediment samples were also collected along Big Bayou Creek and the KPDES-001 bank and from the marsh area. The sampling locations are shown in Figure 2. Sediment sampling was conducted according to ESP 304-1, "Sediment Sampling Procedure--Streambeds." Stream-bank samples, as shown in Figure 2, were taken from either side of the creek bank, depending on which had safer access. Sampling was conducted according to ESP 303-1, "Soil Sampling with a Spade and Scoop." In locations where survey results indicated elevated radiological contamination, soil samples were also obtained.

Samples were initially analyzed at the Field Support Laboratory (FSL) for gross alpha activity and gross beta activity. The samples were then shipped to a contracting laboratory (CEP/Teledyne) for analysis of gross alpha and gross beta activity and for isotopic analysis for the following radionuclides: U-234, U-235, U-238, Tc-99, Th-230, Np-237, and Pu-239. The analyses were conducted in accordance with CEP or Teledyne radioanalytical procedures.

INSTRUMENTATION AND CALIBRATION

Each instrument was calibrated off the site at the Eberline instrument-calibration facility. Calibration certificates were issued for each instrument and probe combination. The calibrations are traceable to the National Institute of Standards and Testing (NIST, formerly National Bureau of Standards [NBS]). Conversion of the NaI count-rate measurements to exposure rate in uR/hr was determined by cross-calibration with a pressurized ionization chamber, using an Ra-226 source. Information on instrument calibration is in Attachment I.

Survey instruments were source-checked on the site daily before and after use to verify if instrument response was stable. The NaI SPA-3 detector was source-checked with a Cs-137 (approximately 8 uCi) source. The G.M. detectors were source-checked on the site with a Tc-99 (approximately 10,300 dpm) source.

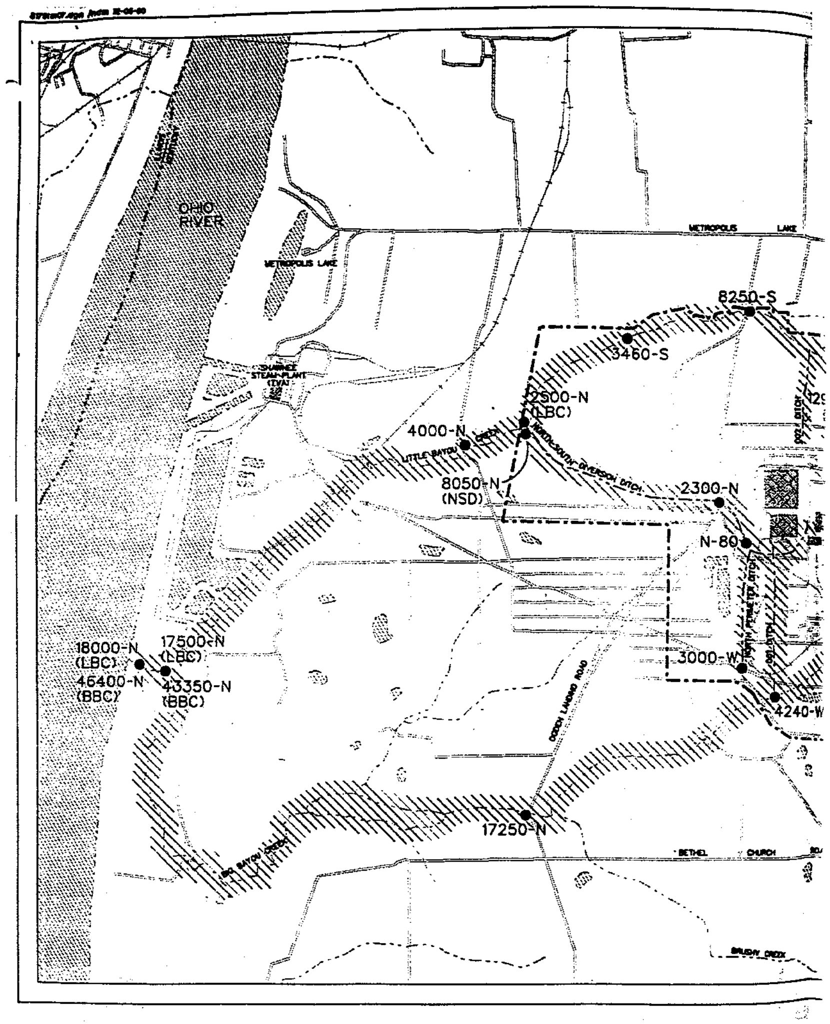
Table 1 lists the instruments used and gives examples of combination detectors and portable rate meters.

MEASUREMENT OF BACKGROUND RADIATION

The natural background radiation level for each type of instrument was established at approximately 18900-S and approximately 19000-S on Little Bayou Creek, about 1 mile upstream of the PGDP. Twenty measurements were taken with each detector (SPA-3, open-window G.M., closed-window G.M.) on March 19 and 25. The average of these measurements was used as a representative background radiation level for stream and ditch walkover surveys. The background radiation levels for the SPA-3 detector type and for the open-window (unshielded) and the closed-window (shielded) G.M. detector are listed in Table 2.

QUALITY ASSURANCE

The sediment and stream-bank samples were initially analyzed at the FSL to identify gross radioactivity levels and to determine U.S. Department of Transportation (DOT) shipping and handling procedures. The FSL Quality Assurance (QA) procedures (Level II) used to prepare and analyze these samples are identified in the draft of *CH2M HILL Field Support Laboratory PGDP Site Investigation Laboratory Procedures Manual* and the draft of *Standard Operating Procedures for the Review and Validation of Gross Alpha and Gross Beta Particle Activity Analysis*.


OHIO
RIVER
METROPOLIS LAKE
8250-S
3460-S
2500-N
(LBC)
4000-N
8050-N
(NSD)
2300-N
N-80
3000-W
4240-W
18000-N
(LBC)
46400-N
(BBC)
17500-N
(LBC)
43350-N
(BBC)
17250-N
BETHEL
CHURCH

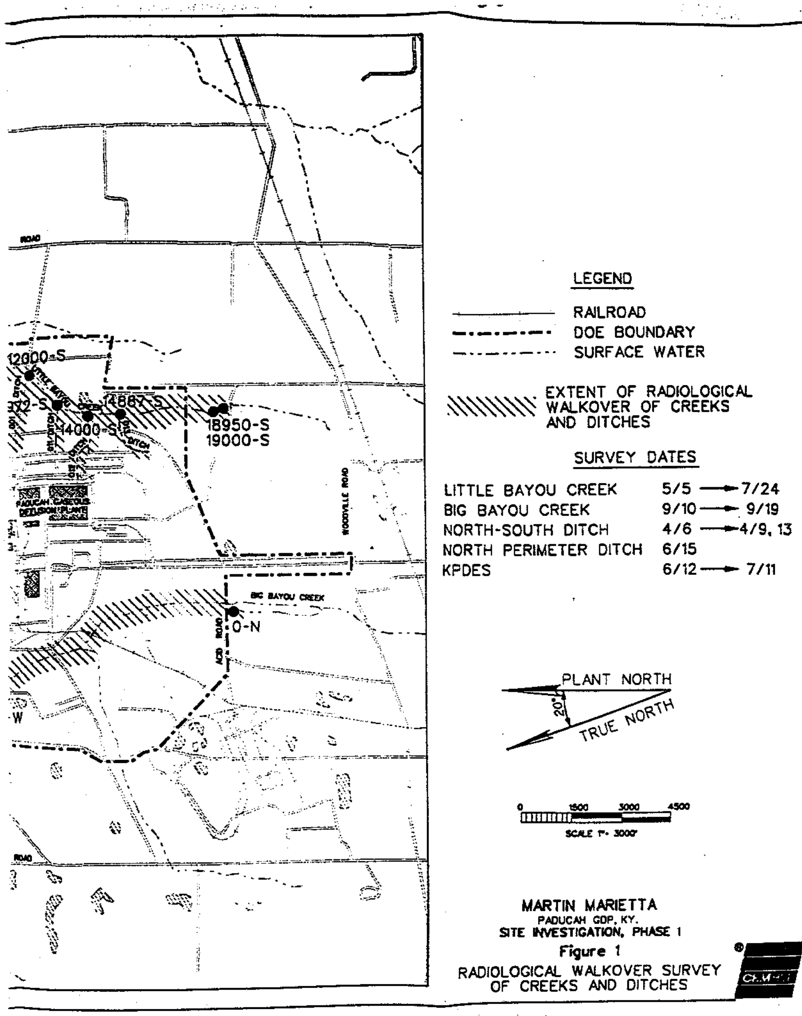
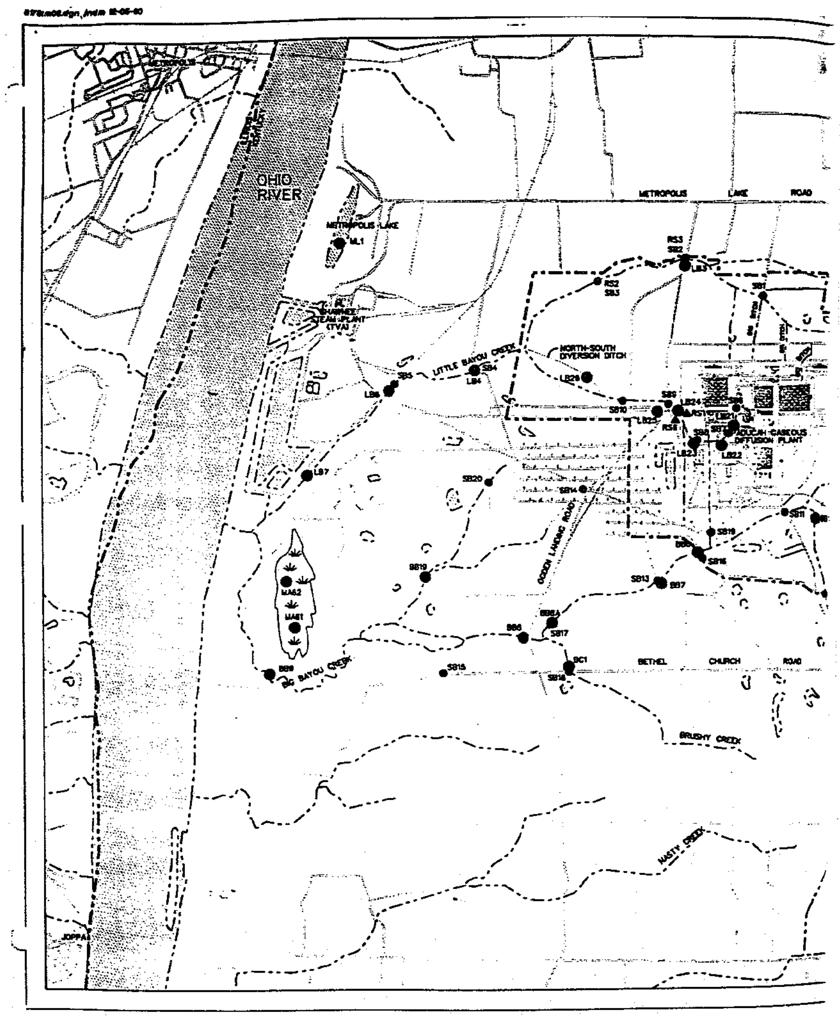


Figure 1
RADIOLOGICAL WALKOVER SURVEY OF CREEKS AND DITCHES


OHIO RIVER
METROPOLIS LAKE
ML1
METROPOLIS LAKE ROAD
LITTLE BAYOU CREEK
NORTH-SOUTH DIVERSION DITCH
PADUCAH GASEOUS DIFFUSION PLANT
OGDEN LANDING ROAD
BIG BAYOU CREEK
BETHEL CHURCH ROAD
BRUSHY CREEK
MASSAC CREEK
JOPPA

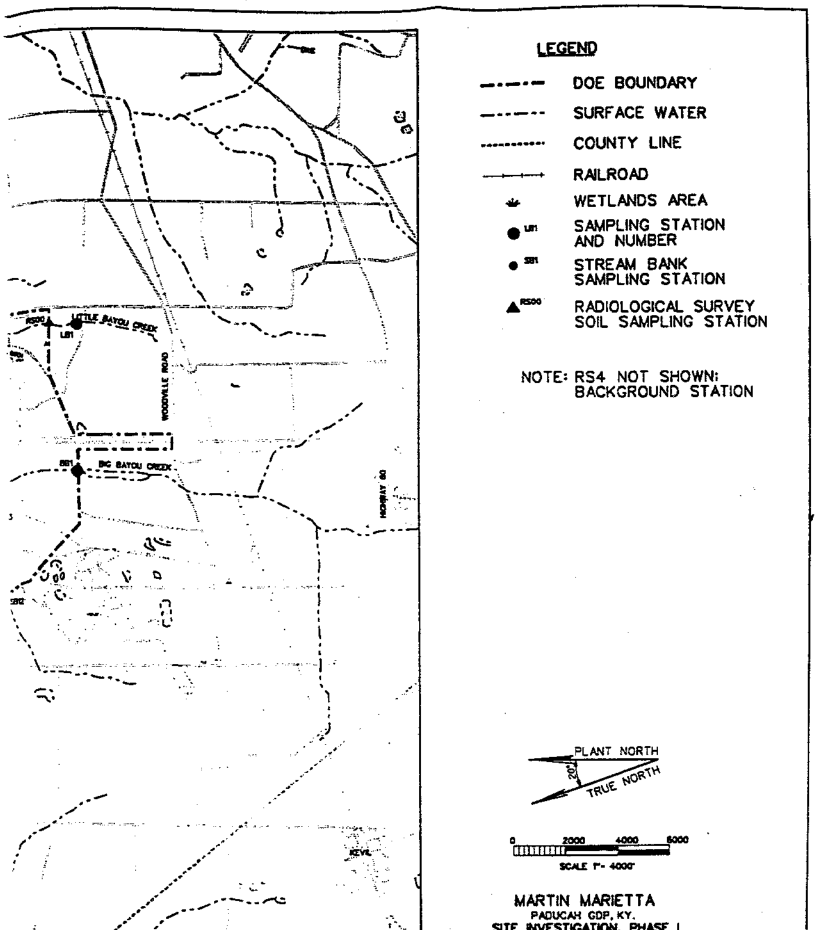


Figure 2
SEDIMENT AND STREAM BANK SAMPLING STATIONS

Table 1
RADIOLOGICAL SURVEY: INSTRUMENTATION

Detector		**Count-Rate Meters**	
NaI Scintillator Detector Model SPA-3 Serial Number		Model	Serial No.
EAC-15		ESP-1	602
EAC-22		ESP-1	602, 732, 2073
EAC-50		PRS-1	275
EAC-80		ESP-1	604, 736, 2014, 2072, 2073
G.M. Thin-Window Detector Model	Serial No.	Model	Serial No.
HP 260		ESP-1	2005
HP-210	EAC-34	PRS-1	481
HP-210	EAC-101	ESP-1	601, 732
HP-210	EAC-102	ESP-1	601, 732, 2072
HP-210	EAC-103	ESP-1	602

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Table 2
AVERAGE BACKGROUND MEASUREMENTS

	Background	
	Counts/Min (cpm)	**Exposure Rate (uR/hr)[a]**
SPA-3 NaI Scintillator Detector		
SPA-3 (80) and ESP-1 (604)[b]	10,575 (1 m) 11,750 (Contact)	8.75 (1 m) 9.73 (contact)
SPA-3 (22) and PRS-1 (332)	9,096	---
SPA-3 (50) and PRS-1 (275)	9,217	---
	Unshielded (cpm)	**Shielded[c] (cpm)**
HP-210 G.M. Detector		
HP-210 (105) and ESP-1 (736)	40	41
HP-210 (101) and ESP-1 (732)	40	34

[a]Conversion from count rate to exposure rate determined by cross-calibration with pressurized ionization chamber to Ra-226 source.
[b]( ) indicates serial number.
[c]HP-210 shielding consisted of 56 layers of Alumax™ 124.

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location as the south survey and extended to the Ohio River (approximately 18000-N). The locations of the results for the elevated-gamma walkover (less than 3 times background) are tabulated in Table 3.

Little Bayou Creek, South

The results of the walkover survey for Little Bayou Creek, south, showed a higher number of elevated readings than the north survey. Very few readings of more than 3 times background were observed between Ogden Landing Road and the North-South Diversion Ditch (approximately 0-S to 8250-S). South of Ogden Landing Road (8050-S to 8450-S), elevated readings were observed (up to 80K cpm). Both banks along this section of Little Bayou Creek, south, often exhibited elevated readings.

Elevated readings were detected along the creek banks between approximately 10100-S and approximately 13000-S. The readings were on the creek bank between the high- and low-water lines. The distribution of the readings along the creek bank resembled a bathtub ring.

Numerous elevated readings were observed in the "bathtub ring" section in comparison to other sections along the creek except for the area 8050-S to 8450-S. The bathtub ring was not always observed on both banks. However, the elevated readings in this section of the creek were often associated with the bathtub ring. One suggestion is that the bathtub ring is produced when the water rises and the radioactive particles preferentially sorb to specific bank soil and then remain when the water recedes.

From South of the KPDES Ditch 011 (approximately 12972-S) to the end of the survey (19000-S), levels greater than 3 times background were not observed. At 18900-S and 19000-S, background readings were obtained for the survey instrumentation. These locations are approximately 1 mile upgradient of the plant and upstream of KPDES ditch influence, so they should not be affected by plant operations.

The isotopic analysis of the sediment samples was performed using Level V data quality objectives (DQOs). The purpose of Level V analysis is to generate data from analyses not specified by the EPA Contract Laboratory Program (CLP) Routine Analytical Services. The quality, validation, and documentation of data are similar to CLP Level IV analyses; data generated by Level IV analyses is suitable for use in litigation support and risk assessment.

CH2M HILL standard operating procedures (SOPs) used as guidance for reviewing laboratory data packages and validating analytical results are listed below:

- SOPs for reviewing and validating analysis of gross alpha and gross beta particle activity
- SOPs for reviewing and validating analysis of gross alpha particle activity
- SOPs for reviewing and validating analysis of gamma activity
- SOPs for reviewing and validating analysis of gross beta particle activity

SUMMARY OF FINDINGS

GAMMA WALKOVER SURVEY MEASUREMENTS

The results of this survey are described below, by location. The criterion for determining elevated radiological surface contamination was approximately 3 times background or greater. The measurements from the gamma walkover survey are reported in units of thousands of counts per minute (K cpm). The measurements were taken at 50-foot intervals along the creek bank and the ditches, except for Big Bayou Creek, which was surveyed at 250-foot intervals. The surveys were conducted on both banks. A complete list of the results of the gamma survey is in Attachment II.

Little Bayou Creek

Little Bayou Creek was split into a north survey and a south survey. Both began at the same 0 coordinate, near Station No. SB3. The south survey extended along the PGDP boundary and ended in the Wildlife Management Area (approximately 19000-S), where the background measurements were obtained. The north survey started at the same 0

Table 3
MEASUREMENTS LOCATIONS OF ELEVATED-GAMMA WALKOVER SURVEY AND G.M. SURVEY*

Page 1 of 3

Gamma Walkover Survey	G.M. Shielded, Unshielded
Little Bayou Creek	Little Bayou Creek
South	South
1050-S to 1100-S (west)	1150-S (east)
1100-S to 1150-S (west)	3500-S (east)
3450-S to 3500-S (east)	10000-S (east)
4900-S to 4950-S (east)	11500-S (east)
6550-S to 6600-S (east)	11750-S (west)
8000-S to 8450-S	12250-S (west)
9300-S to 9350-S (east)	12500-S (east)
9850-S to 9900-S (east)	
9950-S to 10000-S (east)	
10050-S to 13000-S (bathtub ring)	
North	North
500-N to 550-N (west)	1750-N (west)
4800-N to 4850-N (east)	3000-N (east)
4950-N to 5000-N (east)	4000-N (east)
8000-N to 8050-N (east)	5750-N (west)
8300-N to 8350-N (west)	10250-N (west)
16700-N to 16750-N (east)	10750-N (west)
	11000-N (east)
	11250-N (west)
	13750-N (west)
	16750-N (east)
	17000-N (east)
	17250-N (west)

Table 3
MEASUREMENTS LOCATIONS OF ELEVATED-GAMMA WALKOVER SURVEY AND G.M. SURVEY*

Page 2 of 3

Gamma Walkover Survey	G.M. Shielded, Unshielded
North-South Diversion Ditch South** 150-S to 200-S (east) 300-S to 350-S (east) 350-S to 400-S (west) 1600-S to 1650-S (west) 1850-S to 1900-S (west) 1900-S to 1950-S (west) 1950-S to 2000-S (west)	North-South Diversion Ditch South 250-S (west) 500-S (east) 750-S (west) 1000-S (east) 1250-S (west) 1500-S (east) 1750-S (west) 2750-S (west) 3250-S (west) 3445-S (east)
North 0-N to 2250-N 2300-N to 2350-N (east) 4950-N to 5050-N (west) 5050-N to 5100-N (east) 5300-N to 5900-N 5950-N to 6300-N 6400-N to 6450-N (west) 6500-N to 6700-N (west) 6850-N to 7150-N 7200-N to 7300-N 7350-N to 7500-N 7650-N to 7700-N (east) 7900-N to 8000-N (west)	North 0-N (east) 250-N (west) 500-N (east) 1000-N (east) 1250-N (west) 1500-N (east) 1750-N (west) 2000-N (east) 4750-N (west) 5500-N (east) 5750-N (west) 6000-N (east) 6500-N (east) 7000-N (east) 7250-N (west) 7500-N (east) 7750-N (west) 8000-N (east) 8180-N (west)
Big Bayou Creek 25500-N to 25750-N (west)	Big Bayou Creek Less than 3 times background

Table 3
MEASUREMENTS LOCATIONS OF ELEVATED-GAMMA WALKOVER SURVEY AND G.M. SURVEY*

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Gamma Walkover Survey	G.M. Shielded, Unshielded
North Perimeter Ditch 2100-W to 2150-W (south) 2150-W to 2200-W (south)	North Perimeter Ditch 1750-W 2250-W 2750-W
KPDES Drainage Ditch KPDES-001 2750-W to 3400-W (Uranium Cylinder Yard) KPDES-002 2125-W to 2415-W (Cylinder Yard) KPDES-010 At background levels KPDES-011 0 to 1200-W KPDES-012 At background levels KPDES-013 At background levels	KPDES Drainage Ditch KPDES-001 0-W (north) 1850-W (south) 2600-W (north) 2650-W (south) 2700-W (north) KPDES-002 No survey KPDES-010 No survey KPDES-011 0-W to 1200-W KPDES-012 No survey KPDES-013 No survey

*Gamma-survey measurements were at 50-foot intervals along the creeks (except for Big Bayou Creek, which was measured at 250-foot intervals) and ditches and on both sides of the creeks and ditches. G.M. shielded and unshielded measurements were taken at discrete points.

**These are only the significantly elevated readings (see Attachment II).

Little Bayou Creek, North

In contrast to the southern survey region, fewer elevated gamma readings were observed, and those that were observed appeared to localized. Elevated readings of approximately 3 times background were observed between 500-N and 550-N and near the 8000-N to 8050-N survey locations. Other observed elevated readings were at 4800-N to 4850-N (approximately 42k cpm), located near Anderson Road; 8300-N to 8350-N (approximately 30K cpm); and 16700-N to 16750-N (approximately 40k cpm), upstream of the marsh area on TVA property.

North-South Diversion Ditch

The North-South Diversion Ditch survey extended from a 0 coordinate originating at the North Perimeter Fence. The onsite survey of the ditch extended south to approximately 3500-S. The offsite survey of the ditch extended north from the North Perimeter Fence to the convergence with Little Bayou Creek (2500-N Little Bayou Creek). The DOE boundary also was at this convergence (8050-N North-South Diversion Ditch and 2500-N Little Bayou Creek).

The onsite ditch survey showed readings that were greater than background--often more than 3 times background--throughout the length of the ditch. In addition, 6 locations had readings of approximately 10 times background (100K cpm), and 1 location exceeded 200K cpm, approximately 20 times background. These areas are as follows:

Location	Count Rate (cpm)
150-S - 200-S (east)	20-160K
300-S - 350-S (east)	20-180K
350-S - 400-S (west)	25-150K
1600-S - 1650-S (west)	15-130K
1850-S - 1900-S (west)	15-190K
1900-S - 1950-S (west)	15-140K
1950-S - 2000-S (west)	15-210K

Many of the readings from the offsite ditch survey, particularly south of Ogden Landing Road, were more than 3 times background. In some cases, the readings were as much as approximately 7 to approximately 10 times background, such as:

Location	**Count Rate (cpm)**	
	East	**West**
0-N to 50-N	27-116K	40-75K
150-N to 200-N	40-70K	45-80K
200-N to 250-N	40-90K	45-100K

Generally, both sides of the ditch exhibited somewhat similar levels of elevated readings. Table 3 lists the locations of the elevated readings, and a complete list is in Attachment II.

Fewer elevated readings were found north of Ogden Landing Road. Most of them were approximately 3 to 5 times background. Only at one location (5650-N to 5700-N) was the reading approximately 10 times background. At 6850-N to 6900-N (east side) and 7050-N to 7100-N (east side), the readings were up to 7 times background. Similar readings were not typically seen on both sides of the ditch, unlike the survey results south of Ogden Landing Road. The assumption is that the North-South Diversion Ditch was rerouted between Ogden Landing Road and the back entrance to the Martin Marietta Energy Systems, Inc. (Energy Systems) landfill (4550-N).

Big Bayou Creek

The Big Bayou Creek survey extended from Acid Road (0-N) to the Ohio River (46400-N). At approximately 43350-N, Little Bayou Creek enters Big Bayou Creek. At approximately 46400-N, both creeks enter the Ohio River. Only one elevated reading was observed on Big Bayou Creek. At 25500-N to 25750-N, the west bank yielded readings that were between background to 3 times background (8 to 30K cpm). The east bank did not exhibit similar readings at this location.

North Perimeter Ditch

The North Perimeter Ditch runs the length of the PGDP North Perimeter Fence. The ditch is located on the site and runs east-west along the north side of waste management units (WMUs) 30 and 7. The surveyed section of the ditch runs from the North-South Diversion Ditch west to the PGDP site fence (3000-W). Two elevated readings were observed, one at 2100-W to 2150-W (15 to 126K cpm) and the other at 2150-W to 2200-W (18 to 30K cpm). These areas are downgradient of the C-747-A Burn Area (WMU 30).

KPDES Drainage Ditches

Six KPDES drainage ditches were surveyed. The surveyed ditches were located primarily on the east side of the PGDP: KPDES 002, 010, 011, 012, and 013. KPDES-010 intersects Little Bayou Creek at about 12000-S; KPDES-011 intersects Little Bayou Creek at 12972-S; KPDES-012 intersects Little Bayou Creek at 13944-S; and KPDES-013 intersects Little Bayou Creek at 14887-S. KPDES-001 is on the west side of the PGDP and intersects Big Bayou Creek at 4240-W.

The gamma walkovers were not performed on the "onsite" section--North-South Diversion Ditch (0) to 2700-W--of KPDES-001 because of the high background from the Uranium Cylinder Yard. The offsite section of KPDES-001 that extends from the West Perimeter Fence to Big Bayou Creek (4240-W) is 2700-W to 4250-W. The elevated count rates detected from 2700-W to 2750-W (22 to 25K cpm) to approximately 3350-W to 3400-W (16 to 17K cpm) are due to the Uranium Cylinder Yard, which is on the west side of the site.

At KPDES-002, no elevated readings were detected from 100-W to 2125-W. As the survey approached 2125-W, the background readings rose. Background levels continued to rise from 2125-W to 2415-W. An investigation revealed that there is a cylinder yard about 40 feet west of the East Perimeter Fence; the belief is that the yard caused the increase in background.

KPDES ditches 010, 012, and 013 did not yield elevated readings above background in the areas surveyed.

KPDES-011 presents a different profile. Elevated readings were detected throughout the survey and, in many cases, greatly exceeded the criterion of 3 times background.

For the areas surveyed, 0-W to 250-W and 350-W to 400-W, both sides of the ditch had readings of about 10 to 25 times background. For a short stretch (450-W to 600-W), values of less than 3 times background were observed. However, from 600-W to 650-W to 1150-W to 1200-W, elevated readings were observed on both banks, except for 650-W to 750-W (south). In sections 1000-W to 1050-W and 1050-W to 1100-W, the south side of the ditch resulted in readings of up to about 22 times background. At 1200-W, the elevated readings decreased in comparison to the previous readings, primarily because KPDES-011 runs underground starting at this location. The survey terminated at 1410-W, which was at the PGDP perimeter fence.

G.M. SURVEY MEASUREMENTS

The G.M. survey measurements were taken at discrete points at 250-foot intervals on alternating banks of Little Bayou Creek and Big Bayou Creek and along the North-South Diversion Ditch, the North Perimeter Ditch, and the KPDES ditches. A summary of the hot spots is presented in Table 3, and a complete list of the results is in Attachment III. The shielded and unshielded G.M. survey provides information on the contribution of nonpenetrating beta and low-energy gamma radiation. The criterion used for identifying elevated readings was 3 times background or greater. As shown in Table 2, the HP210 background is about 40 cpm (unshielded) and 41/34 cpm (shielded). Note that the data are in gross count rates (cpm); the background has not been subtracted.

The coordinates used during this measurement are comparable to the gamma walkover although these measurements were taken at discrete points. The gamma walkover scanned an area, and a range of values was recorded.

In this section, the beta and gamma results are reviewed and are compared to the results of the gamma walkover survey where applicable.

Little Bayou Creek

As in the case for the gamma walkover survey, Little Bayou Creek was surveyed in two regions, south and north.

Little Bayou Creek, South

Elevated beta and gamma readings were detected at the following locations:

Location	Count Rate (gross cpm)	
	Unshielded	Shielded
1150-S (east)	726	178
3500-S (east)	88	44
10000-S (east)	107 (77) (Dup)	44 (52) (Dup)
11500-S (east)	101	52
11750-S (west)	87	43
12250-S (west)	87	58
12500-S (east)	106	40

According to these results, beta emitters in these locations appear to be the primary contaminant. At 1150-S, elevated gamma readings were also observed. The gamma walkover survey also indicated elevated gamma levels at these locations except for 10000-S and 12500-S. Four of the locations were within the region of the bathtub ring--11500-S, 11750-S, 12250-S, and 12500-S.

Little Bayou Creek, North

Elevated beta and gamma measurements were observed at several locations. According to the shielded and unshielded G.M. measurements, beta emitters were the primary contaminant except for 10250-N. The locations of the elevated readings are as follows:

Location	Unshielded (gross cpm)	Shielded (gross cpm)
1750-N (west)	141	42
3000-N (east)	284	40
4000-N (east)	194	56
5750-N (west)	84	49
10250-N (west)	78	71
10750-N (west)	110	37
11000-N (east)	88	51
11250-N (west)	89	46
13750-N (west)	80	57
16750-N (west)	95	48
17000-N (east)	93	51
17250-N (west)	99	52

At these locations, the G.M. measurements indicated that the gamma component was only slightly elevated (less than 3 times background). During the gamma walkover survey, elevated gamma levels were not observed at these locations except at 16750-N (approximately 10 to 40K cpm).

North-South Diversion Ditch

G.M. shielded and unshielded readings taken with the HP-210 or HP-260 started at the North Perimeter Fence and headed south onto the PGDP site. Elevated results from the beta and gamma survey of the onsite segments of the North-South Diversion Ditch are shown below:

Location	Unshielded (gross cpm)	Shielded (gross cpm)
250-S (west)	205	90
500-S (east)	91	49
750-S (west)	99	64
1000 (east)	116	51
1250-S (west)	97	63
1500-S (east)	98	65
1750-S (west)	157	73
2750-S (west)	99	47
3250-S (west)	188	59
3445-S (east)	146	44

Elevated beta and gamma levels were observed at most measurement locations. Beta emitters were predominant at 250-S, 1000-S, 1750-S, 3250-S, and 3445-S.

Direct readings taken with the G.M. survey instruments starting at the north perimeter of the plant and heading north resulted in elevated beta and gamma levels at the following locations:

Location	Unshielded (gross cpm)	Shielded (gross cpm)
0-N (east)	280	78
250-N (west)	564	138
500-N (east)	268	83
1000-N (east)	173	48
1250-N (west)	110	46

Location	Unshielded (gross cpm)	Shielded (gross cpm)
1500-N (east)	150	51
1750-N (west)	160	180
2000-N (east)	126	42
4750-N (west)	190	50
5500-N (east)	144	44
5750-N (west)	138	46
6000-N (east)	146	46
6500-N (east)	180	46
7000-N (east)	96	50
7250-N (west)	94	56
7500-N (east)	92	72
7750-N (west)	176	40
8000-N (east)	160	58
8180-N (west)	105	56

According to the data from the unshielded and shielded measurements, beta emitters were present at all locations except 1750-N. Elevated gamma readings were detected in a few locations at levels of more than 3 times background. The gamma walkover survey also indicated significantly elevated levels at 0-N to 250-N, but elevated levels also were detected at most locations identified except 6500-N (east), 7250-N (west), and 7750-N (west).

Big Bayou Creek

The banks of Big Bayou Creek yielded readings that were at background levels for beta and gamma radiation. At a few locations, slightly elevated readings were observed (less than 3 times background); the readings were determined to be primarily gamma emitters. The field background levels were slightly higher than in the Eberline field office.

North Perimeter Ditch

Unshielded and shielded measurements along the North Perimeter Ditch identified the following elevated levels:

	Unshielded (gross cpm)	Shielded (gross cpm)
1750-W	285	60
2250-W	1,400	150
2750-W	87	50

As observed, beta emitters are the predominant source of contamination. The G.M. measurements also exhibited elevated gamma levels at 2250-W. However, the walkover results found elevated gamma levels at 2100-W to 2150-W (15 to 126K cpm), but not in the vicinity of 2200-W to 2250-W (11 to 22K cpm).

KPDES-001

The measurements at 0-W to 750-W were taken in 250-foot increments; however, readings were taken at 50-foot increments on alternating banks because of the high background levels caused by the nearby Uranium-Cylinder Storage Yard. For KPDES-001, elevated beta radiation levels were detected from 0-W to 2700-W (the range of unshielded readings was 56 to 126 cpm) except for 1150-W and 2350-W. The gamma readings were at, or slightly above, background, as substantiated by the gamma walkover survey.

KPDES-002

The G.M. measurements were not taken at KPDES-002, so comparison with the gamma walkover survey is not possible.

KPDES-011

Elevated readings were observed throughout the ditch in both the unshielded and shielded measurements, which indicates that both beta and gamma emitters were present. The measurements taken from 0-W through 1200-W showed significantly elevated beta and gamma radiation levels. Elevated beta readings (about 4 to 95 times background) were observed at several locations. For example, at 200-W, the unshielded and shielded count rates were 3,810 cpm and 579 cpm; at 1000-W, the unshielded and shielded count rates were 1,410 and 378 cpm. With very few exceptions (1200-W to 1400-W), the gamma walkover survey also showed elevated gamma radiation levels in this area.

KPDES-012 and KPDES-013

G.M. measurements were not taken at either KPDES-012 or KPDES-013. Therefore, comparison of the G.M. measurements with the gamma walkover survey was not possible at these locations.

SEDIMENT AND STREAM-BANK SAMPLING

The sediment and stream-bank sampling locations are shown in Figure 2. A complete list of the analytical results are in Attachment IV. As noted earlier, sediment samples were collected from Little Bayou Creek, the North-South Diversion Ditch, Big Bayou Creek, and the marsh area. Stream-bank samples were collected from the North-South Diversion Ditch, Big Bayou Creek, and KPDES-001.

Little Bayou Creek

For the stream-bank samples, elevated gross alpha and gross beta concentrations were detected at SB-1, SB-2, and SB-3. As shown in Table 4, the samples also exhibited elevated U-234, U-235, and U-238 concentrations. The SB-1 location was within the bathtub ring region, as identified during the gamma walkover survey. The SB-2 sampling station is in an area that exhibited elevated gamma readings (at approximately 8250-S, 8 to 50K cpm). The RS03 (5133) sample collected at approximately 8300-S indicated elevated gross beta and Tc-99 concentrations (1,126 and 2,938 pCi/g, respectively). In this sample, U-234, U-235, U-238, Np-237, Pu-239, and

Table 4
LITTLE BAYOU CREEK:
SEDIMENT AND STREAM-BANK SAMPLES

		Activity Concentrations (pCi/g)		Radionuclide Concentrations (pCi/g)						
Station No.	Sample No.	Gross α	Gross β	Tc-99	U-234	U-235	U-238	Np-237	Pu-239	Th-230
Sed. Samples										
LBC:										
LB-1	2087	5.8 ± 3	17.0 ± 2.0	2.4 ± 0.7						
LB-3	2088	<3	11.0 ± 2.0	<0.7	0.91 ± 0.05	0.14 ± 0.02	4.8 ± 0.1	<0.03	<0.02	0.21 ± 0.01
LB-4	2089	<3	8.5 ± 2.0	3.80 ± 0.8						
LB-6	2090	<3	4.5 ± 1.8	5.2 ± 1.0						
LB-6	2090 (D)	7.9 ± 3.4	9.3 ± 2.1	10.0 ± 1.0						
LB-7	2091	<3	7.5 ± 2.0	10.0 ± 1.0						
Rad. Survey										
RS02, LBC-E at 3460-S	5132	14.1 ± 2.0	33.7J ± 2.3	10.7 ± 0.7	0.46 ± 0.04	0.92 ± 0.03	2.59 ± 0.1	0.83 ± 0.15	0.07 ± 0.03	<0.05
RS08 (RS02)	5138	130.0 ± 10.0	580.0 ± 10.0	1.2 ± 0.05	33.0 ± 2.0	3.3 ± 0.7	340.0 ± 10.0	<0.09	0.006	0.35 ± 0.03
RS03, LBC-W at 8300-S	5133	154.2J ± 6.4	1125.9J ± 12.3	2938.0 ± 6.0	64.7 ± 0.7	2.2J ± 0.1	79.3 ± 0.7	23.4J ± 0.8	33.4 ± 0.61	4.02 ± 0.11
RS07 (RS03)	5137	38 + 7	140.0 ± 10.0	<0.7	6.1 ± 0.1	1.2 ± 0.1	53.0 ± 10.0	<0.07	<0.003	0.48 ± 0.06
Stream Bank										
LBC:										
SB-1, ~10150-S	2101	120.0 ± 20.0	1700.0 ± 100.0	5.5 ± 0.9	68.0 ± 2.0	5.8 ± 0.7	720.0 ± 10.0	<0.2	<0.007	0.66 ± 0.07
SB-2, ~8250-S	2102	99.0 ± 1.3	900.0 ± 20.0	1.6 ± 0.5	21.0 ± 1.0	5.7 ± 0.2	190.0 ± 10.0	<0.2	<0.008	0.49 ± 0.02
SB-3	2103	21.0 ± 5.0	110.0 ± 10.0	0.79 ± 0.042	9.9 ± 0.3	2.1 ± 0.1	89.0 ± 1.0	<0.09	0.014 ± 0.009	0.51 ± 0.03
SB-4, ~4000-N	2104	16.0 ± 5.0	85.0 ± 5.0	20.0 ± 2.0	7.8 ± 0.2	0.84 ± 0.06	42.0 ± 1.0	0.21 ± 0.07	1.2 ± 0.07	20.0 ± 1.0
SB-5	2105	6.7 ± 3.1	17.0 ± 3.0	4.9 ± 0.9	0.49 ± 0.02	0.03 ± 0.005	0.99 ± 0.03	<0.06	<0.008	0.42 ± 0.02

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Th-230 were also present. Another sample collected at the same location as RS03 (RS07-5137) yielded results considerably different from the results of the previous sample.

The bank sample collected at SB-3 (2103) yielded low concentrations of Tc-99 (0.8 pCi/g), in comparison to the sediment sample collected as RS02 (5132) (10.7 pCi/g). However, the bank sample indicated a higher U-238 concentration in comparison to the sediment sample (5132). Another sample collected at the same location as RS02 (RSO8-5138) yielded results considerably different from the previous sample.

At SB-4, elevated gross beta concentrations (85 pCi/g), U-238, and Th-230 concentrations (42 pCi/g and 20 pCi/g, respectively), and Tc-99 concentrations (20 pCi/g) were observed. SB-4 is on Little Bayou Creek between 4000-N and 4550-N. The G.M. measurements indicated that beta emitters were present (4000-N), and the gamma walkover survey did not yield radiation levels above background. The LB-4 sediment sample indicated lower Tc-99 concentrations (3.8 pCi/g) and lower gross beta concentrations (8.5 pCi/g), in comparison to the SB-4 stream-bank sample (20 pCi/g and 85 pCi/g, respectively). A complete isotopic analysis was not conducted on the LB-4 sample.

North-South Diversion Ditch

The sediment samples collected on the site at LB-21, LB-23, and LB-24 exhibited elevated gross alpha and beta concentrations, particularly at LB-21 and LB-24. As shown in Table 5, the isotopic analyses of the LB-24 sediment sample yielded elevated Tc-99, U-234, U-235, U-238, Np-237, Pu-239, and Th-230 concentrations. The LB-21 sediment sample exhibited elevated concentrations of Tc-99, U-234, U-235, and U-238 but not of Np-237 and exhibited a slightly elevated concentration of Pu-239. The LB-21 duplicate samples did not yield similar analytical results, which may be due to the lack of homogeneity among the samples.

As shown in Table 5, the North-South Diversion Ditch stream-bank samples taken on the site at SB-6, SB-7, and SB-8 and off the site at SB-9 yielded significant gross alpha and gross beta concentrations. Coinciding with these results were elevated Tc-99, U-234, U-238, and Th-230 concentrations. Np-237 and Pu-239 were also detected. SB-9 and its duplicate sample (2110) yielded somewhat similar gross alpha, Tc-99,

Table 5
NORTH-SOUTH DIVERSION DITCH
SEDIMENT AND STREAM-BANK SAMPLES

Station No.	Sample No.	Activity Concentrations (pCi/g)		Radionuclide Concentrations (pCi/g)						
		Gross α	Gross β	Tc-99	U-234	U-235	U-238	Np-237	Pu-239	Th-230
Sed. Samples										
LB-21	2092	69 ± 9	240 ± 10	60 ± [illegible]	140 ± 10	4.7 ± 0.7	150 ± 10	<0.5	0.39 ± 0.01	3.2 ± 0.3
	2093	7.6 ± 3.3	26 ± 3	24 ± 2	18 ± 1	1.4 ± 1	19 ± 1	<0.2	<0.001	1.4 ± 0.1
LB-23	2095	11 ± 4	31 ± 3	83 ± 3	1.5 ± 0.1	0.17 ± 0.02	1.9 ± 0.1	<0.2	0.55 ± 0.02	14.0 ± 1
LB-24	2096	130 ± 10	520 ± 10	770 ± 10	44 ± 1	12 ± 1	74 ± 1	30 ± 3	2.1 ± 0.1	130 ± 10
LB-26	2097	9.3 ± 3.6	20 ± 3	26 ± 2	4.8 ± 0.1	0.18 ± 0.02	7.4 ± 0.1	<0.3	0.14 ± 0.01	15 ± 1
Rad. Survey										
RS01 at -80-N	5131	103.8 ± 4.9	196.6 ± 5.2	37.8 ± 1.1	20.1J ± 0.6	3.27J ± 0.1	314.1J ± 2.2	2.81J ± 0.55	<0.05	1.24 ± 0.22
RS05 (RS01)	5135	470 ± 30	1400 ± 100	3900 ± 100	24 ± 1	4.8 ± 0.2	87 ± 10	43.2 ± 4.3	240 ± 120	0.004 ± 0.001
RS06 at -460-N	5136	350 ± 30	1000 ± 100	2400 ± 100	4.1 ± 2	0.12 ± 0.04	6 ± 0.2	21.5 ± 2.2	44 ± 10	0.004 ± 0.001
Stream Bank										
SB-6	2106	350.0 ± 30.0	1600.0 ± 100.0	320.0 ± 10.0	76.0 ± 2.0	4.0 ± 0.5	420 ± 10.0	12.0 ± 1.0	13.0 ± 1.0	80.0 ± 1.0
SB-7	2107	220.0 ± 20.0	950.0 ± 20.0	3500.0 ± 100.0	150.0 ± 10.0	5.0 ± 0.50	210.0 ± 10.0	63.00 ± 6.00	53.0 ± 1.00	160.0 ± 10.0
SB-8	2108	160.00 ± 10.0	210.00 ± 10.00	420.00 ± 10.00	38.00 ± 1.00	2.70 ± 0.20	48.0 ± 1.0	7.90 ± 0.08	26.00 ± 1.00	1300.0 ± 100
SB-9	2109	330.0 ± 20.0	570.0 ± 10.0	1200.0 ± 100	35.0 ± 1.0	4.4 ± 0.4	52.0 ± 1.0	15.0 ± 2.0	45.0 ± 1.0	270.0 ± 10
SB-9	2109 (Dup.)	340.0 ± 20	590.0 ± 10	1500 ± 100	37.0 ± 1	1.2 ± 0.1	52.0 ± 1	16.0 ± 2.0	53.0 ± 1.0	79.0 ± 1
SB-9	2110	360.0 ± 20	710.0 ± 20	1300.0 ± 100	120.0 ± 10	2.1 ± 0.5	59.0 ± 3	15.0 ± 2	47.0 ± 1	450.0 ± 10
SB-10	2112	23.0 ± 5	40.0 ± 4	36.0 ± 2	5.6 ± 0.2	0.16 ± 0.04	6.5 ± 0.2	0.54 ± 0.1	0.85 ± 0.06	31.0 ± 1

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U-235, U-238, and Th-230 concentrations. The RS01 station, located at approximately N-80, exhibited elevated gross alpha and gross beta concentrations and Tc-99 (37.8 pCi/g), U-234 (20.1 pCi/g), U-235 (3.27J pCi/g), U-238 (314.1J pCi/gP, and Np-237 (2.81J pCi/g). The RS06 station, which is located at approximately 460-N, exhibited elevated gross alpha and gross beta concentrations and Tc-99 (2,400 pCi/g), Np-237 (21.5 pCi/g), and Pu-239 (44 pCi/g).

Big Bayou Creek

Analysis of the sediment and stream-bank samples collected from Big Bayou Creek yielded radiological concentrations at, or close to, background concentrations. The BB7 sediment sample (2082) indicated Tc-99 concentrations slightly above background, but this was not indicated in the duplicate sample.

Background Sediment Samples

Two background samples were taken (Attachment IV), one at Station RS00 on Little Bayou Creek and the other at RS04, about 10 to 15 miles off the site (southeast). RS04 showed approximately 1.7 times the gross beta concentration in comparison to RS00. Uranium 235 and U-238 were detected in RS04; Np-237 was detected in the RS00 sample.

Localized Areas of Higher Activity (Hot Spots)

Numerous localized areas of activity higher than 3 times background were discovered during the survey of Little Bayou Creek, the North-South Diversion Ditch, the North Perimeter Ditch, and the KPDES ditches. In addition, an isolated hot spot was also detected. A hot area was discovered at about 4 feet from the storm drain located between Virginia Avenue and the North-South Diversion Ditch (across from the 400 Building). The boundary of this area was determined to be about 227-feet long, and it varied in width from 3 to 15 feet. The gamma walkover readings at this hot spot were from 30 to 120K cpm (gross), and the G.M. measurements were 1,781, 1,812, and 1,782 gross cpm (unshielded).

CONCLUSIONS

This TM summarizes the results of the gamma and the beta and gamma surface radiation surveys of the creek and ditch banks and the results of sediment sampling. The gamma walkover and the beta and gamma surveys were for (1) identifying areas of contamination and its boundaries and (2) differentiating between the beta and gamma radiation component. The stream-bank sediment samples were used for further characterizing the radiological contaminants at specified locations. The conclusions and recommendations that can be made on the basis of the Phase I stream and ditch surface survey and sediment sampling are as follows:

1. Broad areas of gamma-emitting contamination were observed (elevated gamma radiation readings higher than 3 times background) on Little Bayou Creek, south; the North-South Diversion Ditch, north, and the KPDES-011 ditch.

2. Numerous areas of localized gamma-emitting contamination were observed (see Table 3 and Attachment II).

3. Beta-emitting contamination was observed on Little Bayou Creek, north and south; the North-South Diversion Ditch on the site and off the site; the North Perimeter Ditch; KPDES-001; and KPDES-011.

4. Of important note is that the survey was conducted between March and September 1990; dense undergrowth made access to some locations difficult or impossible. There may be contamination in areas that were not accessible during the survey.

5. The elevated beta and gamma G.M. measurement did not always coincide with the results of the gamma walkover because (a) beta radiation is not detected with the NaI detectors, (b) G.M measurements were taken at discrete locations, unlike in the gamma walkover, and (c) the unshielded G.M. detector will also detect alpha activity (about 6 percent efficiency) and may be more sensitive to "low-energy" gamma radiation.

6. At some locations, the analytical results of the sediment and stream-bank sampling substantiated the survey results and characterized the possible contaminants at certain locations:

   - The analytical results for Little Bayou Creek sediment and stream-bank sampling indicated that Tc-99 and uranium are the primary contaminants. In a few locations (e.g., RS03, SB-4), however, Np-237 and Pu-239 were also detected.

   - Analyses of the sediment and stream-bank samples from the North-South Diversion Ditch indicated that Tc-99, uranium, and Th-230 were present. Np-237 and Pu-239 were also detected in the sediment samples (LB-23, LB-24, LB-26, RS01, and RS06) and the stream-bank samples (SB-6 to SB-10).

   - Analyses of the sediment and stream-bank samples from Big Bayou Creek indicated that there is little contamination. When Tc-99 and uranium were present, they were at low concentrations.

Recommendations for future surveys:

- Gridded civil survey drawings would be extremely useful in maintaining constant and verifiable survey and sampling locations.

- Using thermoluminescent dosimeters (TLDs) to supplement the survey would give integrated dose-rate information for the specific area. This information is particularly valuable for evaluating environmental radiation levels and for developing data for the human-health assessment that will be conducted as part of Phase II of the site investigation.

- Cross-calibration of the NaI detector (SPA-3) with the pressurized ionization chamber (PIC) to a source(s) that better represents the mixed radiation sources exhibited at the PGDP, rather than calibrating the SPA-3 with a Ra-226 source, would be beneficial.

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WDCPAD6/053.51

UNITED STATES OF AMERICA, *ex rel.*
Natural Resources Defense Council, Inc.,
Thomas B. Cochran,
Ronald B. Fowler,
Charles F. Deuschle, and
Garland E. Jenkins
(Plaintiffs)

v.

LOCKHEED MARTIN CORPORATION,
LOCKHEED MARTIN ENERGY SYSTEMS, INC.,
MARTIN MARIETTA CORPORATION, and
MARTIN MARIETTA ENERGY SYSTEMS, INC.
(Defendants)

DISCLOSURE STATEMENT AND EXHIBITS OF THOMAS B. COCHRAN

Sample False Statements and Concealments

In light of the disclosure statements of Messrs. Deuschle, Fowler, and Jenkins, and my personal observations and review of documents relating to those statements and to the Paducah GDP generally, I consider many statements made by Martin Marietta and its successor Lockheed Martin to DOE (and, generally, to Kentucky as well) to be false, misleading, or calculated to conceal or deceive. My compendium of sample false or misleading statements, attached as Appendix B, is by no means complete, and represents only a sample of the systematic concealment of the problems at the Paducah GDP.

In August 1988, technetium and TCE contamination was found in an off-site drinking well, constituting the first public disclosure of off-site contamination from the Paducah GDP. This discovery triggered EPA and DOE investigations. Martin Marietta engaged CH2M Hill company to perform a site investigation.

The Report of this investigation, Phase I of which was completed in March 22, 1991, specifically represented that no plutonium contamination was found in sediment or soils off-site, nor was plutonium contamination indicated on-site. (See Exhibit No. 23, Table ES-1; and Exhibit No. 24, Tables 4-4 and 4-5 of the same report.) However, Martin Marietta knew, and had received numerous significant measurements, that plutonium contamination was present in very significant quantities in off-site sediment, as well as in on-site samples. See, *e.g.*, Exhibit No. 25, obtained through my attorney, who in turn received the document from relator Fowler. Actual data, taken during the site investigation, showed plutonium contamination up to levels of 240 pCi/g. (See also, Deuschle Exhibit Nos. 3 and 4, which also reveal significant plutonium contamination readings between 1989-91.)

It is telling to note that, in the publicly disseminated multi-volume document, "Results of the Site Investigation," that exists in the Kevel public document room, the chief radiological data Appendix 2B-17, "Radiological Walkover Survey of Little Bayou Creek, Bog Bayou Creek, and Plant Ditches," is missing, with a note in its place reading, "TO COME." Likewise, Appendix 2B-12, "Surface Water, Sediment, and Stream-Bank Sampling, August 1990," is missing and has a placeholder reading, "TO COME." (See Exhibit No. 26) No other appendices are missing. When my attorney attempted to retrieve the missing data appendices from the public document room manager, he was told that, notwithstanding a diligent search, they could not be found, even after contacting other public document rooms and consulting with the current PGDP site contractor, Bechtel Jacobs.

Annual environmental reports, submitted to DOE in support of contract requirements, were presented for every year going back until at least the mid-1980s. Every single one of the annual environmental reports between 1989 and the most recent, 1997, contains numerous false or misleading statements relevant to this action. Some of these false or misleading statements are listed in Appendix B.

Implications of False Statements

The implications of the false or misleading statements listed in Appendix B, and others, go well beyond the defrauding of the federal government's monies obtained through government contracts. There also are serious public policy implications.

For example, DOE's baseline environmental remediation plan for the Paducah site currently anticipates leaving the vast majority of contaminated media in place at the Paducah site for all perpetuity. Indeed, the Paducah GDP site appears to have been virtually left out of DOE's 2006 cleanup plan. In contrast, at other sites, such as the Fernald, Ohio site, contaminated media today are being excavated and sent to an authorized disposal facility (usually in Nevada or Utah). Had DOE known the true extent of the contamination at and around the Paducah GDP, particularly with respect to transuranic contamination, it would likely have taken necessary remedial measures earlier, when waste disposal costs were less than they are now. Paducah might have been at the top of the priority list for the 2006 plan. More importantly, had dumping and/or sediment contamination been earlier disclosed, removal could have occurred long ago, sparing groundwater migration and interim health impacts.

The extent of DOE's and the public's ignorance of the real situation at the Paducah GDP as a result of the repeated false statements and concealment by Martin Marietta and Lockheed Martin is illustrated in multifaceted ways. For example, in the April 17, 1997 meeting of the Paducah GDP Site Specific Advisory Board (a DOE-approved board consisting in part of local citizens designed "to improve the decision-making process regarding environmental management issues by providing a mechanism for public involvement in the early stages of decision making," see Exhibit No. 27), DOE was asked by board member and local citizen Mark Donham, in discussing the northeast plume of contamination emanating from the Paducah GDP, if the contamination comes solely from TCE. DOE representative Jimmie Hodges "stated that they had not found any other contaminants. Jimmie stated that there were non detectible levels that were shown on the monitoring report." (See Exhibit No. 28) In the Site Specific Advisory Board meeting with DOE of October 15, 1998, it was incorrectly indicated that "evidence of elevated levels have not been seen" at the Big Bayou Creek Outfall #001. (See Exhibit No. 29)

Likewise, the U.S. Enrichment Corporation ("USEC"), the current leasehold owner of the Paducah GDP gaseous enrichment facilities, appears also to have been deceived. When the ~~facilities were transferred~~ from DOE to USEC, certain environmental due diligence was done, which relied principally on data and information provided by Martin Marietta. In the environmental audit report supporting transition of the Paducah GDP to USEC, sediment contamination was identified as consisting of "PCBs, uranium, metals, VOCs, and Tc-99." (See Exhibit No. 30). Plutonium, neptunium, and other radionuclide contamination is not indicated.

Certification on Source of Knowledge

The information contained in this disclosure statement was gained by me through my personal observations in and around the Paducah GDP, through my personal radiation readings and sediment samples, through interviews with the other relators in this matter, and through analysis of the relators' data attached to their disclosure statements against information obtained in the public domain. To the extent non-public information is referenced, this information was not obtained by me as a result of any criminal or civil action or proceeding, or administrative action, or General Accounting Office report, or the news media, or any other public source.

Thomas B. Cochran

May 19, 1999
Dated

PADUCAH GASEOUS DIFFUSION PLANT ENVIRONMENTAL REPORT FOR 1991

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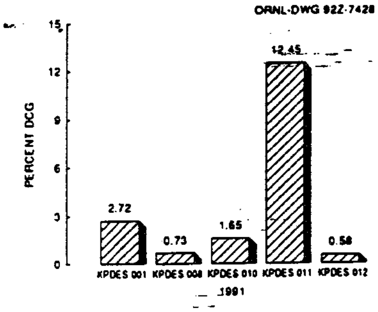

Fig. 3. Uranium concentrations in PGDP liquid effluents in 1991 (percentage of derived concentration guide).

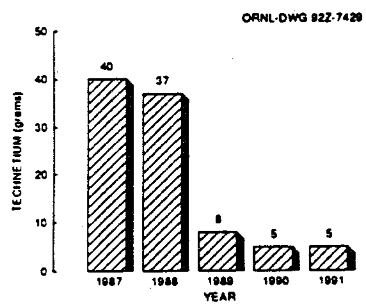

Fig. 4. Technetium discharges to surface water, 1987–1991.

OTHER MONITORING

Biological Monitoring

Vegetation samples are collected at 18 locations surrounding the plant and analyzed for fluorides. The primary objective of vegetation sampling is to determine the total fluorides in the vegetation for comparison with the fluoride-in-foliage section of the Kentucky air pollution control regulations. All samples taken in 1991 were well below the 60 µg/g standard. Samples taken from outside the fence area range from less than 5% to 5.6% of the standard.

During 1991, food crops and deer from the PGDP area were analyzed to determine if there was evidence of increases in the concentration of contaminants to a degree that standards were exceeded. Dose calculations were performed as outlined in Chapter 2. The dose from ingestion of each type of food crop was significantly less than 1 mrem per year. The calculated worst-case dose from ingestion of all types of food crops over a one-year period was 0.58 mrem/year. Ingestion of deer meat under the assumptions discussed in Chapter 2 would result in a dose of 0.63 mrem/year.

Soil and Sediment Sampling

Concentrations of uranium in the soil, annually sampled from 10 locations, showed no significant difference from past data. Although no evidence of enriched uranium was detected, concentrations in the predominant wind directions were higher (at 95% confidence level) than concentrations upwind of the plant. No detectable concentrations of technetium-99, thorium-230, neptunium-237, or plutonium-239 were present at any of the sampling locations.

The downstream sediment-monitoring location on Big Bayou Creek indicated uranium levels 2 times higher than the upstream Big Bayou Creek location. Uranium levels at the downstream annual sediment-monitoring location on Little Bayou Creek were ~7 times higher than the upstream Little Bayou Creek location. Also, polychlorinated biphenyls (PCBs) were detected in Big and Little Bayou creeks. Big and Little Bayou creeks and KPDES outfall ditches have been investigated during ACO activities. Remedial alternatives have been drafted and are being reviewed by the U.S. Environmental Protection Agency and the Kentucky Department for Environmental Protection.

Unusual Occurrences

During 1991, PGDP experienced 638 spills or releases of various materials. A record of each incident is kept in the plant shift superintendent's office. Most of the spills—a total of 271—were PCBs from ventilation duct gaskets. All gasket leaks were

INTEROFFICE MEMORANDUM

Date: 31-Jan-1992 04:21pm CST
From: J L Walker
WALKERJL AT A1 AT PADVX2
Dept: 5110
Tel No: 355-6271

TO: See Below

Subject: potential questions for public briefing

POTENTIAL QUESTIONS FOR FEB. 4 PUBLIC BRIEFING

Q -- Now that you have studied contamination for more than three years, what are you going to do about it and when? How much have you spent investigating and couldn't that money have already been used to start cleaning up?

A -- We have evaluated several alternatives for cleaning up or containing the contamination and will select a remedy this year with input from EPA, the state and public. It is hard to understand why so much money has to be spent on investigation, but it is very important to realize the nature and extent of the problem, especially regarding issues such as Dense, non-Aqueous Phase Liquids, or DNAPLs. It is highly likely that an improper corrective action near a DNAPL could actually make the contamination worse by allowing the pools of contamination to begin moving again, going both deeper into the ground and spreading out more than before the action. It is also important to look at the cost of some alternatives over time. Also, while the investigation is expensive, some alternatives are much more costly than others. Doing the investigation and risk evaluation will allow us to spend money and resources wisely to address first the areas of highest public health risk.

Q -- Some of these cleanup cost estimates seem astronomical. Are you prepared to spend that much money and if so, who pays the bill? Does this ultimately mean our tax dollars?

A -- The EPA requires evaluation of a wide range of alternatives from no action to very extensive cleanups. The intent of that is to compare cost and effectiveness of various options. These briefings allow you the taxpayer, whose dollars ultimately support DOE-owned plants like Paducah's, to have some input into the alternative selected.

Q -- I received information that my well water had TCE (or Tc-99) contamination below the limit you say is the lowest reliable level the plant equipment can detect. What's the difference? To me, a number on a piece of paper means I have contamination in my well.

A -- Plant equipment can verify Tc-99 at 25 pCI\L and TCE at 1 part per billion. Those levels, at which we provide free public water, are significantly below drinking water standards. That means that at those levels, our plant chemists and analysts can be sure the substances are present. Below these levels, instruments cannot definitely determine the presence or absence of the substances.

Q — Some of us appear to be in or near the contamination zone. When are you going to extend free city water to a larger group of people so we can all quit worrying?

A — (Dennis Cope plans to say in his presentation that we will extend the main water line down Metropolis Lake Road to the Shawnee plant border this year to make public water "available if needed" to residents along that route. He also will say that DOE funds are being sought to extend the main line around the plant, and that the investigative results and sampling costs are being reviewed to determine the economic feasibility of giving free water to a group of residents north of the plant who may encounter contamination over the next several years. Comments from others should be consistent with what he will say.)

when was MW 200 sampled – 1990 – why not in ESR

Q — "The Phase II Groundwater Study shows MW 200 where plutonium was found. We have been informed that MW 200 has been destroyed. We ask for an explanation. We further ask for an explanation of why the map of MW 200 was removed from the DOE documents at the depository in Paducah, at the Library?"
(This question is a direct quote from Corinne Whitehead, president of the Coalition for Health Concern, in written comments on the Phase II Site Investigation report.)

A — After receiving these comments, Environmental Restoration staff members examined the well and found it to be intact and in good condition. ER also checked Phase II documents at the library. Several maps showing various monitoring wells, including MW 200, are in the documents.

Q — "ACE (Association of Concerned Environmentalists) is concerned about plutonium contamination of one well previously reported but omitted from this report. Apparently there is evidence in a trial in Ohio that in fact some plutonium ash was handled at the Paducah facility. Full disclosure of this should be made."
(This question is a direct quote from Mark Donham and Lou Coots, who represent the southern Illinois and western Kentucky chapters of ACE, in their written comments on the Phase II SI report.)

what is the avail [illegible]

A — Presumably, you are referring to a well that was not included in the Phase II Report because it was not a part of the Phase II sampling plan. The well was sampled during Phase II by one of our subcontractors, CH2M Hill, and by EPA and the state as part of a special sampling stemming from concern over the plutonium.
(Howard Pulley and Jim Massey need to determine whether we disclose the results of the special testing. It's my understanding that a follow-up

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test did not confirm the results of the initial sample, which had a figure so tiny for plutonium that it was not in itself reliable. If someone asks the question, a specific answer will be expected as to the amount of plutonium and its effect on the public. Plant attorney Alan Harrington reminds that the individual whose well these people apparently are referring to is involved in a lawsuit with the plant. That individual tells me he plans to attend. We definitely do not need to mention his name, or his results.

Another avenue here is to refer comments to the regulators.) -- Joe Walker.

Q -- Both the above-mentioned environmental groups say they are staunchly against incineration as a method of disposal, insisting it does not destroy radionuclides and emits toxins such as dioxins and furans. They advocate above-ground storage until "suitable" treatment technology is developed. How do we respond?

A -- Incineration generally was not considered as a remedial alternative in the AE Report, mainly because of radioactive substances. Methods using heat to separate organic chemicals, such as TCE, from radioactive substances were considered. We cannot comment on the production of dioxins and furans because we are not experts on incineration. Above-ground storage is considered an alternative.

Q -- Kristi Hanson of Brookport, another environmentalist who commented, said several people near the plant have "experienced serious health problems" (flu-like symptoms, skin disorders, blood abnormalities, breathing problems). She encouraged an investigation into those alleged problems. How do we respond?

A -- We have performed (or offered to perform) health evaluations on people who either drank contaminated groundwater or were asked not to use their wells when the contamination was discovered in 1988. An independent medical group that does the testing has reported no findings such as those you mentioned.

Q -- These DNAPLs you talk about seem to indicate groundwater contamination will be ongoing for a long time, maybe even longer than any of us are around. A technical memo in your Alternatives Evaluation report says no DNAPL cleanup technology has ever been fully effective. Is there really any way you can clean up the groundwater here?

A -- The onsite groundwater will be difficult to clean up given current technology. However, a great deal of research is going on across the country to find ways to remediate DNAPLs. They are present at many other sites and a lot of effort is going into finding an effective remediation technique. Cleanup of groundwater away from the DNAPLs is technically possible.

Q -- Somebody from the plant sampled my vegetables sometime last summer. Can I find out the results? Who do I see?

A -- Please see one of the people at the sampling tables. They have some contained transuranic (TRU) and fission product radionuclides. Most of the material was introduced at the Paducah plant, but transuranic elements (particularly neptunium) and the fission product Technetium-99 (Tc-99), can now be detected in most of the process equipment and to a lesser extent in general building contamination, the report says. "Transuranic contaminates are a major determinant in radiation protection practices and will complicate the final D&D process because transuranics are more radiotoxic, and thus controls are more restrictive for D&D activities," the report notes.

Here is an excerpt from the report:

"For a period between 1953 and 1976, uranium used to fuel production reactors at Hanford and Savannah River was reprocessed to recover plutonium and uranium. This irradiated uranium at a slightly reduced enrichment was recycled by converting it into UF6 and enriching it in the gaseous diffusion plants. A total of 101,268 metric tons of this reprocessed uranium was fed to the Paducah gaseous diffusion plant (GDP) in combination with feed produced from natural uranium. Most of the recycled material (96%) had been irradiated in Hanford reactors....Reprocessed uranium represented over 13% of all material fed to the Paducah plant during this time, although in one year, 1973, it comprised 64% of the feed. In most years, however, reprocessed uranium constituted 25% or less of the total feed....

"Over the same period, some 5,600 metric tons of reprocessed uranium from government production reactors were fed to the Oak Ridge GDP. Also, a much smaller quantity, 372 metric tons (or 4% of total reprocessed uranium), of much cleaner reprocessed uranium from commercial power reactors (reprocessed in France) was fed to the Oak Ridge GDP.

"In addition to the minor uranium isotopes U-232, U-234, and U-236, reprocessed uranium contains trace amounts of TRU elements such as neptunium and plutonium, and fission products such as Tc-99. These radioactive isotopes not only present significant problems by degrading the purity of the final product but also pose a radiation hazard to the work force. While relatively clean reprocessed uranium can be prepared as was done in France, this was not the case with Hanford and Savannah River material. Technetium concentrations in reprocessed uranium from government production reactors were found to have between 175 and 700 times the levels found in the reprocessed uranium commercial reactors. In addition, concentrations of transuranics in uranium from U.S. production reactors were 20 to 450 times greater than the concentrations in commercial reprocessed uranium. Thus, the production reactor's uranium contributed more than 99% of the technetium and transuranics fed to the GDPs.

"Technetium is very close to uranium in its chemical nature and forms compounds that carry through the chemical separation processes to a significant degree. A number of its compounds, such as TcF6, are gaseous under cascade conditions and being of lower molecular weight than UF6, diffuse preferentially toward the enriching sections of the cascade. However, this transport of technetium was found to take place rather slowly; technetium compounds are deposited on internal surfaces of the cascade equipment and then, over a period of several years, migrate toward the enriching portion. In the case of Paducah, technetium was found in the Paducah product about two years after the feeding of reactor return materials started.

K

"Some of the technetium initially fed at the Paducah plant was later shipped on to Portsmouth and Oak Ridge as part of the Paducah product feed to those diffusion plants. As a result, contamination of all three diffusion plants, not only with uranium but also with technetium and transuranics can be ascribed to the government's operating policy during the early years. While only a fraction of the transuranics and technetium present in the reprocessed uranium actually enters the cascade and some such as Pu remain relatively fixed near the feed point to the cascade, others tend to migrate throughout all the plants.

"A significant portion of theses radioactive isotopes is considered to have been extracted from the cascade by the two cascade improvement programs, one in the sixties and another in the late seventies when a major portion of the barrier tubes was replaced under both programs with higher performance tubes. However, traces of these radioactive isotopes are still to be found today in cascade equipment....

"The transuranics contaminates are a major determinant in radiation protection practices at Paducah and are expected to complicate the final D&D

process because transuranics are more radiotoxic, and thus controls are more restrictive for D&D activities. The use of respirator and protective clothing and equipment would have to be greater and would impact productivity of the workers carrying out D&D activities and also would increase the cost of labor and supplies. Analytical costs for TRU are greater than those for uranium, and quality control requirements are more extensive. Bioassay for TRU is more difficult to perform and is more expensive than for uranium. Worker training in radiation protection for TRU and health physics support are more extensive and would cost more for D&D activities. Management options are more limited for TRU contaminated waste and storage and disposal may be required at increased cost at a site specifically designed for transuranics.

"Thus, contamination of all of the GDPs by these transuranic elements and fission products was clearly the direct result of feeding reprocessed uranium from the U.S. government's defense production reactors into the GDPs."

LANGUAGE: ENGLISH

105 of 174 DOCUMENTS

Nuclear Fuel

March 4, 1991

SECTION: ENRICHMENT; Vol. 16, No. 5; Pg. 6

LENGTH: 812 words

HEADLINE: TIGER TEAM FINDS 199 PADUCAH PROBLEMS; ACTIVISTS SEEK PLANT CLEANUP, CLOSURE

BYLINE: Wilson Dizard III, Washington

BODY:

DOE experts who reviewed safety, environmental issues, and waste management at DOE's Paducah gaseous diffusion plant found 199 lapses at the plant. Local activists, armed with the ''tiger team'' report and other studies of the plant, are agitating for prompt cleanup and closing of the facility.

The tiger team was assembled at the behest of DOE Secretary James Watkins. It assessed the plant in two periods last year: June 18 through June 29 and July 9 through July 20. Plant executives have prepared an action plan to address the problems at the plant, which included ''a total of 241 Occupational Safety & Health Administration violations.''

Some of the most severe problems, including a risk of electrocution in the plant cafeteria and uncalibrated medical X-ray equipment, were corrected immediately.

The team ''reported no noncompliance issues of a magnitude that would necessitate curtailing overall operations at the plant,'' according to the action plan. At first, the team found 200 issues and four ''noteworthy practices,'' but withdrew one of the air quality findings after further study. One hundred and fifty of the 199 findings had been previously identified either by Martin Marietta Energy Systems Inc., the DOE contractor for plant operations, or other external inspectors.

Sixty-two of the findings related to environmental issues, 123 pertained to safety and health problems, and 14 concerned management affairs. Three of the management findings involved DOE matters.

The action plan will cost $ 56.8-million to put into effect through fiscal year 1992. Of that sum, $ 18.8-million is ''budgeted against'' DOE's five-year plan for defense waste cleanup. DOE plans include spending $ 178-million in current and future budgets for environmental, health and safety activities at the plant. The action plan includes planned actions, schedules for implementing the actions, and costs associated with the steps. ''More importantly, priority is being given to resolving the root causes which led to the specific findings,'' according to the plan.

Radioactive materials of sufficient enrichment can attain criticality when transferred to unfavorable geometry containers.

The Kentucky Division of Waste Management (KDWM) October 12 issued eight NOVs to DOE and two to USEC due to violations of the federal Resource Conservation & Recovery Act (RCRA) hazardous waste law. The violations involved failures to test and maintain safety equipment as well as procedural lapses. Martin Marietta Utility Services is conducting corrective action on the problems, USEC and DOE said.

USEC held that the violation notices did not involve the injury of any workers. "None of these are safety concerns," a spokesperson said.

Nolan Hancock, Washington representative of OCAW, told NuclearFuel that the Labor Department's Occupational Safety & Health Administration (OSHA) has failed to properly exercise its safety oversight responsibilities at the enrichment plants.

"We've still got problems out there," Hancock said. "One of the things bothering us is that the Labor Department is not in a big hurry to fund the inspectors who will be responsible for monitoring health and safety."

Under the Energy Policy Act, which established USEC, OSHA is responsible for nonnuclear health and safety regulation at the plants.

"I don't see any move to put funds in the Labor Department budget to provide for the hiring of people to monitor safety," Hancock said. "We've got a gray area -- it's a never-never land. It's not moving as fast as we had hoped."

While saying that Clinton administration political appointees at Labor were responsive to OCAW concerns, Hancock noted that "It's still a bureaucracy over there.

"In my last conversation with the people at the Department of Labor, they were still looking for funds so they could get started."

An OSHA spokesperson told NuclearFuel that several critical decisions at its agency have been "hanging fire" because the job of assistant secretary for OSHA was vacant until this month, when Joe Gear was confirmed for the position.

Another OSHA official, John Solheim, said his agency is still having internal discussions about what kind of presence, if any, OSHA will have at the two SWU plants.

LANGUAGE: ENGLISH

LOAD-DATE: December 17, 1993

96 of 174 DOCUMENTS

Nuclear Fuel

March 16, 1992

SECTION: ENRICHMENT; Vol. 17, No. 6; Pg. 13

LENGTH: 1017 words

HEADLINE: DECISION TO FEED REPROCESSED U TO GDPs WILL COMPLICATE D&D, REPORT SAYS

BODY:

The decision by DOE's defense programs to enrich reprocessed uranium in the period 1953-1976 will complicate the final decontamination and decommissioning (D&D) of the department's three gaseous diffusion plants.

According to a report by Martin Marietta Energy Systems, the reprocessed uranium from the plutonium production reactors at Hanford and Savannah River

Mr. UPTON. And I would recognize the ranking member of the subcommittee, Mr. Klink.

Mr. KLINK. I just note that we will have additional documents that we will want to insert in the record as well.

Mr. UPTON. Fine.

[The information referred to follows:]

Department of Energy
Washington, DC 20585

September 14, 1999

MEMORANDUM FOR THE DEPUTY SECRETARY OF ENERGY

Dear Mr. Glauthier:

We received today a description of the Department's legislative proposal for addressing potential health-related impacts associated with worker exposure to plutonium and other transuranic elements at the Paducah Gaseous Diffusion Plant. The proposal generally provides compensation to workers who were employed at the plant prior to 1990, were monitored for occupational radiation exposure, and develop a radiogenic cancer (as defined in the Radiation Exposure Compensation Act). This compensation would be without regard to the measured or estimated level of radiation exposure received by the worker.

Although we understand the Department's need to address any valid concerns of the Paducah workers, the proposal establishes a precedent for compensation of occupational radiation injury claims. As discussed in the attachment and in previous memoranda from this office on the proposed beryllium workers compensation program, workers compensation should be medically and scientifically based. The Department has initiated an exposure assessment of these workers which I understand will be completed by March 2000. The results of this study should be used to identify those workers whose actual or potential exposure warrants compensation. Although this will delay implementation of the Department's proposal, it will keep the proposal consistent with other existing Federal workers compensation programs.

I would be happy to discuss the above concerns with you. I can be reached at (703) 603-5632.

Sincerely,

Thomas H. Beckett
Deputy Director
for Naval Reactors

Attachment

Copy to:
E. J. Moniz (US)
E. A. Livingston-Behan (S-1)
D. M. Michaels (EH-1)

NAVAL REACTORS CONCERNS WITH PROPOSED COMPENSATION PROGRAM FOR PADUCAH GASEOUS DIFFUSION PLANT WORKERS

Compensation programs should be medically and scientifically based. DOE has not presented the technical data to support an open-ended commitment of funds to personnel that have worked at the Paducah Gaseous Diffusion Plant, worn a dosimeter or should have worn a dosimeter, and contracted a cancer listed as radiogenic. DOE has not shown that exposures at Paducah due to the low levels of plutonium present, resulted in exposures that would satisfy the "more likely than not" criteria which is the standard criteria for determining compensation associated with occupational radiation exposure. The draft "pilot program" could establish an inappropriate precedent for other DOE and DOD activities where plutonium is handled.

1. A program that __presumes__ causation for occupational radiation injury claims is inappropriate. The proposal improperly uses the proposed beryllium disease compensation program as a reference. Chronic Beryllium Disease can only be caused by beryllium exposure, where it is proper to presume causation. The Paducah proposal inappropriately applies the same presumptive philosophy to causation of cancers. Current federal protocols (Veterans Administration and the Department of Labor Office of Workers Compensation Programs) use scientifically based procedure to calculate the probability of causation from radiation. These protocols identify that compensation should be provided when a medical condition is determined to be "more likely than not" caused by occupational radiation exposure.

2. DOE has not presented evidence that the exposure controls in place at Paducah based on uranium were not appropriate or sufficient for the small amount of plutonium that was also present. In fact, DOE published facts contradict the premise of the proposal that exposures to plutonium were sufficient to warrant compensation. DOE's Report of the Joint Task Force on Uranium Recycle Materials Processing dated 1985 identified that the average Pu-239 level in recycled uranium was less than 10 ppb. This report further states:

> "Routine processing of recycle materials containing less than 10 ppb plutonium can be accomplished with existing administrative and radiation protection practices. This is true since uranium is the dominant radionuclide for health protection purposes at plutonium concentration less than 10 ppb."

This report identifies that at Pu-239 concentrations at such low levels, airborne limits based on exposure to uranium are adequate since the Pu-239 contribution to exposure would only be 3.5% of the overall exposure from uranium.

As an example of the low doses associated with plutonium exposure to uranium recycle workers, the report stated "The internal dose to the recycle workers at Y-12 Plant (the plant that converted uranium trioxide to metal buttons) was 0.019 rem/yr (committed dose to the bone) per employee." (Note: The committed effective whole body dose will be even smaller. Even assuming 0.019 rem/yr for 30 years (0.57 rem), the increased risk of death from cancer is about 0.02% based on BEIR V. As an alpha emitter, plutonium exposure is driven by intake and not by external exposure.)

3. The DOE proposal sets a precedent without identifying the full potential scope of the problem.

- The 1985 DOE Task Force report identifies DOE plants (i.e., the Paducah Feed Plant, the Y-12 plant at Oak Ridge, the Feed Materials Production Center at Fernald, and the Portsmouth Oxide Conversion Facility) other that the Paducah Gaseous Diffusion Plant where recycled uranium was handled.

4. The point paper should not presuppose a determination that radiological controls at facilities throughout the DOE complex were not appropriate and proper for handling radiocaitve materials in general or plutonium in particular. The last sentence of the background section must be ended at "…Plants".

DOE NEWS

NEWS MEDIA CONTACTS:
Jeff Sherwood, 202/586-5806
Walter Perry, 270/441-6830

FOR IMMEDIATE RELEASE
September 14, 1999

Preliminary Observations and Corrective Actions on Paducah Site Announced

Secretary of Energy Bill Richardson today announced the initial observations of the Department of Energy (DOE) team investigating environmental, safety and health issues at the Paducah Gaseous Diffusion Plant in Paducah, Kentucky. A summary of the team's observations and the corrective actions ordered by Secretary Richardson in response are attached.

"The team identified areas that need improvement but found no imminent hazards to the workers or the public and confirmed that the general radiation hazards are low and that radiation protection programs at Paducah have improved over the past decade," said Secretary Richardson. "At the same time, we don't have to wait for their final report to start work on corrective actions in the areas where the team has identified room for improvement."

The team's observations include:

o Confirming that the present health risk from low-enriched uranium is relatively small, but more attention by site management is needed to ensure that radiation exposures are limited to levels as low as can be reasonably achieved.

o While considerably improved from the past, radiation-contamination control practices need to be further tightened, including providing additional necessary worker training, improved onsite and offsite posting and adherance to specified work-control procedures.

o Regarding an existing cleanup agreement between the Department of Energy, the Commonwealth of Kentucky and the Environmental Protection Agency, the team identified opportunities for revising the agreement to accelerate cleanup schedules and other milestones.

o The level of DOE and contractor oversight of environment, safety and health performance needs to be upgraded so as to ensure increased management accountability.

(MORE)

R-99-244

Based on the preliminary observations and to address employee questions regarding ongoing operations, Secretary Richardson on September 8 ordered a one-day stand down of operations at the site to refocus management and worker attention on conduct of operations and environment, safety and health requirements and procedures. The stand down served to direct overall attention to the weaknesses identified by the investigative team regarding operating controls, the posting of hazards and the need for increased training. The stand down also provided an opportunity to address workers' questions and have discussions on both individual concerns as well as departmental expectations for worker safety.

In response to both the investigative team's observations and the stand down, Secretary Richardson directed a series of corrective actions that will be taken immediately. These corrective actions include:

o Initiating an independent review of the contractor radiation protection program and its implementation at Paducah with an eye toward any needed upgrades.

o Examining existing Commonwealth of Kentucky and U.S. Enrichment Corporation site air monitoring systems to confirm that these systems would record any significant DOE contribution to overall site emissions. Additional environmental sampling and analysis both onsite and offsite will be conducted.

o Expanding worker training programs at the site to include more comprehensive treatment of radiation protection practices and environmental protection, particularly for those who supervise subcontractors.

o Strengthening the federal resources at the site by stationing two full-time DOE facility representatives at Paducah who will provide regular surveillance of operations and safety practices.

The investigation currently being completed is the first phase of a two-phase review ordered by Secretary Richardson on August 8. The first phase of the onsite investigation is focusing on issues and concerns from the past 10 years. The second phase will involve examining longer-term legacy environment, safety and health issues prior to 1990 and will draw upon other ongoing reviews in response to the Secretary's Action Plan (see attachment).

The 23-member independent investigation team completed their initial data collection phase on September 3. Team members reviewed documents, conducted numerous interviews with officials and workers, inspected the site, conducted radiological surveys and collected extensive environmental samples. The samples collected are being analyzed by an independent laboratory. Following an assessment of the data collected, the team will return to Paducah later this month to validate the accuracy of their findings. It is expected that the phase-one report will be submitted to Secretary Richardson by early October.

The investigation team has also identified key records from past operations at Paducah. The records detail historic management of certain environment, safety and health concerns at the site, including those associated with processing of contaminated recycled uranium feed material. The team will pursue its investigation of these issues in the course of its phase-two review.

R-99-244 -DOE-

ACTIONS IN RESPONSE TO SECRETARY RICHARDSON'S AUGUST 8, 1999 ACTION PLAN FOR PADUCAH

In addition to the ongoing DOE investigation at Paducah, a number of other departmental responses are underway in response to the Secretary's action plan announced on August 8. In addition to an ongoing Institute of Medicine review of health effects for workers at Paducah and other DOE sites, an ongoing review of needed resources to support near-term actions at Paducah, and a legal assessment of contractual responsibilities of contractors, departmental actions underway include the following.

Review of Flow of Recycled Materials Throughout DOE Complex

This project will address the flow and characteristics of recycled uranium over the last fifty years. The specific goals are to:

1. Identify the mass flow of recycled uranium throughout the DOE-complex from early production to mid-1999. Create an unclassified inter-site flowsheet.

2. Identify the characteristics and contaminants in the major uranium streams, specifically, the technetium, neptunium, plutonium or other isotopic content of concern to worker or public health and safety.

3. Conduct site mass balance activities sufficiently thorough to identify a significant concern for potential personnel exposure or environmental contamination.

DOE expects this work to be complete by June, 2000.

Exposure Assessment Project

This goal of this project, managed by the DOE Office of Environment, Safety and Health and conducted by a team from the University of Utah, is to establish the potential ranges of worker radiation exposures and identify, document and communicate the radiological issues that may have affected worker health at the Paducah site since its opening. This work will inform Paducah workers of their potential radiation exposure and will help determine whether there may be any potential for adverse worker health impacts from occupational radiation exposure.

The project began the week of September 13, 1999 when the University of Utah team began to interview workers and conduct an onsite records search. It is expected to take six months and consists of the following subtasks:

1. Mapping the various processes conducted at Paducah and identifying the associated potential radiological hazards, over time. This will include identification of any events, process changes, or other developments that may have presented potential radiological hazards.

2. Identifying, retrieving and evaluating radiological and worker exposure records to determine

what the available records inform us about radiological conditions and worker exposures.

3. Determining the feasibility of conducting a bioassay program for workers that would measure actual individual radiation dose due to radioactive material taken in the person.

4. Determining the feasibility of a radioassay of residual materials that would determine the radiological content of residual materials at Paducah and be useful in determining workers' potential exposure to hazards.

5. Developing occupational exposure profiles. This subtask will compile all information gained in previous subtasks to develop "bounds" or ranges of possible radiation exposures of workers at Paducah.

6. Instituting a worker communication program to ensure that workers understand and act on results.

This project is expected to be completed by April 2000.

Medical Monitoring for Current and Former Workers

Under an ongoing DOE pilot program, medical monitoring is currently provided for 1,200 former workers per year, 300 at each of the gaseous diffusion plants. As part of the Secretary's action plan, the program will be expanded to include additional former employees at each site as well as current workers at each site. The program will provide an objective, independent and expert evaluation of the health status of workers. The medical monitoring program will be implemented by an organization or consortium of organizations staffed by highly qualified physicians and other health professionals specializing in the field of occupational health. The accompanying educational program will help workers' understanding of prior exposures and current health risks.

As in the current program, medical screening will be conducted for health hazards associated with exposure to silica, beryllium, ionizing radiation, solvents and other hazards related to a participant's work at the facility. The actual screening tests conducted will be tailored to a worker's exposure history and will generally include a physical examination, blood tests, and chest x-rays. Where warranted by a worker's exposure history, specialized tests and other specialized screenings will be conducted. Physicians will review individual test results from the screening program and communicate results to program participants. They will call patients to communicate urgent findings based on examinations and the need for follow-up of abnormal test results. Project personnel will also advise participants who need medical follow up about possible sources of health care. Where appropriate, assistance will also be provided in helping participants file claims for workers compensation.

The program will be independently conducted by the Paper Allied-Industrial, Chemical & Energy Workers Union with support from medical experts from the Queens College of the City University of New York.

CROSSWALK OF PRELIMINARY OBSERVATIONS FROM PADUCAH PHASE I OVERSIGHT INVESTIGATION TO PROPOSED CORRECTIVE ACTIONS

ENVIRONMENTAL PROTECTION

The Paducah site is being cleaned up under an enforceable agreement established with the State of Kentucky and Environmental Protection Agency under requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The site is in general compliance with this Federal Facilities Agreement (FFA) for site remediation and has taken compensatory actions to protect the public from offsite radiological and chemical contamination. Examples include hooking up homes in the path of offsite contamination plumes to public water supply, surface water runoff barriers, limited pump and treat systems, and limited posted warnings. The investigation team, however, questioned the rate of progress toward actual cleanup of the legacy hazards at the Paducah site, and the priorities and funding assigned under the cleanup agreement. These legacy hazards are sources of continuing onsite or offsite contamination of surface water and groundwater. Target level funding will take the site cleanup beyond the milestone for completing cleanup.

Observations

- Since the discovery of the contamination of offsite wells in 1988, the two groundwater plumes containing technetium 99 and trichloroethylene (TCE), as well as trace amounts of transuranic materials, continue to propagate at one foot per day and now extend for over two miles.
- Drum Mountain, contaminated scrap piles, burial grounds, and other legacy hazards continue to contribute to the contamination of Big and Little Bayou Creeks via surface water runoff.
- The site air monitoring programs have not assessed potential legacy "fugitive" emissions from scrap piles, contaminated ground, and rooftops of contaminated facilities.
- Over 30,000 drums of low level waste remain stored onsite, many in degrading 55-gallon drums and on open ground versus cement pads. While there is a regular inspection program and some drums have been overpacked, there is a lack of plans and funding for offsite shipments and only limited onsite facilities are available for inside storage.

Corrective Actions

- Execute a study of existing State of Kentucky and USEC site air monitoring systems to confirm that these systems would record any significant DOE contribution to the overall site emissions. Also, based on these studies, evaluate the calculations contained in the Bechtel Jacobs Company NESHAPS Annual Report.
- Sample the roofs of several shutdown contaminated buildings. This action will be taken to support fugitive emissions calculations. (Safety evaluations are now underway regarding the structural competence of these roofs. Personnel will be tied to safety ropes in some fashion at all times while on these roofs. Only if a substantial level of safety can be demonstrated will sampling be attempted.)
- The Engineering Evaluation and Cost Analysis (EECA) developed under the CERCLA/FFA for the scrap metal piles and Drum Mountain is now under review by the cognizant regulators. Pending approval, characterization of these materials is scheduled to begin late in the summer of 2000. To promote efficiency, DOE will propose that characterization be followed by immediate disposal of

this material. This activity is currently severely constrained by funding.

- Additional sampling and analysis of Paducah off-site areas will be carried out.

RADIATION PROTECTION PROGRAM

Significant improvements were initiated in the Paducah radiological protection program in response to inspection findings and concerns with transuranic material in the early 1990's. At Paducah, current external radiation hazards are low, in comparison to other DOE facilities. BJC workers do not appear to be receiving radiation doses that approach current limits. Although legacy contamination has the potential to cause internal radiation doses, bioassay results indicated that internal uptakes of radioactive materials are presently not occurring. A number of specific deficiencies identified during the investigation, however, indicate a need for improvement in the level of discipline, formality and oversight to ensure exposure to legacy radiological hazards is limited to levels that are as low as reasonably achievable.

Observations

The radiation protection program was subject to significant upgrades in the early 1990's and is generally functional, but a lack of discipline, formality, and oversight is creating deficiencies which impact the ability to ensure that worker exposure to legacy radiological hazards is maintained as low as reasonably achievable (ALARA).

- The investigation determined that 25 subcontractor employees working on a project in the UF_6 cylinder yard since May 1999 could be subject to radiological exposure of greater than 100 millirem in 1 year and should wear personal dosimetry (TLD). The contractor stopped work, conducted training, and is issuing TLDs.

- A number of radiologically contaminated areas were identified onsite and offsite on DOE property that were not adequately posted or barriered in accordance with DOE requirements.

- Training on transuranics was last conducted in 1992 and is not yet incorporated into site safety training courses.

- Drums of uncharacterized waste and concentrated Tc-99 have contributed to worker hazards, including Tc-99 personnel contamination from ruptured containers, the sampling of pressurized drums without containment, and instances of lids blowing off.

- There are weaknesses in the controls essential to radiological protection including radiation work permits, procedures and procedure adherence and air monitoring.

Corrective Actions

- Consistent with discussions during the "stand down" on September 9, 1999, DOE will provide employees with updated information on the management of transuranic waste, and information on TLD and air-emission monitoring.
- An independent detailed review of the Bechtel Jacobs Company radiation protection program and its implementation at Paducah will be initiated.
- A dialogue between DOE, the State of Kentucky and EPA Region IV will be initiated regarding the adequacy of site postings of contaminated areas called for in approved CERCLA or RCRA decision documents, or other agreements.

CONTROL OF LEGACY HAZARDS AND PROTECTION OF WORKERS

This investigation did not reveal any immediate threats to the health and safety of workers, but the Paducah legacy hazards from the Cold War continue to constitute a challenge to worker safety and health. The site has accomplished some characterization of the legacy hazards and has increased the use of personnel protective equipment to protect workers.

Observations

While some characterization of hazardous facilities and materials has been accomplished, the significant amounts of onsite hazardous legacy materials and waste have not been reduced or mitigated.

- The DOE material storage areas (DMSA) contain significant volumes of uncharacterized scrap equipment and materials returned by USEC, that have been stored since at least 1996, and that may constitute potential hazards to the workers.
- Approximately 30,000 55-gallon drums of waste are stored onsite. Many are stored outside in the elements over open ground. Very little low-level waste has been shipped offsite, and a lack of funding and priority has resulted in extending the planned disposal date from 2006 to 2012.
- Process buildings shutdown for over 20 years contain significant amounts of uncharacterized hazardous materials including uranium in the ventilation ducts, receiver ash, and transuranics contamination. Shutdown buildings have been allowed to deteriorate and are subject to animal infestation, broken windows, and leaking roofs, are not included in the 2010 cleanup schedule, and are increasing in risk and cost to decommission.
- The nearly 37,000 uranium hexafluoride (UF_6) cylinders stored onsite in the open at Paducah constitute a radiological exposure hazard and a potential threat to worker and public health in the event of fire and rupture, but the DNFSB Recommendation to upgrade the condition and convert the UF_6 to a more stable form has been impacted by the cancellation of painting 1,400 cylinders due to funding constraints and lack of appropriated funds for a UF_6 conversion facility.
- Fluorine cells were transferred to industry in 1997 and 1998 using uranium release criteria rather than more restrictive transuranic release criteria as committed to in 1990. Sample results indicated that the cells contained detectable quantities of plutonium, americium, and neptunium. Had the more restrictive criteria been applied, the transfer may not have been approved.

Corrective Actions

- A strategy is being developed to address the DOE Material Storage Areas (DMSAs). The initial focus will be to proceed with material characterization and improved storage of containers with uranium-bearing materials.

OVERSIGHT OF ENVIRONMENT, SAFETY AND HEALTH

DOE established a site office in 1989 to provide program direction and day-to-day oversight. However, the level and effectiveness of line management oversight of environment, safety, and health and assurance of compliance with DOE requirements is a matter of concern.

Observations

DOE and contractor management oversight of site activities and ES&H performance has several weaknesses and needs improvement.

- The DOE Oak Ridge Operations Office has not routinely performed oversight at the Paducah Site unless requested by the site office.

- The DOE Paducah Site Office consists of only 10 personnel who are focused primarily on project management. None of these personnel routinely perform ES&H field oversight and the office is not staffed in key technical areas such as facility representatives and health physics professionals.

- Contractor management has performed only limited management oversight of field activities and ES&H performance and is losing the technical capabilities to do so, including a significant loss of industrial hygienists, safety engineers, and hydrogeologists.

- Despite a shift to an M&I contract and increased reliance on subcontractors, the contractor oversight of subcontractor ES&H performance and adherence to applicable DOE requirements is weak.

- Community outreach efforts and activities that are designed to develop and disseminate information on site operations and on environmental protection could be strengthened.

Corrective Actions

- Bechtel Jacobs Company will develop and present a detailed radiation-safety and environmental protection program training module to all Subcontract Safety Advocates. (These are Bechtel Jacobs' personnel who oversee the safety performance of specific subcontractors.)

- The Department of Energy will station two new Facility Representatives at Paducah.

March 11, 1960

Files

THRU : C. L. Dunham, M.D., Director, Division of Biology and Medicine

H. D. Bruner, M.D., Chief, Medical Research Branch, Division of Biology and Medicine

NEPTUNIUM^{237} CONTAMINATION PROBLEM, PADUCAH, KENTUCKY, FEBRUARY 4, 1960

SYMBOL : :MDB

Those contacted were Mr. B. Stiller and Mr. Nietsche of the AEC, Paducah Area Office and Dr. Neal Ward and Messrs. Don Levin, Ed Cain and R. G. Brown of Carbide. Mr. Joe Lenhart of ORCO came up from Oak Ridge and took part in the discussions.

Np^{237} seems to be found only in reclaimed feed material provided by Hanford and therefore it is not a problem for the other separations plants.

It is produced by one or both of the following reactions:

(1) ${}_{92}U^{238}$ (N, p.2n) ${}_{93}Np^{237}$

(2) ${}_{92}U^{235}(n,\gamma)$ ${}_{92}U^{236}$; ${}_{92}U^{236}(n,\gamma)$ ${}_{92}U^{237}$; ${}_{92}U^{237}\xrightarrow[7\ days]{B^- + \gamma}{}_{93}Np^{237}$

This reclaimed U from Hanford now has about 0.05 g of Np/ton of U. The presence of Np was recognized as far back as 1957. At one time during 1958 this feed material had as much as 1 gram/ton but it has been lower lately because Hanford is extracting the Np for other purposes; it would not pay Paducah to try to remove completely this residue and in any case their problem comes from the Np already in the cascade units which now must be taken out, repaired, restored and put back in the systems.

The uranium comes to Paducah as UO_3 which is then reduced to UO_2 and treated with HF to get the green salt UF_4; this is then refluxed with F_2 gas in a hot cyclone type of pipe. The volatile UF_6 so formed goes out the top to be cooled and stored in the solid state in metal "bottles." All contaminants supposedly drop to the bottom of this cyclone pipe and are removed as "ashes," but it appears that Np has sufficiently similar chemical and physical properties to follow along with the UF_6 as NpF_6. The "ashes" show about 15% of Np, the rest entraining with the UF_6.

There is a slight difference in volatility between the NpF_6 and UF_6, which is enough to result in more NpF_6 than UF_6 remaining behind when the contents of a bottle are fed into the cascades. Thus, the concentration of NpF_6 tends to build up in the "heel" as the bottle is used repeatedly. The fractional retention from a single filling is not known.

The NpF_6 passes into the cascades with the UF_6 but the differential in volatility at operating conditions (optimal for UF_6 enrichment) leads to fine deposits of NpF_6 in the tubes of the barriers and the inside surfaces of the cascade units. It is found more often at the distal end of a system of cascades and in the U^{235} channels. This can't be predicted with certainty since some units will have much NpF_6 and some none. Probably about 60% of the NpF_6 deposits out here.

The problem arises when one of these cascade units is taken out of its operation sequence and opened for replacement of barriers. There is a definite program for such restoration and in some cases they are replacing the old barriers with new ones of improved design. These cascade units are housed in thick stainless steel tanks about 12 feet in diameter and 15 feet tall; they are welded shut and in general much too large to be handled by conventional industrial hygiene measures. The units have to be moved with an overhead travelling crane, special multi-wheel trucks, etc.

The units must be cut open with torches to get at the barrier tubes; the pieces certainly can't be handled gently or contained very readily because they are too massive.

The workers are supposed to wear special MSA nose-mouth face masks but they are not controlled too closely--I watched one man push up his mask and smoke a cigarette using potentially contaminated hands and gloves. They have devised some air-scoopes to fit around the ends of the unit as it is being torched open, but I would judge them to be of limited effectiveness. There may be a filter on the exhaust line for this air collector but it was not obvious; the exhaust simply dumps air outside the building.

Nevertheless, this ventilation was said to be very helpful. Fortunately, NpF_6 does not diffuse very readily, it having been found only within 8 feet of where the cascade unit had been cut free, or opened.

According to Handbook 69 calculations (where the 200-year biological half-life is used), the MPC is 8.8d/min/m^3 of air. There are 1526 d/min/μg of Np^{237} so that the MPC equals about 0.0066 $\mu g/m^3$ of air.

Also, using the figures in Handbook 69, the maximal body burden would come to 1.3 d/m/24 hr urine sample coming from an 87.3 µg deposit. This, however, is so impossible that they have been using 13 d/m/24 hr urine sample as their standard on the basis that the true body content, after being out of contact with Np for 6 months to a year, would be 10% of the 48 hour lay-off concentration. (I think I am reporting their logic correctly.) Furthermore, the solubility of Np^{++++} is quite different from Np^{++++++} and it is not known which solubility factor should be used in the calculations.

* *

Np^{237} has a $T_{1/2}$ of 2.2 x 10^6 years and emits α-particles [illegible] 4.77 mev which can't be differentiated from other probable contami-nants by pulse height analysis. Gamma rays are also emitted and the 27.4 day daughter Pa^{233} emits both β- and γ-rays which [illegible].

Recovery of Np from biological samples is poor (80% or [illegible] variable) and Dr. Levin reported trouble in making up standard solu-tions at concentrations of 10^{-11} or 10^{-12} where the biological samples are supposed to fall, a situation similar to the NBS Ra-Th standards distributed by Dr. Beard.

Np^{239} with its 2.3 day $T_{1/2}$ and γ-rays is useful for some work but would not be satisfactory for chronic biological experiments.

Np^{237} can now be detected in urine but not consistently and it is felt not very reliably. With their present techniques, the average is 0.22 d/m/24 hr urine sample for 75 people. The highest was 11 d/m/24 hr sample. Their spiked blank samples ran 25% to 75% of the expected values.

There are possibly 300 people at Paducah who should be checked out but they hesitate to precede to intensive studies because of the union's use of this as an excuse for hazard pay.

The whole body burden for Np^{237} by Handbook 69 is 6 x 10^{-8} curies and tests with a Np^{237} source on the Y-12 whole body counter put 7 x 10^{-9} curies as the counting limit so that the whole body counter may have some usefulness. They (Dr. Ward and others) were not receptive to the idea of sending 8 or 10 of the men with highest urine counts to Y-12 for counting.

I pointed out that we were planning to initiate biological distribu-tion and radiotoxicological studies of Np^{237} which might have the affect of changing the MPC and burdens, but it would be two years or more before the data would be available. In view of that, I urged both Dr. Ward and Mr. Stiller to improve the industrial hygiene measures surrounding the reworking of the cascade units. I don't have too much faith in masks and the dust particles here are about 0.5μ, the very worst size, biologically speaking.

I also pointed out to Dr. Ward the need to get post mortem samples on any of these potentially contaminated men for correlation of tissue content with urine output, but I am afraid the policy at this plant is to be wary of the unions and any unfavorable public relations.

Dr. Levin seems to be one of the authorities in the field of Np chemistry (others are: Weinstock, ANL; Eugene Lamb, ORNL, George Boyd, ORNL) and is interested enough to want to continue with efforts to improve the bioassay techniques. When he succeeds in this we may be better able to tackle this problem of whole body counting.

The potential situation at Paducah is enough to warrant radio-toxicological studies. In addition, there are the requirements for Np^{237} for various devices and the exposures during separation procedures at the Hanford OPP; perhaps Savannah River also is separating this isotope. I was told that the chemical separation of Np from U is very satisfactory, but the human factor in handling gram amounts should be considered a source of potential exposure.

Thus, it appears that Paducah has a Np problem but we don't have the data to tell them how serious it is. They may get into difficulties with the present Handbook 69 numbers and the problem of the body burden will inevitably come more to the forefront.

cc:
Dr. C. S. Shoup, OROO
B. Stiller, Paducah, thru C. S. Shoup, OROO
Director, Division of Production
Director, Office of Health & Safety

HDBruner:IMP
3-11-60

TOTAL P.05

UNCLASSIFIED [redacted]

EXTENSION OF ALPHA CONTAMINATION CONTROL AT K-25 TO INCLUDE PLUTONIUM

KS-286

PLANT RECORDS

I. INTRODUCTION

A. General

The introduction of small quantities of plutonium into the K-25 processing system may require consideration of certain changes in the plant health physics program.

It should first be emphasized that plutonium is an alpha-emitter. Thus, the meth of contamination control outlined in KS-271* for uranium are essentially the same as those which will be needed where plutonium is the problem. Briefly, these include the following considerations, in approximate order of importance:

1. Careful design to maintain material in a closed system.
2. Adequate operating methods and administrative procedures to prevent contamination of the environment if possible or to limit the spread of such contamination where it is impracticable to keep the material confined
3. Maintenance of clean working locations.
4. Personnel respiratory protection and careful attention to protecting wound
5. Adequate specification of personal hygiene habits.
6. Use of protective clothing.

Since plutonium has a specific activity approximately 100,000 times that of urani it may be noted that a very much smaller mass of plutonium is required to produce a given surface or air contamination level than is necessary with uranium, 10 µg. of plutonium and 1 gram of uranium having approximately the same activity and thu giving nearly the same meter reading if thinly spread.

B. Plant Acceptable Limits

From a radiation standpoint, plutonium is considered somewhat more toxic than is uranium with the result that the plant acceptable limit for plutonium air contamination should be lower than is the corresponding uranium limit. A plant acce able limit of 0.1 counts/min./ft.^{3} would be in line with present recommendations of the Permissible Internal Dose Subcommittee of the National Radiation Protectic Committee which is sponsored by the National Bureau of Standards. Similarly, if the present plant acceptable limit for uranium contamination were reduced from th present figure of 2.0 counts/min./ft.^{3} to half of that value, or 1.0 counts/min., the plant limit would be in accord with the present recommendations of the above subcommittee.

It is obvious that in cases where there is a mixture of plutonium and uranium, a limit somewhere between the above two values should be fixed. From the relative specific activities indicated above, material in which the plutonium concentratic is 10 parts of plutonium per million parts of uranium will have half of its acti due to the plutonium. Accordingly, it appears that the plant acceptable limit fo uranium air contamination may be safely used for plutonium-uranium mixtures with a concentration of 1.0 ppm. of plutonium in uranium or less, but that the limit for plutonium should be used for higher concentrations of plutonium. The attach figure shows how the plant limit will vary between the uranium and plutonium limits with an increase in the plutonium concentration.

* KS-271 - Alpha Contamination Control at K-25, February 13, 1952

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The present plant acceptable limits for surface, hand, and clothing contamination appear applicable to the new situation, even though it is estimated that the hazard from ingestion of plutonium is approximately 50 times that for uranium on an activity basis which is measured in counts/min. by radiation detection instruments. However, since it is necessary for the material to be taken into the body before it presents a problem, it is considered that this apparently greater hazard will be adequately met if more stringent requirements of personal cleanliness before smoking or eating are made, if more attention is paid to hand monitoring and the use of gloves where hand contamination is considered probable, and if additional consideration is given to employees involved in spills and material releases. Additional visitor control may also be necessary. More attention should also be given to insuring that employees do not work with unprotected wounds in locations contaminated by plutonium.

II. LOCATION OF POTENTIAL PLUTONIUM HAZARDS

A. Increase in Plutonium-Uranium Ratio

At present, it appears that the relative plutonium-to-uranium ratio may increase to a concentration greater than the feed concentration of 10 ppb. in some plant locations as a result of processing. As indicated above, the health physics problem will not change appreciably unless this concentration is greater than about 1 ppm. which represents a concentration ratio increase of approximately 100.

A knowledge of the possible locations where concentrations may be anticipated is thus a first requisite in meeting the problem. A fairly extensive program of analyses of deposits of contaminating materials in various parts of the plant and in various items of equipment should be undertaken to determine where the plutonium goes and if it may be expected to concentrate in any plant locatio

In locations where a sufficient concentration of plutonium occurs to give a plutonium-to-uranium ratio of 1 ppm. and which will be identified as being plutonium-contaminated, it may be considered desirable to provide somewhat different treatment of employees and equipment from that accorded in the rest of the plant, even as today differences in handling of contaminated and uncontaminated locations are general plant practice. It is not anticipated that extensive areas will have significantly large amounts of material with a plutonium-uranium ratio greater than 1 ppm. Thus, this suggested difference in treatment may involve only a few locations or parts of locations, or even specific items of equipment in the plant. It should be noted that if a plutonium-uranium mixture is further mixed with additional uranium, the plutonium-to-uranium ratio will be reduced. Such a dilution will thus tend to make the hazard of the mixture more nearly the same as that due primarly to uranium.

B. Special Problems

Equipment in which accumulations of material with a plutonium-uranium ratio greater than 1 ppm. will need to receive special attention. However, other equipment in the same location for which no such concentration is anticipated and whose only problem involves superficial surface contamination in small amounts may receive normal handling for maintenance, etc. Handling of such items on a non-continuous basis in locations where uranium contamination alone is usually a problem will not appreciably increase the radiation hazard in those locations since the plutonium will be diluted as indicated above and the problem will thus tend to become one involving uranium only.

Accordingly, it may be that such Feed Plant items as filters and towers may require special maintenance conditions while motors and trays from the same location may be handled normally.

C. Guides to Require Changes in Plant Practice

It is not anticipated that the number of plutonium-contaminated equipment items will be sufficiently large that special maintenance locations will be required. However, it is possible that, on occasion, special precautions and segregation of working space may be necessary in some maintenance locations on a temporary basis and that some in-place maintenance will be required. The same considerations may be involved in decontamination and recovery operations, althoug here too, it is anticipated that the large bulk of material may be handled in a normal manner.

Under conditions that the increased concentrations of plutonium occur only in closed equipment and that the possibility of its spread due to accident or due to normal operation and maintenance is small, it may be possible to treat a building or other working location which is concerned in a normal manner. However, in general, it would probably be preferable to consider such a building or other area as a plutonium-contaminated location.

It will be desirable to have a special tag for identifying equipment and locations where plutonium concentration introduces additional hazards. At this time, it does not seem probable that additional laundering facilities will be required although it may be necessary to launder separately clothing from th locations where special precautions are necessary because of plutonium. In general, adequate waste disposal facilities are available at X-10, though here again it may be pointed out that the hazard is essentially that due to uranium where there is less than 1 ppm. of plutonium in the uranium.

III. SUGGESTED GUIDES FOR WORKING WITH PLUTONIUM

A. Since plutonium is an alpha-emitter, the same precautions now specified for uranium will also be effective for plutonium with the exception that no consideration need be given to penetrating radiation as is necessary for protection against the uranium daughters; hence, the use of such personnel monitoring devices as dosimeters and film badges will not be necessary except as they are required for fission products or other materials associated with the plutonium. It should be noted, however, that such fission products very probably will be associated with the plutonium entering the plant. Control methods are given in some detail in Standard Reference Information, SP-Nos. 15(151, 180, 181, 182, 183, 190, and 191, and in Standard Practice Procedures, SPP-Nos. 315 and 379.

B. Routine monitoring with an alpha-detecting meter such as the Zuto or the Samsor will detect plutonium contamination in significant amounts from a health hazard standpoint as readily as it will detect significant uranium contamination. The same applies to hand counts with present instruments. Thus, the same plant acceptable limits may be used for both materials.

[redacted]

In maintaining a clean working location, the following steps are essential:

1. Design equipment and operate it so that contaminating material does not escape routinely.
2. If maintenance requires the opening of a system, device a temporary means to prevent widespread contamination.
3. Use a radiation detection instrument to monitor an area after any condition such as a special job or material release where contamination might be spread. Decontaminate any areas which are above the P.A.L. immediately.
4. Routinely monitor all parts of the working location on a regular schedule --- each shift, daily, or weekly as necessary. Decontaminate any areas which are above the P.A.L. immediately.

D. To provide protection from air-borne contamination, the following should be done

1. Take shift-length air samples.
2. If these indicate air contamination above the P.A.L., locate and remove the contaminating source. This may be a leaky flange, or the result of an inadequate operating method or faulty design.
3. Take spot air samples in locations or at jobs where contamination may exist.
4. If these samples indicate an air hazard in a given location, take steps to remove the contaminating source immediately; if they show that a given job produces the over-P.A.L. contamination and it is not practical to prevent such contamination, see that all employees are required to wear respiratory protection whether they are working on the given job or merely working in its immediate vicinity.
5. Shift-length samplers should be stopped for any period during which all employees in the vicinity of the sampler are wearing respiratory protection and the time during which they are stopped recorded.
6. The plant acceptable limit for locations with the possibility of material having more than 1 ppm. of plutonium in uranium will be 0.1 counts/min./ft.^{3}; the plant acceptable limit for locations with materi[al] having less than 1 ppm. of plutonium in uranium should be 1.0 counts/min./ft.^{3}.

E. Rigid protection of open wounds will be required.

1. No employee should be permitted to work in a contaminated location unless an open wound is covered by a tight bandage, collodion, or other device specified by the Medical Department.
2. Care should be taken for all wounds on any part of the body, but especial attention should be given to the hands.

F. Personal hygiene will be necessary.

1. Hands should be washed and counted before eating, smoking, or going home, and the count should be below the plant acceptable limit of 100 counts/min./hand.
2. The body should be bathed periodically, either at the plant or at home.

G. Protective clothing should be required where necessary.

1. Gloves of the proper type for the work done are of first importance fo[r] all working on contaminated equipment.
2. Company-issue shoes or shoe covers should be worn where surface contamination is a problem.

[redacted]

3. Coveralls should be worn by workers regularly involved in handling contaminated equipment or working in locations where an appreciable fraction of the surfacesis contaminated.
4. Cloth caps should be worn where other items of protective clothing are used or where there is a possibility of air contamination.
5. Socks and underwear may be used though not considered essential.

H. Contaminated equipment and areas should be identified.

1. Tags are available for general identification.
2. Special tags will be made available for tagging those items or containers where material with plutonium concentration greater than 1 ppm. in uranium is involved.
3. Hazardous work permits should be used properly.
4. Areas with surface contamination above the plant acceptable limit should be tagged at the boundary of the contaminated portion.
5. Areas with temporary contamination above the P.A.L. resulting from a spill or other temporary condition should be roped off and tagged until cleaned.
6. Identification of contaminated or non-contaminated equipment should be based only on the results of monitoring with a radiation detection instrument or definite knowledge of the use history of the item concerned.
7. Tags should be removed when no longer necessary.

I. Maintenance on contaminated equipment should be performed only in those shops or areas where the personnel are properly protected and contaminated equipment is routinely handled.

1. If the work is required for equipment having plutonium in excess of 1 pp as compared with uranium, temporary segregation of the immediate working location from similar work and special decontamination after completion of the job may be necessary. This applies only to equipment in which a relatively large amount of contamination is anticipated, and will include items of equipment in which the uranium-plutonium mixture accumulates.
2. If the plutonium-contaminated piece of equipment is only possibly superficially contaminated on the outer surface as an incidental part of its service, no special precautions other than those recommended for uranium concentration will be necessary. This will include, in general, items in plutonium-contaminated locations for which the amount of contamination with high-fraction plutonium material is produced only incidentally by widespread material releases or by the general spread of small amounts of contaminating material.
3. In-place maintenance on plutonium-contaminated equipment may be advisab at times rather than taking the item concerned to the shop.

J. Segregation of areas.

1. Special attention should be given only to those locations where plutoni in a concentration greater than 1 ppm. as compared with uranium is foun
2. In general, this special attention should be given only to those parts of the location where plutonium of the above concentration is actually found. However, for administrative reasons, it may be desirable to consider the entire building or other area in which this plutonium is foun as the special control area.
3. The personnel protective measures outlined in Sections E, F, and G abov should be rigidly enforced for personnel working in these specially controlled areas.

[redacted]

4. For a visitor to these areas, the following may be necessary:
   a. Such items of protective clothing and respiratory protection as necessary should be supplied him and he should be required to use same.
   b. He should check his hands and record the result when leaving.
   c. He should abide by any other special rules concerned with health physics as applicable to this location.

K. Medical Requirements.

1. Personnel working in these special control areas should receive medical checks of the type and at the frequency specified by the medical director.
2. All employees involved in material releases or other exposures to radioactive materials should be sent to the dispensary as specified.
3. Employees who find it impossible to remove hand contamination should be sent to the dispensary.

L. Waste disposal and laundering.

1. For waste materials with plutonium in an amount of less than 1 ppm. as compared with uranium, normal disposal should be made; otherwise, disposal at X-10 may be possible.
2. Clothing from areas where plutonium is involved should be laundered in a batch separate from other clothing even though the same laundry equipment is used.

Safety and Radiation Hazards Department

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APPENDIX I

PLANT ACCEPTABLE LIMITS FOR ALPHA CONTAMINATION

A. SURFACE

Area Considered	Instrument Reading (Counts/min.) Surface	Wipe
Floors	800	100
Tables, equipment, etc.	500	100
Clothing	500	100
Shoes - Personal	500	-
Shoes - Company Issue	5000	-
Respiratory Protective Equipment	100	50
Body	250	-
Hands	100 per hand	-

B. AIR

Material Considered	Concentration (Counts/min./ft.^{3})
Uranium	1.0 *
Plutonium	0.1 **

* Value suggested in line with recommendations of the Subcommittee on Permissible Internal Dose of the National Committee on Radiation Protection, National Bureau of Standards. Present limit is 2.0 counts/min./ft.^{3}.

** Value suggested in line with recommendations of the Subcommittee on Permissible Internal Dose of the National Committee on Radiation Protection, National Bureau of Standards.

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APPENDIX II

A. MAXIMUM RECOMMENDED LIMIT* FOR INGESTION

Material	Concentration in Drinking Water		Total Daily Ingestion	
	Activity $\mu c/cm.^3$	Mass $\mu g/cm.^3$	Activity μc	Mass μg
Normal U (Soluble)	80×10^{-6}	118	18×10^{-2}	2.6×10^{5}
Pu (Soluble)	1.5×10^{-6}	2.4×10^{-5}	0.33×10^{-2}	5.3×10^{-2}

Ratio $\left\{\frac{\text{Daily Ingestion Limit for U}}{\text{Daily Ingestion Limit for Pu}}\right\} = \begin{cases} 53 \text{ on activity basis} \\ 5 \times 10^{6} \text{ on mass basis} \end{cases}$

B. MAXIMUM RECOMMENDED AIR CONCENTRATION LIMIT* FOR INHALATION

Material	For Continuous Exposure			For 40 hr./wk Exposure***		
	Activity		Mass	Activity		Mass
	$\mu c/cm.^3$	$c/m/ft.^3$**	$\mu g/cm.^3$	$\mu c/cm.^3$	$c/m/ft.^3$**	$\mu g/cm.^3$
Normal U (Soluble or Insoluble)	1.7×10^{-11}	0.32	2.5×10^{-5}	0.5×10^{-10}	1	0.75 x
Pu (Soluble or Insoluble)	2×10^{-12}	0.04	3.2×10^{-11}	6×10^{-12}	0.1	1.0 x

Ratio $\left\{\frac{\text{Maximum Inhalation Limit for U}}{\text{Maximum Inhalation Limit for Pu}}\right\} = \begin{cases} 8.5 \text{ on activity basis} \\ 8 \times 10^{5} \text{ on mass basis} \end{cases}$

Present K-25 Plant Acceptable Limit for air contamination = 1.05×10^{-10} $\mu c/cm.^3$ or 2.0 $c/min./ft.^3$.

C. MAXIMUM RECOMMENDED LIMIT* FOR AMOUNT FIXED IN THE BODY

Normal U (Soluble) - 0.009 μc or 1.3×10^{4} μg.

Plutonium (Soluble) - 0.04 μc or 0.5 μg.

Ratio $\left\{\frac{\text{Maximum Fixed Amount U}}{\text{Maximum Fixed Amount Pu}}\right\} = \begin{cases} 0.22 \text{ on activity basis} \\ 2.6 \times 10^{4} \text{ on mass basis} \end{cases}$

D. PRESENT MAXIMUM ALLOWABLE PLUTONIUM CONCENTRATION IN THE ATMOSPHERE FOR 40 HOUR WEEK AT OTHER AEC INSTALLATIONS

X-10 - 3×10^{-11} $\mu c/cm.^3$ = 0.6 $c/min./ft.^3$ **

Y-12 - 3×10^{-11} $\mu c/cm.^3$ = 0.6 $c/min./ft.^3$ **

Hanford - 1.25×10^{-11} $\mu c/cm.^3$ = 0.2 $c/min./ft.^3$**

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* All figures taken from, or calculated from data given in, Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentration in Air and Water, by the Subcommittee on Internal Dose of the National Committee on Radiation Protection, prepublication.

** Alpha counts/min./$ft.^3$ as determined by air activity collection and counting methods in use at K-25.

*** Calculated from value recommended for continuous exposure on the basis of the assumption stated in the report of the Subcommittee on Internal Dose, that the standard man breathes 10^7 $cm.^3$ of air per 8 hour work day and a total of 2×10^7 $cm.^3$ of air per 24 hour day.

APPENDIX II

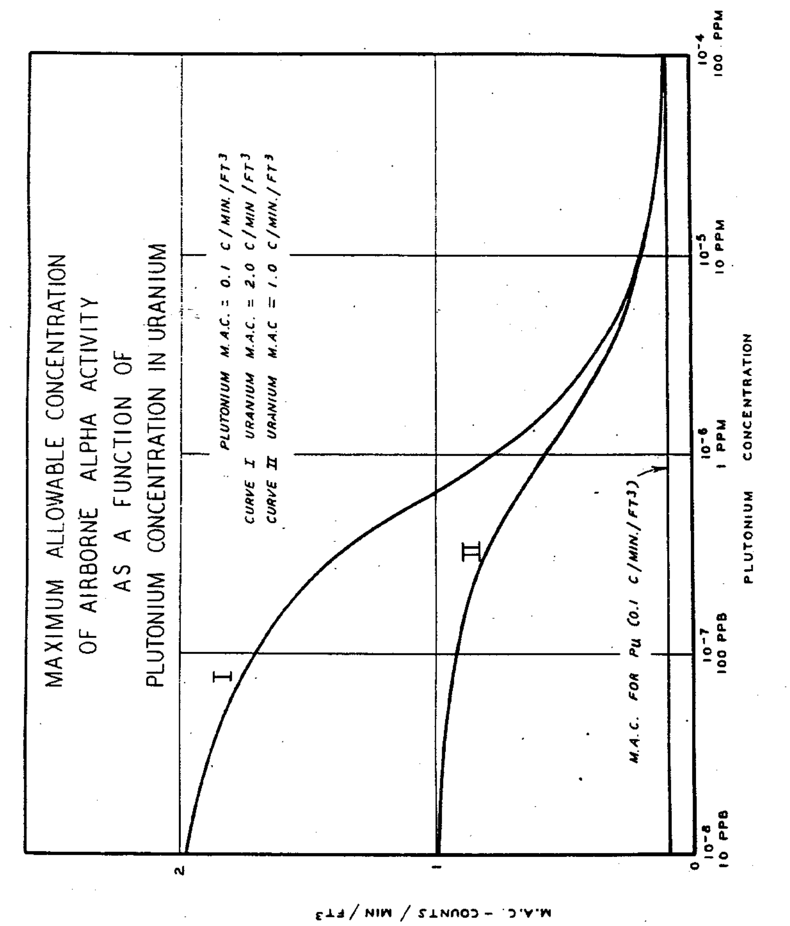
AVAILABLE K-25 INFORMATION ON CONTAMINATION CONTROL

A. Standard Practice Procedures

SPP-315 - Identification of Radiation Hazards and Accountability of Contaminated Equipment. Date: May 23, 1949
SPP-379 Radiation Control and Reporting - Date: March 27, 1951

B. Standard Reference Information

SP-110 - Atomic Nuclear Theory - Basic Atomic Theory
SP-111 - Atomic Nuclear Theory - Radioactivity
SP-120 - Uranium - Physical and Chemical Properties
SP-121 - Uranium - Biological Effects
SP-130 - Plutonium
SP-140 - Radiation Biology - Practical
SP-141 - Radiation Biology - Technical
SP-150 - Personnel Protection - General
SP-151 - Personnel Protection - Equipment
SP-152 - Maximum Permissible Radiation and Contamination Values
SP-160 - Personnel Monitoring - General
SP-161 - Personnel Monitoring - Film Meters
SP-162 - Personnel Monitoring - Pocket Chambers and Dosimeters
SP-163 - Personnel Monitoring - Hand Counting
SP-180 - Contamination Control of Area and Equipment - General
SP-181 Contamination Control of Areas and Equipment - Specific Methods
SP-183 - Contamination Control of Areas and Equipment - Decontamination
SP-190 - Health Physics Program Administration
SP-191 - Form Listing


MAXIMUM ALLOWABLE CONCENTRATION
OF AIRBORNE ALPHA ACTIVITY
AS A FUNCTION OF
PLUTONIUM CONCENTRATION IN URANIUM
PLUTONIUM M.A.C. = 0.1 C/MIN./FT3
CURVE I URANIUM M.A.C. = 2.0 C/MIN/FT3
CURVE II URANIUM M.A.C = 1.0 C/MIN./FT3
I
II
M.A.C. FOR Pu (0.1 C/MIN./FT3)
10-8 10 PPB
10-7 100 PPB
10-6 1 PPM
10-5 10 PPM
10-4 100 PPM
PLUTONIUM CONCENTRATION
M.A.C. - COUNTS / MIN / FT3
0
1
2

KRR-219

RADIATION PROTECTION CRITERIA AND STANDARDS:
THEIR BASIS AND USE

PLANT OPERATIONS

The Paducah Plant is a government-owned gaseous diffusion plant operated by Union Carbide Nuclear Company for the Atomic Energy Commission. The diffusion plant, with the associated uranium hexafluoride manufacturing plant and uranium metal foundry, processes large quantities of relatively pure uranium compounds. The major sources of external penetrating radiation from such materials are the daughter products, isotopes of thorium and protactinium, formed by the alpha decay of the parent uranium, and which are concentrated in the ash produced during the fluorination process. The element uranium ~~may prove~~ can be hazardous only if allowed to enter the body. The chemical toxicity of the uranium materials processed at the Paducah Plant overshadows any radiation danger from this element, thus making it comparable as an industrial risk to lead, mercury, or other well known heavy metals.

RADIATION STANDARDS OBSERVED

Basic Standards

The radiation standards recognized at the Paducah Plant are those documented in NBS Handbooks 59 and 69, including the addendum to the former.

Thus, for external penetrating radiation the basic standards observed are the 13-week limits of 3 rems of gamma radiation to the body and 6 rems of beta radiation to the skin. The added restriction is imposed for gamma radiation that no employee shall exceed an accumulated dose greater than (N-18) x 5 rems where N is his age in years, with a comparable restriction for cumulative exposure to the skin from radiation of low penetrating power (beta) being (N-18) x 10 rems.

For internal deposits of uranium, the limiting quantity is considered to be the 0.005 microcuries listed in NBS Handbook 69 as the maximum permissible body burden when the kidney is considered as the critical organ. The maximum permissible con-

C. L. Young 7-17-96

centration observed for uranium in air for plant work areas is 6×10^{-11} microcuries per cubic centimeter of air.

Action or Control Limits

It has been the plant policy to observe action points at some fraction of nationally recognized standards to insure against any employee exceeding the established limits. Thus, for penetrating radiation any employee whose total exposure reaches either 2.4 rem of gamma radiation or 4.8 rem of beta radiation within a 13-week period is rotated to a job having no radiation exposure until such time as the exposure quarter has ended. Such job rotation has been extended ~~within the past year~~ [illegible] to all employees in various [illegible] so that the probability of any employee exceeding even the action levels has been greatly reduced.

While it may be calculated from the maximum permissible body burden for uranium, and the various factors for the distribution of and excretion from this body burden, that an excretion rate of approximately 50 micrograms per day may be considered indicative of a ~~maximum permissible body burden~~ significant internal body [illegible] of normal uranium, the plant action point is set at 12 micrograms per day. When a series of urinalyses indicate an employee is excreting more than 12 micrograms of uranium per day, he is removed from further uranium exposure until such time as his excretion rate is below this level.

OPERATING METHODS

Plant Personnel

The basic philosophy of the Paducah Plant is that each member of the line organization has a responsibility for the safety and health of employees commensurate with his responsibility for the operation of the plant. The operating groups have radiation detection instruments and have been trained in the use of such equipment. They have the responsibility for the maintenance of ventilating equipment, both general area and local exhaust, as well as that of keeping operating equipment in such condition that the need for such ventilation will be minimal. The responsibilities of using the proper protective equipment, of maintaining a clean work area, and of rotating personnel to different jobs or work areas as needed to comply with plant radiation and uranium action points are all that of line supervision.

The Medical and the Health Physics and Hygiene Departments are maintained as staff groups, equipped to provide technical information and assistance as required. The functions served include making inspections of all areas and all operations, maintaining a film meter service, coordinating a bio-assay program, monitoring of workroom air for many chemicals used as well as for uranium, making audit surveys of the radiation levels for various jobs or work areas, conducting an environmental monitoring program to assure that no damage may result to adjacent communities or individuals and to provide protection in the case of unwarranted litigation, providing a periodic and special health examination schedule, and assisting in the training of all employees.

A total of seven employees work in the Health Physics and Hygiene Department, comprising approximately 0.4% of the plant work force. In addition There are 16 employees in the plant Medical Department.

In addition to the above groups there are various service groups which provide specialized engineering, chemical and radiochemical laboratory, and maintenance functions. None of these people work exclusively in radiation protection, but many spend a very significant portion of their time in such endeavor. There are 3 to 4) [illegible] analyst days spent each day on laboratory analyses directly involved in radiation protection.

<u>Plant Design</u>

The basic method employed to control exposure to uranium is the confinement of the material being processed. All diffusion plant equipment is designed so the UF_6 is pumped through the miles of piping, and other essential associated diffusion plant equipment, with the probability of the exposure of any employee being reduced to insignificance. However, the system must occasionally be opened for maintenance, and the product and tails material must be withdrawn into appropriate containers.

[ ] to minimize

At such times, the possibility of some small amount of the material becoming airborne ~~is increased, and~~ [the necessary precautionary measures are followed.] ③

Essentially the same rules apply in the uranium hexafluoride manufacturing portion of the plant. [~~The greater frequency with which some of this equipment must be entered for maintenance work also elevates the likelihood of some escape of uranium materials from that equipment.~~ To compensate ~~for this~~ where greater use is made ~~here~~ of local ventilation exhausting through filters designed to prevent the escape of the uranium. EC (4) ?

Routine inspections are made of all equipment to detect any conditions which require remedial action. Such inspections are performed daily by line supervision and their employees, and on a less frequent basis by members of the Health Physics and Hygiene Department.

Assessment of Exposure

A routine film badge program is maintained such that each employee having a significant probability of exposure to penetrating radiation wears a film meter which is collected, developed, read and evaluated on a monthly cycle. Currently, approximately one-third of the plant population ~~are~~ is included in this program; however, all plant employees will be badged in the near future when a new combination security-film badge is delivered from the company which received the contract for the fabrication of them. This will be one step in a program designed to give complete coverage of employees so that exposures may be evaluated more rapidly and accurately in any future unscheduled critical reaction.

Employees whose work involves any possibility of exposure to uranium are scheduled for urinalysis at a frequency which is determined by their job exposure probability. The frequency of such schedule may vary from a weekly one for an employee whose recent urinalyses have indicated an excretion rate approaching the plant control limit to an annual one for an indivudual who works in an area where no uranium should be encountered.

Continuous air samplers operate in all areas where an audit of the air borne uranium has indicated a need for such. The samplers collect onto a filter paper the particulate matter from air which is sampled over an 8-hour work shift. The filter paper is then alpha counted in a laboratory type instrument to determine the airborne uranium concentration. New equipment or jobs, or any changes in operating procedures on existing jobs, are checked by an inspection which includes an evaluation of air samples collected in the breathing zone of employees and in the general work location.

~~The problem of~~ Airborne beta-gamma active decay products of uranium ~~is~~ are controlled by maintaining the alpha activity of uranium within acceptable limits, but such air samples are less frequently counted for beta-gamma activity as an added precaution. Checks are also made of such trace impurities as fission products and transuranic elements to evaluate and eliminate any possible hazard from an unexpected accumulation of such materials.

PLANT EXPERIENCE

The effectiveness of any program may be assessed by the results produced. During the year of 1959 there were 7 plant employees who were temporarily rotated to jobs involving no radiation exposure, but none of these exceeded the recognized quarterly limits. In the same year a total of 66 employees were temporarily rotated to jobs having no contact with uranium, but none of these over a period of six months averaged an excretion rate indicative of half the maximum permissible body burden.

The monitoring of plant areas for radioactive contamination has shown that most work is done in an environment which is maintained well below the maximum permissible concentration for airborne uranium. There are jobs which produce localized areas of somewhat elevated concentrations of uranium in air for short periods of time, but as new operating techniques are developed these events occur less frequently. The mean of 8810 shift-length air samples collected in work areas during 1959 was

2.04×10^{-11} microcuries of alpha activity per cubic centimeter of air; this represents 34% of the maximum permissible concentration of 6×10^{-11} $\mu c/cc$.

COSTS OF RADIATION PROTECTION PROGRAM

It is rather difficult to evaluate the cost of radiation protection in a plant in which the basic responsibility for such protection reverts to line supervision, and still exclude the costs incurred from the efforts of ~~that group~~ the operating personnel. The annual budget for the Health Physics Department for FY-1960 is approximately $65,000, or about 0.3% of the operating expense for the plant, exclusive of power costs.

In addition to this basic cost, other items such as the maintenance of radiation instruments which belong to other groups, maintenance of local exhaust ventilation, and the cost of maintaining respirators and masks might also be included. These activities will approximately equal the cost of the Health Physics budget.

PROTECTION OF ENVIRONS

Even normal uranium at $11.45 per pound is a rather expensive element; so this represents a great incentive to recover as much in any situation as is economically feasible. The added desire to maintain a wholesome relationship with neighboring communities and individuals makes it essential that all waste air be exhausted through filters, and that all effluent waters be maintained at extrèmely low concentrations of uranium.

The results of the plant environmental monitoring program for 1959 indicate that the average of 3×10^{-13} microcuries of uranium per cubic centimeter of air at the perimeter fence is below NBS Handbook 69 standards for air beyond control areas by a factor of 10. The mean result for beta activity, 2×10^{-12} microcuries per cubic centimeter of air, is a factor of 500 below the applicable standard.

The monitoring of water in the small, wet weather streams on each side of the plant during 1959 gave an average alpha activity of 1.07×10^{-7} microcuries per cubic centimeter and a mean beta analysis of 2.88×10^{-6} $\mu c/cc$. These figures are approximately factors of 200 and 10, respectively, below the standards recommended for water beyond a restricted area. Samples collected in the Ohio River below this plant show no greater alpha activity than samples collected above the plant in that river. The beta activity of 2.23×10^{-7} μc/cc, while slightly elevated above the upstream results, is a factor of approximately 100 below the standard listed in NBS Handbook 69.

EFFECTS OF POSSIBLE CHANGES IN LIMITS

In the eight years of operations at the Paducah Plant the accumulation of internal deposits of uranium by employees has been minimal, and exposures to penetrating radiation have been less than the maximum figures accepted nationally. There has been no clinical evidence of injury, either acute or chronic, to any employee from radiation or radioactive materials. [~~However, as with employment in any industry, there may remain some remote possibility of injury. The question remains as to what extent one should go in attempting to reduce~~ such exposures to zero.] ?

It has been estimated that if standards were reduced to 50% of the current values, an expenditure of approximately $2,000,000 might be necessary. This would ~~to~~ provide ~~either~~ a method for doing much maintenance and handling of material by remote control such as that utilized around nuclear reactors and in the processing of ~~the more hazardous~~ plutonium, [~~in reducing the frequency for the need of handling such materials or performing maintenance on such equipment.~~] If the present radiation standards were to be reduced by a factor of 5 or 10, however, the ramifications would be numerous. A cost vs. result relationship which might be nearly linear if radiation limits were reduced by a factor of 2, would probably more nearly be exponential at the factor of 10. Thus, costs and difficulties in meeting them would increase much more rapidly than would the desired reduction in radiation exposure. In addition to the initial expense involved, and increased operating costs, such changes could stem from ~~it would be necessary to employ more~~ employees being required to use respiratory equipment and other protective devices for ~~people to rotate so the exposure per person could be reduced. Thus, the continuing~~ extended periods rather than for specific short-term jobs as is now the case. ~~expense of an increased annual payroll would result.~~ The reduction of the maximum permissible concentration of some isotopes would reduce these levels below those which can be measured today.

Conversely, if such standards were to be raised by 50% of the present values, it would be possible to save some of the money being expended to control exposures.

The accumulation of evidence over the past 8 years at the Paducah Plant, and the past 15 years at other plants operated by Union Carbide Nuclear Company in this industry, shows that standards are being met, and there seems to be no evidence that anyone has suffered damage at these levels.

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NATIONAL
LABORATORY

MARTIN MARIETTA

ORNL/TM-8077

Contaminated Scrap Metal Inventories at ORO-Managed Sites

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METALS AND CERAMICS DIVISION

NUCLEAR WASTE PROGRAMS

ORO Metal Waste Management
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CONTAMINATED SCRAP METAL INVENTORIES AT ORO-MANAGED SITES

J. E. Mack

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OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37830
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Burial

Burial of contaminated scrap metal as waste is the disposal method used primarily at ORNL. The contaminants are typically mixed beta and gamma emitters, and the potential for decontaminating the metal for recycle or recovery by existing methods is negligible. Also, ORNL buries contaminated metals received occasionally from ORAU and CARL, which are not routine generators. Waste burial charges at ORNL are based on total cost recovery operations at the current rate of $\$271/m^3$ ($\$7.68/ft^3$). It should be noted that the volume of existing ferrous scrap stockpiles alone is estimated at nearly 10^5 m^3 (3×10^6 ft^3). The Y-12 plant and GAT have used burial as a means of disposal, although both also stockpile contaminated metals in above-ground storage yards. The CEER recently shipped about 20 tons of contaminated metal (primarily aluminum) from decommissioning a research reactor to Barnwell, South Carolina, for disposal by burial.[7]

Above-Ground Storage

Above-ground storage is the major handling method employed for the bulk of the contaminated scrap generated at ORO-managed sites. Scrap yards are used at all three enrichment plants (Figs. 1 and 2), as well as at the FMPC in Fernald (Figs. 3 and 4) and at Y-12 in Oak Ridge (Fig. 5). This is perhaps the most economical short-term means of handling the scrap, provided that land is available and the necessary precautions have been taken to minimize leaching of radionuclides by rain to the soil and groundwater.

Stockpiling of classified contaminated metals requires covered storage and security fencing. This material is currently stored in vaults or secured warehouses, which is slightly more expensive than unclassified scrap yard storage. Much of the classified scrap is already scheduled for declassification by smelting, which is discussed later.

The practice of scrap yard stockpiling was originally envisioned as an interim solution until regulations establishing minimum contamination levels for low-enriched uranium were approved. Although this method is economical in the short term, the negative aesthetics of the scrap yards and the questionable use of land, facilities, and resources make them a less than desirable long-term solution, particularly in view of the current emphasis on resource conservation, corporate responsibilities, and environmental concerns.

Smelting

Smelting is used at several sites primarily as a means of declassifying shape-classified nickel and aluminum scrap. In addition, smelting provides volume reduction and decontamination of most metals by slagging,[8] although decontamination of aluminum by slagging has been demonstrated only on a laboratory scale.[9] The remaining contaminants are dispersed throughout the metal. Accurate analysis is also possible by sampling the molten metal before ingot pouring. Smelting transforms scrap yard metal into rows of stacked ingots, which are then available for recycle or burial at significantly reduced costs. However, much of the scrap metal consists of large components, which require extensive size reduction to fit into the furnace; thus smelting is labor as well as capital intensive.

Smelting is used most extensively at the Paducah Gaseous Diffusion Plant, primarily for shape declassification. Smelting capabilities at PGDP consist of a 6-ton Brown-Boveri induction furnace, a reverberatory furnace, and a direct-fired drip melter. The latter two are used basically for aluminum melting. The drip melter in particular is used for selective melting of aluminum from uncontaminated composite scrap metal components generated by Y-12.

The induction furnace can handle both ferrous and nonferrous scrap. It has been used for production runs of nickel, aluminum, Monel, cobalt, and most recently nickel-plated steel. The scrap is melted and cast into one-ton ingots directly from the furnace by a hydraulic tilt-pour mechanism (Fig. 6). Ingots are dumped from the molds when cooled and stored outside the building on concrete pads (Fig. 7). A pretreatment system is being installed to defluorinate the uranium-contaminated nickel before smelting. This is done to minimize corrosion of the furnace liner. Once this system is installed, PGDP will begin a smelting campaign with

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PGDP

PADUCAH GASEOUS DIFFUSION PLANT

UNION CARBIDE

HISTORICAL IMPACT OF REACTOR TAILS ON THE PADUCAH CASCADE

R. F. Smith

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HISTORICAL IMPACT OF REACTOR TAILS ON THE PADUCAH CASCADE

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Technical Services Division

Prepared by the
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operated by
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for the
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ABSTRACT

A knowledge of cascade history relative to reactor tails has been useful in answering many questions which have arisen over the years and continue to arise. This report contains a comprehensive summary of historical data which should be useful in answering such questions in the future.

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INTRODUCTION

A knowledge of cascade history relative to reactor tails feeds has been useful in answering a substantial percentage of questions referred to the Analytical Services Lab by various PGDP and other Nuclear Division groups. Questions continue to arise concerning concentrations of radiochemical impurities and minor isotopes in PGDP feed, product, and tails. Much of the historical data has been published in voluminous classified reports; however, production reactor tails information has since been declassified. Presented here is a comprehensive unclassified summary of reactor tails feeds to the PGDP cascade from startup (FY-53) through the last year such material was fed (FY-76). Data relative to destination of minor isotopes and radiochemical impurities are included. It is hoped that this summary will be useful in answering future questions concerning the cascade.

DOMESTIC REACTOR TAILS RECEIVED AND FED AT ENRICHMENT PLANTS

Appendix 1 summarizes feeds to and withdrawals from the PGDP cascade from startup (FY-53) through FY-76. Depleted reactor tails were fed to the cascade from FY-53 through FY-64. That feed was again reinstated in FY-69 and continued through FY-74 except for FY-71 when none of the feed was of reactor origin. Enriched reactor tails received from Hanford were fed to the cascade during only three FY's, those being 73, 75, and 76 (Actually was fed from April through June 1973, and June 1 through September 11, 1975). No reactor tails, depleted or enriched, have been fed to the Paducah cascade since September 11, 1975. We still have in the yard for future feeding 335 MTU of depleted reactor tails at an average assay of 0.633 wt. % ^{235}U. We received more enriched reactor tails than was fed; however, the remaining material was never converted to UF_6 and is being shipped to NLO as UO_3. The material being shipped to NLO has an assay greater than 0.80 wt% ^{235}U.

Appendix 1 can be used in making ball park judgments concerning the cascade for any of the 24 years from startup through FY-76. Although the history of PDF and SHAFT feeds are not precisely known, they have little effect on anything but ^{236}U since impurities preferentially move up stream. It will be observed from Appendix 2 that approximately 65% of the PGDP cascade feed for FY-73 was reactor tails. That is by far the highest percentage for any year. Periods with the next greatest percentage were FY-57 and FY-70 with about 35% each. Although percentage of reactor tails feed was relatively small, the period between June 1 and September 11, 1975 is of interest since ERT contained higher concentrations of Tc and ^{236}U.

Appendix 3 gives a detailed summary of all production reactor tails fed to enrichment cascades through FY-74. Not included is 1373 tons ERT fed to the PGDP cascade between June 1 and September 11, 1975 (415 tons in FY-75 and 958 tons in FY-76). It will be observed that over 94% of all production reactor tails were fed at Paducah with less than 0.5% being fed at GAT.

Some foreign reactor tails, chiefly French and English (BNFL), have been received and fed at ORGDP. An average of 20 cylinders per year has been received by them since 1969, with the range being 0 to 53 cylinders per calendar year.

Appendix 4 compares total quantities of reactor tails and normal fed to the three enrichment plants through FY-74. Other feeds for the period were recycle material; PDF, SHAFT, and ORGDP or PGDP product.

Appendix 5 summarizes total feeds and productions at Paducah through FY-76 (24 years). It will be observed that recycle (PDF and SHAFT), normal (natural), and reactor tails feeds constituted approximately 69%, 17%, and 13%, respectively. Production was about 82% tails, 16.5% product and 1.5% special side withdrawal.

Appendix 6 summarizes the enrichment plant tails stockpile as of June 30, 1975, while Appendix 7 gives net enrichment plant tails through June 30, 1975. It is obvious that most tails produced through that time had been refed as PDF or SHAFT. Shipments and discards listed in Appendix 7 were from Paducah, chiefly as UF_4 and U metal.

CONTENT OF SUBSTANCES PECULIAR TO REACTOR TAILS

MINOR ISOTOPES

Appendix 8 compares calculated ^{236}U production in reactors with analytical measurements, and good agreement is shown for material received prior to 1967. Material processed after recycling started contained more ^{236}U as expected; however, calculations are not possible without complete history. Measurements indicated that reactor tails received after 1967 contained an average of about 20% more ^{236}U than that received earlier (eg: 133 instead of 110 ppm for HRT and 204 instead of 170 ppm for SRT). All enriched reactor tails have been recycled, so there is no way of calculating ^{236}U concentration. Six measurements performed (3 on UF_6 fed to the cascade and 3 on UO_3 sent to NLO) gave a ^{236}U average of 473 ppm (0.0473 wt. %) with a range of 270 to 680 ppm.

Unlike ^{236}U which is of reactor origin, ^{234}U tends to enrich and deplete in proportion to ^{235}U as UF_6 moves through the cascade. Thus, ^{234}U doesn't vary greatly for any specific ^{235}U concentration; however, feed distribution can produce some ^{234}U variability which is difficult to visually detect over the Paducah isotopic range. A high proportion of PDF or SHAFT feed tends to reduce the ^{234}U gradient relative to ^{235}U since ^{234}U has been preferentially depleted in such material. A high proportion of reactor tails feed tends to enhance the ^{234}U gradient relative to ^{235}U since ^{235}U in such material has been depleted while ^{234}U remained relatively unchanged.

TECHNETIUM-99

In November 1973, I gave Alice Story a ^{99}Tc estimate of 7 ppm ±30% (U basis) for all depleted reactor tails received at Paducah. Hundreds of measurements had been performed from 1959 up to that time and essentially all of them clustered in a range of 4 to 10 ppm on a U basis. That is still the best ^{99}Tc concentration estimate for all HRT and SRT uranium received through FY-74. Only five measurements were performed on ERT, two on material fed to the cascade and three on material shipped to NLO, and the average concentration was 16 ppm on a U basis which is the best estimate for that material. Appendix 9 summarizes HRT, SRT, and ERT uranium fed to the Paducah cascade and estimates the ^{99}Tc received in it. Based on Tc balance data accumulated prior to December 1973, Alice Story estimated that about 95% of Tc entering the feed plant with UO_3 is withdrawn in the UF_6 product, and about 90% of that in feed plant product cylinders is vaporized to the cascade giving a net cascade feed percentage of about 85. As seen in Appendix 9 an estimated 539 kg of Tc was fed to the cascade after correcting the net cascade feed percentage for approximately 27 kg of Tc trapped in C-410 MgF_2 traps.

NEPTUNIUM-237

Neptunium concentration of reactor tails uranium is summarized in Appendix 10. Measurements were not made on material received prior to FY-57 and most measurements performed after that were on monthly composite samples of UO_3 received. Complete analyses were not performed on any stream, and measurements on some were more fragmentary than others. Even so, Appendix 10 gives the best estimate for the quantity of ^{237}Np received in reactor tails fed at Paducah. Between 10% and 40% of ^{237}Np received entered the cascade with UF_6 according to estimates made by W. R. Golliher and associates. Using an estimate of 25%, approximately 4.6 kg of ^{237}Np was fed to the Paducah cascade.

PLUTONIUM-239 (INCLUDES PLUTONIUM-240 CALCULATED AS PLUTONIUM-239)

Plutonium concentrations of reactor tails uranium is summarized in Appendix 11. Measurements were made starting in FY-54; however, analyses were biased high for material received prior to 1967. Up to that time, pulse height analyses were not performed to correct measurements for alpha emitting impurities (chiefly Np); so, the 4 ppb average constitutes an upper limit for ^{239}Pu. Most Pu received was deposited in Feed Plant ash receivers, and very little accompanied UF_6 into the cascade. Cascade dusts near reactor tails feed points were analyzed for Np and Pu in 1966. Since Np is known to be more mobile in the cascade than Pu, the relative ratio of Np and Pu alpha activity should have given a conservative upper limit for Pu fed. Those measurements showed ^{239}Pu activity to average <0.2% of the ^{237}Np activity. Extrapolating on the assumption that 4.1 kg. Np had been fed to the cascade up to that time, less than 0.1 gram of Pu would be indicated. Plutonium fed after 1967 was <20% of that fed previously, so 0.1 gram is the best estimate of ^{239}Pu fed to the cascade.

FISSION PRODUCT BETA AND GAMMA

A nuclear power reactor fueled with ^{235}U produces fission products at more than 80 different mass numbers which further decay to produce a total of more than 260 radioactive species. Most of the radioactive nuclides have short half lives, and decay to negligible concentrations in a matter of a few months. A few have long half lives and/or low yield resulting in negligible radioactivity. Considering half life, fission yield, and radioactive emission, seven species would be expected to produce a predominance of fission product gamma radioactivity after a period of 4 to 6 months aging; those being ^{95}Zr-Nb, ^{103}Ru, ^{106}Ru, ^{125}Sb, ^{137}Cs, ^{141}Ce, and ^{144}Ce. In the mid-seventies, I devised a procedure for measuring those seven species as a substitute for the antiquated gamma specification measurement which was based on using a high pressure gamma chamber to compare fission product gamma to that of aged natural U. The new procedure which permits modern pulse height analyzer instrumentation to measure fission product gamma has been proposed to DOE. In the processing of spent reactor fuel, transuranic elements and fission products are preferentially separated from uranium, further reducing fission product radioactivity; however, decontamination factors differ for the various species.

At least four of the seven expected gamma emitting fission products were identified by ORNL in Paducah Feed Plant ash during the 1957-1958 period; those being ^{95}Zr-Nb, ^{106}Ru, ^{137}Cs, and ^{144}Ce. They identified the same four species in 1963 Feed Plant ash and failed to detect ^{125}Sb. In the mid sixties, the Paducah Lab identified fission product gamma energies in reactor return UO_3 which could account for part or all of the following nuclides; ^{103}Ru, ^{106}Ru, ^{137}Cs, ^{141}Ce, and ^{144}Ce. Thus, it is possible that six of the seven gamma emitters have been indicated in reactor return UO_3 or Paducah Feed Plant ash. ^{125}Sb has not been indicated, and I am not aware of a positive identification for ^{103}Ru and ^{141}Ce. Most reactor returns were processed at Paducah before sophisticated instrumentation was available to identify specific radioactive nuclides, so trace concentrations of unidentified species were possible. I once saw a report draft that quoted the following fission product gamma distribution for typical reactor return material, but I am not privileged to the source of the data.

Radioactive Nuclide	% of Total Fission Product Gamma
^{106}Ru	75
^{95}Zr-Nb	22
^{137}Cs	1
^{144}Ce	1
All others	1

Although there are about a half dozen pure or essentially pure beta emitting fission products with adequate half life and fission yield to survive 4 to 6 months aging, most of them apparently have relatively large decontamination factors in the uranium recovery process. Technetium is a notable exception since it was received in the greatest concentration of any fission product; however, it has been discussed separately. One other pure beta emitter, ^{90}Sr, was possibly received in trace concentrations. A few ORNL measurements in 1957 indicated positive concentrations of Sr in Paducah Feed Plant ash while similar measurements in 1958 indicated Sr concentrations to be below the detectability level. In 1963, ORNL detected Sr in Paducah Feed Plant ash but not in reactor return UO_3. If other pure beta emitters were received, they were not identified.

In summary, we received large quantities of ^{99}Tc in reactor return uranium material. Four gamma emitting fission products were positively identified in Paducah Feed Plant ash; those being, ^{95}Zr-Nb, ^{106}Ru, ^{137}Cs, and ^{144}Ce. There are indications that ^{90}Sr, ^{103}Ru, and ^{141}Ce were received. Except for Tc, only trace quantities of fission products were received in reactor return UO_3. Total fission product gamma was consistently less than 10% the gamma activity of aged natural uranium.

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FOREIGN REACTOR TAILS RECEIVED AT ORGDP

As mentioned earlier, an average of 20 cylinders per year of foreign reactor returns has been received at ORGDP since 1969. At least a few of the cylinders, designated as "Russian" by the intermediate supplier, had apparently never been in a reactor. Most of the foreign reactor returns came from England (BNFL) or France, with France providing the predominance of the material. France supplied all the cylinders received in the past two years (61 cylinders total for CY-81 and CY-82).

Cylinders were 2-1/2 ton capacity, so ORGDP has been receiving an average of about 34 tons reactor return uranium per year. Total for 14 years is about 470 tons.

Appendix 12 summarizes isotopic and radiochemical measurements on French reactor returns for CY-82. None of the foreign reactor returns has exceeded radiochemical specifications since 1973, and isotopic specifications have never been exceeded. Other specifications have been exceeded on only four cylinders of foreign reactor returns since 1973, and all those were French cylinders received in 1982 which failed to meet the Mo specification. Federal Register Specifications have not been exceeded by any foreign reactor returns except those from France. During the period CY-69 through CY-73, ten French reactor return cylinders failed to meet specifications; six for transuranic alpha, one for fission product beta and gamma, and three for elemental Mo.

The transuranic alpha measurement is derived from neptunium and plutonium analyses. Over the past two years, the Pu has ranged from <0.01 to about 0.04 ppb on a uranium basis while the Np has ranged from <3 to 10 ppb.

DISTRIBUTION OF MINOR ISOTOPES AND RADIOCHEMICAL IMPURITIES IN PGDP CASCADE

MINOR ISOTOPES

Measurements have been made for minor isotopes in PGDP tails and product at random intervals since 1955, and data is summarized in Appendix 13. Unfortunately, no measurements were made for the period June 1973 through July 1976. Gaps between successive measurements are relatively brief for the remainder of the time period October 1955 through December 1982.

For the measurements made, ^{236}U in nominal 0.2 wt. % tails attained a maximum of 0.0045 wt. % in December 1969. For nominal 0.3 wt. % tails, the

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maximum measured was 0.0092 wt. % in December 1972. The highest ^{236}U measured in PGDP product was 0.0701 wt. % on a cylinder withdrawn May 21, 1973 which had a ^{235}U enrichment of 1.6 wt. %.

As expected, the ^{234}U assay range for specific ^{235}U enrichments was relatively small. For example, ^{234}U in nominal 0.2 wt. % tails ranged from 0.0006 to 0.0010 wt. %. For nominal 0.3 wt. % tails, ^{234}U ranged from 0.0012 to 0.0018 wt. %. The highest ^{234}U measured in product was 0.0172 wt. % obtained in June 1978 when product enrichment was at a nominal 1.95 wt. % level.

Maximum ^{236}U enrichments in PGDP product have been estimated by comparing available measurements to cascade feeds (Appendices 2 and 13). Reactor tails constituted a far greater fraction (~65%) of feed to the PGDP cascade in FY-73 than for any other year, and a portion of that feed for the last quarter was ERT which had a much higher ^{236}U enrichment than depleted reactor tails. Four minor isotope measurements were made on FY-73 PGDP product, and all were higher than any measurement performed in another year. A ^{236}U enrichment of 0.0292 wt. % on 1.7 wt. % product was obtained at the end of December 1972 when reactor tails constituted about 85% of the cascade feed but before ERT feed was introduced. The highest enrichments measured were for May 1973 when ERT constituted about 52% of the feed and combined reactor tails accounted for about 93%. Average ^{236}U enrichment of three cylinders withdrawn that month was 0.0625 wt% (0.0701, 0.0608, and 0.0565).

Estimates have been scrutinized to determine the maximum ^{236}U enrichment contributed to reactor grade UF_6 (3 wt. % ^{235}U) by the ^{236}U in PGDP product. Enrichments in the order of 0.1 wt. % ^{236}U would be expected if cylinders produced in the last quarter of FY-73 were fed undiluted to an upper cascade. Product from all other periods would be expected to produce reactor grade UF_6 with ^{236}U enrichments less than 0.05 wt. %; however, higher concentrations cannot be completely ruled out for the period June 1 through September 11, 1975 when ERT constituted a relatively small percentage of PGDP feed.

TECHNETIUM-99

Measurements for Tc in cascade tails were not made on material withdrawn prior to June 1973 when I asked that two tails cylinders be field sampled specifically for measuring radiochemical impurities. Reactor tails constituted approximately 65% of the total feed to the cascade in FY-73 and about 27% for the preceding year. For the month in which the two tails cylinders were withdrawn, over 96% of the feed to the cascade was reactor tails.

Measurements for Tc indicated the concentration to be <1 ppb for both cylinders. A cascade product cylinder sampled the same month contained 20 ppm Tc, the highest concentration ever measured on that stream. At least 35 additional tails cylinders were analyzed for Tc for the period FY-75 through FY-82, and all measurements were below the detectability level (1, 5, and 10 ppb detectability levels were used during the period). Thus, there is no reason to assume that any Tc went with the PGDP tails stream.

A MgF_2 trap was installed in C-310 to reduce Tc concentration in cascade product, and started operating January 28, 1963. ORGDP made Tc measurements on PGDP product for the five months preceding the installation, and the concentration average was 3.2 ppm. They continued measurements for four months following installation during which time the average dropped to 0.15 ppm. The trap was dumped about four months after installation, and 5.0 kgs Tc was contained in the MgF_2. The second trap bed was dumped 5.5 months following the first and contained 6.4 kg Tc. At some later date, dumping the MgF_2 trap beds became lax, saturation resulted, and Tc again increased in cascade product. Unfortunately, there were no Tc measurements on cascade product from 1963 till FY-72; however no reactor tails were fed for the period FY-65 through FY-68 nor for FY-71.

Routine Tc measurements on cascade product were not started until FY-72. Measurements since that time are summarized in Appendix 14. It will be observed that the Tc concentration peaked at an average of about 6 ppm in FY-74 and declined from that point on. In FY-82 for the first time the Tc concentration in PGDP product averaged below the detectability level of 0.01 ppm.

No attempt is made here to establish a material balance for Tc entering the cascade. It is known that substantial quantities were shipped out in PGDP product, trapped in MgF_2, and removed with cascade equipment during the two improvement programs. Also, some Tc was vented out the C-310 stack.

NEPTUNIUM-237

Measurements for Np in cascade tails were not performed until two June 1973 cylinders described in the previous section were subsampled for radiochemical analyses. Measurements indicated Np concentration to be <1 ppb on both those cylinders. At least 38 additional tails cylinders were analyzed for Np during the period FY-75 through FY-82, and all measurements were below the detectability level (1 and 5 ppb detectability levels were used). Thus, there is no reason to assume that any Np went with the PGDP tails stream.

Three PGDP product cylinders withdrawn in May 1973 were the first to be analyzed for Np, and 59 additional product cylinders were analyzed over the period FY-76 through FY-82. A few cylinders in the FY-76A-77 period exceeded the 5 ppb detectability level, and one of the 10 cylinders in FY-80 exceeded the 1 ppb detectability level being used that year. The highest concentration measured was 27 ppb in a cylinder from the FY-76A-77 period.

There were earlier indications that traces of Np were entering the product stream. Three MgF_2 trap beds dumped in the 1964 to 1966 period contained an average of 1.9 ppm Np after being leached, while the leach solution contained 0.38 ppm. By way of comparison, average Tc concentrations for the three trap beds were 9000 ppm in the leach solution and 2266 ppm in the leached MgF_2 pellets.

In summary, it is known that a small quantity of Np was trapped in C-310 MgF_2 beds during the mid sixties. Some product cylinders withdrawn in the FY-76A-77 period contained Np at a level above the 5 ppb detectability level, with the highest concentration measured in any cylinder being 27 ppb. Thus, it is concluded that some product UF_6 produced at the PGDP contained traces of Np.

Most Np which entered the cascade was probably removed with cascade equipment during the two improvement programs. Small quantities were shipped out with PGDP product and collected on MgF_2 trap beds. Also, it is likely that traces were vented out the C-310 stack to the environment.

PLUTONIUM-239 (INCLUDES PLUTONIUM-240 CALCULATED AS PLUTONIUM-239)

Measurements for Pu in cascade tails were not performed till 1964 when the Italians claimed U metal fabricated from PGDP tails contained 1.5 ppm Pu. Analyses were made at that time to assure the material shipped to them contained <0.01 ppm Pu, and the Italians eventually agreed that they were in error. Low detectability limit measurements were not performed on PGDP tails withdrawn prior to June 1973 when two cylinders referred to in the previous sections were analyzed for radiochemical impurities. Both cylinders contained <0.01 ppb Pu. Precise measurements have routinely been made on PGDP tails since 1975, and the detectability limit of 0.01 ppb has not been exceeded. Thus, it is concluded that no Pu has been withdrawn in PGDP tails.

Three PGDP product cylinders withdrawn in May 1973 were the first to be analyzed for Pu, and cylinders were analyzed each year from FY-76 through

FY-82. Of 60 measurements made, only two cylinders gave positive concentrations, those being 0.02 and 0.06 ppb. Thus, it is possible, but by no means conclusive, that traces of Pu fed to the cascade were withdrawn in product. At the levels observed, contamination in one of the laboratory preparation steps is always a possibility. The 0.06 ppb measurement was obtained in the FY-76A-77 period when the detectability level was 0.05 ppb while the 0.02 ppb measurement was obtained in FY-80 when the detectability level was 0.01 ppb.

I have estimated that only about 0.1 gram Pu entered the PGDP cascade. Most of that was undoubtedly removed with cascade equipment during the two improvement programs. It is possible, but not probable, that traces of Pu entered the PGDP product stream.

FISSION PRODUCT BETA AND GAMMA

Only two fission products have been identified in the PGDP cascade. Discussed earlier was ^{99}Tc which moved slowly from feed points up the cascade to C-310. Trace concentrations of ^{137}Cs have been identified in cascade dusts. It is possible that traces of the shorter half life fission products (^{95}Zr-Nb, Ru, and Ce) could have been detected in cascade dusts if sophisticated instrumentation had been available during the period when most reactor tails were being fed to the cascade.

CONCLUSIONS

The overall average ^{236}U concentration of 101,268 tons reactor tails U fed to the Paducah cascade from startup through FY-76 was about 126 ppm (0.0126 wt. %). Measurements for ^{236}U in nominal 0.2 wt % PGDP tails have ranged from essentially zero when no reactor tails was being fed to a maximum of 0.0045 wt. %. Measurements on product have ranged from essentially zero to 0.0701 wt. % which was at a 1.6 wt. % ^{235}U enrichment. Reactor tails feeding history and ^{236}U measurements for 24 years indicate that the predominance of PGDP product could have been enriched, undiluted, to reactor grade UF_6 (3 wt. % ^{235}U) without attaining 0.05 wt. % ^{236}U. A notable exception is PGDP product produced in the last quarter (April through June) of FY-73, which contributed about 0.1 wt. % ^{236}U to reactor grade UF_6. A possible exception is product from the period June 1 through September 11, 1975; however, it is estimated that ^{236}U concentration contributed by it was well below the 0.1 wt. % level.

It is estimated that 534 kg, 4.6 kg, and 0.1 gram, respectively, of Tc, Np, and Pu have been fed into the PGDP cascade. There is no indication that any of these substances ever entered the PGDP tails stream. Substantial quantities of Tc entered the product stream as did trace quantities of Np. The predominance of Pu apparently didn't migrate extensively from feed points.

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GAT - Goodyear Atomic
SRT - Savannah River
SHAFT-

APPENDIX 1

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

ERT - Enriched
FR

FY-53 THROUGH FY-76

Source	Feeds Quantity Tons U	Feeds Assay Wt. % ^{235}U	Type	Withdrawals Quantity Tons U	Withdrawals Assay Wt. % ^{235}U
		FY-53			
PDF	6029	0.40 to 0.65	Tails	7609	0.39 to 0.82
ORGDP SHAFT	1462	0.43 to 0.72	Prod.	1440	0.87 to 1.04
HRT	1565	0.66	Misc.	3	
Misc.	96	0.71			
	9152			9052	
		FY-54			
PDF	16588	0.38 to 0.68	Tails	20679	0.29 to 0.51
ORGDP SHAFT	3869	0.43 to 1.02	Product	3941	0.98 to 1.53
HRT	4104	0.67	Misc.	9	
Misc.	218	0.69 to 1.44			
	24779			24629	
		FY-55			
PDF	40070	0.25 to 0.80	Tails	44101	0.20 to 0.32
ORGDP SHAFT	3964	0.37 to 0.80	Product	4104	0.88 to 1.31
GAT SHAFT	1619	0.37 to 0.80	Special	1459	0.695 to 0.715
HRT	4066	0.66	Misc.	19	
Misc.	116	0.40 to 0.73			
	49835			49683	
		FY-56			
PDF	50039	0.17 to 0.33	Tails	56942	0.16 to 0.20
ORGDP SHAFT	4819	0.20 to 0.67	Product	8096	0.70 to 1.00
GAT SHAFT	2954	0.18 to 0.24	Special	427	0.71
HRT	7383	0.67	Misc.	23	
UK SHAFT	95	0.39 to 0.42			
FPN	140	0.708			
Misc.	54	0.29 to 1.05			
	65484			65488	

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APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

Source	Feeds Quantity Tons U	Feeds Assay Wt. % ^{235}U	Withdrawals Type	Withdrawals Quantity Tons U	Withdrawals Assay Wt. % ^{235}U
		FY-57			
PDF	3632	0.18 to 0.33	Tails	9585	0.17
ORGDP SHAFT	4984	0.29 to 0.40	Tails	7889	0.23
GAT SHAFT	4871	0.29 to 0.40	Product	9968	0.85 to 1.11
HRT	9674	0.66	Special	204	0.95
UK SHAFT	598	0.39 to 0.43	Misc.	11	
FPN	3051	0.709 to 0.712			
Misc.	859	0.29 to 1.02			
	27669			27657	
		FY-58			
PDF	3514	0.27 to 0.33	Tails	22769	0.28 to 0.42
ORGDP SHAFT	5328	0.38 to 0.42	Product	7425	1.10 to 1.32
GAT SHAFT	5238	0.38 to 0.41	Special	534	0.95
HRT	7653	0.65	Misc.	8	
UK SHAFT	409	0.38 to 0.44			
FPN	8502	0.693 to 0.712			
Misc.	38	0.37 to 1.34			
	30682			30736	
		FY-59			
PDF	9205	0.14 to 0.35	Tails	33034	0.30 to 0.34
ORGDP SHAFT	5666	0.39 to 0.42	Product	7014	1.38 to 1.42
GAT SHAFT	5490	0.38 to 0.41	Special	1143	0.95
HRT	6193	0.65	Misc.	9	
FPN	14364	0.696 to 0738			
TEN	230	0.71			
Misc.	38	0.84 to 1.40			
	41186			41200	

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APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

	Feeds		Withdrawals		
Source	Quantity Tons U	Assay Wt. % ^{235}U	Type	Quantity Tons U	Assay Wt. % ^{235}U
		FY-60			
PDF	4761	0.35	Tails	29745	0.34
ORGDP SHAFT	6271	0.40 to 0.50	Product	6452	1.40 to 1.60
GAT SHAFT	5926	0.40 to 0.41	Special	1223	0.95
HRT	6292	0.64	Misc.	20	
SRT	25	0.60			
FPN	10211	0.696 to 0.707			
TEN	3928	0.711			
Misc.	41	0.60 to 1.52			
	37455			37440	
		FY-61			
PDF	8622	0.35 to 0.43	Tails	34507	0.34
ORGDP SHAFT	6409	0.39 to 0.43	Product	6428	1.45 to 1.63
GAT SHAFT	6245	0.39 to 0.42	Special	904	0.95
HRT	6205	0.64	Special	6	1.2
SRT	12	0.60	Misc.	8	
FPN	9466	0.697 to 0.710			
TEN	4892	0.711			
Misc.	8	0.59 to 1.60			
	41859			41853	
		FY-62			
PDF	16808	0.36	Tails	40449	0.34
ORGDP SHAFT	6065	0.39 to 0.51	Product	6257	1.38 to 1.62
GAT SHAFT	6148	0.39 to 0.42	Special	282	0.95
HRT	6713	0.63	Special	399	1.2
SRT	265	0.60	Misc.	7	
FPN	6692	0.711			
TEN	4676	0.711			
Misc.	3	0.77 to 1.62			
	47370			37394	

APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

	Feeds		Withdrawals		
Source	Quantity Tons U	Assay Wt. % ^{235}U	Type	Quantity Tons U	Assay Wt. % ^{235}U
		FY-63			
PDF	55578	0.34	Tails	71738	0.30 to 0.31
ORGDP SHAFT	5509	0.38 to 0.42	Product	6361	1.19 to 1.41
GAT SHAFT	4508	0.36 to 0.40	Special	1172	0.95
HRT	7293	0.64	Special	7	1.20
SRT	452	0.60	Special	419	1.24
FPN	2311	0.709	Misc.	6	
TEN	4058	0.711			
Misc.	1	1.24 to 1.41			
	79710			79703	
		FY-64			
PDF	55779	0.30 to 0.32	Tails	67679	0.29 to 0.30
ORGDP SHAFT	4102	0.37 to 0.40	Product	4834	1.25
GAT SHAFT	3556	0.30 to 0.33	Special	1991	0.95
HRT	6025	0.63	Special	559	1.25
SRT	978	0.60	Misc.	1	
FPN	711	0.70 to 0.71			
TEN	3848	0.711			
Misc.	1	0.84			
	75000			75064	
		FY-65			
PDF	24610	0.32	Tails	20690	0.20
Misc.	1	0.86	Product	3851	0.95 to 1.22
			Special	69	0.95
			Misc.	3	0.30 to 0.50
	24611			24613	
		FY-66			
PDF	25334	0.20 to 0.31	Tails	21572	0.20
			Product	3704	0.95
			Special	106	0.95
	25334			25382	

APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

	Feeds		Withdrawals		
Source	Quantity Tons U	Assay Wt. % ^{235}U	Type	Quantity Tons U	Assay Wt. % ^{235}U
		FY-67			
PDF	21244	0.30	Tails	18312	0.20
Misc.	7	0.96	Product	2934	0.96
	21251			21246	
		FY-68			
PDF	26560	0.27 to 0.30	Tails	23796	0.20
Misc.	7	0.96	Product	2762	0.96
	26567			26558	
		FY-69			
PDF	7106	0.20 to 0.33	Tails	12234	0.20
ORGDP SHAFT	2463	0.26 to 0.52	Product	6022	0.98
GAT SHAFT	2654	0.24 to 0.51	Misc.	2	
HRT	4781	0.64			
FPN	538	0.708 to 0.712			
TEN	700	0.711			
Misc.	13	0.21			
	18255			18258	
		FY-70			
PDF	50	0.20	Tails	7678	0.20
ORGDP SHAFT	4463	0.39 to 0.52	Product	5438	0.90 to 0.97
GAT SHAFT	3618	0.38 to 0.50			
HRT	4518	0.64			
SRT	11	0.59			
TEN	412	0.711			
	13072			13116	

APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

Source	Feeds: Quantity Tons U	Feeds: Assay Wt. % ^{235}U	Withdrawals: Type	Withdrawals: Quantity Tons U	Withdrawals: Assay Wt. % ^{235}U
		FY-71			
PDF	56	0.20	Tails	7789	0.20
ORGDP SHAFT	4958	0.19 to 0.53	Product	6144	0.89 to 1.05
GAT SHAFT	4526	0.46 to 0.52	Misc.	2	
TEN	4354	0.711			
Misc.	1	0.705			
	13895			13935	
		FY-72			
ORGDP SHAFT	6062	0.46 to 0.60	Tails	6	0.20
GAT SHAFT	3010	0.34 to 0.51	Tails	13316	0.30
HRT	5283	0.64 to 0.65	Product	5917	0.90 to 1.40
TEN	4918	0.711	Misc.	4	
	19273			19243	
		FY-73			
ORGDP SHAFT	844	0.59 to 0.62	Tails	11256	0.30
HRT	7744	0.63	Product	4042	1.15 to 1.70
SRT	1379	0.59	Misc.	1	
ERT	781	0.729			
FPN	43	0.711			
TEN	4494	0.709 to 0.711			
Misc.	21	0.69			
	15306			15299	
		FY-74			
ORGDP SHAFT	1373	0.37 to 0.55	Tails	10398	0.30
SRT	500	0.58	Product	3782	1.33 to 1.90
FPN	116	0.70	Misc.	1	
TEN	12204	0.709 to 0.711			
	14193			14181	

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APPENDIX 1
(Continued)

SUMMARY OF FEEDS AND WITHDRAWALS - PADUCAH CASCADE

FY-53 THROUGH FY-76

Source	Feeds Quantity Tons U	Feeds Assay Wt. % ^{235}U	Withdrawals Type	Withdrawals Quantity Tons U	Withdrawals Assay Wt. % ^{235}U
		FY-75			
ORGDP SHAFT	703	0.529	Tails	10944	0.30
ERT	415	0.751	Product	4030	1.40 to 1.92
FPN	6477	0.709 to 0.712	Misc.	3	
TEN	7428	0.711			
	15023			14977	
		FY-76			
PDF	8873	0.30	Tails	17177	0.25
ORGDP SHAFT	757	0.32 to 0.53	Product	3772	1.5 to 1.9
ERT	958	0.77 to 0.82	Misc.	4	
FPN	2371	0.709 to 0.710			
TEN	8078	0.711			
Product	4	1.4			
	21041			20953	

PDF = Partially depleted feed which involves refeeding Paducah tails.

SHAFT = Slightly high assay feedable tails which may have originated at ORGDP, GAT, or the United Kingdom as designated.

HRT = Hanford reactor tails.

SRT = Savannah River reactor tails.

ERT = Enriched reactor tails (from Hanford but ^{235}U assay >0.711 wt. %)

FPN = Feed plant normal (Natural UF_6 produced in our Feed Plant).

TEN - Toll enrichment normal.

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APPENDIX 2

REACTOR TAILS AS PERCENT OF
TOTAL PADUCAH CASCADE FEED

FY	Type	% Reactor Tails
53	HRT	17
54	HRT	17
55	HRT	8
56	HRT	11
57	HRT	35
58	HRT	25
59	HRT	15
60	HRT and SRT	17
61	HRT and SRT	15
62	HRT and SRT	15
63	HRT and SRT	10
64	HRT and SRT	9
65		0
66		0
67		0
68		0
69	HRT	26
70	HRT and SRT	35
71		0
72	HRT	27
73	HRT, SRT, & ERT	65
74	SRT	4
75	ERT	3
76	ERT	5

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APPENDIX 3

DOMESTIC REACTOR TAILS FED TO ENRICHMENT CASCADES THROUGH FY-74

FY	HRT Quantity Tons U	HRT Assay Wt. % ^{235}U	SRT Quantity Tons U	SRT Assay Wt. % ^{235}U	ERT Quantity Tons U
			PGDP		
53	1565	0.66			
54	4104	0.67			
55	4066	0.66			
56	7383	0.67			
57	9674	0.66			
58	7653	0.65			
59	6193	0.65			
60	6292	0.64	25	0.60	
61	6205	0.64	12	0.60	
62	6713	0.63	265	0.60	
63	7293	0.64	452	0.60	
64	6025	0.63	978	0.60	
69	4781	0.64			
70	4518	0.64	11	0.59	
72	5283	0.64			
73	7744	0.63	1379	0.59	781*
74			500	0.58	
Subtotal	95492	0.64	3622	0.59	781
			ORGDP		
58	1596	0.69			
59	487	0.65			
60	1256	0.63	88	0.60	
61	242	0.62	932	0.59	
62			318	0.60	
70	392	0.64			
74	316	0.64			
Subtotal	4289	0.64	1338	0.60	
			GAT		
Subtotal	574	0.64	0	—	—
Total	100355	0.64	4960	0.59	781

*Average ^{235}U assay = 0.73 wt. %.

DOE/OR-859

The Report of the Joint Task Force on Uranium Recycle Materials Processing

Task Force Members

DICK EGLI, Oak Ridge Operations Office, Chairman
DAVE CONNER, Savannah River Operations Office
RALPH ERICKSON, Office of Materials Production
CARLOS GARCIA, Albuquerque Operations Office
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OAK RIDGE OPERATIONS
U.S. DEPARTMENT OF ENERGY
REPORT NO. DOE/OR-859

THE REPORT OF THE JOINT TASK FORCE ON URANIUM RECYCLE MATERIALS PROCESSING

DOE/OR--859

DE88 012848

<u>Date</u>

September 1985

<u>Task Force Members</u>

Dick Egli, Oak Ridge Operations Office, Chairman
Dave Conner, Savannah River Operations Office
Ralph Erickson, Office of Materials Production
Carlos Garcia, Albuquerque Operations Office
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Rick Collier, Oak Ridge Operations Office, Executive Secretary

Abstract

A Joint Task Force on Uranium Recycle Materials Processing was assembled by the Department of Energy (DOE) to study past and current practices relating to the processing of uranium recycle materials at DOE's Feed Materials Production Center (FMPC), Oak Ridge Y-12 Plant, and the DOE operations at the RMI Company. The DOE facilities providing the uranium recycle material and selected end users of the recycle material were reviewed in a cursory manner.

The Task Force determined that uranium recycle material produced by the DOE reprocessing sites will always contain trace levels of transuranics (e.g., plutonium and neptunium) and fission product (e.g., strontium and cesium) elements. However, the DOE processing sites such as the FMPC, Y-12 and RMI Company can safely handle and further process the recycle material if a clear understanding of the contaminant levels exists and available technology is utilized to assure environmental, safety, and health protection of both the plant worker and the general public. It was recognized that past practices regarding the processing of recycle materials could have been better (e.g., better understanding of contaminant levels in the feed material), however, from the data reviewed, the Task Force did not disclose any instance in which the environment, safety or health of plant workers or the public were jeopardized or compromised. It should be made clear that a lack of data hampered the Task Force throughout its efforts.

Irrespective of past practices, the Task Force judged that more attention should be given to the processing of uranium recycle material. The primary recommendation from this study is to develop formal specifications on maximum permissible levels of contaminants in feed materials. This work is already underway with an expected completion date of September 1985. Deficiencies in personnel/contamination control and environmental monitoring were confirmed by the Task Force; however, efforts were already underway to effect previously requested improvements. Additionally, recommendations were offered by the Task Force for a closer examination of selected recycle material workers at the Paducah and Portsmouth Gaseous Diffusion Plants due to unique processing operations at those DOE sites. This work is also underway.

MARTIN MARIETTA

K/ETO-30

NEPTUNIUM EXPERIENCE AT PGDP

R. L. Ritter
L. D. Trowbridge

Enrichment Technical Operations

S. E. Meiners

Health Physics

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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NEPTUNIUM EXPERIENCE AT PGDP

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Process and Long-Range Technical Support
Enrichment Technical Operations

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Health Physics

September 1990

Prepared by the
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for the
U. S. Department of Energy
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TABLE OF ACRONYMS

AEC	Atomic Energy Commission
Ci	curie, a unit of radioactivity defined as 3.7×10^{10} disintegrations per second
CIP	Cascade Improvement Program
CUP	Cascade Uprating Program
DAC	Derived Air Concentration
DOE	Department of Energy
dpm	disintegrations per minute
HPD	Health Physics Department
LLW	Low Level Waste
mCi	milli-curie, 3.7×10^{7} disintegrations per second
MTU	Metric Tons of Uranium
NLO	National Lead of Ohio
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
PGDP	Paducah Gaseous Diffusion Plant
RCCP	Radioactive Contamination Control Policy
RT	Reactor Tails
RU	Recycled Uranium
TRU	Trans-Uranic material

INTRODUCTION

DOE 5400.5

A recent incident at the Paducah Gaseous Diffusion Plant (PGDP) (a spill from a drum of waste in the 746-Q building[R90-1]) has led to increased concern about transuranics (TRU) in PGDP, notably neptunium-237. Contributing to this concern is a recent rule change significantly lowering allowable ^{237}Np activity levels in the environment.[R90-3] This report is intended to provide a background summary of neptunium experience at PGDP, including historical information, operational aspects, and health physics aspects. Environmental issues are under review by a separate team,[R90-6] and will not be dealt with in this report.

^{237}Np has been of concern in the gaseous diffusion complex since the late 1950s. It is part of a larger issue relating to radionuclides in reprocessed uranium, also known as "reactor returns," "reactor tails" (RT), or "recycled uranium" (RU), which has received a good deal of attention through the years. Other radionuclides that have been of concern include other transuranics (^{239}Pu), fission products (^{99}Tc; ^{106}Ru; ^{125}Sb), other isotopes of uranium (^{232}U, ^{233}U, and ^{236}U), and daughter products of all the above radionuclides. Of the nuclides in the above group, ^{99}Tc has historically been of greatest concern in the gaseous diffusion complex. This is because the quantities fed to the cascades were large relative to other radioactive impurities and because it forms slightly volatile chemical species at cascade conditions that permit it to migrate through much of the diffusion cascade.

UF_6 feed from RU was generated on-site from UO_3 in a feed plant, and was fed during intermittent campaigns at Paducah from the early 1950s until the mid 1970s. This feed contained trace quantities of the above impurities; the presence of ^{237}Np was first recognized in this material a few years after feeding had commenced.[R56-1] Np was first detected in the isotopic cascade in 1959.[R59-2] It previously had been thought that the trace transuranics would be separated from the UF_6 in the feed manufacture process. ^{237}Np and ^{99}Tc were, for a time, recovered from feed plant waste streams for use in other Atomic Energy Commission (AEC) programs.

Reactor return uranium has not been fed since the late 1970s, although 335 MTU of unfed UF_6 from the Paducah feed plant remain on-site, and a considerable number of cylinders of commercial RU (containing about 900 MTU) have been received from Comurhex. There is continuing encouragement on the part of Department of Energy (DOE) to consider feeding reactor returns.[R89-1] The activity levels of transuranics in currently received RU are very much below standards so these materials do not appear to constitute a significant new source of Np or Pu; receipt should be re-evaluated in light of recent changes to radiological standards. Considering the many complex uncertainties, PGDP has recommended against the processing of RU unless the benefits far outweigh the costs.[R89-1]

The majority of the Np that entered the site has entered the waste streams, most of which appears to be either buried in low level waste (LLW) sites or stored in drums.

A number of comprehensive reviews of at least major aspects of the subject of reactor return transuranics have been done in the past. Recent studies include that of reference R84-1, which discusses the historical impact of reactor return feed on PGDP. Reference R86-1 is aimed primarily at discussing historical discharges, but also gives an overview of the operations affected by transuranics and ^{99}Tc presence in the plant. Several other studies of PGDP neptunium material balance were conducted (see references R66-2; R71-1; R74-1; R76-11). These studies, and their uncertainties, will be discussed in the material balance section of this report.

Once it was recognized that neptunium was entering the Paducah cascade, studies were proposed[R59-1] and initiated[R60-1,R60-2] to study its biological effects. This apparently was the first significant biological study of the health effects of neptunium, which previously had been treated as being "similar to plutonium" based on chemical similarity and brief studies in the 1940s. Standards are the province of health physics and will be discussed in a later section. In general, specifications on TRU were established to assure that if uranium guidelines were satisfied, that TRU guidelines would automatically also be satisfied. The UF_6 feed specification on transuranics is expressed in terms of "transuranic α dis/min per gm U." Prior to 1966, this limit was 150 α dpm/gmU, which translates to 0.1 ppm Np or less (assuming no other transuranics are present). In 1966, the standard was relaxed to 1500 α dpm/gm U (i.e. 1 ppm Np or less).[R81-2]

In the various sections of this report, the quantity of Np is sometimes expressed in grams or kilograms, sometimes as disintegrations per minute (dpm), and sometimes in curies (Ci). To simplify conversion between these units, their relationship is shown in Table 1. For comparison, the properties of selected other isotopes present in the cascade are also shown. All of the isotopes shown in Table 1 are alpha emitters with the exception of ^{99}Tc, which is a beta emitter.

Table 1. Radiological properties of isotopes of interest

		Specific Activity	
Isotope	Half-life	dpm/g	μ ~~m~~Ci/g
^{237}Np	2.14×10^6	1.57×10^9	705
^{239}Pu	2.41×10^4	1.38×10^{11}	62,100
^{235}U	7.04×10^8	4.80×10^6	2.16
^{238}U	4.51×10^9	7.40×10^5	0.333
^{99}Tc	2.13×10^5	3.77×10^{10}	17,000

OPERATIONS INVOLVING TRANSURANICS

UF_6 Feed Plant

Reactor returns came primarily from the AEC facilities at Hanford and Savannah River. This material came in the form of UO_3, and was converted to UF_6 in a multi-step process in the feed plant in the C-410 building. The first steps of the process converted the UO_3 into UF_4. As this was a solid to solid process, transuranics in the original feed material would remain in the UF_4. The final step in this process was a high temperature fluorination with F_2 to produce UF_6, which was cold-trapped and transferred to feed cylinders for later introduction into the plant. Some of the UF_4 did not completely react. Solids left from this high temperature fluorination were termed "ash," and consisted of intermediate fluorides of uranium (e.g., UF_4, U_2F_9, UF_5) as well as non-volatile fluorides of impurities in the feed. Neptunium and plutonium form volatile fluorides in high concentrations of fluorine, but less readily than does uranium. A fraction of the Np originally present remained with the ash, and the remainder transferred to the UF_6 feed as NpF_6. The steel UF_6 feed cylinders would have a tendency to react with NpF_6. After feeding, the cylinder heels (i.e. residual uranium) was washed and recycled through the C-400 uranium facility. Most of the Np originally present remained in this stream. Given the poor effectiveness of uranium recovery methods for recovery of neptunium, some Np no doubt remained in the cylinders.

Only a fraction of the neptunium originally received in the UO_3, estimated to be between 10% and 40%, actually entered the cascade equipment as NpF_6. The feed plant also produced UF_6 from natural feed (i.e. "mined" as opposed to recycled uranium). The feed plant began operations in 1953 and closed in 1977, and did not operate during the 1965-1967 period.[R86-1,R88-1] Wastes from the feed plant process contained most of the Np and Pu that entered the plant. Until 1970, these waste streams were processed by aqueous chemistry methods to recover uranium. Wastes generated after 1970 at the feed plant have not been reprocessed, but have been stored.[R86-1]

Neptunium Recovery Process

The neptunium found in the RU was originally seen as a useful resource. Shortly after its discovery, a recovery facility was proposed,[R57-2] the process researched at Oak Ridge National Laboratories (ORNL),[R58-2] and a facility built at PGDP in the C-400 building.[R62-1, R62-2] The process used aqueous chemistry and ion exchange methods to recover Np from two waste streams from the feed facility (ash and cylinder washings). Production continued until about 1962; a total of about 3 kg of Np was recovered at PGDP in this campaign, and a further 1 kg was recovered at ORNL from raw material provided by PGDP. The Np recovered was shipped to Hanford; only a small quantity (9 gm) of Np remains on site at PGDP from this program.

Isotopic Cascade

A fairly small fraction of the Np received at PGDP entered the isotopic cascade. This has been estimated variously as 1 to 5 kg of Np, with analyses of materials removed from the cascade favoring lower values. It is generally assumed that, since the barrier contains well in excess of 99% of the surface area to be found within the plant, the majority of any adsorbed material will be found on the barrier. In comparative studies quantifying Np and Pu on material removed during the Cascade Improvement Program/Cascade Uprating Program (CIP/CUP), this assumption appears to be born out: typically 90% or more of the Np is found associated with the barrier.[R77-5,R77-11] One area that doesn't seem to have been considered is the feed piping. The feed system is the first cascade surfaces that UF_6 entering the plant would contact, and constitutes a potential location for deposits of reduced neptunium or plutonium fluorides.

Neptunium, as discussed in the chemistry section of this report, is relatively immobile. A survey of equipment removed from the cascade during the more recent upgrade program showed Np concentrated in the vicinity of the historical feed points for RU, several years after it had been fed to those locations in quantities sufficient to account for the material found.[R77-11] On the other hand, a small proportion of product cylinders in the late 1970s showed ppb levels of Np. Thus, there may be a very slight tendency to mobility on a time scale of decades. Most likely, the Np fed to the cascade is still in the equipment to which it was fed. Some of the converters, however, were physically relocated within the cascade, and a large number had their barrier and other cascade components removed during upgrade programs.

Ni smelting

As a result of maintenance and upgrade operations, a considerable fraction of the Np that entered the cascade has been removed. Two barrier and equipment upgrade programs took place since the 1950s. Both removed a significant fraction of the diffusion barrier (which contains the vast majority of the surface area of the cascade). The first improvement program ran from 1954 to 1961. The diffusion barrier was changed out, presumably taking a significant fraction of the Np present at that time. The barrier from the first upgrade program was shipped to Oak Ridge Gaseous Diffusion Plant (ORGDP), and, with similar material from ORGDP, was shipped to an International Nickel Company facility in the early 1960s.[R90-5]

The second program (CIP/CUP), started in 1973 and ended about 1981. Most of the barrier in the affected cascade areas was removed, taking associated deposits with it. Some equipment, however, was relocated to other areas in the plant. CIP/CUP was used as an opportunity to measure concentrations of Np in cascade equipment. Np and Pu distributions concentrated around the feed area, primarily (>70%) on barrier surfaces.[R77-4,R77-5,R77-11,R84-1]

During the CIP/CUP campaign, the barrier removed from PGDP, as well as barrier from Oak Ridge and Portsmouth, was smelted into nickel ingots[R77-1] at PGDP. These ingots were intended for sale, but failure to establish a de minimus standard for radionuclides in nickel has prevented this. The nickel ingots, as well as the slag from the process, remain on-site at

PGDP. The Np originally on the barrier separated strongly into the slag in this process.[R75-6] Furnace liners also retained elevated concentrations (on the order of 700ppb), but not large total quantities, of Np.[R82-1]

Decontamination of cascade equipment

Aqueous decontamination of cascade equipment and cylinders is used to remove uranium deposits by first dissolving and then later precipitating and filtering the solution. These decontamination processes have been designed to produce filtrates very low in radionuclides. Historically these have been discharged to the environment when below allowable standards. Sludges and filter cake historically were processed for uranium recovery at PGDP for small scale quantities, or sent to the DOE facility at Fernald for larger scale recovery. At present there are no known uranium recovery facilities operating. Filter cake currently being produced at PGDP is stored on-site.

Until about 1980, the primary decontamination process used an ammonium carbonate wash solution. This was used during the CIP/CUP program on material removed from cascade service. Laboratory tests[R77-2] showed that this method had fairly poor decontamination factors for Np (i.e. <2) compared to the factor for removal of uranium (on the order of 9). The decontamination factor is defined as ratio of original contaminant to amount remaining after decontamination. An evaluation[R76-2] of decontamination factors for barrier during CIP/CUP showed similar numbers for barrier: 9.5 for U and 1.1 for Np. Aluminum components showed similar low factors for Np, but ranged from 1.2 to 4 for decontamination of uranium.

In the 1980s, the decontamination process was changed to use sodium carbonate. Barrier and aluminum cascade components were decontaminated prior to smelting during and shortly after CIP/CUP. In these processes, decontamination factors were again on the order of 2 for Np versus factors of about 7 for U.[R83-1]

The cascade may be a continuing source for low levels of Np, primarily through decontamination operations during equipment maintenance. For example, analyses of decontamination solutions from the C-400 precipitation process shows the levels of Np during 1980 declining by 50% from its average for the period 1974 to 1980.[R81-1]

Waste Streams

Operations over the course of four decades resulted in the creation of numerous waste streams potentially containing neptunium. While it is beyond the scope of this document to attempt to identify and detail the history of all specific streams, certain categories identified as containing transuranics should be mentioned; these are summarized in Table 2.

As will be seen in the discussion of Np material balance elsewhere in this report, most of the Np that entered PGDP is to be found in these various waste streams. Surveys and inventories quantifying transuranics in these waste streams have been done in the past. PGDP transuranic material balance studies contain inventories of the locations of Np-containing materials known on-site at the time the studies were made. One such study was done in 1971,[R71-1] and an update was done in 1974.[R74-1] The 1974 study examined, among other things, soil contamination levels in drainage ditches that had been used during early years of the plant for discharge of liquid streams potentially containing radionuclides (ditches draining C-404, C-400, and C-410 to Little Bayou). From these analyses it was estimated that less than 4 grams of Np were present in the soil of these drainage ditches.

In the UF_4 process streams, emissions are controlled by chemical trapping (passing gas streams through columns containing pellets which chemically absorb the impurities). Chemical trapping of recycled feed was generally done with MgF_2. This was intended primarily to remove technetium, but was also considered to be effective for Np and Pu removal. Studies have been done with CoF_2[R75-4,R82-2] for trapping of trace transuranics from UF_6 feed (in contemplation of further reactor return feeding).

Table 2. Np-containing waste and other materials categories

Feed Plant
Unused UO_3 from feed plant
"Ash" (unreacted UF_4 and intermediate uranium fluorides)
Decontamination and U recovery solutions (e.g. cylinder heels)
Feed plant hardware and material holdup therein
*UF_6 produced from feed plant but not yet fed
*Cylinders used as feed cylinders
Np recovery plant
Hardware
Waste streams (i.e. ion exchange resin; solutions; filtrates)
Decontamination Operations
Decontamination solutions
Decontamination sludges/filter cakes
Removed cascade equipment
Hardware
Barrier smelting plant
Hardware (furnace liners)
Slag
*Ni ingots

*Not necessarily to be considered as waste or surplus

Campaigns to upgrade waste handling practices have occurred several times over the years.[R72-1,R84-1,R85-1] In 1985, at the request of DOE, a study was undertaken to identify waste categories generated during the RU campaigns, and to recommend the best disposal methods. Quantities of several of the waste streams identified above are listed in Ref R85-2, and some are not inconsequential. For example, about 1.5 tons of UO_3 were on hand as were 7.5 tons of Feed plant ash. A program had been in progress to prescribe and carry out waste treatment of TRU containing waste drums.[R85-1,R85-2] Waste treatments have been recommended for many of the stored materials at PGDP, but apparently not decided upon, so that the majority of the wastes listed in this 1985 document remain on-site in storage. Restrictive transportation requirements for TRU-containing materials have prevented transport of samples of the waste to facilities where research could be done on appropriate methods of disposal.

The recently developed "Transuranic Assessment Plan...," (attached as an Appendix), proposes to do a thorough update[R90-2] of these waste inventories as part of an effort to locate all significant TRU in PGDP. Much of the needed information appears to be available in the records of the Uranium Accountability organization at PGDP.

Reactor Return Studies

Investigations continued into the 1980s on technical problems related to continued reactor return feeding (see reference R83-2 and references therein). At that time, it was thought that reactor return feed would occur primarily at ORGDP, as (a) the material would come in the form of UF_6 (unlike the earlier Hanford and Savannah River material, which was converted on-site from UO_3), and (b) a feed trapping facility using CoF_2 had been constructed at ORGDP. Laboratory scale tests indicated a decontamination factor of 400 for NpF_6 could be achieved using CoF_2.

Based on PGDP health physics and Industrial Hygiene analysis, a total cascade content of 9 kg of ^{237}Np was, at that time, considered to be allowable at PGDP based on the then-prevailing protection standards. In the 1983 analysis, ^{237}Np in reactor return feed was considered but not regarded as a significant potential problem because (1) without trapping, many years would be required to load the cascade with its limiting quantity of Np if reactor return feed had Np at the transuranic α specification on UF_6 feed; (2) chemical trapping would be used in any case; (3) analysis of actual reactor return feed from Comurhex had a factor of 200 less transuranic α than the specification. From an impurity standpoint ^{106}Ru was considered to be more of a potential problem because no demonstrated trapping method existed at the concentrations that would be important. In any case, significant reactor return feed has not been used, largely due to concern over the levels of ^{236}U, a synthetic isotope of uranium, which of course is not amenable to chemical separation techniques from the fissionable ^{235}U. The significantly lowered environmental and health limits on neptunium relative to uranium, to levels difficult to easily and routinely detect in operation, will probably add to that concern.

The question of feeding reactor returns is by no means a dead issue. Recently, at the request of DOE/ORO, a systems analysis was conducted exploring the costs and benefits of feeding reactor returns.[R89-1] In light of uncertainty in future regulatory requirements, PGDP recommended against feeding reactor returns unless the benefits far outweigh the cost.

QUANTIFICATION OF NEPTUNIUM FLOWS AND INVENTORIES

Neptunium Flows Into the Paducah Plant Site

Neptunium-containing reactor tails material, in the form of UO_3, was received at the Paducah plant site from both Hanford and Savannah River from FY 1953 through FY 1975. However, the presence of Np in this material was apparently not recognized until 1956, with the first mention of Np (that we have been able to find) occurring in an ORNL report[R56-1] dated 3/19/56. Prior to that time, the Np content of the reactor tails is very uncertain which has led to problems (discussed below) in estimating the quantity of Np received during these early years. No reactor tails material has been fed to the Paducah cascade since September 11, 1975.

A detailed summary of all feed streams to the Paducah cascade during this time period was made in 1984.[R84-1] These data are presented in Table 3 and Fig. 1, where both the cascade feed prepared from reactor tails material and the total cascade feed are shown for each year in terms of tons of U. While the percentage of feed material made from reactor tails varied widely from year to year (as high as 65% in FY 1973), these percentage variations were largely the result of variations in the other feed materials; the feed rate of reactor tails material was actually fairly constant over most of the period, i.e., between 6,000 and 10,000 tons U per year, with smaller quantities being fed in the early years of the program and only very small amounts being fed in FY 1974 through FY 1976.

The quantity of Np received at Paducah has been estimated by several authors.[R66-1,R66-2,R71-1,R72-1,R74-1,R84-1] The estimate of 18.4 kg Np made in the latest of these documents[R84-1] is more than 4.8 kg larger than the last previous estimate of 13.6 kg.[R74-1] These figures are reconciled by the fact that the larger number includes an estimate of the quantity of material received during FY 1953 through FY 1956 for which no analytical data are available, while the smaller number neglects Np receipts during this time period. We have estimated that this accounts for nearly all of the difference in the two figures. While the true figure may lie somewhere between the two, it has been concluded that the value of 18.4 kg is as accurate a value as can be made at this time;[R90-7] accordingly, in the plant material balance discussed later we have used the figure of 18.4 kg Np, which leads to the most conservative estimates (larger amounts) of the quantity of Np unaccounted for. The estimated quantities of Np (in kilograms) received yearly at Paducah in the reactor tails material is shown in Table 3 and also in Fig. 2 (on both a yearly and cumulative basis) for FY 1953 through FY 1976.

In addition to the Np received in reactor tails material, some Np was returned from the Oak Ridge and Portsmouth sites during the CIP/CUP, associated with scrap metal (principally barrier) removed from the respective cascades and sent to Paducah for smelting and metal recovery operations. However, the quantity of Np associated with this scrap was relatively small, probably amounting to, at most, a few tenths of a kg of Np. Because of the large uncertainty associated with the quantity of Np received in the reactor tails material, as discussed above, this small additional Np input to the Paducah site has been neglected in the material balance presented below.

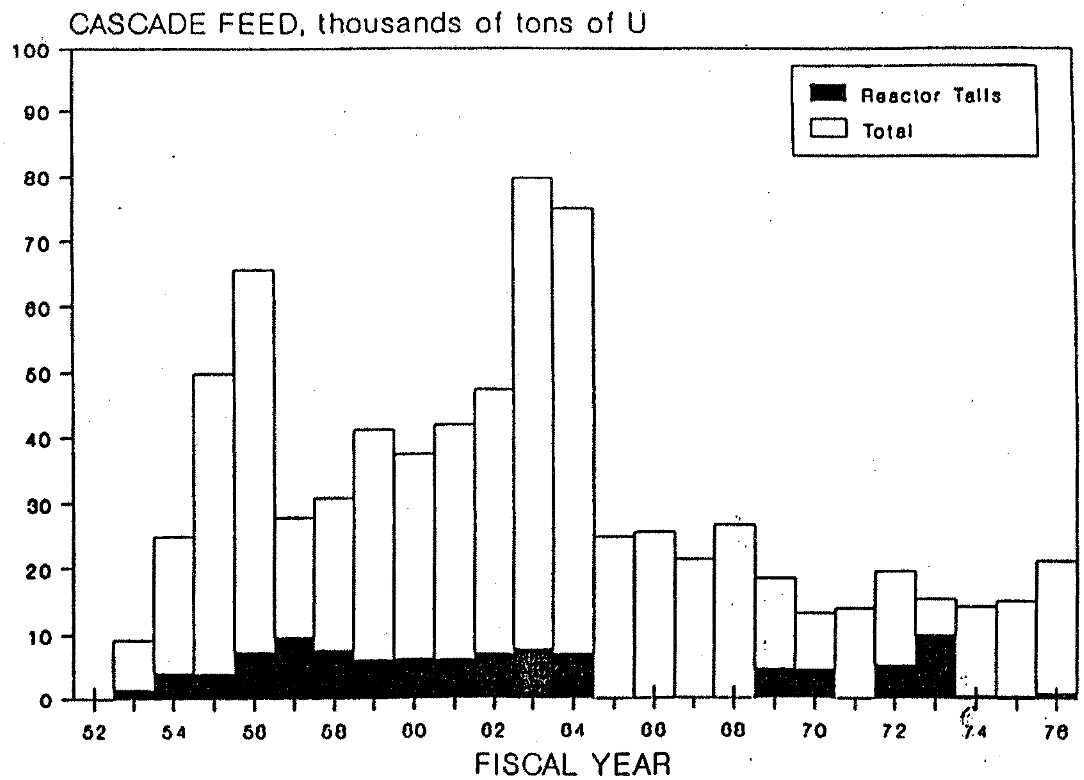

Fig. 1. Paducah cascade feed material.

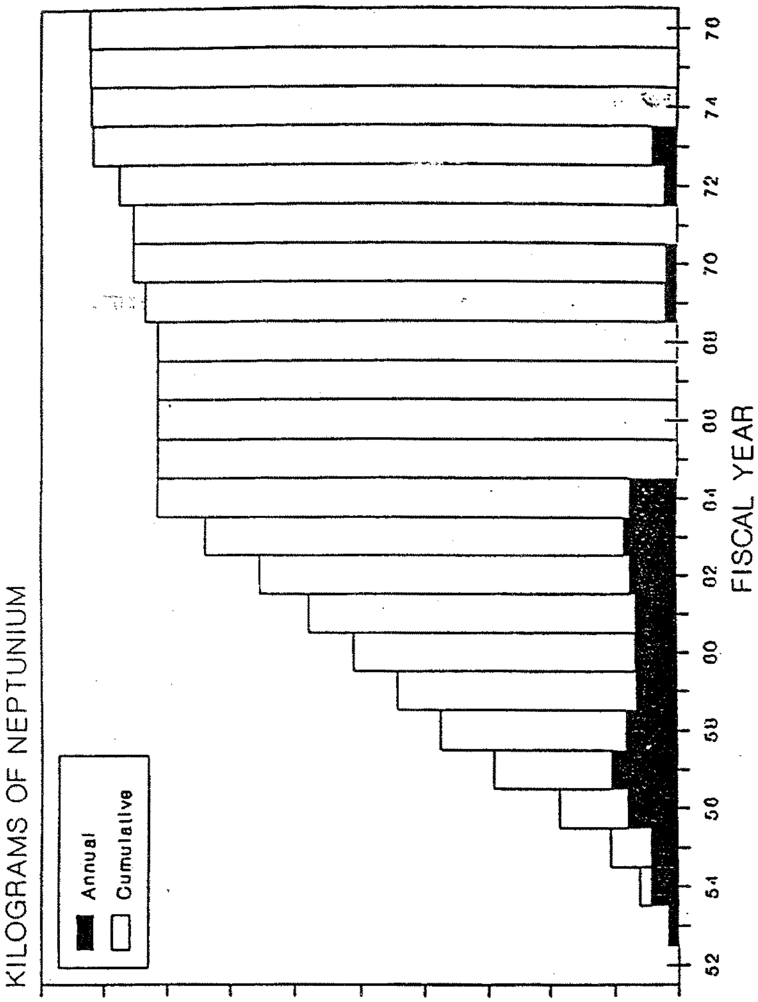

Fig. 2. Estimated neptunium received at Paducah.

Table 3. Total feed, reactor tails feed, and Np received at PGDP

FY	Total Feed tons U	Reactor Tails Feed tons U	Reactor Tails Feed % of total	Np Received kg
53	9152	1565	17.1	0.34
54	24779	4104	16.6	0.89
55	49835	4066	8.2	0.88
56	65484	7383	11.3	1.61
57	27669	9674	35.0	2.11
58	30682	7653	24.9	1.67
59	41186	6193	15.0	1.35
60	37455	6317	16.9	1.37
61	41859	6217	14.9	1.35
62	47370	6978	14.7	1.52
63	79710	7745	9.7	1.69
64	75000	7003	9.3	1.52
65	24611	0	0.0	0.00
66	25334	0	0.0	0.00
67	21251	0	0.0	0.00
68	26567	0	0.0	0.00
69	18255	4781	26.2	0.39
70	13072	4529	34.6	0.37
71	13895	0	0.0	0.00
72	19273	5283	27.4	0.43
73	15306	9904	64.7	0.81
74	14193	500	3.5	0.05
75	15023	415	2.8	0.02
76	21041	958	4.6	0.04
Total	758002	101268	13.4	18.40

Neptunium Flows Out of the Paducah Plant Site

During the period from November 1958 to October 1961[R71-1] Np was recovered from fluorination tower ash and cylinder washings to satisfy the requirements of another AEC contractor. These recovery operations were carried out partially at ORNL and partially at Paducah. A total of 4.3 kg Np was recovered and shipped from the site.[R66-1] Included in this total were 1.1 kg Np recovered from the fluorination tower ash and 3.2 kg Np recovered from the cylinder washing solutions.

Estimates have recently been published of the radionuclide releases from all of the 5 facilities operated by Martin Marietta Energy Systems (ORNL, Y-12, ORGDP, Paducah, and Portsmouth)[R88-1] and specifically from the Paducah site[R86-1] for the period 1953 thru 1987. Included in these reports are the estimated quantities of Np removed from the Paducah site in the form of liquid releases and on-site burial of solid waste (while on-site burial is not a physical flow out of the plant site, it is a well defined sink for removal of Np from the process areas and therefore has been included in this section). These estimates are summarized, both on an annual and cumulative basis, in Figs. 3 and 4 for the liquid releases and solid burials, respectively. A total of 5.6 kg Np has been estimated to have been removed by these flow streams, 2.9 kg in the form of liquid releases and 2.7 kg as solid material buried on-site. The estimated quantity of Np released to the air was less than 0.1 kg, which is considered negligible compared to the uncertainties in the total quantities of Np received on site (see earlier discussion).

During the first cascade improvement program in the time period from 1954 through 1961, the barrier in the cascade was replaced with improved material. The barrier which was removed was ground into small flakes and returned to the International Nickel Company plant at Huntington, West Virginia.[R90-5] It is estimated below (in discussion of the plant material balance) that between 0.3 and 0.8 kg of Np was removed from the cascade in association with the barrier.

Two other paths by which small quantities of Np are known to have been removed from the plant site should be mentioned. Neptunium has been detected in a few product cylinders shipped to the other diffusion sites.[R84-1] Three cylinders were analyzed in May of 1973, and during the period FY 1976 through FY 1982 fifty-nine additional cylinders were sampled. A few of the cylinders sampled in the FY 1976A-1977 period exceeded the detectable limit of 5 ppb Np, with the highest concentration observed being 27 ppb. One of the 10 cylinders sampled during FY 1980 exceeded the lowered detectable limit of 1 ppb Np. Small concentrations of Np had earlier been detected in MgF_2 trap beds during the period of FY 1964 through FY 1966. A 10-ton UF_6 product cylinder containing 27 ppb Np (the highest observed) would contain only about 0.2 g of Np. Thus, the quantity of Np removed in product cylinders is considered to have been negligible. Measurements made on a total of 41 tails cylinders from FY 1973 through FY 1982 indicated Np levels to be below the detectable limit in every case.

Finally, some Np is known to have been contained in drums shipped to NLO (Fernald) for reprocessing of uranium.[R81-1] This material consisted of sludge from the C-400 precipitation system produced from the treatment of solutions generated during decontamination of equipment removed from the cascade during the CIP/CUP period. For the period 1/30/74 through 6/30/80, which includes a large majority of the CIP/CUP equipment decontamination, this amounted to about 0.1 kg Np. Again, this is considered a negligible quantity when compared to the large uncertainty in the total quantity of Np received at the Paducah site.

It might be noted that the flows which have been considered negligible in this and the previous section (an input of a few tenths of a kg on material returned from the other sites for smelting, and outputs of about 0.1 kg in the form of airborne releases, about 0.1 kg shipped to NLO, and an unquantified but very small quantity in product cylinders) will probably come very close to canceling each other in the overall material balance so that their omission will not effect the conclusions drawn from the results of the material balance presented in the next section.

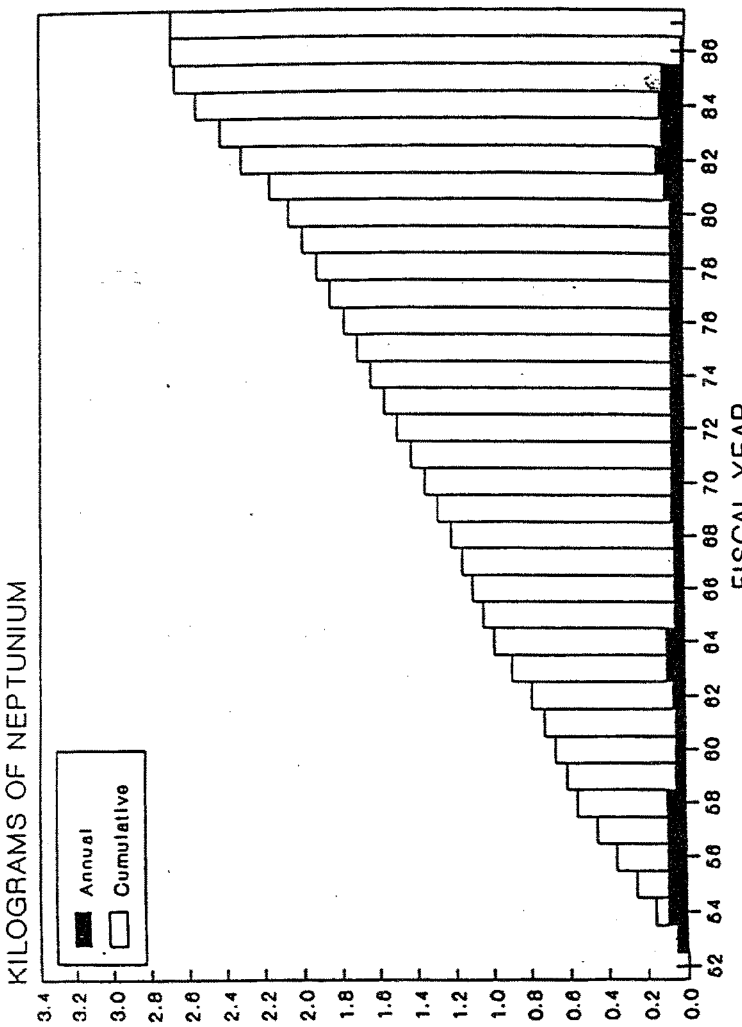

Fig. 4. Neptunium in solid waste buried on-site.

Neptunium Flows Within the Paducah Plant

A neptunium material balance for the Paducah site, including the site inputs and outputs discussed in the preceding sections as well as estimates of the intra-plant flows, is shown in Fig. 5. The methods employed to calculate the various intra-plant flows are discussed in the following paragraphs.

As discussed above, the total amount of Np received at the Paducah site has been estimated to be 18.4 kg (although the number is subject to some uncertainty) which was contained in the reactor tails material received from the Hanford and Savannah River facilities. This material was received as solid UO_3, which was then processed in the feed plant through a series of steps to convert the material to gaseous UF_6 for feed to the diffusion cascade. The first two steps involved reduction of the UO_3 to UO_2 followed by hydrofluorination to form UF_4; these were both solid-gas reactions and the Np would be expected to remain with the U through these reactions. Some dusting occurred during these reactions, and it has been estimated[R72-1] that about 5% of the Np, or 0.9 kg Np, remained in the vacuum dust removed from these systems. In the final step of the feed conversion process, the UF_4 was fluorinated to form gaseous UF_6. Unreacted UF_4, intermediate reduced uranium fluorides (such as UF_5 and U_2F_9), and a portion of the Np were removed during this process in the form of an ash residue. It has been estimated[R72-1] that 20% of the Np fed to the feed plant, or about 3.7 kg Np, was removed in this tower ash. Thus, a total of about 4.6 kg Np was removed in the process of the feed plant operations, with the remaining 13.8 kg Np being transferred along with the UF_6 into the UF_6 feed cylinders.

It is known that a substantial fraction of the Np in the product cylinders remained in the cylinder (in what was commonly referred to as the cylinder heel) after vaporization of the UF_6 into the diffusion cascade; this retained material was subsequently removed in a cylinder washing process. (Undoubtedly, some portion of the Np contained in the cylinder heels remained in the cylinders after washing; no attempt has been made in this study to quantify this remaining material or to identify the cylinders involved and their ultimate disposition.) For many years, it was assumed that 50% of the total Np received in the reactor tails material was retained in the feed cylinder (2/3 of the Np in the cylinder, since only 75% of the received Np was transferred to the cylinders), and that 25% of the received Np (1/3 of the Np in the cylinders) was fed to the diffusion cascade. This has led to an estimate of the total quantity of Np fed to the cascade of 4.6 kg,[R84-1] (25% of the 18.4 kg received).

The 25% figure seems to have originated in a 1966 document.[R66-1] A plant material balance on Np had shown that a maximum of 50% of the total Np received could have been fed to the cascade. The argument was presented that this 50% figure was too high, since analyses of dust samples from the cascade had indicated that less than 1 kg Np was contained in the cascade, which would indicate that more on the order of 10% of the Np had been vaporized into the cascade. A study had also been made in which feed cylinders had repeatedly been filled with UF_6 and then washed after a number of cycles to determine the Np present in the cylinder heels. Two series of such tests resulted in figures of 0% and 50% of the Np in the cylinder having been vaporized to the cascade. As a result of these considerations, it was decided at that time that the best estimate of the fraction of Np vaporized to the cascade was 25% (admittedly with a very large uncertainty), and that the true figure almost certainly was between 10% and 40%.

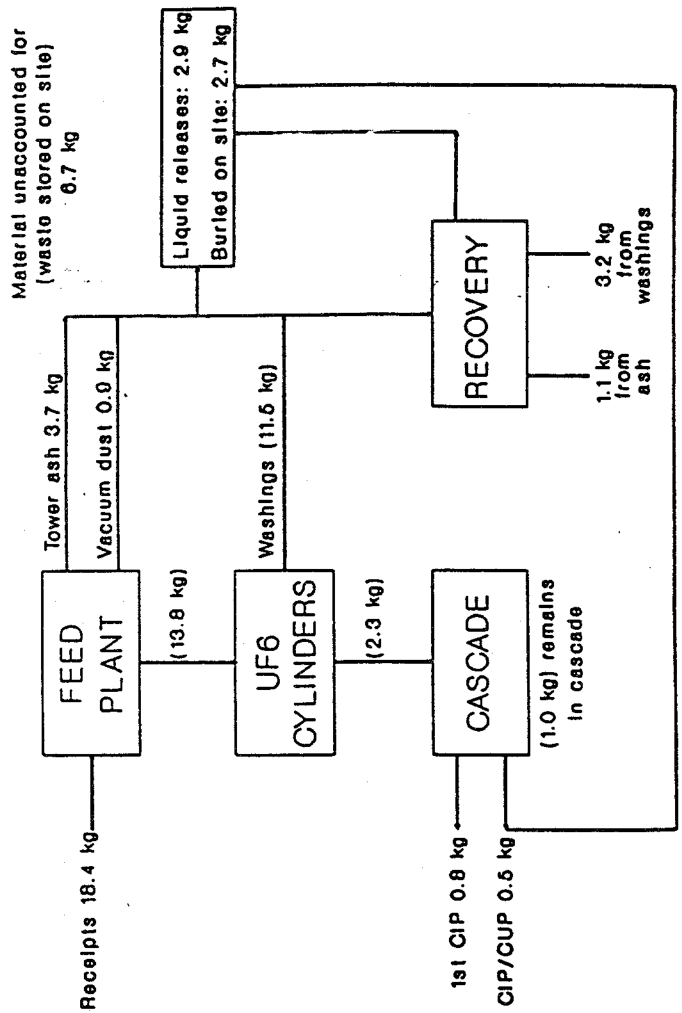

Fig. 5. Neptunium material balance.

Probably the most reliable study of this problem was published in a 1975 document.[R75-8] Based on the results of both laboratory studies and plant tests, it was concluded that at least 83% of the Np in a cylinder had been reduced and therefore not fed to the cascade. Using this figure (17% of the Np in a cylinder is fed to the cascade), the quantity of Np fed to the Paducah cascade has been recalculated; the results are shown in Fig. 6 and Table 4, which indicate that a total of 2.3 kg Np may have been fed to the diffusion cascade, although there is additional evidence (discussed below)

Table 4. PGDP cascade inventory of neptunium

FY	Np Fed kg	Total Fed to cascade kg	Removed 1st CIP kg	Removed 2nd CIP kg	Remaining after 2nd CIP, kg
53	0.04	0.04			0.04
54	0.11	0.15			0.15
55	0.11	0.26	0.03		0.23
56	0.20	0.46	0.05		0.38
57	0.27	0.73	0.09		0.56
58	0.21	0.94	0.12		0.65
59	0.17	1.11	0.15		0.67
60	0.18	1.29	0.17		0.68
61	0.17	1.46	0.20		0.65
62	0.19	1.65			0.84
63	0.21	1.86			1.05
64	0.19	2.05			1.24
65		2.05			1.24
66		2.05			1.24
67		2.05			1.24
68		2.05			1.24
69	0.05	2.10			1.29
70	0.05	2.15			1.34
71		2.15			1.34
72	0.05	2.20			1.39
73	0.10	2.30			1.49
74	0.01	2.31		0.01	1.49
75		2.31		0.03	1.46
76	0.01	2.32		0.05	1.42
77		2.32		0.09	1.33
78		2.32		0.10	1.23
79		2.32		0.12	1.11
80		2.32		0.08	1.03
81		2.32		0.01	1.02
82		2.32		1.02	
Total	2.32		0.81	0.49	

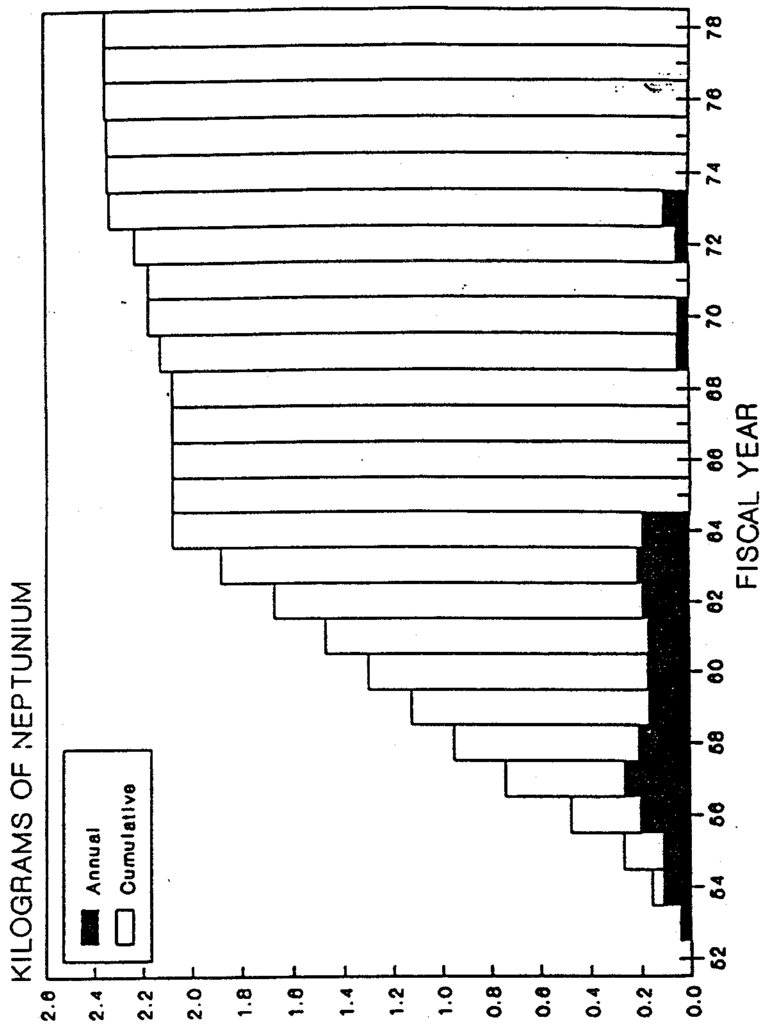

Fig. 6. Estimated neptunium fed to cascade.

which indicates that even this figure may be too large. Since no Np has been detected in the tails withdrawals and only negligible quantities have been detected in the product material from the cascade, it is concluded that essentially all of the Np fed to the cascade has been retained therein, with the exception of material removed during equipment changeouts. A portion of the Np fed to the cascade was removed during the two cascade improvement programs, during which most of the equipment in the cascade was removed and replaced with improved designs. In the first of these improvement programs, which occurred during FY 1954 through FY 1961, all of the barrier was removed from the cascade and replaced with new material. Since the barrier represents better than 99% of the total metal surface area in the cascade, it was assumed that essentially all of the Np would be associated with the barrier. To estimate the quantity of Np removed from the cascade it was assumed that 1/7 of the barrier was removed and replaced during each of the 7 fiscal-year duration of the program, so that in each of these years 1/7 of the Np present in the cascade was removed, which produced an estimate of 0.8 kg Np removed from the cascade during the first improvement program; the quantity of removed material has been included in Table 4.

The second improvement program, commonly referred to as the CIP, occurred in the period from March 1973 through September 1981. During this program, 101 of the 120 "000" cells (84%) and 52 of the 80 "00" cells (63%), were equipped with new barrier. The removed barrier was decontaminated and then sent to the Paducah metal smelter for melting and recovery of the nickel. Neptunium was recovered from the decontamination solutions using a precipitation technique. During the period from January 1974 through June 1980, which represents most of the period of the improvement program, a total of 237 g Np was recovered from the decontamination solutions.[R81-1] Assuming a decontamination factor of 2,[R76-3] this would indicate a total of 474 g Np contained on the removed barrier, so that a reasonable estimate of Np removed from the cascade during the CIP was taken as 0.5 kg; the quantity of removed material has been included in Table 4.

Removal of a total of 1.3 kg Np during the two improvement programs, coupled with the estimated 2.3 kg Np fed to the cascade, results in the estimate of 1.0 kg Np remaining in the Paducah cascade as shown in the material balance in Fig. 5. The total Np in the diffusion cascade, corrected for the material removed during the improvement programs, has been summarized in Table 4 and is shown in Fig. 7.

As mentioned earlier, there is evidence that the current cascade inventory of Np may be significantly less than the value of 1.0 kg shown on the material balance of Fig. 5. During the CIP, an attempt was made to determine the distribution of radionuclides in the Paducah cascade by the routine sampling and analysis of the equipment as it was removed from the cascade; the results of the Np analyses have been published.[R77-11] While some spreading of the Np both upstream and downstream from the feed point was evident, the results clearly show that the Np is concentrated near the feed points. From the data presented, average concentrations of 4 g Np per "000" cell and 1 g Np per "00" cell can be derived. Since 101 "000" cells and 52 "00" cells were replaced during the CIP, this would indicate that a total of 456 g Np should have been removed during the CIP, in excellent agreement with the observed total of 474 g cited earlier. These data also indicate that the cascade should currently contain only 104 g of Np. These numbers lead to estimates of 0.6 kg Np in the cascade prior to the CIP, removal of 0.3 kg Np during the first improvement program, and a total of 0.9 kg Np fed to the cascade. Thus, while the material balance of Fig. 5 indicates

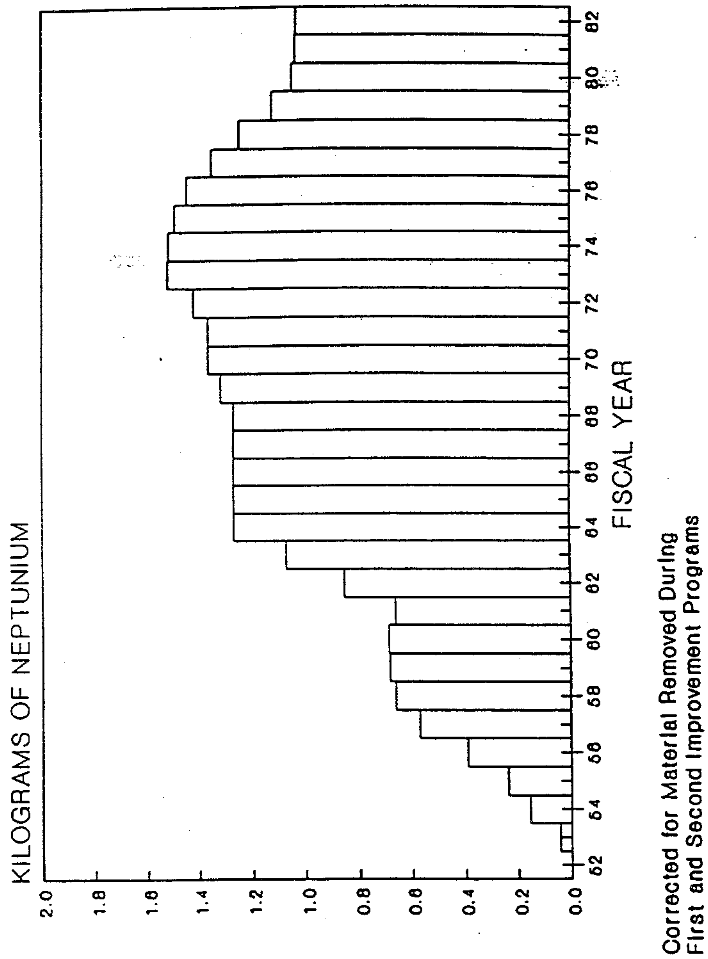

Fig. 7. Estimated neptunium in Paducah cascade.
(Cumulative)

a total feed to the cascade of 2.3 kg Np and a current cascade inventory of 1.0 kg Np, these values may be as low as 0.9 kg and 0.1 kg, respectively. A total feed of 0.9 kg Np would indicate that only 6.5% of the Np in the UF_6 feed cylinders was vaporized to the cascade, not a totally unreasonable number.

Because of the uncertainty in (1) the total quantity of Np received at the Paducah site and (2) the fraction of this total quantity which was eventually fed to the cascade, it might be well to consider several possible cases. These are summarized in Table 5.

Table 5. Results of several possible Np material balances

Case	1	2	3	4	5	6
			kg of Neptunium			
Total received on site	18.4	16.0	13.6	18.4	16.0	13.6
Removed in feed plant (25%)	4.6	4.0	3.4	4.6	4.0	3.4
Fed to UF_6 feed cylinders	13.8	12.0	10.2	13.8	12.0	10.2
Fed to cascade	2.3	2.0	1.7	0.9	0.9	0.9
Removed during 1st CIP	0.8	0.7	0.6	0.3	0.3	0.3
In cascade after 1st CIP	1.5	1.3	1.1	0.6	0.6	0.6
Removed during 2nd CIP	0.5	0.5	0.5	0.5	0.5	0.5
Current cascade inventory	1.0	0.8	0.6	0.1	0.1	0.1
Liquid releases	2.9	2.9	2.9	2.9	2.9	2.9
Buried on-site	2.7	2.7	2.7	2.7	2.7	2.7
Recovered and shipped	4.3	4.3	4.3	4.3	4.3	4.3
Np unaccounted for	6.7	4.6	2.5	7.8	5.4	3.0

In the 6 cases tabulated, three different values for the total Np received at the Paducah site are considered: (1) the maximum previously reported value of 18.4 kg[R84-1] (cases 1 and 4), (2) the minimum previously reported value of 13.6 kg[R74-1] (cases 3 and 6), and (3) the average of these two values, i.e., 16.0 kg (cases 2 and 5). For each of these three values of Np received on-site, the quantity eventually fed to the diffusion cascade has been calculated by two methods: (1) assuming 17% of the Np in the UF_6 cylinders is fed to the cascade (cases 1, 2, and 3), and (2) back-calculation of the quantity fed starting with the removal of 0.5 kg

Np during the CIP, as has been described in the previous paragraph (cases 4, 5, and 6). The results of case 1 are those which have been shown in the material balance of Fig. 5.

As can be seen from Table 5, the quantity of Np unaccounted for, which for the purposes of this document we define as material either stored in on-site storage facilities (it is known that substantial quantities of such stored material exists) and perhaps some additional losses to the environment, ranges from 2.5 kg to 7.8 kg. Perhaps the most reasonable estimate of unaccounted for material is 5.4 kg Np as shown in case 5, which assumes total receipts of 16.0 kg and a current cascade inventory of 0.1 kg.

CHEMISTRY

Reactivity in Cascade Environment

The ranking of reactivity of the volatile actinide hexafluorides is: $UF_6 \leq NpF_6 < PuF_6$. All three have a tendency to react with surfaces (e.g. materials of construction) to form non-volatile reduced fluorides. In common UF_6 handling practice, metals chosen for use as materials of construction are generally those which can be "passivated" by forming a stable protective fluoride layer that inhibits further reaction. The exception to this is steel, whose fluoride layer is not particularly protective but for which the reaction rate is sufficiently slow that the metal's low cost makes it attractive for moderate temperature service, most notably as UF_6 cylinders. Due to the higher reactivity of NpF_6 and PuF_6, much of the Np is left in a cylinder after feeding the UF_6, as is essentially all the Pu.

"Surfaces," as used above, can also include reduced fluorides of the more stable members of the series. In particular, NpF_6 and PuF_6 would be expected to react with UF_5 or UF_4 to form UF_6 and NpF_5 or PuF_4. Adsorption measurements conducted as part of a chemical trapping study indicated that NpF_6 did, at cascade temperatures, react with UF_4 to a degree that could not be explained by adsorption; presumably it underwent the postulated oxidation-reduction reaction. By contrast, materials likely to be found on cascade surfaces (NiF_2, CuF_2 and AlF_3) consumed NpF_6 at an area-normalized rate consistent with monolayer or partial monolayer coverage. In this study, however, difficulty was experienced with adequately passivating surfaces for use with NpF_6, and never achieved with PuF_6.[R75-8]

In addition to reaction with deposits of reduced uranium fluorides, NpF_6 is likely to react with UO_2F_2 deposits to form either an oxyfluoride or reduced fluoride of Np, liberating UF_6. As long as the cascade contains deposits of UF_5 (created by corrosion reactions of UF_6 with cascade materials of construction) and UO_2F_2 (created on reaction of UF_6 with inleaking moist air), NpF_6 should be relatively immobile. Recent campaigns to minimize such deposits may increase the mobility of NpF_6. Attempts have been made to "clean up" the cascade from the standpoint of uranium deposits. This process has included the use of off-stream treatments with fluorinating agents (F_2 and ClF_3), and the return of the reaction products of these treatments (including the UF_6 raised by the procedure as well as residual fluorinating agents. It is, therefore, possible that the mobility of NpF_6 could be increased directly (by refluorinating NpF_5 to NpF_6) or indirectly (by removal of UF_5 or UO_2F_2).

Evidence for significant mobility of Np in the cascade is equivocal but tends to support immobility. In the CIP/CUP survey (conducted on equipment as it was removed from 1975 through 1977) Np concentrations peaked in the feed area. Feeding of RU was continuing at that time, albeit at a low level, as the program proceeded, but the total quantity of Np estimated in the feed area of the cascade was much larger than the total Np fed to the cascade in the several years preceding the survey. Thus, the concentration of Np in the feed area of the cascade had to have survived for at least 5 years.

Surveys of a number of product and tails cylinders were conducted between 1973 and 1982. Of about 40 tails cylinders, none showed detectable Np (the detection limit changed from 5 to 1 ppb during this time). Of about 60 product cylinders examined, a few showed Np above the detection limit.[R84-1] The possibility of cross contamination (e.g. reuse of a "tainted" cylinder) was not addressed. If the product UF_6 contains Np at just below the detection limit, the quantity of Np removed, if real, is minuscule (a gram or so a year). A similar rate of product stream flow (1 gm/yr) was observed in the early 60s in analysis of MgF_2 traps for Np.[R66-2] Currently, analyses for transuranics are done on one product cylinder a month. No ^{237}Np at or above the reporting limit of 5 ppb U has been detected in recent years, nor has Np been detected in recent years in chemical trap materials in the C-310 product withdrawal facility.[R90-4]

Taking these two observations at face value, one is led to the conclusion that Np in the cascade environment is very immobile, but might have sufficient mobility for a few tenths of a percent of the cascade load to leave the cascade each year through product streams.

HEALTH PHYSICS

Current Concern

Waste material containing transuranic material was released from a storage drum in the C-746-Q warehouse on March 22, 1990. The spill site was successfully decontaminated; however, the presence of TRU materials initiated an investigation into the extent of TRU materials at the PGDP facility. The investigation was designed to include an analysis of historical radiological survey data, and historical plant operations for the purpose of determining past TRU levels and likely locations of TRU material.

Personnel exposure data has historically been analyzed for uranium contamination. A re-assessment of the in vivo and in vitro data has been conducted to evaluate potential TRU exposure. Radiation workers currently involved in operations located in areas with a high potential for TRU contamination have been placed on an enhanced bioassay analysis program. Expanded in vivo and in vitro analysis has been initiated on this subset of the over radiation worker population.

Allowable limits for surface and air contamination may change substantially pending the results of a site characterization. A program has been initiated to characterize contamination in the process buildings as well as the overall site. Facility survey plans for air and surface contamination are outlined below in the section entitled "Current Actions."

Historical Studies

An evaluation of archived data by the site Health Physics Department (HPD) indicated that several evaluations of TRU materials had been conducted between the late 1950s and mid 1980s. The reports specifically discuss the influence of TRU materials on radiological work and the potential health effects associated with exposure to such material.

A Certified Health Physicist was retained by PGDP as a consultant following the March 1990 TRU contamination incident. The study was commissioned to evaluate the Health Physics program for TRU materials. Included in the project scope was a review of all available pertinent historical data, development of suggested actions necessary to assess the health impacts to employees and the public, and suggest sampling plans. The report indicated that TRU materials were identified as a potential problem as early as September 1959. Several personnel monitoring activities were initiated and concluded between the late 1950s and the mid 1980s, yet no significant exposure to personnel, based on in vivo data and pre-1988 standards were evident.

Regulatory Limits

Allowable limits for contamination and exposure are defined in more detail today than at any time in the history of radiation protection. The issuance of DOE Order 5480.11 (order) on 12-21-88 and the DOE Oak Ridge Operations Radioactive Contamination Control

Policy (RCCP); Revised 10-89 have provided guidance for personnel exposure and facility contamination which has a large impact on the conduct of operations at DOE facilities.

The PGDP facility has been operated as a "Uranium" facility since the issuance of the order. Confirmed presence of TRU material following data review of the current assessment program will result in operational changes to release limits for personnel and property, as well as Derived Air Concentrations (DAC). The size of airborne radioactive areas and subsequent respirator usage will be increased due to a 1,000 fold decrease in the allowable DAC for TRU materials versus the DAC for uranium. The size of contamination areas will increase due to a factor of 50 decrease in surface contamination limits.

Current Actions

A survey plan has been developed to evaluate the presence and extent of TRU contamination at PGDP. The plan (attached) "Transuranic Assessment Plan for Paducah Gaseous Diffusion Plant" encompasses a review of historical data, as well as a three step survey plan based upon potential contamination. The survey scope includes facility air and surface contamination, and an expanded personnel dosimetry analysis. An implementation schedule is included for phase one of the assessment plan.

Additional short term support has been procured in order to completely evaluate the TRU concerns at PGDP. Analytical laboratory support for analysis of air and surface contamination, and bioassay samples is provided via a sub-contract. Health Physics technical resources have been coordinated through two consulting organizations. The quantity of instruments available for facility air and surface contamination characterizations has been enhanced and personnel egress monitoring equipment has been supplied by other Energy Systems facilities.

The release of material in C-746-Q on March 22 1990 occurred as a result of improper transportation technique and inadequate facility design. Modifications to the drum movement procedures and facility upgrades have been recommended.

Continuous job coverage by the Health Physics Department (HPD) has been instituted to assist in the future characterization of TRU concerns and personnel protection for jobs which involve:

- UF_6 process system breaks
- Seal changes/rocker assemblies and motor coupling removal
- Welding, grinding, or buffing on UF_6 process related equipment jobs with the potential for high air borne concentrations.

Related Regulatory or Health Concerns

Specifications on quantities of transuranics in reactor return uranium in the past were devised to assure that radiological limits and handling practices for uranium would automatically satisfy similar standards for transuranics. For example, water release standards for neptunium and plutonium until very recently were higher in terms of activity (i.e. disintegrations per unit time per unit volume) than for uranium (per DOE Order 5480.1A, ^{237}Np was $3x10^{-6}$ mCi/l versus $6x10^{-7}$ mCi/l for ^{234}U). A very recent change, DOE Order 5400.5,[R90-3] lowered the allowable discharge level for ^{237}Np to $3x10^{-8}$ mCi/l while leaving ^{234}U the same. Thus, while it formerly was valid to control to the uranium activity levels, the rule change (which was to take effect in May of 1990) makes this no longer true. Similar problems arise with natural daughter products of uranium.

A number of issues have been identified during the recent attention given to Np in the PGDP. Many of these are covered in the action plan for radiological assessment. These deal largely with contamination control and health physics controls. One that is not is the subject of heat stress. Since early May, probably prompted by new limits for airborne contamination of neptunium and certain daughter products of natural uranium,[R90-2] maintenance activities on open equipment in the PGDP cascade have been done with "head-to-toe" protective clothing (formerly, only respirators were required). The cascade buildings typically are in excess of 100°F as it is; fully suited workers in this environment face the potential of heat injury. Typically, workers have been able to work about 15 min in this environment before taking 45 min off to recover from the high temperatures. Industrial hygiene and medical department personnel are giving this matter their attention; the possibility of air conditioned suits is being considered. In the present situation, however, it is not clear that the overall safety of the employees has been improved by these protective measures.

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CONCLUSIONS

Conclusions that can be drawn from this study are as follows. The presence of transuranic contamination and the associated health physics implications have been recognized at the Paducah plant since the 1950s. While procedures were instituted that led to effective simultaneous control of uranium and TRU contamination, recent DOE order changes may require a significant revision to past contamination control practices, and the presence of transuranics requires significantly different control procedures.

Much of the information described in this report as "not determined" is probably not "lost to history," and a more thorough review of the available historical material may reveal more information about these subjects. A more complete data review appears to be a part of the overall action plan (reference R90-2). This should assist in prioritization of disposal or consolidation efforts.

A few potential locations where transuranic residues may occur have been discussed in this report that were not explicitly mentioned in earlier studies. These include residues in cylinders historically used for containing feed produced from RU, and the cascade feed facility's associated plumbing.

It should be noted that ORGDP also had a feed plant which produced UF_6 from RU, although in quantities significantly smaller than at PGDP. Similar (but probably smaller-scale) TRU concerns may, therefore, apply to ORGDP as well as at PGDP.

Though this report has dealt primarily with neptunium experience at PGDP, the entire range of radiological hazards should be considered as an integrated and balanced whole. These hazards include TRU, U-isotopes (including ^{232}U, ^{233}U, and ^{236}U), fission products, and the daughter products of the above. Under the new guidelines, certain daughter products, such as ^{230}Th and ^{231}Pa, may be of as much concern as TRU materials.

Finally, in defining the protective measures necessary, care must be taken to assure that those measures do not themselves jeopardize the health and safety of employees.

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APPENDIX

The following is the text of the "TRANSURANIC ASSESSMENT PLAN for the Paducah Gaseous Diffusion Plant," which was developed in response to the recent TRU concerns.

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TRANSURANIC ASSESSMENT PLAN FOR PADUCAH GASEOUS DIFFUSION PLANT

I. HISTORY

Large quantities of recycled uranium (reactor returns) from Department of Energy (DOE) programs at Hanford, Washington, and Savannah River, South Carolina were introduced into the process feed system at the PGDP from its startup in 1952 until the mid 1970s. These reactor returns contained transuranic (TRU) elements which were formed during the irradiation of the original fuel elements. The most important TRU materials from a personnel exposure perspective are ^{237}Np and $^{239/240}$Pu.

Most of the contaminants were removed during chemical reprocessing, but plutonium and neptunium carried through the uranium recovery process and were introduced into the cascades during the UF_6 feed process. The amount of TRU materials in the feed cylinders was characterized, but recent sampling indicates that TRU contaminants introduced into the process lines may be higher than previously estimated. In the mid 1970s a major effort was initiated to upgrade the PGDP cascade facilities. Improvements included replacement of most of the gaseous diffusion barrier. This occurred during the time the last TRU material was fed and after the last recycle of uranium had been fed through the plant. Removal of the barrier was assumed to have reduced the TRU inventory in the process system, but there is no data which indicates that the surveys were compared to TRU release limits.

II. PURPOSE

This survey plan is designed to assess TRU materials and the associated radiological hazard at the Paducah Gaseous Diffusion Plant (PGDP).

Sampling has been conducted on various process equipment, process materials, airborne and waterborne radiological emissions, and the workplace during the 1970s and 1980s. These surveys did not address the presence of TRU materials by using appropriate survey instrumentation procedures nor release guidelines. This survey plan is designed to provide information on the presence and quantity of TRU materials at the PGDP.

III. SURVEY SCOPE

This Transuranic Assessment Plan will be conducted in phases, with the scope of each phase determined by the results of the previous survey activity. This plan will discuss the first phase of the survey activity in detail with later phases only generically described.

A. PHASE 1 SURVEY PLAN

The purpose of the Phase 1 survey will be to review historical data, establish sampling criteria for process radioactive materials, identify workplace areas with potential TRU concerns and provide radiological characterization of TRU levels in those areas, evaluate specific health physics requirements for personnel protection, and establish monitoring requirements for workplace and personnel.

1. Workplace Evaluation and Sampling

Samples of uranium materials and process solutions will be collected from the workplace to determine the presence and ratio of TRU activity to uranium activity. The sampling of the workplace environment is prioritized based on the potential radiological hazard from TRU materials, based on number of personnel in each facility and operational activities.

Group I		Schedule
• C-410/420	Feed Plant & Expansion	04/23/90*
• C-400	Cleaning Building	05/09/90*
• C-720	Maintenance & Stores Building	05/16/90*
• C-746	Warehouses	06/08/90
• C-310	All Floor Cells 2,4, & 6	05/15/90*
• C-333	Process Building	06/08/90
• C-337	Process Building	04/17/90*
• C-335	Process Building	06/08/90
• C-331	Process Building	06/08/90
• C-409	Stabilization Building	04/19/90*

* Survey and laboratory analysis completed.

Group II		Schedule
• C-333-A	Feed Vaporization Facility	06/15/90
• C-337-A	Feed Vaporization Facility	06/06/90*
• C-710	Technical Services Building	05/30/90*
• C-310	Product Building (Remaining)	06/08/90
• C-315	Surge & Waste Building	05/30/90*
• C-620	Compression Building	05/30/90*
• C-750	Garage	05/30/90*
• C-360	Toll Transfer & Sampling Building	05/30/90*
• C-200	Guard & Fire Department	05/30/90*
• C-102	Medical Facility	06/15/90

* Survey and laboratory analysis completed.

Group III			Schedule
•	C-300	Central Control	06/22/90
•	C-302	Operations Administration Building	06/22/90
•	C-724	Carpenter Shop	06/22/90
•	C-340	Conversion Facility (Shut Down)	05/30/90*

* Survey and laboratory analysis completed.

- Samples of spray booth wash solutions will be collected to provide an estimate of the material present in cascade equipment.

- Process gas (PG) inventory samples will be collected to provide information regarding the potential for TRU contamination of the workplace through PG releases.

- Analyses of process vent samples will be performed to identify any detectable TRU in emissions to the environment.

- Wipe samples of internal cascade equipment surfaces will be collected to provide additional information regarding TRU contamination levels in various cascade locations, concentrating on C-333 and C-337.

- Selected samples collected at the PGDP site will be sent to an independent laboratory for confirmatory analyses.

- Samples will be collected from decontamination buildings and uranium recovery areas, specifically:

  Cylinder wash solutions
  Raffinate from uranium recovery

2. Evaluation of Workplace Radiological Survey Data

   a. Workplace Contamination Surveys

The process data on TRU contaminant levels will be evaluated to determine the presence of TRU material. Based on this data, an evaluation will be conducted to determine whether the current radiological controls are adequate for the level of TRU contamination. Current workplace monitoring data will be evaluated to determine whether additional sampling specific to TRU contamination will be required. The TRU contamination found in the process materials will be used to determine any changes to the survey and posting requirements for radiologically controlled areas. Implementation of modified facility controls and survey methods will occur on a phased schedule based upon contamination levels, occupancy, and facility use.

b. Workplace Air Contamination Monitoring

The PGDP facility has ~25 continuous passive air monitors located in various areas of the workplace. These samples are changed daily and counted for gross alpha and gross beta activities. Air filters which have 4.4 dpm/m^3 or more of alpha activity will be analyzed for TRU materials. This action level was chosen based on the DAC for neptunium which is 4.4 dpm/m^3.

c. Personnel Protection

Personnel protection requirements will be evaluated based on the ratios of TRU to U activity found in each area/process. Current requirements have been specified based on health physics evaluations of the work activity, representative air sampling, and surface contamination monitoring. In general, PGDP controls are based on 10% of the DAC for the most restrictive radionuclides present on the sample, and the contamination levels specified in DOE Order 5480.11, Attachment 2.

Selected personnel will be sent to the Feed Materials Production Center, Fernald, Ohio, for confirmatory in vivo analysis. Additional personnel may be added to the program pending the results of the initial study.

d. Dose Assessment

The PGDP site currently performs in-vitro and in-vivo analyses for exposed and potentially exposed personnel. The in-vitro analysis includes total uranium and technetium analyses; the in-vivo count includes ^{235}U, ^{238}U, ^{237}Np, ^{99}Tc, and other radionuclides. Whole body counting can determine long lived deposits of ^{237}Np, but should not be used for current dose control of employees. Urinalysis is a better method of detecting low levels of ^{237}Np due to its excretion rate, complemented by WBC data. The criteria in the DRAFT DOE bioassay standard will be used to perform this assessment. Urine samples will be analyzed by sub-contract laboratory.

3. Schedule

• Initiate survey plan	05/21/90
• Complete survey	06/22/90
• Complete sample analyses	08/17/90
• Submit draft report to Program Manager, ES Health Physics	08/31/90
• Submit final report to Program Manager, ES Health Physics	09/28/90

B. PHASE 2 SURVEY PLAN

The purpose of the Phase 2 survey is to further characterize those areas identified in Phase 1 which have known TRU contamination. A detailed sampling plan will be developed to fully assess each building.

C. PHASE 3 SURVEY PLAN

The purpose of the Phase 3 survey is to characterize those areas of the PGDP which were not characterized during the Phase 1 effort. These facilities will be characterized in accordance with the site implementation plan for DOE Order 5480.11.

DISTRIBUTION

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C. A. Caves
O. L. Ewing

DRAFT 01/22/93

02/08/93

To: File

From: J H Stebbings

CC: Distn

Subject: Trip Report - Paducah GDP, Paducah, KY, 14-18 Dec 92

On December 14-18, 1992, nine NIOSH staff members visited the Paducah Gaseous Diffusion Plant with the overall objective of evaluating the feasibility of an epidemiologic study of the workers relative to health effects of soluble uranium and electromagnetic field exposures.

Major objectives were to carry out a pilot study of EMF exposures, to familiarize ourselves with relevant programs (such as personnel and medical), to review available health physics data in some detail, and to do a preliminary inventory of record systems and archives at the plant. Although gaps remain (as expected), significant progress was made in all areas thanks to the willing cooperation of the management and staff of the Paducah GDP.

NIOSH team members included S. Ahrenholz, D. Booher, J. Cardarelli, M. Methner, D. Reeder, H. Spitz, J. Stebbings, D. Utterbach, and T. Wenzl.

Special assignments included (* indicates leader/report writer):

EMF measurements:	S. Ahrenholz D. Booher M. Methner T. Wenzl*
Industrial Hygiene:	D. Utterbach*
Record Systems:	D. Reeder* (& J. Stebbings)
Health Physics:	J. Cardarelli H. Spitz*
Overview:	J. Stebbings*

A separate trip report has been prepared by each group and are incorporated by attachment in this report.

Individuals in both union and management expressed concern over leukemias at the plant. At least one other specific issue was brought to NIOSH's attention anonymously and a specific response is required.

While a great deal of additional effort will be necessary, gaps in our information can be prioritized. Major gaps appear to be in the area of understanding what data is on administrative computer systems (largely in Oak Ridge), and what data is currently in the hands of ORAU. It is recommended that direct discussions with the Oak Ridge Field Office be opened relating to data at Piketon and Paducah and at ORISE.

(A note on local name usages: in two instances the formal name of contacts is a diminutive, Donnie or Jimmie, while at times below the informal version, Don or Jim, is used.)

Overview and General Activities

Opening Meeting

The only activity on Monday was a general meeting of the NIOSH staff with PGDP, DOE, and union representatives on the afternoon of the 14th. A large conference room was filled (a sign-in sheet for MMES/DOE staff is available). The Guards Union was not represented, but OCAW was. The NIOSH team were introduced and their specific interests were summarized for the audience. NIOSH involvment in radiation studies and the MOU with DOE was summarized. The meeting broke up sharply at 3:30 pm, the end of the local workday. No substantive issues were dealt with at this meeting. The tone was amicable, but restrained.

Union Meeting

At NIOSH request, a separate meeting with union representatives was held. This meeting was scheduled for 9:00-10:30 Thursday, 17 December, but started at 9:40, was moved mid-meeting to a cafeteria conference room, and ended about 11:00 as we were again displaced. Union representatives at the meeting were Bill Harrison of OCAW, W.A. (Bill) Brien of the United Plant Guard union, and Leroy Branham of OCAW. While a wide range of specific exposures, procedures, and plant organization issues were covered in a desultory fashion, the main purpose of the meeting was to let each group become comfortable with the other and in this it was successful. The unions are concerned about health and safety issues (mentioning asbestos and PCBs as well as radiation), and raised concern about excess leukemias.

NIOSH made clear our willingness to continue meeting separately with the unions, on or off-site, and our intent to copy them with materials at the same time as management and DOE received them.

A good relationship with knowledgable union leaders can be expected in this study barring the unforeseen.

DOE Meeting

Advantage was taken of the actions of the Oak Ridge Field Office (see Legal Issues below) to request a direct meeing with senior DOE Site Office staff. As background, it should be recalled that Jim Hodges, Safety and Health Manager for the Site Office, had called Salam Kadamani here just as I sent a long introductory letter to Don Chumbler of MMES (copies to unions and DOE) regarding our study and visit. Hodges asked that that letter be directed to the DOE Site Office. After discussion with Anne Fidler, it was decided that our posture would be that, since NIOSH's concern is primarily with the workers and not the site or the production function, and since MMES and not DOE is the legal employer of the workers, it is proper for NIOSH to deal directly with MMES and the unions, keeping DOE fully informed, of course.

There was a one-hour meeting Thursday p.m. with myself, Jim Hodges, and the head of the Site Office, Don Booher (not a typo, his name is the same at that of one NIOSH team member). I took the opportunity to enquire about the Oak Ridge Field Office's interest in our study and to review briefly the legal issues summarized below, which had been resolved by that point. I reviewed the intent of our study, and the only action item resulting was their request for a copy of the project summary and, when available, the protocol. I reviewed my experiences regarding the roles of the site and field offices in DOE's human health research program and the way communications normally worked.

The meeting was smooth and amicable, but I am not sure it went as well as I thought at the time given the concerns raised by MMES at the close-out meeting.

Close-Out Meeting

A brief close out meeting was held on Friday morning before departure of the (remaining members of) the NIOSH team. MMES's main representative here was Steve Penrod, head of MMES's ES&H Division. Donnie Chumbler, who had been our primary contact and escort, also represented MMES. DOE was represented only by a young management trainee. NIOSH staff reviewed the accomplishments of the various groups. MMES expressed gratitude that it really was not an audit, and were pleased that NIOSH staff were so lauditory both of the records management at the site and of the excellant cooperation received from MMES staff on site. Both were in fact very good, and several MMES staff went well beyond what would be expected in assisting NIOSH staff.

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The only slightly sour note was that Donnie Chumbler again raised the issue that MMES would prefer that we direct ourselves through the DOE Site Office. I reiterated our position and suggested that the matter had been adequately dealt with the preceding afternoon and that MMES would find that DOE would now accept our posture. In fact, to this day I don't know if MMES raised the subject on its own or whether the DOE site office still objects to our posture and requested MMES to raise the issue again at the meeting.

In fact, NIOSH needs to deal directly with the Oak Ridge Field Office regarding studies at Piketon and Paducah, and data at ORISE.
(I have initiated this conversation begining on 4 February 93.)

Legal Issues

Questions relating to the Privacy Act and access of NIOSH staff to records negatively impacted the activities of the NIOSH field team to some degree.

On 29 Sep 92, Jane M. Greenwalt, FOIA/Privacy Act Officer at the Oak Ridge Field Office, faxed an extensive set of material on the Privacy Act to all of the contractors under the Field Office (copy attached). This is being followed up by visits to each contractor by Greenwalt in which this material is presented to managerial and administrative staff. The presentation is said to emphasize the legal penalties for violating the Act. Greenwalt made her personal presentation at Paducah GDP shortly (date undetermined) before our visit. It seems the faxed material also constituted the viewgraphs of her presentation. It is not clear whether she specifically was invited to, or took the initiative in, presenting this material as specific preparation for NIOSH's visit to the Paducah site.

By Tuesday (15 Dec) noon Dave Utterbach reported that industrial hygiene staff would not even let him have copies of blank forms, let alone sanitized records, because of some orders they had received at the end of the week preceding our visit. I immediately raised this issue with Donnie Chumbler, who let me read a file of interoffice memoranda (copy attached) dated 10-11 Dec. This material originated at the office in Oak Ridge of MMES's chief counsel. An unfortunate aspect to these was the consistent reference to "NIOSH Auditors." Donnie Chumbler was the source of this terminology, and it apparently reflects not a miscomprehension on his part of our intent, but his routine duties, which include shepherding auditors of various sorts.

Early Tuesday afternoon I discussed the matter with Chumbler, and while he believed some staff were overinterpreting the MMES memos, he was uncertain of their exact interpretation. We decided to call Don Woods, MMES chief counsel, and had a lengthy conversation with him mid- afternoon Tuesday. Donnie Chumbler and I were on a speakerphone, so the contents of the conversation would not be in doubt. We requested a detailed explication of the memos. Woods was perfectly agreeable and aboveboard, while I did not request (for this visit) more than random spot access to records with names, and the right to obtain copies of blank forms and of records with identifiers removed. The problem was then solved, except for the Medical Dept. where the Administrator, in the absence of the physician who had given her her orders, stuck to what she had been told by the M.D. Jane Greenwalt was unavailable that afternoon.

Being curious and somewhat dubious of the role of the Oak Ridge Field Office in responses to our interest in Paducah, I had a brief conversation early Wednesday morning with Donna Cragle to find out who Jane Greenwalt was, who her superior was, and whether she had inquired about NIOSH's interests with Donna Cragle. (I also, as a consequence, insisted on a meeting with Doe Site Office staff, discussed elsewhere.) This stimulated a quick and apologetic response telephone call from Greenwalt, who insisted it was a routine presentation which she was also planning to make at Piketon.

Greenwalt admitted to being perfectly aware that the DOE Health and Mortality studies had made their accommodation with the Privacy Act some 15 years previously. I suggested that since these sites were all under study that it would be most appropriate to add a viewgraph or two to her presentation to explain how the Health and Mortality studies interacted with the Privacy Act. She agreed.

Greenwalt added what I suspected, that NIOSH had been added to the list of routine users sometime in the mid-1980s (I knew application was made during the Piketon Study). I don't believe we have the details of that; I also suspect we need to have persons identified authorized to access those records, and perhaps the list distributed distributed as on pp. 24-25 of the larger attachment.

Jane Greenwalt is at 615-576-1216 (U.S. Dept. of Energy, P.O. Box 2001, Oak Ridge, TN 37831-8510); James Foutch, the Chief Counsel at Oak Ridge Field Office, is at 615-576-1212. The Paducah GDP counsel is Alan Harrington at 502-441-6228, but he is not seen as playing a role in these issues. The MMES counsel in Oak Ridge is Don Wood at 615-574-2218.

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Future Plans

The extensive discussions in this report are relevant to future operations relating to the Paducah site, but immediate decisions can be made in the absence of complete knowledge of record systems and exposures.

First priority is capture of a roster for death search and cohort definition purposes. This involves combining MMES data files on current workers, ORISE's roster of Paducah workers, copying of employee information summary cards, followed by at least the employment application from the main personnel file (remember: for current workers, job assignments are in "field files" scattered throughout the plant. The employee summary card in theory covers job assignment changes.

At least external dosimetry files (probably computer from Oak ridge) and the urinalysis data must be captured and computerized while the death search is underway. The in vivo files are small and should also be captured.

It will be a several year job to fully understand the plant and worker assignments, and, with respect to ionizing radiation, unless results of the mortality search yield suspicious results when analysed with the dosimetry data, full comprehension of the environment may not be warranted.

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MEMO: 29 January, 1993

FROM: Henry B. Spitz

RE: Paducah Gaseous Diffusion Plant
Trip Report

TO: Distribution

INTRODUCTION

A technical evaluation of the contemporary and historical health physics personnel dosimetry monitoring program was performed during a visit to the Paducah Gaseous Diffusion Plant from 14 through 17 December, 1992. The objective of the evaluation was to determine whether the radiation exposure monitoring data, generated by programmatic health physics monitoring, was sufficiently comprehensive, adequately documented, reliable, complete, and stored in an easily retrievable manner to support the technical requirements for performing a study of the health effects in people who have ever worked at the plant as employees of the Government Owned, Contractor Operated facility (GOCO).

No central records repository exists although the GOCO facility maintains a comprehensive set of records on radiation exposure monitoring stored at several locations (including Oak Ridge National Laboratory), in many different formats on computer files and paper documents. Although the number of people who have ever worked at the facility is relatively small (viz., approximately 6000 workers) compared to other GOCO facilities, there is considerable health physics monitoring data for each worker including urinalysis, external dosimetry, and in vivo measurement results.

Based upon observations obtained from the site visit, it is concluded that there is adequate radiation exposure monitoring data for individual workers to facilitate the epidemiological evaluation of the health of employees at Paducah Gaseous Diffusion Plant. In addition, the quality of the data and the conditions associated with occupational exposure to uranium and the other physical and chemical hazardous being similar to those at the Portsmouth Gaseous Diffusion Plant, it may be possible to combine these two working groups into a larger cohort for study.

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PERSONNEL INTERVIEWED

Mr. Donald Chumbler was our host and facilitated all necessary arrangements to meet technical and administrative personnel at the plant, enter restricted areas, and witness records and files on an ad hoc basis. Those with Q-level clearance have unrestricted access to the site, including the vault where most of the historical records are stored. Access to secure areas and classified materials was provided by escort for those without required clearance authorization. It was not possible to obtain copies of personnel records and sample forms because of some recent management directive regarding interpretation of the privacy act. Although this directive made it impossible to obtain sample copies of the relevant records observed during our visit, it is anticipated that this problem will be resolved prior our return to Paducah.

[redacted] and [redacted] were identified during the opening session as individuals associated with plant operations who have worked at the plant for forty years and represent a considerable resource for institutional memory. Both started working at the facility in 1951.

Our team was introduced to Mr. Jim Hodges, the deputy DOE director located at the plant site. Representatives from the Oil, Chemical, and Atomic Workers (OCAW) union attending the opening session were Jim Key and Bill Harrison. Jim is also the representative on Environmental, Safety and Health issues. Bill is the Safety and Health chairperson.

Messers Tony Dodd (ext. 6058) and Kenneth Duncan (ext. 6058) represent the professional health physics staff and are located in the 743 building which is outside the security island. They have responsibilities which emphasize external and internal dosimetry, respectively. Mr. Orville Cypret (ext. 6173) is the overall manager of the health physics dosimetry organization. (During our visit, the NRC was also at the plant in preparation for the pending transition of the site to a private corporation. The health physics staff was required to attend meetings with the NRC on 16 December.)

[redacted] a retired employee who formerly was manager in the health physics organization, visited with us for four hours on 15 December and offered considerable information about the historical health physics and environmental monitoring practices. He is willing to participate as a paid consultant in future discussions. I believe that his services will be required in any future studies of this facility.

It was suggested that we contact Rhonda Bogard (615-574-3539), a supervisor at the Martin Marietta Y12 Processing center, to obtain more information and historical records and

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procedures post 1983 which are consolidated at the corporate center. [Note that [redacted], Rhonda's spouse, was the former manager of Bioassay and Dosimetry at ORNL-X10 as is now involved with dose reconstruction for Martin Marietta.]

Mr. John Price is the supervisor of the bioassay laboratory. Mr. Ray C. Shrewsberry has worked in the bioassay lab since the early 1970s and represents an important resource for interpretation of the uranium bioassay analysis performance characteristics. Steve Holshouser is the section head of the analytical laboratory function.

HISTORY

The Paducah facility was constructed starting in January, 1951 through December, 1954. However, one of the cascades came on-line in October, 1952, so that processing of enriched uranium commenced at that date. The feed plant began manufacturing UF_6 in 1953. Significant upgrades to the facility were made in the 1970s. Approximately 1,850 people were involved in the first operations of the facility. Paducah has always been associated with the Oak Ridge National Laboratory through the GOCO relationship. Until recently, the Portsmouth Gaseous Diffusion Plant was operated by Goodyear Atomic. Now, both facilities are operated by Martin Marietta. Prior to Martin Marietta, the DOE contractor for the Oak Ridge and Paducah sites was the Union Carbide Corporation.

Low assay, enriched U_3O_8 is converted to UF_6 in the conversion plant. The majority of first occupational uranium exposures were associated with the conversion plant. A significant health hazard is associated with amount of fluorine involved in the process since UF_3 + H_2O yields hydrofloric acid (HF) . There were very few releases of uranium during the first ten years of operation. In 1960, a new vaporizer and condenser was installed at the feed plant which provided better controls for the product and tailings.

An explosion and fire occurred in 1962 which produced the most noteworthy acute release at the plant.

Fifty to seventy tons of UO_3 had to be converted to UF_6 on a daily basis in building 320 which required from thirty to forty tons of fluorine per day! In 1956, a uranium metal foundry was constructed. Building 340 was used to store UF_4 in 55 gallon drums for uranium metal conversion.

An aluminum smelter was constructed in the 1960s to process the contaminated metal (compressor blades, uranium scrap from declassified weapons components, etc.) arising from the cascade upgrade project. It was thought that the contaminated aluminum reclaimed from the smelter could be used for the next cascade upgrade.

A nickel smelter was also constructed to process the classified barrier material components that did not meet performance specifications. The unused nickel, which was not contaminated since it did not meet requirements for installation in the cascade, was considered a national strategic asset that eventually could be important. A considerable amount of contaminated barrier material was also available from repairs and upgrades performed on the cascade.

The operation of the enrichment facility involves input of natural uranium as UF_6 which becomes enriched in the U^{235} isotope via the gaseous diffusion process in the cascade building. The Paducah plant reaches a maximum enrichment of approximately 2%. Output product from Paducah is used as feed material for the Portsmouth gaseous diffusion plant where enrichments in excess of 90% are attained.

Along with the enrichment of U^{235} comes U^{234} which is responsible for the majority of the internal dose. It is not possible in the gaseous diffusion process to efficiently separate these isotopes since their masses are so close. Likewise, because some of the feed material had been cycled within the weapons complex with less than optimum quality control, some plutonium, technicium, and neptunium has contamined the cascade facility. These contaminents have necessitated implementation of bioassay monitoring.

The enriched product is shipped to the Portsmouth Gaseous Diffusion Plant as UF_6 in gas cylinders where enrichment may continue to proceed to provide U^{235} in excess of 90% by mass. In addition to enrichment capabilities, Paducah differs from the Portsmouth facility in the manner in which it uses "non-firm" contracts for the purchase of electric power. Paducah will take advantage of cheap power in the evening and increase the gas density in the cascade as a method of increasing production.

Ten tons of UF_6 are liquified, stored and shipped in cylinders to Oak Ridge or Portsmouth where it would be vaporized into their cascade system. Tailings from the higher enrichment process were returned in the same cylinders to Paducah for reprocessing.

The U. S. Department of Transportation requires that the high pressure cylinders used to store and transport the product and feed materials be disassembled, filled with a wash solution, rinsed, and pressure tested. The fluorine buildup in these cylinders could present an exposure hazard. Likewise, the buildup of bremmstrahlung and other radiations emitted by these cylinders, especially when empty, do pose a serious external exposure risk for the workers in close proximity to the cylinders. Since the Paducah plant does not produce highly enriched uranium, these gas cylinders represent the most likely source of whole body external radiation exposure.

HEALTH PHYSICS MONITORING PROGRAMS

Summary of Records

The old badge number, which was assigned as a personnel identifier, included only 4 digits. A new 6-digit badge number has recently been introduced. (The first digit is an identifier for the plant so the personnel identifier is really only 5-digits.) These numbers are unique personnel identifiers and have never been reassigned to other than the original owner. A conversion key is available to track the personnel identifier from the old to the new badge number. Social security number is also used as the personnel identifier in some of the records systems at Paducah. The badge numbers were unique an never reassigned to another individual after termination or retirement. Should a worker be rehired, the original badge number would be reassigned. Security also has their own access authorization identification number, called the slip number. Most health physics data is associated with the badge number or social security number. Security's slip number is likely to be useful only as a contemporary identifier to track work locations.

A computer listing, Report #28, Program PERXL-028, includes all active employees by name, social security number, and date of birth. Ken Duncan and Tony Dodd, who both use this report on a regular basis, showed us this listing and suggested that it would represent the most comprehensive personnel report available on a routine basis. It also includes division/department, badge no., social security no., name, date of birth, sex, etc. A data base maintained by the benefits organization includes active and terminated workers. There is very low turnover in the ranks of employees at Paducah since the plant is the only major employer in the community.

An air monitoring program has been started during the past two to three years to measure the airborne concentration of uranium in strategic areas on a continuous basis around the plant to characterize exposures by job type. These records, which are not easily retrievable, are maintained by operational health physics.

Records of personnel dosimetry results and survey measurement data are maintained by the Oak Ridge National Laboratory Computers & Telecommunication Department (C&TD) at the K-25 facility. The K-25 facility is acting as the official repository for all external dosimetry records for the Paducah plant. Copies of routine computer-generated dosimetry summary reports, microfiche, and contemporary computer listings are kept at Paducah. A three-plant (Paducah, K-25, and Y-12) dosimetry history computer data file is maintained by C&TD in Oak Ridge. Presently, C&TD is attempting to produce a 4-plant history tape which includes the Portsmouth Gaseous Diffusion Plant. Tony Dodd and Ken Duncan have attempted to download the Paducah data from the computer files at C&TD. Although they possess a file on their local computer system, the data has not been audited for accuracy and may, by virtue of the download process as an E-Mail message, not be accurate.

Oak Ridge has a composite history for all work sites. Personnel and benefits records follow with the job. Urine analysis results cards show work location for each monitored worker until 1977 when use of the cards was ended. Some previous employment history, especially ORNL swapping, is maintained on the history taped maintained at Oak ridge. Copies of data on microfiche are kept by Paducah

Oak Ridge maintains an occupational exposure history computer records for Oak Ridge and Paducah. The system is based upon Flow Gemini, a records management reporting and recording system, and is not a data base suitable for records retrieval and manipulation. Data records include several different types of flags which may signify that 1) results that are greater than or equal to some pre-determined level, 2) identify an acute/chronic exposure, 3) set a sampling or monitoring frequency, 4) identify a nuclide, or 5) even the amount of time since last result was obtained.

Records are maintained by subject and employee. Paducah is working towards a central records repository for dosimetry data. Computerization of raw data is being accomplished using the existing clerical staff on a voluntary overtime basis for data entry. In vivo records are entered with little, if any, formal quality control. Professional review of the historical bioassay data for accuracy and quality assurance involves a cursory review of a computer-generated listing created after data is input. There are no formal procedures for quality assurance or documentation to describe the data entry project. Consensus professional opinion is used to resolve discrepancies during the data input verification process. A reasonable effort has been made to insure that all the data has been retrieved for data entry. During data entry, the clerks can set an "integrity" flag if any question about the data is raised. An edit is performed on data input to check social security number, badge number, and name. This edit is certainly not comprehensive. For example, no check is made to validate maiden names.

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Historical bioassay data recorded in the files represents "raw" data. The records show no mathematical analysis results, such as body burden or dose calculations. Individiual personnel files, if available, may contain dosimetry evaluations if the worker was involved in an Unusual Occurrence (UO) or if a formal report documenting the incident was issued as a result of an investigation. Otherwise, the majority of the data files include only raw data.

It appears that the uranium urinalysis data was used as a control mechanism to confirm that large acute or chronic exposures were not a routine occurrence. That is, routine urinalysis results below administrative action levels supported the conclusion that the established engineering work control mechanisms and procedures were functioning as planned and were sufficient to adequately protect the worker according to the regulations and limits in place at the time of monitoring. Whenever a unusual exposure scenario was identified, bioassay data (both urinalysis and in vivo measurements) were obtained to document the exposure. Internal radiation doses may be in the personnel files for individuals who were involved in an unusual occurrence (UO).

No internal burden or dose results have ever been reported to workers since this was not required until 1989 with the implementation of DOE Order 5480.11. DOSE XPRT, a computer code developed by Keith Eckerman at Oak Ridge National Laboratory, is now used to calculate internal doses. Paducah also has INDOS and CINDI which are used solely for incident evaluations. The need to calculate and report annual and committed effective dose equivalent for all monitored workers will require a significant upgrade in the internal dosimetry program at Paducah.

The majority of the data available for workers at Paducah are dosimeter and urinalysis results. There is very little fecal data and no blood or sputum sample data. There is also some data from the in vivo monitoring program, but it may not be of value since the performance of the detection system was unreliable and erratic. Paducah used the mobile in vivo monitoring system from Y-12 and could schedule exams only infrequently. It was usually not possible to perform an in vivo exam immediately after a suspected UO since the mobile system was either not on site or may be out of service being repaired. Since the uranium processed at Paducah was typically quite soluble, the lack of an in vivo examination on demand was a serious deficiency.

There are approximately 107,000 urine sample results handwritten on 5" x 7" cards through 1977. Stating in 1978, and thereafter, approximately 10,000 results per year have been entered into the computer system.

The bioassay laboratory creates a laboratory notebook entry for each sample processed. The laboratory technician will also perform a computer data entry after the sample has been recorded in the logbook. Since, 1989, the bioassay laboratory enters the results into the computer network. Prior to that time, results on logsheets were entered by the C&TD group at Paducah. In 1989, the VAX Analyst System was implemented.

External Dosimetry

Personnel dosimeters were worn by the workers and taken home at the end of the shift. Originally, film badges were processed at Paducah. The badge used standard Kodak X-ray film packs and was similar to that developed for the original Manhattan project used at Los Alamos, Mound, and Hanford. An old densitometer was found in the vault should it be necessary to attempt to perform a re-analysis of the old data.

The frequency of monitoring was dependent upon the time of history and the job. Records show quarterly and monthly frequencies. Summary data of external dosimetry results from 1953 are recorded on microfiche. No old procedures were available to document what practice was followed in the event of a lost dosimeter. Approximately 100 lost dosimeter badges were acknowledged through 1983. Doses recorded on co-workers badges was used to replace the lost result. A flag is used to document the "estimated" dose result.

Starting in 1983 Paducah used the Harshaw style TLD badge. These badges have been processed at Oak Ridge Y-12 plant which is fully accredited by the DOELAP program. (Paducah is now also an accreditated user of the Y-12 system and maintains a chain of custody program as part of the DOELAP requirements.)

The first TLD badge used at Paducah was a 2-chip dosimeter. It was upgraded to a 4-chip dosimeter in 1988 as part of the DOELAP accreditation. All employees wear a dosimetry (except for one individual who does not work at the site). Badge exchange is now quarterly. Extremity monitoring was initiated in 1988, especially for jobs involving cylinder inspection. Portal monitors were added to the site security program in 1990 and have been detecting a lot of naturally-occuring radon.

Some direct-reading, pencil (pocket) dosimeters have been used the results of which are recorded in independent log books.

A centralized External Dosimetry Computer System (CEDS) is now being maintained by Oak Ridge for all the external dosimetry data. This information is shared with another computer program, OHIST, which matches the dosimeter issued with the user's identification record.

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The historical external dosimetry data was hand-entered into the computer system since the old TLD readers could not be interfaced directly to the computer system. Certainly, dosimeter results from the film dosimeters was entered by hand at some time in the past. Copies of procedures may exist in the Vault.

Internal Dosimetry

Simulated and true 24-hour urine samples were collected during the last few years. Contemporary results are listed in units of dpm U/liter or dpm U/day. Historical results are recorded in units of microgram U/liter or microgram U/24 hour. Most of the historical data is derived from single-void urine samples which were always processed by florimetry. There was a small pilot study to explore the feasibility of using fecal sample analyses for dosimetry. The laboratory notebooks containing the official result records are maintained by the bioassay laboratory. Historical records are maintained in the vault at Paducah.

The uranium urinalysis system is based upon the florimetric process. U^{234} is the main contributor to internal dose. The maximum enrichment was approximately 2% and is the value typically adopted in converting from mass to activity.

Results are recorded in units of milligram U/liter from 1955 through 1977. Thereafter results are recorded in units of microgram U/liter.

The contemporary florimetric process involes taking a 22 ml aliquot from the urine sample submitted by the worker. The aliquot is digested in nitric acid, extracted using TOPO, and fused onto a sodium floride pellet for florimetric analysis. Previous methodologies used a 2 microliter aliquot of raw urine which was fused directly onto the sodium floride pellet. Uranium isotopic analyses are used to analyze the 24-hour samples. The MDL for the florimetric technique is about 5 microgram U/l.

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The action levels adopted for health physics monitoring are as follows:

Soluble UF_6	50 microgram U/l	(initial recall)
UO_2F_2	100 microg U/l	(admin. control)
	200	(restriction)

These limits are based upon 20%, 35%, and 50% of the ALI for class D, soluble uranium with a sample collection frequency of 30 days. The Minimum Detectable Aamount (MDA) of uranium using the florimetric method is reported to be 5 microgram U/l. The gross beta analysis (for technicium) has an MDA of approximately 10 dpm/l. Liquid scintillation analyses are performed at Y-12 and can detect approximatley 0.05 dpm beta /sample depending upon the yield, quenching, and type of sample.

Two followup samples are collected and analyzed as a routine procedure to confirm a result which may be indicative of an intake. Followup sample results will be flagged in the computer records. The flag is a "2" for a special sample and "8" for a sample used to determine (or calculate) a dose. There are eight different sample reason codes (visitor, routine, contractor, special, random, initial).

There are approximately 10,000 records of old bioassay results up through 1977. Approximately 70 - 100 samples are collected each month for special analysis and 500 to 550 samples each month are routines. Workers are scheduled for bioassay monitoring if they work anywhere throughout the plant. Change houses and break rooms are not considered radiological areas. The schedule requires collection of samples during the mid to latter part of the work week.

Each department is responsible for the logistics of transporting samples to the lab. Scheduling is accomplished by E-mail to the department managers who distribute notices to supervisors and workers. (There is a compliance tracking program now, but no such for compliance tracking was accomplished in the past. Likewise, notifications for bioassay sample submission were formerly distributed via plant mail to managers and supervisors who were responsible to notifying workers.)

The minimum acceptable volume for a single void sample is 60 ml and for a 24 hour sample is 1000 ml. The latter is less than that excreted by the ICRP Reference Man Publication #23 which recommends 1400ml as the 24-hour urinary excretion volume for men and 1000 ml for women. Retrospective evaluation of intake may have to consider adjusting any recorded uranium intake for the low 24-hour sample volume. The dates assigned to samples represent the sample collection for single voids and the end-collection date for 24-hour samples.

It was claimed that the use of a full 24-hour urine sample collection was a "political" exercise which was requested to deomonstrate that any uranium uptake was not large. Apparently, results of 24-hour sampling was not used other that often other than to document that uranium intake was small. No dosimetry evaluation results were observed in any of the documentation or records reviewed during this visit. Such information, if available, must be contained in UO reports or individual personnel files.

The bioassay laboratory also processed samples of water for wells. Plutonium and Am^{241} urinalyses were performed at the Oak Ridge X-10 lab.

The actual results for contemporary analyses are recorded in the computer data base along with the MDA. Historical records contain only the result. There appears to have been no bias or corruption of the data. Some zeros were observed in the result reports. Very old data was determined by visual comparison of flourescence with standards. Some 0+ entries were seen in the records which indicates that the samples were not exactly zero but did not meet the expected flourescence for the first standard.

In vivo measurements have been performed using the Y-12 mobile whole body counter since about 1967. Although upgrades to that very old system have been made through the years, results of routine monitoring for uranium of low enrichment still remains unreliable and, in my opinion, have limited value. Measurements performed in support of accident investigations may be useful with the bioassay data in evaluating intake. This decision is based upon the the uncertainty associated with background of the large NaI(Tl) detectors used to measure low photon energies from U235. In fact, background is difficult to characterize because the results are so variable from subject to subject. This variability, combined with the limited sensitivity of the detector system for low energy photons from U^{235}, severly impacts the reliability of results from routine monitoring. On the other hand, in vivo measurements of workers having a known or suspected intake may provide supplementary information to confirm an exposure.

In vivo monitoring was performed for both uranium and neptunium. Approximately 300 to 400 examinations were performed each year depending upon the scheduled visits of the mobile facility. The system has not been used since 1989 because of system deficiencies. The DOE Tiger Team identified the in vivo monitoring program as deficient.

Result records of both in vivo and bioassay measurements were reviewed in the files at Paducah. An inventory of records

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transmittal report. (#UCN-2776) was reviewed. In vivo monitoring reports (#UCN8254 (10/87) and #UCN8254 (8/67)) were also reviewed.

Bioassay result records starting in 1991 began to show negative numbers rather than entries <1 μg U/ℓ.

Notes from Meeting with [redacted] Institutional Memory

Mr. [redacted] was a manager at the Paducah plant. He was invovled in both the environmental evaluation and health physics programs. He was the author of a very important report on occupational exposures to UF_6 which he prepared as a consultant to Martin Marietta after retiring. This report is ERDA-93 or KY-8-198.

Contamination in the cascase process was due to approximately 100 tons of UO_3 from Hanford which contained plutonium in the range from 10 ppb plutonium to a few hundred grams per ton.

Neptunium-237 was also a contaminant in the uranium cascade arising from neturon capture of U^{235} to U^{236}. The U^{236} would be recycled through the weapons fuel cycle program (i.e., Fernald to Hanford to enrichment) and, following irradiation at Hanford, transmute to Np^{237}. The concentration of Np^{237} ranged between 0.2 and 0.5 ppm. Late in the 1950s, Paducah initiated a program to purify Np^{237} for the SNAP devices.

Accumulation of Tc^{99} in the cascade also occurred as a result of processing of reactor tailings. The source of the Tc^{99} is the fission products from the reactor tailings.

The cascade improvement taking place between 1958 through 1962 first identified Np^{237} as a continuing problem. A neptunium bioassay procedure was developed for personnel monitoring but the results could not be interpreted for lack of a suitable metabolic or dosimetry model. The Y-12 mobile whole body counter was used as the primary means of detecting neptunium exposure in workers. Neptunium-239, produced when Pu^{239} captures a neutron, was used as a tracer for the Np^{237}. This is really less than an adequate tracer since the mechanism for producing these two neptunium isotopes so so different. Considerable assitance in evaluating this problem was provided to Paducah by Lyle Schwindenman from PNL.

A new vaporizer for processing feed materials was installed in 1960. This vaporizer was expected to provide better control at the condensor for both the enriched product and tailings. The plant experienced a rather large layoff in 1961-1962. this impeded following workers with sustained burdens related to their occupational exposure.

Although there were relatively few accidental releases of materials during the first ten years of operation, in 1962 there was a big explosion and fire in which releases were very signficant. The conditions associated with this incident are well documented in reports and monitoring data.

In 1953 the first UF_6 was produced in the feed plant. Fifty to seventy tons of material were converted on a daily basis in building 320. The flourine plant had to produce 30 to 40 tons/day to keep up with production.

In 1956 a uranium foundry was constructed for production of uranium metal. The aluminum smelter was fabricated in 1960 as part of the system upgrade. Both clean and contaminated scrap from compressor blades and declassified weapons components were processed in the smelter. Contaminated and clean scrap were processed separately. The intention was to reuse the contaminated aluminum for the next cascade upgrade.

The nickel smelter was fabricated to reprocess barrier materials that did not meet performance specifications since the classified parts could not be returned or sold as scrap. The contaminated barrier materials were considered as a national strategic asset and would be saved for future use as nickel ingots.

Initially, data associated with occupational exposures were not published for fear of alarming the workers. This was changed and a work restriction policy was implemented whenever high dosimeter or urine samples were observed.

High beta dose rates (e.g., 30 - 50 rad/hr beta) could be received at the flourine reactor vessel from the Th^{234} and Pa234. Merril Eisenbud, HASL Publication #58, identified that aging the ash in the reactor vessel would significantly reduce these dose rates.

Workers in the feed plant frequently experienced contamination of their dosimeters making the results inaccurate. A dosimeter exchange frequency of weekly was established for those workers who were most likely to receive exposure. Other dosimetry badging frequencies were used in addition to weekly since it was not necessary to monitor those unlikely to be exposed so rigorously.

The design of the external whole body radiation dosimeter came from Oak Ridge. In 1952 - 1953 a calibration system for the dosimeter using Eastman film was developed. Dosimeters were originally not taken away from the plant site. Badge boards were provided at the exit points. This policy was changed in the early 1960s. Thereafter, some strange readings became a frequent occurrence. The estimate for the minimum detection limit for a badge was approximately 30 mrem.

Urine samples were collected at the start of a shift week. Later this was extended to the start and end of a shift week. Some exposure to soluble uranium was observed from the results of the urinalysis. If a sample from a worker was higher than expected, follow-up samples were scheduled. Rigorous follow-up sampling was initiated in the event of an incident or accidental exposure.

At the inception of the bioassay program, the labortory was comingled with the plant labortory. Later, the bioassay laboratory was relocated to medical.

Three measurements were made with each sample and the average was recorded as the official result. The analyst would make errors in the laboratory notebook. The sample # and badge # would be entered into the official record book however the analyst would enter sample log # and not the worker's name.

Mr. Gene Grown was the industrial hygienist for Mr. Baker. He died last year. Mr. Charles turock was the replacement health physicist who left and went to Union Carbide (Oak Ridge) in 1970.

There was little technicium and neptunium bioassay after the initial studies since it was decided that you can't have these nuclides without measureable uranium. That is, if the uranium was in the body then it is very unlikely that any technicium or neptunium were present either.

Starting in 1960, a few workers were transported to Y-12 for whole body counting. The production workers were scheduled for whole body counting at Oak Ridge starting in 1962. The Y-12 mobile whole body counter started visiting Paducah in 1968 on an annual basis for one month at a time. A few individuals from each 10 man crew received in vivo measurements when the counter was at paducah. A total of approximately 100 workers and controls would be measurement. There were significant problems with the results of these measurements which was assigned to the presence of radon decay products.

Most of the in vivo measurement data was negative which tends to support the results of the air monitoring data. Of course, neither of these two methods was quite sensitive enough to detect low level acute or chronic exposure.

Fixed air monitor filters were changed every eight hours. Operating people were used to exchange the filters. An automatic strip filter mechanism, operated by a clock, was later installed to automate the process of filter changes.

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Special air monitoring was implemented during cascade element rebuilds. Breathing zone air samples, which were assumed to be ninety percent efficient, were attached to workers during the shift. These filters became contamined with sodium carbonate and ammonium carbonate.

Chemical exposure to #1 fuel oil and mineral spirits was common during 1952 - 1953. There was no carbon tetrachloride. An emissions inventory was completed in 1954 to identify what materials were being emitted. Enormous walk-in vapor degreaser cabinets involving trichloroethylene (TCE) were used to decontaminate and degrease components. These cabinets were approximately 13' x 20' in dimensions. Significant ventilation was provided to exhaust the solvent vapors. The vaporized TCE found its way into soil. Approximately 1 ton/day of TCE was released to the atomsphere.

Cylinder washing and testing was required by the Department of Transportation (DOT). Approximately 10 tons of liquified UF_6 is contained in a cylinder when completely full. The cylinders are shipped to Y-12 or Portsmouth where it would be vaporized into their cascade systems as a product material. Tailings from the higher enrichment proces would be returned in the "empty" cylinders to Paducah. Cylinders would periodically be disassembled, filled with a wash solution, turned, tilted, and drained as per DOT regulations.

The empty cylinders would experience a ThF buildup which would result from the thorium floride particles not being entrained in the gas stream during offgassing at Y-12 or Portsmouth. The hazards associated withthe ThF were minimized by storing the cylinders for three months after emptying but before washing. Considerable beta activity remains even after 14 half lives.

Air filters were counted using a parallel plate pulse counter. The whole filter was inserted into the proportional counters. High volume air filters were 4" in diameter. Long-term filters were 1" in diameter. The strip filter paper in the automatic sampler provided 1" diameter circles. Air monitoring was performed during disassembly and salave work.

The highest exposures were experienced in the feed plant. All workers in the feed plant were monitored using urinalysis and air sampling. People were rotated through different areas so they might be exposed to beta activity, soluble uranium, and florine areas during the year. The highest potential for exposure was the job of handling ash in the feel plant.

Heat stress was a significant concern. A cooling box was constructed which allowed a worker to be cooled rather quickly.

Workers developed a tolerance for heat stress. It was found that rapid cooling was better for reducing the effects of heat stress than ambient cooling conditions.

The medical supervision was quite good. Both exposures to uranium and florine (HF) were monitored by the medical staff.

The first cell of the K-25 diffusion plant was finished in 1943-1944. The system became operational in 1945. K-27 started operation in 1945. K-29 started in 1949.

Labor Union Meeting

Changes implemented by management without consultation or explanation were cause for great concern to the workers. Many of these changes were implement overnight. It was claimed that the vaporizer area was the location were most exposure was received. Concern was also raised about the PCB storage facility.

Conclusions and Recommendations

The wealth of available personnel occupational radiation exposure monitoring data should provide adequate support for a study of health effects observed in the working force at Paducah. A signifcant effort must be undertaken to transform this data into a computer-compatible format since most of the bioassay records are either handwritten or on microfiche. The plant is currently in the process of entering some bioassay data into a computer data base system. Unfortunately, lacking adequate resources in manpower and funding, the quality of these new computer files may not be adequate. The first priority in initiating the study at Paducah should be to develop procedures and a rigorous quality assurance program for computerizing the exposure monitoring data.

Several individuals have been identified and are available who would provide us with a resource for capturing the institutional memory for the Paducah gaseous diffusion plant. Information provided by these individuals is very important for interpreting some of the historical procedures and operations which may have led to occupational exposure. Another priority effort must be to develop a formal, contractual relationship with a team of individuals who represent the institutional memory so that NIOSH has a technical resource for interpreting the history of the facility.

The similarity in operations and exposure monitoring programs between the Paducah and Piketon gaseous diffusion plants would present a good opportunity to combine the working force at these two facilities in order to increase the size of the study population.

The labor unions have encouraged NIOSH to undertake a health effects study of workers at Paducah.

The bioassy urinalysis program for uranium, neptunium, plutonium and technicium are similar to procedures and methodology used at other sites. Paducah used Oak Ridge as resource for all its bioassay procedures. The routine in vivo monitoring data is not likely to provide any useful information for classifying workers into exposure categories. On the other hand, in vivo measurements of workers with a known or suspected intake should provide useful information for exposure assessment.

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To: File

Date: January 15, 1993

From: Dianne Reeder
Managerial Technical Information Specialist

Subject: Trip Report of Visit to Paducah Gaseous Diffusion Plant

On the following pages, the inventory of each Department will be preceded by a program synopsis, and followed by an overall inventory of estimated record totals (cubic feet). Each inventory will also contain, if available, detailed information describing:

Record Types	:Cards, one or two-sided, computer printouts (burst/unburst), Fiche, bound log books, data binders, spiral notebooks, etc.
Clipped files	:Records containing staples, paper clips, string, bands, etc.
Special print	:NCR carbonless paper, red pencil, blue pencil, lead pencil, etc.
Paper types	:Standard, legal, onion skin, card stock, etc.
Drawer Capacity:	Full .50 .75 1.25 & 1.5 (these drawers have files stacked both vertically and

SUMMARY OF RECORDS MAINTAINED ON SITE

Health Physics Records (Vault Area)	=	56.00 Cu. Ft.
(Office Areas)	=	22.75 Cu. Ft.
Benefits (Office Area)	=	8.00 Cu. Ft.
Personnel (Office Area)	=	70.50 Cu. Ft.

Medical (Office Area & Estimated Vault) = 167.25 Cu. Ft.

TOTAL = 324.50 Cu. Ft.

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INVENTORY STATUS OF HEALTH PHYSICS RECORDS

Health Physics records (active) exist in numerous areas on the site. Records are retained in external dosimetry, In Vivo, and the bioassay lab. From this initial visit, it appears as though 90% of the inactive records (all areas previously listed) for Health Physics are presently stored in the on-site record vault.

During this initial visit, the following inventories were completed:

External Dosimetry
Employee Bioassay Cards
In Vivo Printouts
Visitor External Dosimetry Cards
Employee Temporary TLD Cards
Fiche
Inactive Health Physics Records

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INVENTORY OF HEALTH PHYSICS RECORDS
RETAINED IN ON-SITE VAULT
MARTIN MARIETTA SITE
PADUCAH, KY

(Department Contact: Tony Dodd)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
1. AEB Urine Data.	July, 1990	Sept., 1990
Full Drawer = 1.5 Cu. Ft.		
2. Film Badge Work Sheets.	1952	1959
Full Drawer = 1.5 Cu. Ft. Red Binders No Staples Some data written in red pencil		
3. Film Badge Work Sheets	1960	1974
Full Drawer = 1.5 Cu. Ft. Red Binders and Clipped Records Staples		
4. Film Badge IBM Printout	1953	1973
Full Drawer = 1.5 Cu. Ft. 8 1/2" Printouts Groupings bound by string Printouts - not burst		
5. Film Badge IBM Printout	1974	1977
Full Drawer = 1.5 Cu. Ft. Full sized Printouts Groupings bound by string Printouts - not burst		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
6. Urinalysis log sheets . . . . . . (Visitor data included in logs)	1952	1962
Full Drawer = 1.5 Cu. Ft. Bound log books Spiral notebooks Red Binders		
7. Urinalysis log sheets	1963	1973
Full Drawer = 1.5 Cu. Ft. Red binders		
8. Urinalysis log sheets	1974	1978
Full Drawer = 1.5 Cu. Ft. Red binders		
9. Fixed Continuous Air Samples C-410, C-420, C-340, C-710 Pump Room, C-400 Temp. Lab.	Feb, 1953	June, 1977
Full Drawer = 1.5 Cu. Ft. Staples 2-sided records NCR Paper (Blue ink)		
10. Fixed Continuous Air Samples C-400, C-409 Converter, C-720 Converter	July, 1953	Jan, 1979
Full Drawer = 1.5 Cu. Ft. Staples 2-sided records NCR Paper (Blue ink)		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
11. Fixed Continuous Air Samples C-310, C-315, C-720 Compressor . . .	May, 1953	Jan., 1979

Full Drawer = 1.5 Cu. Ft.
Staples
2-sided records
NCR Paper (Blue ink)

12. Portable, Air 1952-1972 (All Area Samples).	1952	1972
High Vols. Air 1952-62	1952	1962
Special Test C-340.	1958	1959
Summary Fixed & Portable Air and Flow Sheets.	1953	1964

Approximately 25 bound logs
containing approx. 300 pages/log = 1.5 Cu. Ft.

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
13. Film Badge Reports to Area Supervision (Also includes summaries by Area)	NO DATES	
HP and Hygiene	1953	1956
C-315 Oper	1953	1957
C-340 Oper	1957	1959
Maint.	1957	1958
C-400 Oper	1952	1959
Utility Maint.	1954	1958
C-410 Oper. Incl. C-331 Vaporizer.	1952	1959
Maint.	1953	1959
Inst Maint	1953	1957
Elec. Maint.	1953	1958
C-710 Lab including early C-400 Isotopic Lab.	1953	1959
C-720 Compressor Shop.	1955	1958
C-720 Rebalding.	1955	1956
C-720 Machine Shop	1955	1956
C-720 Converter Maintenance.	1955	1957
C-720 Mechanical Inspection.	1954	1957
C-720 Weld Shop.	1958	1958
C-720 Sheet Metal Shop	1957	1957
Misc. Film Badge Results including Winger Construction	1955	1959
Health Physics Inspections, Reports and Audits.	1952	1967

Full Drawer = 1.5 Cu. Ft.
Red Binders approx. 3" thick
Onion Skin paper throughout each bound log

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
14. Hand Contamination Surveys (Hand Counts)	1952	1956
P.B. King over PAL	1954	
Status Reports & Worksheets	1952	1958
HP Investigations of External. Exposure	Oct., 1953	Nov., 1959
HP Invest. of Continuous Fixed Air Samples above Guide	Feb., 1953	Aug., 1959
Portable Air Sample Results, various areas including graphs	1953	1961
Inventory & Inspection of Rad. Sources	1952	1967
Status Reports	1968	
Misc. Lab Reports	1954	1961
Isodose Plots C-400, C-410, C-410	Feb., 1961	Apr., 1969
Personnel Contamination (Coveralls, gloves), C-410, C-340, C-710	1958	1962
HP Inspection Reports, C-410, C-420, C-720	1961	1964
Hours worked in Tower Area	1958	1963
Pocket Chamber Rpts., C-720 Mechanical Inspection	1953	
Hrs. worked in Trace Area, C-400	1961	1964
Ten Highest Ext. Exposure (Yr. & Qtr.)	1959	1964
Divisional Reports	1958	1959
Quarterly Reports	1952	1958
Subcommittee Reports (HP)	1952	1962
Misc. Maint. Division HP Procedures	1952	1961
Description of Operations Air Samples, Midgit Impinger and Grab	1952	1957

Full Drawer = 1.5 Cu. Ft.
Red Binders
Staples
Quarterly Reports have staples and clips

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
15. Film Badge Assignment, Work Sheets and Reports (Includes weekly readings)	.1952	1960
Full Drawer = 1.5 Cu. Ft. Red Binders (75% of binders are 11" x 17") Staples		
16. Urinalysis IBM Printouts by Quarter.	1977	
Dept. Summaries and by Individuals Requests for Exposure Data		
One binder approx. 3" thick = .75 Cu. Ft.		
17. Health Physics Inspection Reports		
C-400, C-409, C-746-B.	.June, 1957	Dec., 1979
C-400, C-409, C-720 Converter Maint.	.Jan., 1961	Dec., 1979
Scrap and Surplus.	.Sept., 1960	Dec., 1979
C-340.	.Dec., 1960	Apr., 1977
C-410 Isodose Plots Gamma Rad. . . .	.Aug., 1968	Aug., 1976
C-410, C-420	.Sept., 1967	June, 1977
1.5 Drawers = 2.25 Cu. Ft. Red Binders Stapled Clipped		
18. Urinalysis Log Sheets.	.Jan., 1980	Dec., 1980
Full Drawer = 1.5 Cu. Ft.		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
19. In Vivo Counter Data (Generated by Y-12)	1968	1977
1.5 Drawers = 2.25 .5 Drawer of Interoffice Envelopes containing data 4 Boxes of In Vivo Tapes Printouts - unburst		
20. In Vivo Counter Data (Generated by Y-12)	1978	1982
1.5 Drawers = 2.25 Cu. Ft. Printouts Approx. 5-7 boxes of disks for 1982 data		

****

Further inventory efforts resulted in locating the following HP data:

21. Summaries and Quarterlies for Departments and Individuals.	1979	1982
(Drawer Location: E-7-5) Drawer = .75 Cu. Ft.		
22. Raw In Vivo Data (Drawer Location: E-9-5) 0.5 Drawer = .75 Cu. Ft. Printouts - unburst		
23. Uranium Urinalysis Workbooks	1952	1959
(Drawer Location: E-1-6) Full Drawer = 1.5 Cu. Ft. Approx. 35 logs, 150 pgs/log Bound Log books		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
24. Uranium Urinalysis Logs. . . . . . . (Drawer Location: E-1-5)	1959	1966
.75 Drawer = 1.0 Cu. Ft. Approx. 20 logs, 300 pgs./log Bound Log books		
25. Uranium Urinalysis Logs. . . . . . . (Drawer Location: E-1-2)	1966	1976
Approx. 8 red binders Approx. 200 pgs./log.	1977	1981
(NOTE: Uranium Fluorimetric Procedures for years 1961 and 1979 taped inside red binder covers) Red Binders = 1.0 Cu. Ft.		
26. Uranium Urinalysis Logs. . . . . . . (Drawer Location: E-1-4)	1977	1981
Full Drawer = 1.5 Cu. Ft. Approx. 25 logs, 200 pgs./log (1966-1976 data) Bound Log books		
27. Fluoride Urinalysis Logs . . . . . . (Drawer Location: JJ-1-6 aka E-1-1)	1952	1961
Full Drawer = 1.5 Cu. Ft. Approx. 25 logs, 100 pgs./log Bound Log books		
28. Joe Harding Litigation Case (Man growing horns, no stomach) (Drawer Location: E-4-6)		
Full Drawer = 1.5 Cu. Ft. 3-4 Expanding Files Bound Litigation Files		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
29. Employee Termination Reports to K-25 Exposure Reports	1975	1978
Transfers to Central Repository		
(Drawer Location: E-7-6)		
Full Drawer = 1.5 Cu. Ft.		
Correspondence files in all configurations		
30. Standard Procedure/Policy for Health Physics	1964	
Respiratory Protection Procedures		
Contamination Limits		
Radiation Manual	1958	
HP Training Manual		
HP Program Manual	1964	
Paducah HP Program	1961	
Joe Harding File (Worker Litigation)		
Purdue File (Worker Litigation)		
(Drawer Location: NN-9-6)		
Full Drawer = 1.5 Cu. Ft.		
Files		
Manuals		
Red Binders		
Notebooks		
Stapled Articles and Files		
31. Stack Samples		
(Drawer Location: E-8-4)		
.5 Drawer = 1.0 Cu. Ft.		
Printouts		
32. OCAW Exposure Reports of Employees to Union		
(Drawer Location: E-8-5)		
1.5 Drawer = 2.25 Cu. Ft.		
Staples		
Copies of Logs		

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From	Through
33. OCAW Exposure Reports of Employes to Union (Drawer Location: E-8-6) 1.5 Drawer = 2.25 Cu. Ft. Staples Copies of Logs		
34. AEB Data on Building: Wipes, Surveys of Equip. (Drawer Location: E-12-1) 1.5 Drawer = 2.25 Cu. Ft.		
35. Correspondence on Survey Requests UF6 Release and future prevention (Drawer Location: E-12-2) 1.25 Drawer = 2.0 Cu. Ft. File Folders Red Binders Staples		
36. Urinalysis data Fallout from AEC Test. . . . . Finding way to measure Neptunium227 in Human Urine (Drawer Location: E-12-3) Full Drawer = 1.5 Cu. Ft.	1955	
37. Urinalysis Logs: 2 Large Binders . . (Drawer Location: E-5-6) 0.5 Drawer = 1.0 Cu. Ft. Legal-size Red Binders	1975	1976

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HEALTH PHYSICS RECORDS (Continued)

DESCRIPTION OF RECORDS	INCLUSIVE DATES From Through
38. Film Densitometer (Location: Top of HP File Cabinets)	

TOTAL INACTIVE HEALTH PHYSICS VAULT RECORDS
INVENTORIED = 56 Cu. Ft.

DRAFT 01/22/93
INVENTORY OF HEALTH PHYSICS RECORDS
EXTERNAL DOSIMETRY
RETAINED IN EXTERNAL DOSIMETRY DEPARTMENT
PADUCAH URANIUM ENRICHMENT PLAN

(Department Contact: Tony Dodd)

DESCRIPTION OF RECORDS

1. Employee Bioassay (Urine) Cards

   2-Sided Cards = Total of 3920 Cards
   40 Cards/inch
   Drawer = 14" long
   7 Drawers total = 10.5 Cu. Ft.

2. Visitor External Dosimetry Cards

   1-Sided Cards = Total of 5760 Cards
   40 Cards/inch
   Drawer = 24" long
   6 Drawers total = 9.0 Cu. Ft.

3. Employee Temporary TLD Cards

   1-Sided Cards = Total of 1920 Cards
   40 Cards/inch
   Drawer = 24" long
   2 Drawers total = 3.0 Cu. Ft.

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ACTIVE EXTERNAL RECORDS (Continued)

4. 3-Plant Tape (Contains only Paducah data)
   External Dosimetry Microfiche
   Contains data from 1952 through Sept. 27, 1990

   37 Fiche = .25 Cu. Ft.
   18 Pages x 15 Pages = Total of 9990 Pages of Samples
   (NOTE: Number of employee records are unknown, 9990 pages of samples is not equal to the number of employee records contained in the fiche.)

TOTAL ACTIVE EXTERNAL EXPOSURE RECORDS INVENTORIED = 22.75 Cu. Ft.

DRAFT 01/22/93
INVENTORY OF HEALTH PHYSICS RECORDS
IN VIVO DATA
RETAINED IN EXTERNAL DOSIMETRY DEPARTMENT
PADUCAH URANIUM ENRICHMENT PLAN

(Department Contact: Kenny Duncan)

DESCRIPTION OF RECORDS

In Vivo Printouts of Employee Records

Printouts - Unburst
Drawer - 28" long
4 Drawers Total = 6.0 Cu. Ft.

TOTAL IN VIVO RECORDS INVENTORIED = 6 Cu. Ft.

DRAFT 01/22/93
EMPLOYEE BENEFITS

A review of record inventory and introductions to Hal Anderson and Gene Rollins were accomplished during Dianne Reeder's visit to this Department. Jim Stebbings had a brief meeting with Hal Anderson on Thursday afternoon, directed towards understanding the computer data bases. Of all groups interviewed this seemed to be the least cooperative, but that may reflect the fact that the adminiatators in fact know little about the details of the filing and computer systems, the latter being in Oak Ridge. Basically Anderson was unwilling to tell us what was available, but rather insisted on our asking for specific pieces of information. According to Joel Ellington of Personnel, Pat Moss (on vacation during our visit) is the person to talk to. She deals with all deaths of active or pensioned workers, and sends copies of death certificates to Oak Ridge routinely.

A sanitized copy of Form WCP-56, "Wage Standards", was the only record obtained during this brief department visit (See Attachment 1). This card includes Department#, Date, Job Title, Job Title Code, Rate, and a Remarks field.

During the short discussion period with Gene Rollins, Dianne expressed NIOSH's interest in capturing institutional memory at various sites. According to Rollins, benefit reports are created quarterly. These reports include:

Retirees Name
Spouse's Name
Type of Retirement
If Deceased
Date of Birth
Address (Updated as info. received)
Date of Retirement

Rollins did offer to supply NIOSH with an up-to-date copy of the above upon request, and would be willing to identify employees possessing the most knowledge in areas of greatest interest to us. This selection would be based on not only knowledge of areas and/or processes, but also those most willing to cooperate with a survey, employees in a specific age bracket (65 yrs. vs. 80 yrs.), etc.

Due to the 40-year celebration at the site, workers with service of 40 years were listed on the Cafeteria bulletin board. (See Attachment 2 for this listing.)

Permission to inventory inactive Benefits records was not granted, resulting in no initial inventory of records stored in the site vault. The following inventory is based, therefore, solely on records stored in the Department office areas.

DRAFT 01/22/93
INVENTORY OF SITE RECORDS
EMPLOYEE BENEFITS
RETAINED IN BENEFITS DEPARTMENT
PADUCAH URANIUM ENRICHMENT PLAN

Department Contact(s): Hal Anderson, Benefits
Gene Rollins

DESCRIPTION OF RECORDS

1. Employee Work Histories (Active & Inactive)
2-Sided cards contain: Dept. #, Date, Job Title
Code #, Pay Rate, and Remarks Column
Form #WCP-56 (3/54) Wage Standards Form

Inactive Employees
2-Sided Cards = Total of 3800 Cards
50 Cards/inch
Drawer 16" long, 2 rows/drawer = 2.0 Cu. Ft.
Drawer 22" long, 2 rows/drawer = 2.0 Cu. Ft.
Active Employees
2-Sided Cards = Total of 3200 Cards
50 Cards/inch
Drawer 15" long, 2 rows/drawer = 2.0 Cu. Ft.
Drawer 17" long, 2 rows/drawer = 2.0 Cu. Ft.

2. BENEFITS RECORDS IN VAULT WERE NOT INVENTORIED DUE TO SITE REFUSAL OF ACCESS TO RECORD INVENTORY

TOTAL BENEFITS RECORDS INVENTORIED = 8 Cu. Ft.

left to security.

A review of record inventories stored in the Personnel Offices was accomplished during Dianne Reeder's visit to this Department. Permission was not granted for conducting an inventory of inactive personnel records stored in the site vault. The following inventory is based solely on records stored in file cabinets, card files, and safes maintained in the department office areas.

DRAFT 01/22/93
INVENTORY OF SITE RECORDS
PERSONNEL RECORDS
RETAINED IN PERSONNEL DEPARTMENT
PADUCAH URANIUM ENRICHMENT PLAN

(Department Contact: Joel Ellington)

DESCRIPTION OF RECORDS

1. Employee Applications . . . .
Files are divided among action and no action groups
Files range from 2-50 pages each

No Action Files
Drawer = 24-25" long
Drawer #1, 0.50 full = .75 Cu. Ft.
Drawer #2, 0.50 full = .75 Cu. Ft.

Action Files
Drawer = 24-25" long
3 Drawers Full = 4.50 Cu. Ft.

2. Current Employee Files
Files contain Employee Status Change, Educational Information,
Transcripts, course data, Clearance data (not PSQ's), Key Control sheets

Approximately 30 sheets per file
Drawer = 24-25" long
4 Drawers per Cabinet
32 Full Drawers = 48.00 Cu. Ft.

3. Termination Files
Information contained on cards
Drawer = 25" long
50 cards/inch
2 Full Drawers = 3.0 Cu. Ft.

4. Employee and Applicant Files
Index cards
Drawer = 16" long
4 Full Drawers = 13.50 Cu. Ft.

5. PERSONNEL RECORDS IN VAULT WERE NOT INVENTORIED DUE TO SITE REFUSAL OF ACCESS TO RECORD INVENTORY

TOTAL PERSONNEL RECORDS INVENTORIED = 70.5 Cu. Ft.

DRAFT 01/22/93
MEDICAL DEPARTMENT

Review of the Medical Department, its records, and procedures was performed by both myself and Jim Stebbings. Linda O'Hara, Medical technician, summarized the program, the types of medical tests performed on and off the site, and reviewed the standard forms used by the department.

Some general questions were first covered. Death certificates are only incidentally available; Benefits is the proper source for those. Medical absences of 3+ days require a visit to medical before return to work, as do extended leaves of absence. Personal medial data comes with workers arriving from other MMES plants (like Oak Ridge facilities) and departs to those with transferring workers. The current smoking questionnaire is excellant; some smoking questionnaire has been in use for 10-15 years; it was not possible to access sample records prior to that to determine is smoking was included in clinical histories.

Routine medical data collected include CBC's, urinalyses, pulmonary function (might be interesting!), audiometry, chest and fracture x-rays, vision testing by machine, limited blood chemistries (including cholesterol and blood glucose), and a physical examination. Pregnancies are kept track of, and cancer diagnoses if told. Visitors and subcontractors get emergency care only. X-rays are stored off site in a federal facility.Routine lab tests (internal and external) are on a MUMPS database at Oak Ridge (X-10), as are H-ICDA codes. A few tests (PCBs, blood lead) are not in MUMPS. It was said that Paducah has never had any luck getting anything back out of the MUMPS system at X-10. It appeared not to be known whether the MUMPS system held old results or just maintains the up-to-date results (I would guess a mixture of both). Piketon is said to use Flow Gemini.

A number of mandatory programs for tracking and examining workers in certain programs have recently been defined: an asbestos worker program is a major one; others include emergency squad, DOT, fire driver, security inspector, hazmat, hazardous waste, and confined space programs.

Data entry into the computer program was still at Oak Ridge in 1975, and it was stated that quality control was lacking and the main use of the system was reporting.

No copies of record forms were released and permission was not granted for conducting an inventory of inactive medical records stored in the site vault. The following inventory is based solely on records stored in the file cabinets; the inactive record inventory information was from the memory of the medical technical, Linda O'Hara.

DRAFT 01/22/93
INVENTORY OF SITE RECORDS
MEDICAL RECORDS
RETAINED IN PERSONNEL DEPARTMENT
PADUCAH URANIUM ENRICHMENT PLAN

(Department Contact: Linda O'Hara)

DESCRIPTION OF RECORDS

1. Employee Medical Files (Active)

Kardex Rotating File Cabinet
18 Record Trays
Each Tray = 7 Ft. Long
17 Full Trays = 89.25 Cu. Ft.

2. MEDICAL RECORDS IN VAULT WERE NOT INVENTORIED DUE TO SITE REFUSAL OF ACCESS TO RECORD INVENTORY

Estimated amounts were given of Inactive records stored in the site vault.
Those amounts are as follows:

Upstairs Vault = Approx. 12 Drawers
Drawer = 25" long
12 Full Drawers = 18 Cu. Ft.

Downstairs Vault = Approx. 40 Drawers
Drawer = 25" long
40 Full Drawers = 60 Cu. Ft.

APPROXIMATE TOTAL OF MEDICAL RECORDS ON SITE = 167.25 Cu. Ft.

DRAFT 01/22/93
SECURITY RECORDS

Jim Stebbings interviewed Janis Morris, MMES's head of Security, on Thursday morning. As expected, Security files are unlikely to be of immediate interest.

Security maintains a hard-copy file of individuals with current or pending clearances. This file includes QSPs (PSQs), letters requesting and granting clearances, spouse change forms, name changes, infraction reports, a debriefing form, and a (copy of or original?) rolodex file card (Form 312) from an older rolodex file (see below). Most individuals now have only L clearances. Two years after termination files are moved to the vault, and Morris believed that five years later they go elsewhere, either to Oak Ridge Field Office or a federal records center. Cleared subcontractors have folders, uncertain as to whether they are filed separately.

A recent system of generating QSPs (the form) by computer, and filling them in on the computer, has been instituted. Morris hopes this leads to a future database with all the QSP contents.

A second hard copy file, a rolodex summary card with attached photograph used to be maintained. It has recently been replaced by a ring binder file composed of single sheet printouts of the computer database entry for each person plus an attached photograph.

Entrance registers and vehicle registers (including company name, vehicle year and make, state license number, date, and time) are maintained. Entrance registers are kept indefinitely.

Visitor access requests (new hires, interviews, physical examinees, subcontractors, etc.) are kept for 50 years, but policy is only 10 years old and 1976 is the oldest available. Other hard copy files are not maintained on uncleared subcontractors.

An online PC-based computer database is now maintained. There are three types of records: (1) employees or pending employees; (2) subcontractors; and (3) escort required tags (for entry >1 day).

Copies of some current forms were obtained: the "Visitor Access Request," the "Data Report on Spouse," and printouts of the fields of the online database for each of the three categories noted above.

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To: File

From: Dave Utterbach

Subject: Summary of Field Notes, Paducah, KY, December 14-17, 1992:

Industrial Hygiene Records

Industrial Hygiene records for the Paducah Gaseous Diffusion Plant were reviewed on December 16 and 17, 1992. Larry Brantley, Industrial Hygiene Department Manager, was the primary contact and provided information on the records. Mr. Brantley has been the IH manager for less than two years. He was primarily familiar with the records in the IH Department Office. Many of the historical records contained in the C-100 Building vault apparently had not previously been seen by Mr. Brantley.

All industrial hygiene records are apparently on-site. More recent records are maintained in organized files in the Industrial Hygiene Department. These include computerized files and hard copy back-up. Historical records are maintained in the C-100 building vaults on the first and second floors. These records are not systematic nor do they appear complete.

Computerized records of exposure monitoring are maintained by the Paducah-IH staff in at least four separate file systems. Between 1977 and 1985, Union Carbide filed records in a system called Coordinated Industrial Hygiene Record Keeping and Logistics Evaluation System (CIHRKLES). According to Paducah-IH staff, these data were transferred to a Bernoulli disk which can not be located. Between December 1985 and January 1991, Martin Marietta kept IH records on the Local Area Network. These records continue to be on-line and available in a file named IHSAMPLE. Since January 1991, Martin Marietta has collected IH data in a system called Occupational Health Information System (OHIS). Standardized forms are use to code data for the file. However, Paducah-IH reports that they are unable to access any information in this system at this point in time. The PCB and PCP biomonitoring are located on floppies.

Many computerized records have a back-up copy that currently is kept in the IH Department (list of files attached). IH staff indicated that prior to about 1990, data are probably more complete on hard copy than in the computer files. Additional written records of industrial hygiene samples and results are maintained in vaults in the C-100 building. Access to these records is restricted. Many of the records appear to have been either removed or not deposited here.

A list of substances that have been monitored over the years is attached. Currently, there is no way to determine the total number of samples collected or job titles, plant areas or periods of time covered by the sampling. There also is no centralized record of where samples have been collected. However, the records appear to indicate that prior to 1977, only a few industrial hygiene samples were collected. Emphasis during this period was on noise and heat stress monitoring. There was also an attempt in 1973 to estimate breathing zone concentrations of trichloroethylene in the degreaser operation area with a MIRAN.

Since 1977, the number of IH records has grown considerably. Although much emphasis has been placed on asbestos, a large number of samples have been collected for other substances including polychlorinated biphenyls, nickel, lead, hydrogen fluoride, and uranium. Some records also exist for mercury, beryllium, fly ash, and coal dust. A large number of heat stress and noise exposure monitoring records also are available. Noise exposures in excess of 95 dBA appear commonplace with some readings in excess of 100 dBA.

The IH Department currently has biological monitoring programs for PCB's in blood and fluoride in urine. There have also been brief attempts to establish programs for blood lead and pentachlorophenol in urine. All but the flouride monitoring is conducted on volunteers.

A systematic computerized record system was developed recently to track hazardous materials on the site. Tank content records for 1986 through 1990 are also maintained in a data file on the LAN. Prior to these data systems, records for hazardous materials appear haphazard. Many areas of the plant were surveyed for hazardous material usage in the 1980's. Records are maintained in the C-100 files of Building Surveys.

In addition to sample records, the following documents were received from Paducah-IH staff:

A) List of Job Categories for Homogeneous Exposure Groups
B) Index for the Environment Safety and Health Procedures Manual
C) Gaseous Diffusion Facilities and Processes
D) Toxic Substances Control Act Federal Facilities Compliance Agreement Paducah Gaseous Diffusion Plant Implementation Plan
E) Report of Extremely Low Frequency (ELF) Testing at the Martin Marietta Paducah Gaseous Diffusion Plant.

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Summary Notes -- It is obvious from the records that about 50% of the industrial hygiene sampling effort since about 1986 has been dedicated to asbestos. In the late 70's and early 80's, PCB's in cascade buildings and metals in the smelting operation recieved the greatest attention. Hundreds of records exist for both of these groups of substances even though only a handful of workers were present in the smelter according to Jim Key, OCAW Health and Safety Representative. Prior to the mid-70's, only scant industrial hygiene records are available with the greatest emphasis on noise and heat stress monitoring. Other interesting records that were discovered include a large computer file of legionella disease-causing bacteria in water samples, a file on worker leukemia deaths through 1981 (IH Department, Drawer 10), sample record form without any results from 1973 for the sawing of transite (C-100 vault, Drawer E-08-06), cause of death records for workers for 1975 (C-100 vault, Drawer E-08-06), an entire file drawer on unusual occurences (IH Department, Drawer 7), three separate files on kidney stone analyses (C-100 vault), nickel overexposures in 1953 and 1956 at 4 to 32 mg/m^3 (C-100, Drawer E-08-06).

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Computerized Records

CIHRKLES -- Union Carbide's Coordinated Industrial Hygiene Record Keeping and Logistics Evaluation System, 1977-85. Database for all IH samples and results. Data has been down-loaded to a Bernouli which cannot be located (Paducah-IH will continue to search). Hard copy records for much of this period is present in the C-100 vault and in the IH office.

Industrial Hygiene Sampling Data Sheet -- Internal Paducah-IH record keeping system for 1986 through 1990. Hard copy back-up is on-site in IH office and the C-100 vault. Data is on-line and available. Total of 7,700 records. Sample data file and field identifiers were retained. Materials sampled in attached list.

Occupational Health Information System -- Martin Marietta Energy System record keeping system for IH records since 1991. All data is entered to Oak Ridge but Paducah-IH cannot access records. Hard copies on file in IH office.

\cd\bozo\OLDDAT1 --- Local Network data file. Contains sample records and results for 1967-1985 with 1969-1971 and 1973 missing. Possibly the missing CIHRKLES data. Records for 1976 (copies retained) compared with hard copies in C-100 vault with no match.
FLUORIDE -- Urinary fluoride measurements for 1989-1992. Currently about 6 months out of date. Data read into file from analytical lab computerized records. Sample data file retained.

LDB -- Legionella disease-causing bacteria measurements in water systems on the site collected since 1983. Sample data file retained.

BLOODPB -- Blood lead levels with a total of 22 records for 1988 to 1989. Apparent pilot program that did not go very far.

PCB -- On floppy. On-going record of PCB in blood. Still pilot scale with measurements apparently from volunteers and controls. Also has SGOT and SGPT. Summary data file without personal identifiers retained. Sample data file retained.

PCP -- On floppy. Total of 25 records for Pentachlorophenol in urine. Only two samples barely above limit of detection. Workers were engaged in overpacking of drums of PCP during 1990.

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Substances Identified in IHSAMPLE Data File

Acetic Acid	Acetone	Acetylene
Aluminum	Amines	Ammonia
Arsenic	Asbestos	Carbon Dioxide
Carbon Disulfide	Carbon Monoxide	Chlorine
Chlorodiphenyl	Chlorpyrifos	Chromium
Coal Dust	Coliform	
Cyclohexylamine		
DOP Oil	Diazinon	Diesel Fuel
Dimethylsulfate	Dioctylphthalate	
Ethylenediamine		
Fiberglass	Fluorides	Fluorine
Freon	Freon-113	Freon-114
Glutaraldehyde	Hydrogen Fluoride	Hydrogen
Chloride		
Hydrogen	Hydrogen Cyanide	Hydrogen
Peroxide		
Hydrogen Sulfide	Hydroquinone	Iron
Iron Oxide	Isopropyl alcohol	Lead
Mercury	Methylene Chloride	Mineral
Spirits		
Nickel	Nitric Oxide	Nitrogen
Dioxide		
Nuisance Dust	Pentachlorophenol	Phosgene
Polytec	R-114 Freon	Silver
Soda Ash	Stoddard Solvent	Sulfur Dioxide
Sulfuric Acid	Toluene	
Trichloroethane		
Trichloroethylene	Uranium	Vanadium
Xylene	Zinc Chromate	Barium
Calcium	Calcium Oxide	Copper
Fly Ash	Manganese	Tin
Dioxane	Ethylbenzene	Sodium
Hexane	Phosphoric Acid	Phosphorus
Silica		

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Written Records

Upstairs Vault, C-100

Chain of Custody Records for Samples, 1988	B-04-04
Industrial Hygiene Analysis Procedures, 1988	B-04-04
Monthly Progress Reports, 1982-1988	B-04-04
Chain of Custody Records, 1982-1988	B-04-04
Building Surveys, 1986: 2 Files	B-04-04
Inventories of hazardous materials attached	
Asbestos Workers	B-04-04
Asbestos, HSA Contractor: 2 Files	B-04-04
Asbestos Worker Notification and Sampling, 1988-1990 5 Files	B-04-04
Storage Tank Labels, 1975-1978	A-04-06
Unlabeled File	A-04-06
Contains Unusual Occurances File: Asbestos 1989, Pesticide Overexposure, Explosion 1978 and other acute incidents.	
Building Surveys	A-04-06
Critical Facilities Review	A-04-06
PGDP Waste Handling and Disposal Systems Overview after 1987	
Correspondence, 1987	A-04-06
Includes Sample Results Reports	
Employee Status Changes, 1988-1990	A-04-06
Field Service Requests, 1990	A-04-06
Real-time area for heat, confined space and fluorine	
Hood Survey Information	A-04-06
Kidney Stone Analysis	A-04-06
Medical: 9 Files	A-04-06
Fetal Protection Program Notification Letters	
Memos IH Staff	A-04-06
Includes memo on PCB Biomonitoring	
Noise 1982	A-04-06
Noise Monitoring, 1976-1992	
Sampling Load	A-04-06
Safety Report	A-04-06
Embryo Protection Program: 5 Files	A-07-05
Employee Protection -- Other	A-07-05
Includes Fetal Protection Documents for Portsmouth and Paducah, Roster of Female Employees Sept 1985	
Noise Stress/Abatement	A-07-05
Legionella Disease Causing Bacteria, 1983-87	A-07-05
LDB and Cr6 in water grab samples	
Organizational Changes, 1986-1987	A-07-05
Pesticide Programs: 11 Files	A-07-05
Policy Procedures Records	A-07-05
Respiratory Protection Program, 1973-1988	
Air Sampling--Asbestos, 1987-89: 5 Files	B-07-04
Asbestos, C-746 Scrapyard, 1988-1990	B-07-04
Asbestos: Data Support: 3 Files	B-07-04

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Work Authorization, Sampling Records including
some breathing zone, Work Histories
Downstairs Vault, C-100

Originals of HP Files to OCAW in 1981	E-07-03
Group of IH and HP Records Requested by OCAW	
Uranium and Hydrogen Fluoride, 1952-1957	E-08-06
Industrial Hygiene Sampling Records, 1981-1982	E-14-05
Industrial Hygiene Sampling Records, 1952-1981	E-14-04
Medical Approval Cards for Respiratory Protection through 1989	E-14-01

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Materials where exposure concentrations exceeded current REL/PEL/TLV

Trichloroethylene
Lead
Nickel
Mercury
Xylene
1,1,1-Trichloroethane
Fluorine
Uranium

DRAFT 01/22/93

Date: January 19, 1993

From: Steven H. Ahrenholz

Subject: EMF Survey Observations, Considerations, and Suggestions for Follow-Up EMF Site Visits
Paducah GDP Paducah, Kentucky
Survey Dates: December 14-18, 1992

Purpose:

To provide an exchange of information/observations from the perspective of an assisting industrial hygienist participating in the qualitative magnetic field exposure assessment activities on-site.

Findings:

Sampling conducted during the night shift in the switchyard and on one of the process operators demonstrated that the EMBDEX IIs have the ability to sample at three second intervals for broadband and subharmonics for a period of 12 hours. Sufficient battery life remained at the end of the sampling period to permit satisfactory downloading of the accumulated data in the EMDEX II. Requesting the workers to assist in sampling by maintaining a brief activity log also proved to be successful for the three individuals monitored.

Issues for Consideration in Follow-up Surveys:

Obtain prior to the survey a listing of job titles and the number of each by department/building/shift for random selection prior to conducting the survey. This would facilitate better identification of who will be included in the exposure characterization efforts.

Request the active participation of workers regarding at least an abbreviated activity log. This may be used in conjunction with the EMBDEX II data to describe the individual's exposure experience.

Obtain more extensive descriptive information and an inventory of potential EMF sources in the areas frequented by workers whose exposures are being evaluated. Considerations concerning potential for exposures to other chemical and physical agents may also be worthy of inclusion for documentation purposes. This would provide a more complete picture of the environment within which the magnetic field exposures occurred.

Actively obtain electric field measurements and frequency data to characterize the overall EMF environment in which the magnetic field exposures were obtained. This should include documentation of the difficulties and uncertainties encountered due to the technology, facility restrictions, and the characteristics of electromagnetic fields.

Consideration of the zones of influence presented by different sources in the work environments may be another aspect of exposure characterization worthy of incorporation in exposure assessment activities.

Obtain floor plans and photographs of all major areas evaluated/of interest to document conditions and sources as well as to provide assistance with the source inventory.

Survey Logistics:

Daily briefings with survey team members need to be conducted to inform personnel of what they are to accomplish, to ascertain problems encountered by personnel, provide clarification and/or modifications of the protocol when needed, and to obtain feedback and insight from other survey participants into the conduct and success of the survey. This also provides the project officers (PO) with assistance in identifying troublesome or problem areas associated with the conduct of the survey that may need to be more directly addressed by the POs.

DRAFT 01/22/93

To: File

From: Thurman Wenzl

Subject: Trip report, Electromagnetic field measurements, Paducah, December 14-16, 1992

During 3 days at the Paducah Gaseous Diffusion plant, personal measurements of magnetic field exposure were conducted for workers in a variety of jobs. These workers came from production, maintenance and professional jobs, and were sampled for periods ranging from 70 min. to 11 hours, with the majority sampled for about 3.5 hours. Emphasis was given to production operators on this visit, since maintenance workers were heavily represented during the earlier visit to Piketon. Combined results for both plants are attached as Table 2.

Average exposures varied from 0.27 to 8.5 milliGauss (mG) for the 29 workers measured. Instantaneous peaks ranged up to 3600 mG for a power operator, but their duration was usually only a few seconds. About half the measured workers wore the EmdexII device, which allowed an estimate to be made of the extent to which harmonics (above 60 Hz) may have been present in their magnetic field exposure. For these workers very little magnetic field strength was found above 100 Hz.

Three of the 29 workers wore the measuring instrument during their work on the overnight (12 hr.) shift, showing that this was feasible. These workers also provided brief written records of their locations and tasks during this time, which will allow a more detailed interpretation of their exposure-time profiles. For example, with these records we will be able to better estimate locations which correspond to peak exposures. Such diaries will be integrated into the followup visit protocol.

In a few cases location, in addition to job title, appears to be a predictor of magnetic field exposure; further inquiry will be undertaken to confirm this tentative finding and incorporate it into the exposure assignment protocol for the epidemiologic study.

Spot measurements with hand-held meters were also made to identify sources where possible, and to explore the range of influential sources such as motors. These measurements will become part of a strategy to estimate maintenance worker exposures in the past.

Adequate information concerning the range of expected exposures was collected to complete a protocol for returning to the plants for the followup magnetic field measurements.

TABLE 2

DRAFT 01/22/93

MAGNETIC FIELD EXPOSURE SUMMARY*
BY JOB GROUP

JOB GROUP	N	median of arithmetic mean exposure (mG)**	Range
cascade operators	16	2.25	.64-7.2
other operators	4	0.94	.31-1.6
electrical maintenance (including power operators)	9	16	1.7-73
other maintenance	14	1.2	.35-83
technicians (incl. security)	7	1.5	.55-3.1
managers and supervisors	7	0.89	.27-2.8

*: Combined results from surveys of personal exposure averages at the gaseous diffusion plants in Piketon (September 1992) and Paducah (December 1992).

**: This statistic is the median across workers of the arithmetic mean of each measured worker's sequentially measured exposures.

Mr. KLINK. First of all, I want to thank you for holding this important hearing, and I would applaud the staff for the work that they have done to help put this hearing together.

The Department of Energy and the Atomic Energy Commission have a decade-long disgraceful record of denying workers at the nuclear weapons plants who labor every day with highly radioactive material, often under dangerous conditions, the compensation that they deserved when they fell ill. They also have a long and shameful history of telling their workers that handling radioactive material is not dangerous and punishing those that ask questions or who conducted the studies that determined otherwise.

In many ways this hearing is the latest in a series of hearings that this committee has been holding for over 2 decades, and it is depressingly similar. In 1978 we heard from a cancer researcher who was fired by the DOE when he found unusually high cancer deaths among the workers of the Hanford Nuclear Weapons Facility.

In 1988 we took testimony about failed safety programs, plants unsupervised by government owners, safety reports buried in back cabinets, safety regulations routinely ignored, and award fees that encourage contractors to hide safety problems from the government. In 1994 this subcommittee worked with the GAO to reveal that every year DOE was paying over $40 million to private law firms to keep from paying workers' compensation claims and environmental damages that resulted from its contractors' deliberately negligent behavior. Over the years probably $1 billion has been spent to avoid liability, and all of it was taxpayer money.

We had some successes. Admiral Watkins and his tiger teams changed as much as possible in the DOE culture. The Whistleblower Protection Act was passed to protect contract workers who came to Congress to talk about the problems. Billions of dollars was appropriated for cleanups. Independent oversight was instituted and hopefully will not be destroyed by the DOE reorganization recently approved by the House. But this is not enough. The testimony we will hear today will again address these historic problems and will show that at Paducah, workers and the environment are still not being protected. The workers are not being compensated, and the lack of action I believe is deliberate.

As far back as 1952, the Department recognized that to avoid worker exposure to both uranium and small quantities of plutonium in recycled feedstock when used in the gaseous diffusion processing system, the material should be maintained in a closed system, workers should have respiratory protection and protective clothing. They should never be allowed to work with open wounds. Every single one of these restrictions was violated at Paducah. Management was also told to determine where plutonium would go and whether it would concentrate and at what levels it would concentrate. They did not.

By the late 1950's the Paducah and Oak Ridge laboratories were finding cesium, and strontium in the feedstocks, and by 1960 the Biology and Medicine Division of the AEC reported neptunium contamination at Paducah and resulting worker exposure problems.

The authors of this memo said that 300 people at Paducah should be checked for exposure but that the site hesitated to "proceed to intensive studies because of the union's use of this as an excuse for hazard pay. I am afraid the policy at this plant is to be wary of the unions and any unfavorable public relations." That is the end of the quote.

Another memo in 1960, which admitted there were jobs which produced localized areas of somewhat elevated concentrations of uranium in air for short periods of time, also worried that any reduction in exposure would cost money. None of this was ever told to the workers. The health physics program to check their exposure was nonexistent in the early days, and we will hear from two health physicists at the radiation control program at Paducah it was still nonexistent in the early 1990's. Management told one of the physicists that Paducah was a chemical plant. The contractor didn't have adequate staff for measuring instruments for uranium. Although contamination was everywhere, there were no posted areas, and workers freely walked throughout the site. In fact these witnesses, both hired by Martin Marietta, supposedly to put the plant in order, were not told by management that plutonium and neptunium were present.

The environmental side of Paducah was little better. Contaminated drums and trash have been buried willy nilly on the site, sometimes off the site; trichloroethylene, TCE, a toxic solvent was poured onto the ground. Contaminated scrap and metal were left out in the weather in huge piles, adding to the contaminated ground plumes leaving from the site. There is an old pond filled with drums containing uncharacterized waste. After the pond was full, the barrels were piled on the ground and covered with dirt. A much larger pile was called drum or barrel mountain. It also contains contaminated drums and other refuse covered up by dirt. The two largest groundwater plumes which contained techtinium 99 and trichloroethylene move one foot per day.

Despite the expenditure of $400 million in cleanup funds at Paducah, there is no adequate remediation underway for this most obvious of waste streams. Dump sites are not even located, much less characterized. DOE and its contractors have not bothered to talk to the workers to find out where they dumped the waste.

What has been Martin Marietta's and the DOE's response over the past decade? Some upgrades have been made prior to the transfer of the plant to the U.S. Enrichment Corporation, but according to the latest DOE investigation, the radiation control program on the DOE part of the site is still deficient. Worker training to deal with transuranics occurred once in 1992. Bioassays to determine uptakes of radioactive material by workers still have not been done. The most contaminated process buildings were shut down, but they have not been characterized. For several years they were used as changing rooms; security personnel sometimes used them for training, going around in the contaminated dust. Now under DOE's direct control, they are falling apart because of disrepair, which also releases contamination.

During the development and manufacture of nuclear material, many people were injured. Most have now been compensated in some way only after years of suffering. The soldiers at the test sites have been compensated. The Marshal Islanders have been compensated. The institutionalized children that were subjected to radiation experiment have been compensated. The uranium miners have been compensated, but the workers have never been compensated. If they ask questions about their health and working conditions, they were vilified, threatened and lied to by the government to which they were so dedicated. Joe Harding's heirs were told in 1991 that DOE dismissed his claims of dangerous working conditions and declared the plant to be safe. DOE said there was no presence of a thick uranium hexafluoride dust because it was not consistent with the mode of operation, but uranium was found in Mr. Harding's bones and today we will hear testimony from two eyewitnesses about the thick uranium and asbestos dust in the plant that workers were forced to breathe.

When Joe Harding left the plant in 1972 he was told he would get a disability pension for an unrelated leg injury. But when Union Carbide reneged and the DOE, backed by the Justice Department, fought every claim for workmens' compensation and wrongful death, Joe Harding finally died in 1980 at the age of 58. And just 2 years ago his widow finally received $12,000 in settlement of her claims. Just last week, secretary Richardson called Joe Harding a cold war hero and gave his widow a medal. Clara Harding doesn't need a medal. She is impoverished and has lost her home. She deserves the widow's benefit that she has been denied for almost 20 years.

Today, Mr. Chairman, I am announcing that I am sending a letter to Secretary Richardson asking him to reopen that settlement and pay with interest the full amount owed to Clara Harding. It would be a small beginning to ending this very disgraceful era, and I would ask unanimous consent that my letter to Secretary Richardson be included in the transcript of this hearing.

Mr. UPTON. Without objection.

[The information referred to follows:]

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON COMMERCE
September 22, 1999

The Honorable BILL RICHARDSON
Secretary
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

DEAR SECRETARY RICHARDSON: Last week, you personally awarded Clara Harding, the 76-year-old widow of Joe Harding, with a medal from the U.S. Department of Energy (DOE). You called her late husband a "Cold War hero," and honored Mrs. Harding for her "personal contribution in reminding us of the human face of the men and women who contributed to the nation's effort and the ultimate success in winning the Cold War."

It is true that the injured workers are the forgotten victims of the Cold War. While the Department has spent billions of dollars to clean up the environmental damage caused by the negligent handling of toxic, hazardous and radioactive waste, minuscule amounts have been spent to compensate workers made ill by the very same materials. In fact, over the years, the Department has spent tens of millions of dollars in legal fees to make sure that these workers did not receive workmen's compensation, medical assistance, disability payments and pensions. The entire legal establishment of the federal government was massed to avoid these claims. Sick workers were ridiculed, vilified and lied to and about.

The case of Joe Harding is a classic example of this treatment. However gracious and heartfelt this gesture to Mrs. Harding may have been on your part, it cannot obscure the decades' of shabby, dishonest treatment and poverty that the Hardings were subjected to by the actions of the Department, its contractors and its lawyers. Nor can it obscure the fact that it took Mrs. Harding more than *15 years* to receive a paltry $12,000 settlement for her late husband's workmen's compensation claims. This payment, which was fought for years by Union Carbide's and DOE's own lawyers, was received less than two years ago.

Joe Harding worked for 18½ years at the Paducah Gaseous Diffusion Plant (GDF). He was a process operator who worked without any radiation protection in air thick with uranium dust that was also contaminated with plutonium, neptunium and possibly ruthenium. Sometimes he did maintenance in pipes that moved uranium hexaflouride from building to building. He suffered lesions, stomach pain and other symptoms of radiation illness. But the company told him that his work environment was safe even though it knew that it was not.

When Mr. Harding left the Paducah GDF in 1971, he was 49 years old and ill, probably with the cancer to which he ultimately succumbed. Before he left, he was promised a 100 percent disability pension from Union Carbide. But he never received that a nickel of that pension. He lost his health insurance. He never received a retirement pension. After Mr. Harding died, the Department issued a report said that there was not enough radiation exposure at Paducah to cause his illness, and that "The presence of thick dust in the air which Mr. Harding stated occurred . . . is not consistent with the mode of operation" at the plant. As testimony at the Subcommittee's hearing today will show, the DOE report writers lied to deny Mr. Harding his compensation. Mr. Harding's statements were absolutely consistent with the mode of operation at Paducah. Workers frequently labored in thick uranium dust, and many were sick. You heard many similar statements from workers yourself last week.

Mrs. Harding deserves an "honor" that she can take to the bank. By this letter, I am requesting that you direct the Department's Office of General Counsel and Union Carbide to go back to the court of jurisdiction in which the Harding settlement was filed and move to reopen that settlement so that it can be increased to fully reimburse Mrs. Harding for her years of pain and penury. Additionally, I am requesting you to investigate what happened to Mr. Harding's retirement pension. We have been told by DOE officials that he was offered a pension, but never returned the paperwork. This would be surprising since Mr. Harding fought many years to obtain some kind of compensation for his work.

Please respond in writing by Thursday, September 30, 1999, with the steps the Department intends to take to fully compensate Mrs. Harding and to investigate the retirement pension. If you have any questions, please have your staff contact Edith Holleman, Minority Counsel, at (202) 226-3407.

Thank you for your immediate attention to this very important matter.

Sincerely,

RON KLINK

Ranking Member, Oversight & Investigations Subcommittee

cc: Rep. Fred Upton
Mrs. Clara Harding

Mr. UPTON. At this point I recognize the chairman of the full committee, Mr. Bliley, for an opening statement.

Chairman BLILEY. Thank you, Mr. Chairman. This hearing builds on the committee's ongoing commitment to hold the Department of Energy and its contractors accountable for poor management practices that compromise worker safety, cause unnecessary environmental contamination, and waste billions of taxpayer dollars. The long list of poorly managed DOE projects and programs has kept the committee very busy over the past several years. Unfortunately, we do not have the resources to keep track of all of DOE's mistakes, but it has been necessary to take a hard, close look at several issues.

The subcommittee's past DOE hearings include the Pit 9 cleanup disaster in Idaho, the spent nuclear fuel project at Hanford, the troubled Office of Science and Technology, the radioactive tank waste at Hanford, the questionable funding of Molten Metal Technologies, misdirected contract reform efforts, and just recently, a review of the Department's nuclear safety program. Each of these hearings have informed the committee of some of the more pressing problems at DOE. Today's important hearing will review worker safety and environmental contamination at the Paducah Gaseous Diffusion Plant located in Kentucky.

I have been alarmed by the reports I have read about the Paducah site. My first priority is to determine whether current conditions at the site and contamination offsite are threatening workers and the community. For this information I must rely on DOE and the Federal and State agencies. The committee has communicated with each of these agencies and the picture is still unclear. Last month Secretary Richardson sent a team of investigators to the site. He has stated that DOE has not uncovered "any imminent threat to the public health, worker safety, or the environment, but we are continuing to investigate these concerns."

The Secretary has been quick to react to Paducah's problems, but only since they have received front page attention. Where has the Department's health and safety oversight been? Why does it take a special investigation to find out whether the workers at Paducah are safe? I have an answer: It is because the Department's safety oversight responsibilities at Paducah have been severely mismanaged. The initial findings of the Department's investigation have uncovered serious mismanagement by DOE, and several problems with DOE's contractor, Bechtel Jacobs Corporation, regarding nuclear safety oversight, radiation protection of workers and environmental monitoring. However, these findings are not new. Many of the problems uncovered by the Department's recent investigation were identified in a July 1990 Tiger team safety review at Paducah, initiated by former Secretary Watkins.

For instance, in 1990 the Tiger team found DOE oversight roles and responsibilities have not been well defined, documented or communicated. A correction plan was put into place in 1991, and millions were spent for improvements, but 9 years later the same problems persist. Thus, what confidence can we have that corrective actions from DOE's new investigation will be implemented? Furthermore, how can we be confident that DOE's 2-week review is sufficient?

Today's hearing will allow us to review what further actions need to be taken by DOE, DOE's contractors and the regulators to ensure the safety of workers and the community.

The Paducah site and its dedicated workers have a proud place in history. The uranium enriched at the site helped win the cold war, and today it helps supply 40 percent of the world's nuclear fuel for electricity. We owe it to the Paducah community to cut through the culture of silence and deceit at Paducah, and allow for the truth to come out. The truth and the answers will start today at this hearing. I thank you for it, Mr. Chairman.

Mr. UPTON. Thank you. Mr. Strickland.

Mr. STRICKLAND. Thank you, Mr. Chairman. The subject of today's hearing is shocking and terribly disturbing. The lives of thousands of workers and the safety of local communities depends on our swift and just response to this crisis. I applaud the Secretary of Energy for this initiative to thoroughly investigate these recent reports and to take responsibility to address the needs of past and present workers who have been placed in harm's way. I represent southern Ohio, not Paducah, Kentucky. Southern Ohio is the home of the uranium enrichment plant located near Portsmouth. It is Paducah's sister plant.

It is totally unacceptable that the current worker compensation proposal offered by this administration covers only Paducah workers, leaving Portsmouth workers out in the cold. In other words, employees charged with carrying out the same work for this government, who may have been injured as a result of the work, are being treated differently simply because they lived and worked in different places. Is this just? Is it fair? Of course it isn't.

That is why this committee and this Congress should correct this inequity. Our government must take responsibility for all of its employees, past and present, who have been injured due to the exposure to hazardous materials. When the administration's proposal is sent to Congress for action, I pledge to do everything humanly possible to ensure equal treatment for all DOE workers.

Because this crisis demands our immediate attention, Mr. Chairman, I urge you to join me in working to make this legislative proposal more inclusive and to see that it is swiftly passed into law. Further, I am requesting that this subcommittee hold a similar hearing on the Department of Energy's investigation of the Portsmouth site at the earliest appropriate time, and I urge you to join me in working to rectify our government's abandonment of cold war veterans and their modern day colleagues.

Finally, our action will demonstrate to the American citizens just what kind of government they have and what kind of people we are.

Thank you, Mr. Chairman.

Mr. UPTON. We certainly appreciate your interest on this and I assure you we will continue to monitor this and I know that questions for this site obviously reflect a deep interest in your site in your State as well.

Mr. STRICKLAND. Thank you, Mr. Chairman.

Mr. UPTON. Mr. Whitfield.

Mr. WHITFIELD. Thank you, Mr. Chairman. I particularly want to thank Chairman Bliley and Chairman Upton and Mr. Klink for agreeing to have this hearing and to speed up the process, particularly regarding the health and well-being of the current and former workers at the Paducah Gaseous Diffusion Plant, as well as citizens in the surrounding area.

And before I read my statement, I would like to announce that we have been trying to obtain approval for DOE to reprogram $1.96 million to begin cleaning up uranium hexafluoride cylinders at the Paducah plant. There are over 37,000 of them there, and we obtained that approval this morning and so that is a very small step in beginning to immediately try to address this problem.

I am delighted that Mr. Klink talked about Joe Harding. I might also say that the Paducah Sun in 1986 ran an article talking about all of its problems at the Paducah plant, with the exception of the plutonium. It is tragic that it has taken this many years to focus on this and to begin to clean it up. The events of the last month and a half at the Paducah plant have all the elements of a best selling spy novel—exhumed bodies with uranium; allegations of missing documents; coverups; long-term exposure to toxic materials; black radioactive ooze at landfills. Unlike a great book with a good ending, this story is still unfolding, and I am determined that the ending of this story is not a tragic one.

Since my election to Congress 5 years ago, I have worked with the employees at the Paducah plant to preserve collective bargaining rights, to protect their pension benefits and jobs in the midst of privatization, to minimize the impacts of the declining domestic uranium market and increased Russian uranium imports, and to obtain funds for the construction of a uranium hexafluoride conversion facility to convert the depleted uranium.

But today I am committed to finding answers to important questions which have been raised by a Federal lawsuit and subsequent articles.

The first panel of witnesses includes employees of the Paducah plant who have raised serious allegations of wrongdoing by former DOE contractors, Lockheed Martin and Martin Marietta, as well as Union Carbide.

They allege that the contractors knowingly presented false and fraudulent claims for payment, cost compensation and awards under contracts with the Department of Energy, and they endangered the health and welfare of the employees. From this panel I want to hear the specific allegations and the evidence to support those allegations.

The second panel is composed of witnesses representing past and present DOE contractors and the current operator of the production facility—Lockheed Martin, Bechtel Jacobs, and the United States Enrichment Corporation. From this panel I want to know if the allegations raised are true. In addition, we want to know whether the deficiencies enumerated in the Tiger team assessment of 1990 have been corrected; what problems exist in cleaning up the site today; what is the timetable and site management plan for the cleanup; and was there a calculated effort to keep workers and the community in the dark about the presence of plutonium in the materials the plant received, and what Congress can do to facilitate the cleanup.

The third panel includes the Federal and State regulators of the plant—the Department of Energy, and the Nuclear Regulatory Commission, the Environmental Protection Agency and the Kentucky Department of Natural Resources. From this panel I want to know why supervision of the plant has been so lax, to explore the Energy Department's proposal for a pilot project to compensate workers with injuries resulting from radiation exposure, is the plant safe today and what steps will be taken to clean up the contaminated sites and to correct mismanagement of the past.

Mr. Chairman, I represent men and women who have worked and still work at the Paducah Gaseous Diffusion Plant. They have not asked for, nor do they expect much. They do, however, expect their employers and the government to be honest with them, to provide them with a safe place to work, to pay them a fair wage and to compensate them for medical expenses incurred because of their responsibility by the government or its contractors.

The entire Paducah community is entitled to answers about the plant to clean up this area and to correct past wrongs. I hope my colleagues on the subcommittee will help uncover why it took an investigative report and a Federal lawsuit to bring these revelations to light.

Help us separate fact from fiction. We want to know the truth, and we want a safe working place for workers not only at the Paducah plant, but at Portsmouth and Oak Ridge and other DOE facilities around the country. Thank you.

Mr. UPTON. Thank you.

We recognize the ranking member of the full committee, a member of this subcommittee, Mr. Dingell.

Mr. DINGELL. Mr. Chairman, I thank you and I commend you for holding this hearing. Worker safety at DOE nuclear sites has long been a matter of interest to me and also to the committee. It was the subject, as members of this subcommittee will recall, of regular investigative work by this subcommittee during the 1980's and early 1990's. Back when I chaired the subcommittee in 1994, I made one observation that still holds true: One of the largest groups of likely American victims of the cold war are the workers who labored for years in our vast nuclear weapons complexes across the Nation.

Unfortunately, last week, Mr. Chairman, the House of Representatives, when it voted to create an autonomous nuclear weapons agency within the Department of Energy, turned its back on these workers and communities around the weapons facilities and the environment. The House voted to return to the secret days of the Atomic Energy Commission when so many of these tragedies began and when the culture was created that we suppressed public flow of information and didn't give a whoop about the environment, worker safety and other things.

That created a situation where our employees at these facilities, whether they be Federal or contractors, were calmly and serenely irradiated and subjected to other risks of employment and when the communities found that contamination of every one of these sites was regular order of business. And I would observe to you, Mr. Chairman, this was all done under a culture which was caused because of its secretive character, the suppression of information to the public at large, the media, and of course to the Congress which was viewed as a threat by that agency at that time. And it took us years to break that attitude on the part of that agency.

Today we are seeing that the Congress has willingly returned to that in the legislation we passed last week. Worker safety in these times was knowingly jeopardized in favor of weapons production, and the safety of people in adjacent communities was severely risked; and as a result, all of the sites under the former jurisdiction of the Atomic Energy Commission, acting under a veil of secrecy, are now contaminated with hazardous both high- and low-level of nuclear waste.

Those who had the temerity to ask questions were systematically harassed, intimidated, and the Congress and others were stonewalled. When outsiders made inquiry on these matters, lying was the usual refuge of bureaucrats in that agency.

Today's hearing is important, and again, Mr. Chairman, I commend you. What went on at Paducah was outrageous, but what went on at Paducah was replicated at many other sites run by the Atomic Energy Commission.

Last week's vote by the House was also outrageous. We do need many more hearings like this to convince the leadership of this House to reverse the course and go out for independent and aggressive oversight of the weapons complex to see to it that we work to bring about the necessary cleanup and to see to it that that cleanup involves not only the physical cleanup of sites, but a cleanup of an attitudinal problem at DOE, which is the inheritance of the mantle of the Atomic Energy Commission, and to see to it that we have a situation come about where the Congress can find out what goes wrong and properly supervise this matter instead of returning to the veil of secrecy which caused so many of the problems.

I thank you and commend you, Mr. Chairman.

Mr. UPTON. Thank you.

Mr. Bryant.

Mr. BRYANT. Thank you, Mr. Chairman. At this time, I would request to be able to pass and reserve my time.

Mr. UPTON. Mr. Burr.

Mr. BURR. I thank the chairman and I also thank the entire committee and our witnesses, because the postponement of this hearing allowed many of us to go back to the State of North Carolina and address what still today is a significant disaster and will continue to be a problem.

I want to commend Mr. Whitfield for one of the finest opening statements that I have heard in a long time, and one that clearly tells me that he has stayed focused on the human face behind the issue, and that is the workers in Paducah and the many people that live around this plant.

Paducah does have a long history, a history that goes back to the 1950's, a history that if this were the book, it would include the cold war, it would include the need for nuclear development, and this was at the centerpiece of that effort.

Throughout those 50 years, much has happened. And quite honestly, questions have been raised about safety and contamination. Mr. Whitfield alluded to the Paducah Sun article in 1986. Had we only listened then, maybe we could have started this process much sooner.

It has been amazing to me after reviewing the documents for this hearing, my conclusion is why didn't we listen? Why didn't we listen to the Paducah Sun? Why did it take the Washington Post and other news outlets finding documents that this committee and Congress could not obtain through the Department of Energy because in many cases contractors never filed those papers with that agency. How is it that for 9 years, an appendix to the report could be lost and all of a sudden reappear?

Ladies and gentlemen, I think that raises the question that we should be here to ask: How hard are contractors and the Department of Energy working today to solve the problems at Paducah? Much time has been spent talking about other investigations, other sites, and clearly that is a responsibility of this Congress, but I am hopeful that what we will do today before we leave is that the Department of Energy, the contractors, and the Congress will commit that we will clean this site up and assure worker safety.

Let me read you a quote from Dave Michaels with the Department of Energy that appeared in the Post on September 9. He said, "We are most concerned that these problems continue to repeat themselves and that the laboratory management, despite commitments made in previous enforcement actions, have failed to correct identified problems. We have used enforcement on things that we knew were real and contractors haven't responded."

Well, I understand that the investigations are ongoing. I am concerned that the Department of Energy's preliminary observations announced September 14 are simply a rehash of earlier investigations. If in the end DOE does not improve in the way in which it oversees contract operations, how it evaluates contractor performance, and the way that it actually writes its contracts, then none of the other changes it makes will take hold. If DOE will not make the needed changes in contract management, I am certain this committee and this Congress will have a large say in how we proceed in the future.

Mr. Chairman, I thank you for holding this hearing, but I especially thank those media outlets that were able to access documents that furthered the urgency for this hearing and I yield back the balance of my time.

Mr. UPTON. Mr. Green.

Mr. GENE GREEN. Thank you, Mr. Chairman. And as a Member of Congress and an American, it makes me ashamed to read the documents that we have and that we as a country treated our workers, or through the contractors we hired, this way.

I want to thank the chairman for scheduling this hearing and, again, not having the long-term seniority that our ranking member has, it is frustrating, I imagine, to be here year after year and be told that something is being done and yet it is not.

Over and over we hear of lax standards and nonexistent safety protocols and hazards and dangers that no one should have to tolerate. Despite action and oversight by this committee, it seems every time Congress hears how these problems are fixed, you hear the latest plan for improving the working conditions at these facilities, we instead have to hear more problems: our most recent problem at Paducah, Kentucky where for almost 40 years we have managed to avoid dealing with clear evidence of radiation hazard for workers.

In one report from 1960, it appears that the people we put in charge kept the information about the real possibility that dangers and unsafe working conditions existed secret because the managers were afraid that they would have to pay hazardous pay. We will hear testimony from environmental safety officials at the plant about exposure of workers to plutonium which is so radioactive that one millionth of an ounce, if inhaled, can cause cancer.

As early as 1952 we knew that exposure of workers to plutonium and other man-made metal was dangerous. That did not stop those who ran the facilities from ignoring the dangers to workers and failing to protect them from exposure. It seems that the contractors we hired knew that there was widespread and systematic and documented failures in their effort to stop the spread of these materials, but did nothing to try to correct it.

Our government bears much of the blame for the lack of oversight which has led to this and other situations. However, I hope that by now we would have identified the problems and been far down the road toward solving them, and I hope that the Department of Energy and the contractors have done a better job at our other facilities, whether they be in Ohio or Texas, and I look forward to the testimony today from the witnesses. Thank you, Mr. Chairman.

Mr. UPTON. Mr. Bilbray.

Mr. BILBRAY. Mr. Chairman, I would like to thank you and the ranking member for holding this hearing, and I think the bipartisan aspect of this hearing is something that we should encourage more often.

I would like to congratulate the gentleman from Kentucky, Mr. Whitfield, because ever since he came to this Congress I know that this issue has been one that he has been doggedly following and hounding. He knew that it was an issue that was not going to go away, and he did it in a very organized, to a degree quiet at times, but very effective way of forcing this issue out into the light of day. And Mr. Whitfield, I think you set an example for a lot of us, that you may feel strongly about things, but screaming and shouting is not the only way to take care of problems. Actually addressing them is appropriate.

Mr. Chairman, the more I read these reports, I thank my lucky stars that when I was working around a nuclear facility I was working under the Department of Defense rather than the Department of Energy, and I just say that as somebody who has worked and seen the safety precautions and the employee protection that the Department of Defense rendered to those of us working in those environments, and I have to raise up my hands and shrug my shoulders and say why not here.

But I also have to point out that we can find blame and fault, and that is really easy for us who are legislators to point fingers at any administration. The problem is, can we find answers? And I would ask to take a look at the fact that all of us bear in some degree responsibility in the past, t we bear more responsibility to make sure that these situations are addressed in the future. And I would ask all of us what are we doing to initiate some answers here.

And just this morning I have heard the statement of cleanup mentioned countless times, and I would just ask every member who has ever mentioned the issue of cleanup, at are we doing to make cleanups safer and more cost effective?

A good example is the problem doesn't stop with the DOE. The fact is that we just had a situation last year where the Army Corps of Engineers cleaned up a World War II site, shipped the material from New York all of the way to California, and then disposed of it illegally in a facility that is not supposed to be taking nuclear material. And their reason for doing it, to save money.

So I think that we need to look around and say there is a deeper problem here, and I will just ask all of us to remember that every time we talk about cleaning up a nuclear site, we should be asking ourselves and the public should be asking us what are we doing to provide the facilities to cleanup these sites, cause the material removed has to go somewhere. And I ask this committee as an oversight committee to take a look at what happened last year and what we need to do in the future so that the material can be cleaned up and transferred to an appropriate disposal site, which is something that none of us want in our neighborhood, but we all want done somewhere.

We need to learn from the mistakes of the past; let's change the system but maybe change our own attitudes about being proactive in nuclear cleanup, and say what is this committee as the Commerce Committee doing to initiate the ability for Paducah to be cleaned up in a safe, cost-effective manner? And I think that this hearing can remind us that doing nothing is not an option.

I yield back the balance of my time.

Mr. UPTON. Thank you.

Mr. Stupak.

Mr. STUPAK. Thank you, Mr. Chairman. I apologize that I will be in and out of this hearing because I have a number of congressional hearings today. I am very interested in this hearing because I think it is important that we examine the safety record of the Department of Energy with respect to its handling of plutonium and other radioactive materials. Yesterday the Washington Post reported that radiation risks to workers were concealed at Paducah because of "fear of a public outcry." While it is unclear from the news article whether DOE had knowledge of the contamination, it is clear that their oversight of the operation was disastrous. This disaster has caused people to pay with their lives, due to cancer they contracted while working in that unsafe environment.

The Department of Energy has done a horrendous job of protecting the public workers and the public in Paducah from radiation exposure and harm. DOE is now proposing to ship plutonium through both of our districts as well as that of Mr. Blunt from this subcommittee. DOE assures us it will be handled safely by a responsible government contractor. Yet to this point, the DOE has refused to have public hearings in my district or anywhere else along the shipment route. Even though the Canadian Government is having public meetings on the shipment, DOE is refusing to even hold one hearing in this country. Are they afraid of public outcry? Does this situation sound disturbingly similar to the subject of this current hearing today? I hope not.

I believe DOE and its contractors should be open and forthright with respect to their responsibility in the operation at Paducah. I believe they have both a duty and an obligation to find out who is responsible for these lapses and ensure the victims are treated fairly.

Furthermore, I believe DOE should quit stalling and begin hearings on the proposed MOX fuel shipment scheduled to go through our districts. Enough coverups. We need public discussion. DOE's track record with Paducah gives us a serious doubt and reason to doubt the safety of DOE's nuclear weapons program. Only public discussion and reparation will repair that lost trust. Let me remind DOE officials here today, last week the House unanimously passed my amendment to hold public hearings before you begin shipment of the plutonium and the MOX fuels.

Four hundred thirty-five Members said hold hearings. I darn well hope that we have those hearings and have them soon.

Thank you for holding this hearing, Mr. Chairman. I look forward to working with you on this issue as well as the MOX fuel shipment issue.

Mr. UPTON. I supported your amendment on the House floor and only a slow subway and the rain stopped me from getting over there to speak in favor of it.

Mr. STUPAK. Mr. Bryant.

Mr. BRYANT. I want to thank you for having this hearing. My colleague from Tennessee, Zach Wamp, represents the Oak Ridge area and for those of you who know him, know how strong he feels about all issues and certainly will work aggressively to ensure that the right thing is done in this instance to include Oak Ridge.

I do want to associate myself with the remarks of Mr. Strickland and Mr. Whitfield who also have facilities. We have talked a little bit and as I sit here and listen and review the materials, I too am very concerned about what appears to be not negligence but active coverup over a number of years, and for reasons that are very inappropriate given the risk involved here.

I do again thank all of you for being here. I look especially forward to hearing from the workers, both at Paducah and Oak Ridge, and I don't know if this is their first opportunity to actually testify, but I welcome that and look forward to that and I yield back the balance of my time.

Mr. UPTON. Thank you.

At this point we welcome our first panel. They include Mr. Jim Key, Mr. Ronald Fowler, Mr. Thomas Cochran, and Mr. Brad Graves. It is my understanding that many of you, if not all, brought counsel with you, which is certainly fine and fits under the committee rules, but by doing so they need also to be sworn, in that everything is under oath here. If you would identify them when you begin your testimony, that would be appropriate. At this point if you would stand and raise your right hand.

[Witnesses sworn.]

Mr. UPTON. By the way, your counsel need to do the same thing. Identify yourself and then we will swear you in.

Mr. COOPER. Charles Cooper, representing Mr. Jenkins and Mr. Fowler.

Mr. EGAN. Joe Egan, representing Mr. Jenkins and Mr. Fowler and Mr. Cochran.

Mr. MCMURRAY. William F. McMurray for Mr. Jenkins and Mr. Fowler.

Mr. MULL. Martin Mull for Mr. Jenkins and Mr. Fowler.

Mr. LAWRENCE. Mr. Lawrence for Mr. Jenkins and Mr. Fowler and Mr. Cochran.

Mr. UPTON. For counsel, who did not take the oath previously, raise your hand I will swear you.

[Counsel sworn.]

Mr. UPTON. Now you are all under oath. Mr. Key, we will start with you. We would like you to limit your remarks to 5 minutes. Your statement will be made fully part of the record in its entirety, if you can stay pretty close to 5 minutes.

By the way, because of the delay in the hearing from last week due to the hurricane, we very much appreciate getting your testimony on time so we could review it over the weekend. Go ahead.

TESTIMONY OF JIM H. KEY, PACE LOCAL 5-5550; GARLAND E. JENKINS; RONALD B. FOWLER; M. BRAD GRAVES, LOCKHEED MARTIN ENERGY SYSTEMS; AND THOMAS B. COCHRAN, DIRECTOR, NUCLEAR PROGRAMS, NATURAL RESOURCES DEFENSE COUNCIL, INC.

Mr. KEY. Thank you, Mr. Chairman, for allowing me to come before you today. My name is Jim Key.

Mr. UPTON. Could you bring the mike a little closer?

Mr. KEY. Thank you, Mr. Chairman, and committee members for allowing me to come before you today. I am Jim Key, an hourly electrician at the Paducah Gaseous Diffusion Plant at Paducah, Kentucky. I was hired by Union Carbide in 1974 as a laborer and I have worked for a succession of contractors, including Martin Marietta, Lockheed Martin, and most recently the privatized United States Enrichment Corporation. Since 1989 I have also served as the environmental safety and health representative for Local 5-550 of the Paper Allied Industrial Chemical and Energy Workers Union.

At the outset, allow me to clarify for the record that neither I nor PACE Local 5-550 is a party to any litigation with respect to health and safety issues at Paducah at this time. The Department of Energy headquarters oversight staff have included me in daily outbriefs when they investigated the Paducah site during the Phase I study between August 17 and September 3, 1999. It was disturbing to learn, however, that elements within Department of Energy now want to exclude me from further participation, apparently based on the erroneous charge that I had leaked my notes from the outbriefs to the press. This is wholly inaccurate and appears to be a function of the Department of Energy looking for a scapegoat to blame for the publicity associated with the disclosure of the oversight team report.

If there is one message that I want the committee to receive from the workers at Paducah today, it is this: The majority of current and former workers are afraid that they may have been exposed to substances like plutonium without proper protection and that they will, as a result, be stricken with a fatal disease and lose their lives.

Allow me to describe some of the working conditions and I think you will understand the fear. Shortly after I was hired in 1974 I joined the group of workers who were directed to take drum loads of uranium metal shavings from the machine shop and dump them into deep, onsite pits. The uranium spontaneously ignited before the metal chips ever hit the bottom of the hole and a pungent and irritating smoke enveloped us. A coworker used a front-end loader and dumped soil to cover over the fire. The reason the uranium metal caught fire is it is hydrofluoric.

During the plant upgrades CIP-CUP project, 20-foot diameter converters were hoisted by overhead cranes with pipe openings that emitted clouds of smoke. The smoke was uranium hexafluoride reacting with moisture in the air. Sometimes the smoke was so thick, you could not see the overhead crane operators. Respirators were not required. Between 1977 and 1982 I was assigned the responsibility of grinding asbestos transite to fit as covers over high-voltage electrical cable. I was not provided any personal protective equipment or air monitoring. At the end of the day when I went to the change room, my entire body was covered with white asbestos dust.

Union Carbide Nuclear Corporation knew in 1952 that the introduction of plutonium-contaminated reactor tails into the uranium enrichment process at Oak Ridge, a process similar to Paducah, may require consideration of certain changes to the health physics program, including a contamination control program.

In 1985 DOE identified a need to protect workers from exposure to transuranics. The report concluded that Paducah management, in conjunction with DOE, should conduct an exposure assessment for those workers involved in processing and recycling material at Paducah Feed Plant.

A similar recommendation was made to conduct an exposure assessment at the Portsmouth, Ohio Oxide Conversion Facility. DOE admitted no such exposure assessment was performed for the first time last week.

Another report in 1990, "Neptunium Experience at PGDP," concluded that the presence of transuranics at Paducah requires significantly different control procedures. What is clear is that the government's contractors knew the need to protect workers from plutonium and other transuranics since 1952. It took 40 years after the Union Carbide memo cited above to implement a contamination control program specifically for transuranics such as neptunium and plutonium. Because the site didn't have this basic radiation control equipment for almost 40 years, contamination of all types was tracked from building to building, into vehicles and into workers' homes.

In summary, workers are afraid of what may happen to them in the future. They have worked in conditions which exposed them to radiological and chemical contamination that have long legacy periods. These workers who served our Nation as veterans of the cold war production era must not be forgotten. The workers at Paducah and DOE sites deserve more than medical monitoring. They deserve coverage of the work force under the Federal workers' compensation system that shifts the burden of proof onto the Federal Government to demonstrate that workplace exposures didn't lead to illnesses in light of the Department of Energy's deceit and failure to monitor workers for radiation and other types of risk; and, two, health insurance coverage for all at-risk workers and their spouses.

The harm to humans must be taken as seriously as the environmental harm to dirt. Thank you, Mr. Chairman.

[The prepared statement of Jim H. Key follows:]

PREPARED STATEMENT OF JIM H. KEY, PAPER, ALLIED-INDUSTRIAL, CHEMICAL & ENERGY WORKERS INTERNATIONAL UNION

I am Jim Key, an hourly electrician at the Paducah Gaseous Diffusion Plant ("PGDP") in Paducah, Kentucky. I was hired by Union Carbide in 1974 as a laborer, and I have worked for a succession of contractors including Martin Marietta, Lockheed Martin, and most recently for the privatized USEC, Inc. Since 1989, I have served as the Environment, Safety & Health Representative for Local 5-550 of the

Paper, Allied-Industrial, Chemical and Energy Workers Union ("PACE") and its predecessor the Oil, Chemical & Atomic Workers Union ("OCAW").[1]

PACE represents approximately 850 hourly production, maintenance, environmental restoration, waste management and escort workers who are employed by USEC, Inc. Approximately 30 PACE workers who are performing waste management and cylinder management under USEC's direction are scheduled to be transitioned to the DOE's Management and Integrating Contractor, Bechtel-Jacobs LLC, on October 4, 1999.

At the outset, allow me to clarify for the record that neither I, nor PACE Local 5-550, is a party to any litigation with respect to health and safety issues at Paducah at this time.

DOE Headquarters Oversight Staff has included me in the daily out-briefs by the DOE Oversight Team when they investigated the Paducah site during the Phase I study between August 17 and September 3, 1999. It was disturbing to learn, however, that elements within DOE now want to exclude me from further participation, apparently based on the erroneous charge that I had leaked my notes from the outbriefs to the press. This is wholly inaccurate, and appears to be a function of DOE looking for a scapegoat to blame for the publicity associated with the disclosure of the Oversight team report. DOE needs to provide public assurances that a designated union representative will continue to be included in all outbriefs as the Paducah investigation continues.

1. A Fundamental Concern of Workers at Paducah

If there is one message I want the Committee to receive from the workers at Paducah, it is this:

> The majority of current and former workers are afraid that they may have been exposed to substances like plutonium without proper protection and that they will, as a result, be stricken with a fatal disease and lose their lives. I *have* this fear from my 25 years of work at Paducah.

Allow me to describe some of the working conditions and the site's historic failures to protect workers from exposure to everything from asbestos to radiation, and I think you will understand that fear.

2. Brief History of My Personal Working Conditions and Lack of Exposure Monitoring to Transuranics

URANIUM FIRES: Shortly after I was hired in 1974, I joined a group of laborers who were directed to take drum loads of uranium metal shavings from the machine shop and dump them into deep holes behind an on site (C-746) warehouse. The uranium spontaneously ignited before the metal chips ever hit the bottom of the hole and a pungent and irritating smoke enveloped us. A co-worker used a front loader and dumped soil to cover over the fire. We don't know if the fires were smothered by the soil, because we were directed to go back and get another truckload of uranium shavings which also ignited when we dumped those drums. The reason the uranium metal caught fire is that it is pyrophoric, which means that, under certain conditions, the uranium will simply self-ignite and burn. To my knowledge, this dumping ground has yet to be characterized, and is not included in the DOE's 2006 Plan for Environmental Cleanup.

URANIUM DUSTS: I worked on the Cascade Upgrade Project ("CIP-CUP"), removing and installing the large motors that drive the thousands of compressors in the enrichment process. During the disassembly process, 20-foot diameter converters were hoisted by cranes with pipe openings that were emitting clouds of smoke. The smoke was uranium hexaflouride ("UF6") reacting with moisture in the air. When this reaction occurs, uranium becomes airborne. My co-workers reported that the smoke was so thick, they couldn't even see the crane operators. Respirators were not required.

ASBESTOS EXPOSURES: Between 1977 and 1982, I was assigned the responsibility for grinding asbestos transite to fit as covers over high voltage electrical cable. I was provided no Personal Protective Equipment ("PPE") or air monitoring. At the end of the day, I went to the change room with my entire body covered with asbestos dust.

NO RESPIRATORY PROTECTION: I worked in the C-410 building which, beginning in 1953 and continuing through 1976, was used to convert plutonium-contaminated uranium, known as "reactor tails," back into uranium hexaflouride for introduction into the uranium enrichment plant at Paducah. I recall having to hold my

[1] The Local was chartered by the Oil, Chemical & Atomic Workers International Union ("OCAW") on January 21, 1953.

breath to get through clouds of unknown fumes in the C-410 building and there was no respiratory protection required.

TRANSURANICS: In the mid-1970's, I observed operators cleaning up spills of "black powder" (crushed spent reactor fuel that contained plutonium, neptunium, and technetium-99) in the C-410 Feed Materials Building. Workers were not advised on the presence of transuranics, or the need for special health physics monitoring. The first time I ever learned plutonium or neptunium was used and employees were at risk of exposure was in 1990, when Martin Marietta advised of the need for monitoring employee exposure to transuranics.

NO CONTAMINATION CONTROL: There were no formal contamination control procedures in use at Paducah until 1990. Contamination control involves the use of radiation detectors that workers pass through to make sure that they don't have contamination on their clothes, skin or shoes that they could track outside of the building. Because the site didn't have this basic radiation control equipment for almost 40 years, contamination of all kinds was tracked from building to building, into vehicles, and off-site into workers' homes.

3. DOE and Its Contractors Deliberately Failed to Protect Workers from Uptakes to Neptunium and Plutonium For Nearly 40 Years

Union Carbide Nuclear Company knew in 1952 that the introduction of plutonium contaminated "reactor tails" into the uranium enrichment process at Oak Ridge—a process similar to that at Paducah—"may require consideration of certain changes to the plant health physics program", including a contamination control program.

This March 26, 1952 Union Carbide memo, which was declassified in 1995, states, "[S]ince plutonium has a specific activity approximately 100,00 times that of uranium, it may be noted that a very much smaller mass of plutonium is required to produce a given surface or air contamination level than is necessary with uranium." The memo added: "From a radiation standpoint, plutonium is considered somewhat more toxic than is uranium with the result that the plant acceptable limit for plutonium air contamination should be lower than is the corresponding uranium limit." Additionally, the memo stated that under certain conditions it would be necessary to have specific contamination controls for plutonium, including labeling areas as "plutonium contaminated locations" and tagging equipment accordingly. (Memo attached)

Again in 1985, DOE identified the need to protect workers from exposure to transuranics. *The Joint Task Force on Uranium Recycle Material Processing* (DOE/OR-859), September 1985 concluded that "Paducah management, in conjunction with DOE, should conduct an exposure assessment (to transuranics and fission products) for those workers involved in the processing of recycled material at the Paducah Feed Plant." A similar recommendation was made to conduct an exposure assessment at the Portsmouth, Ohio Oxide Conversion Facility. We have no evidence that these recommendations were acted upon or communicated to the workforce. (Excerpt attached)

In yet another report, *Neptunium Experience at PGDP,* K/ETO-30 (September 1990), DOE's contractor concluded that "[t]he presence of transuranics [at Paducah] requires significantly different control procedures." (Excerpt attached)

What is clear is that the AEC and DOE contractors knew of the need to protect workers from plutonium and other transuranics with special safeguards as early as 1952. The need for exposure assessment to transuranics was declared in 1985. Finally, 40 years after the Union Carbide memo cited above, Martin Marietta Energy Systems commenced a contamination control program specifically for transuranics (neptunium and plutonium). The Environment, Safety and Health Information Bulletin (February 29, 1992) states: "The program demands a higher level of compliance with Health Physics Practices and lowers the acceptable limits for air and surface contamination in the plant." (Excerpt attached).

In 1990, Martin Marietta commenced a voluntary program for workers to provide a simulated 24-hour sample for transuranics. The 30 people who volunteered, however, were not necessarily those who were most at risk for transuranic uptakes, i.e. those who worked in the feed plant buildings or the enrichment process areas. Approximately 16 hourly workers were included—less than 2% of the hourly workforce.

The results were invalidated, however. On February 11, 1991, Martin Marietta Energy Systems announced it would "invalidate" the sample results due to "several concerns and discrepancies" at the contract laboratory that performed the work (memo attached). Martin Marietta asked that employees resubmit new samples, and announced that Oak Ridge National Laboratories would re-analyze samples. Only 7 workers elected to participate in the re-test—three of which were hourly. Apparent mistrust of Oak Ridge National Labs, a DOE controlled operation, was cited as a reason why far fewer Paducah workers elected to participate in the follow-up tests. To rectify the concern, the local union identified independent labs, but Martin Marietta completely rejected their use.

Results for the 7 workers were reported on July 15, 1991. All 7 reported less than detectable levels of plutonium and other transuranics. However, the results from the original 30 bioassay sample results and the written analysis of what went wrong at the contract laboratory have never been disclosed. Recently, I was told by USEC, which controls access to DOE's information, that this particular information about the 30 bioassay samples is "sensitive" and "management is reluctant to release this information due to concern about how it would be used".

If management is correct that the contract laboratory simply erred in its performance, there should be nothing to fear from the full and free examination of this data. However, such needless secrecy breeds mistrust. Perhaps, the Commerce Committee could assist in securing this data for the workers.

DOE claims that it has historically provided whole body counting machines for detecting internal dose. According to a 1993 NIOSH Memorandum[2], Paducah used the mobile in vivo monitoring system from Oak Ridge Y-12 and could only schedule exams infrequently. The detection system produced results that were "unreliable and erratic" according to NIOSH, and it was not usually possible to perform an in vivo exam immediately after a suspected uptake by a worker since the mobile system was either not on site or out of service being repaired. Since uranium processed at Paducah was typically quite soluble, "the lack of an in vivo examination on demand was a serious deficiency", according to NIOSH.

The reality of plutonium contamination in the production process did not register with the overwhelming majority of the hourly workforce at Paducah until an article appeared in the *Washington Post* on August 8, 1999. Why was the workforce in the dark when Martin Marietta had instituted a voluntary testing for transuranics in 1990? After 1990, when the term "transuranics" was introduced to the hourly workforce, a listing of specific radioactive elements, such as plutonium, was rarely included in employee communications, and when plutonium was mentioned, it was labeled as a "trace" quantity. It is true that some people received limited training on the presence of plutonium. But even today, the current basic training manuals (General Employee Training, Radiological Worker I and Radiological Worker II) that every employee must study to work at the plant do not communicate the presence of plutonium and neptunium.

5. Workers' Locker Rooms Were "Hot"

Reactor tails and feed processing stopped when the government was ordered to buy UF6 from outside vendors in the late 1970's. The so-called "feed" building (C-410) remained in use for 13 more years for support activities, such as the locker room for changing, and storage and repair of computers. Surveys of the C-410 locker area in November 1989 found lockers had up to 350,000 dpm (disintegrations per minute) of fixed contamination. The toilet and shower areas had 175,000 dpm. The computer storage area had 175,000 dpm. By comparison, the limit for off site release is 5,000 dpm for fixed contamination. At these levels, the DOE Radiation Control Manual suggests that these areas should have been posted as a "contamination area" or as a "high contamination area," and, thus, should not be used as a clean change area. Further, these surveys do not identify what isotopes were in the buildings. The reported contamination could have included some amounts of plutonium

The C-410 Feed Building was closed shortly thereafter. The C-410 building, as well as C-420 and C-340 (a uranium metals production and hydroflouric acid production building), are not adequately characterized, and no plan or funding exists for decontaminating and decommissioning. Animals have taken up residence in the C-410 building and are tracking contamination out of the building.

To the best of my knowledge, the DOE contractors did not require workers to provide bioassay samples to determine if there had been ingestion of plutonium, neptunium or other transuranics until 1991. If any sampling did occur, internal dose or burden results of these transuranics were not reported to workers. Although the union has requested it, there has been no epidemiological morbidity or mortality study at the site.

5. Current Worker Safety Problems Identified by the Oversight Team on the DOE Part of the Paducah site

The DOE oversight team made a number of observations, including:

[2] Trip Report, Paducah Gaseous Diffusion Plant, Henry B. Spitz, January 29, 1993, attached to Memorandum to File from J.H. Stebbings, NIOSH, February 8, 1993

- the air sampling process used at the site today does not ensure that air sample results are effectively used to establish the need for respiratory protection, or that the respirators now in use provide adequate worker protection.
- there has not been adequate radio-isotopic characterization, adversely impacting the effectiveness of the rad protection programs.
- radiation control procedures are generic and may need to be tailored to specific jobs and hazards.
- radiation control training doesn't adequately address radiological hazards, such as transuranics, nor do rad work permits describe the radiological hazards.

If these and other worker safety findings are validated, DOE will need to take hands-on steps to make sure that the contractor and subcontractor radiation protection programs are brought into compliance with the Price Anderson Act regulations.

The DOE team made two additional significant observations:

- Release criteria for radiologically contaminated property is not being consistently used and justified. For example, fluorine cells were sold to private industry without regard to the presence of detectable plutonium.
- DOE's oversight of contractor and subcontractor activities has been very limited

The two findings are particularly significant, as DOE has announced a program to recycle and selling a major part of the 60,000 tons of radiologically contaminated metals that are stored at Paducah. DOE is proposing to recycle 9,350 tons of radiologically contaminated nickel that has become contaminated throughout (volumetrically) with uranium, plutonium, neptunium and technetium-99.

This proposal is being made by DOE even though the NRC has not established a *de minimus* standard for releasing volumetrically contaminated metals into unrestricted, every day commerce. Every effort to permit this activity has been met with widespread public opposition from the public and the scrap-based steel industry.

The oversight team's observations raise fundamental questions about whether DOE should be trusted to control the free release of massive quantities of radioactive materials into the scrap metal market that could result in intimate human contact. This includes everyday items such as baby carriages, knives and forks, surgical implants such as hip replacements, iron tonics and eyeglass frames.

The Oak Ridge Operations Office has not conducted an intensive safety oversight review at Paducah in many years. The Paducah Plant only has 10 federal employees, and cannot be expected—given its scarce resources—to carry out a vigorous oversight program. **What the situation demonstrates is that you cannot oversee a plant the size and complexity of Paducah from 350 miles away by telephone. Yet this is how Oak Ridge manages Paducah. Congress needs to establish a Paducah Operations Office with sufficient federal staff, budget and contracting authority to manage the site.**

DOE also found that Bechtel-Jacobs' oversight of subcontractors has not been visible and effective. Consequently, the DOE observed, many DOE requirements are not being effectively implemented. This raises a red flag about DOE's embrace of the Management & Integrating contact approach—a model that DOE has touted as the wave of the future.

The DOE team found that information provided to the public has been delayed, is in forms not clearly understood by the general public and stakeholder groups, and leads to a perception that DOE and the contractor are withholding information from the public. This observation validates the experience of PACE, which has been stonewalled in its efforts to obtain basic health and safety data, such as requests for data on leukemia incidence, bioassay data, and in vivo monitoring data for Paducah workers surveyed at Fernald.

6. DOE Headquarters Oversight Efforts Have Been Inadequate

The Department of Energy's Office of Enforcement is responsible for enforcing the radiation protection regulations that were adopted pursuant to the Price-Anderson Act Amendments at 10 *CFR* Part 835. To my knowledge, they have never conducted an inspection at the Paducah Plant. DOE has only assigned 4 inspectors to cover the DOE nuclear complex nationwide. Congress needs to beef up DOE's Enforcement capacity, because DOE doesn't seem willing to do it on its own.

7. Summary

Workers are afraid of what may happen to them in the future. They have worked in conditions that have exposed them to radiological and chemical contamination that have long latency periods and can have catastrophic results. These workers—who served our nation as veterans of the Cold War production era—must not be forgotten.

Medical monitoring by independent, certified occupational physicians is needed today to identify diseases which hopefully can be caught early enough to be successfully treated. DOE's medical surveillance program needs to be expanded and funded so that any nuclear worker who wants a medical exam at Paducah, Portsmouth and Oak Ridge can obtain one. Monitoring is imperative, but without any other remedy, monitoring is simply a process to watch people get sick and die.

The workers at Paducah and other DOE sites deserve more than just medical monitoring. They deserve:

(1) coverage for the workforce under a federal workers compensation system that reverses the burden of proof onto the federal government to demonstrate that workplace exposures didn't lead to illness, in light of DOE's failure to monitor workers for radiation and other toxic risks, and

(2) health insurance coverage for all at risk workers and their spouses through retirement.

The harm to workers must be taken as seriously as is the harm to dirt. Resources must be committed the human beings who were unknowingly exposed to these many hazards.

Mr. UPTON. Thank you, Mr. Key. Mr. Jenkins.

TESTIMONY OF GARLAND E. JENKINS

Mr. JENKINS. Mr. Chairman, members of the subcommittee, good morning. My name is Garland E. Jenkins. I don't normally go by the name of Garland. People generally call me Bud. I live at 2744 Lake View Church Road, Benton, Kentucky. I'm here today to testify about conditions at the Paducah Gaseous Diffusion Plant in western Kentucky. I've never testified before a congressional committee or subcommittee before, so I hope you'll be patient with me. But I think what I have to say is important. My main concern is the safety of my fellow workers and the neighborhood.

I have lived in the Paducah area all my life, for over 30 years. The Paducah Gaseous Diffusion Plant is not a particularly beautiful place but the area around it is. The area immediately next to the site is a wildlife refuge and used frequently for hunting, fishing, et cetera. I've spent a good deal of time there myself with my family.

I have spent my whole working career at the Paducah site. I began working there in 1968 after graduating from high school and getting out of the military. I still work there. I began working there for Union Carbide. I've also worked for Martin Marietta Energy Systems, Lockheed Martin Energy Systems, Lockheed Martin Utility Services, and United States Enrichment Corporation. So I've got over 30 years' experience at the site and with its operations and working conditions.

Looking back on my experience at the Paducah site, I guess you could say it's almost hard to believe. But what I'm going to tell you is the absolute truth. I worked for a long time as one of the operators in the C-410 and C-420 plant. This plant took various kinds of uranium from outside sources, converted it chemically to black oxide, uranium dioxide, then to greensalt, or UF4, and finally to uranium hexafluoride or UF6. The UF6 was the feedstock for the enrichment cascades.

Around 1973, Union Carbide began to resume using uranium that had been recovered from spent reactor fuel. We called this stuff RT tails, or rat tails. It was pulverized into a very fine powder in Building 400 and then it come to the 410 feed plant. When it was moved to the 410 feed plant, it came to us in hoppers, with the consistency of flour, but much heavier. I know that we handled many thousands of tons of these RT tails. I know now, but didn't know then, that these RT tails were contaminated with plutonium, neptunium and other radioactive substances.

The work environment in C-410 and C-420 was awful. The air was extremely dusty with black oxide, greensalt and chemical smoke from UF6 releases. Sometimes it was difficult to breathe. Two exhaust fans blew the contaminated air outside, but as far as I am aware, these releases were not reported. We didn't use respirators unless it got so bad that breathing or seeing was impossible, so we were constantly inhaling the dust and fumes. There were no devices to measure radioactivity in the air. We wore no radioactivity protective clothing, just regular white overalls and work gloves. We ate meals in these contaminated clothes. Of course we often showered before leaving the plant, but still these were just regular showers, nothing special. So often we would still be contaminated when we got home. Bed linens in the morning would often be green or black from the black oxide and greensalt.

Waste management practices was pretty bad. Five ton hoppers of RT tails and yellowcake uranium frequently spilled, and dust would fly everywhere and eventually settle on the floor. At the end of the shift we would sweep it into a dumpster along with the regular nonradioactive trash. All would be taken to a sanitary landfill, just like regular household trash. I believe other contaminated materials were also sent to sanitary landfills. When this contaminated stuff spilled outside, we hosed it down into ditches, usually at night.

I also worked on recycling metals, such as gold, from nuclear weapons. To my knowledge, none of this gold was ever surveyed for radioactivity before it was released. This is even though the recycling operations took place in the same contaminated building where plutonium contaminated RT tails were pulverized.

There was just no effective radiation protection. We were told that the uranium substances we were working with were safe and posed no threat to our health or to the health of our families. We were told we were not getting any dose. We were even told that materials were safe enough to eat. There were no health physics professionals present in the workplace. There were no radiation warning signs or markings, no restricted areas where entry was controlled, and no radiation maps of the building. We had film badges but they weren't checked very often. There was no regular checking for uranium that we might have breathed or consumed, and it would still be in our body. Every other year or so, a truck-mounted body counter would arrive at the site to take whole body counts. I remember the technicians who ran the counter taking the readings over and over again, saying they could not believe the numbers. We were never told the results. I went to a special facility near Cincinnati once for a whole body count and was assured everything was okay but was never given the results.

These are just some of my experiences at the Paducah plant. I am not sure of what radiation dose I received over the years. I am now sure it was extremely high but I certainly don't believe the contractor's records. I've always believed what I was doing at the Paducah plant was important to the national defense. I'm proud to have played a small part in the cold war and in protecting this great country from harm. Thank you for listening to me.

[The prepared statement of Garland E. Jenkins follows:]

PREPARED STATEMENT OF GARLAND E. "BUD" JENKINS

Mr. Chairman and members of the Subcommittee, good morning. My name is Garland E. Jenkins. I don't usually go by the name Garland. People usually call me Bud. I live at 2744 Lakeview Church Road, Benton, Kentucky. I'm here today to testify about conditions at the Paducah Gaseous Diffusion Plant Site in western Kentucky. I've never testified before a Congressional Committee or Subcommittee before so I hope you will be patient with me. But I think what I have to say is important. My main concern is the safety of my fellow workers, past and present, the safety of their families, and the safety of my neighbors.

I've lived in the Paducah, Kentucky area for over thirty years. The Paducah Gaseous Diffusion Plant itself is not especially beautiful. But the area around it, and western Kentucky, is nice. The area immediately next to the Site is a wildlife refuge and is used frequently for hiking and fishing. I've spent a good deal of time there myself with my family.

I've spent my whole working career at the Paducah site. I began working there in 1968 after graduating from high school and serving in the military. I still work there.

I began there working for Union Carbide. I've also worked for Martin Marietta Energy Systems, Lockheed Martin Energy Systems, Lockheed Martin Utility Services, and U.S. Enrichment Corporation. So I've got over thirty years experience at the Site, and with its operations and working conditions.

Looking back on my experience at the Paducah Site, I guess you could say it's almost hard to believe. But what I'm going to tell you is the absolute truth. I worked for a long time as one of the operators in the C 410 and C 420 feed plant. This plant took various kinds of uranium from outside sources and converted it chemically to black oxide (or uranium dioxide), then to greensalt (or UF4), and finally to uranium hexafluoride (or UF6). The UF6 was the feedstock for the enrichment cascades. Around 1973, Union Carbide began to resume using uranium that had been recovered from reactor spent fuel. We called this stuff RT tails, or "rat tails." It was pulverized into a very fine powder in Building C 400, where I have also worked. Then it was moved to the feed plant. It came to us there in 5-ton hoppers, with the consistency of flour, but much heavier. I know that we handled many thousands of tons of these RT tails while I was there. I know now, but didn't know then, that these RT tails were contaminated with plutonium, neptunium, and other radioactive substances.

The work environment in C 410 and C 420 was awful. The air was extremely dusty with black oxide, greensalt, and chemical smoke from UF6 releases. Sometimes it was difficult to breathe. Two exhaust fans blew the contaminated air outside, but as far as I am aware these releases were not reported. We didn't use respirators, unless it got so bad that breathing or seeing was impossible, so we constantly inhaled the dust and fumes. There were no devices to measure radioactivity in the air. We wore no radiological protective clothing, just regular white overalls and work gloves. We ate meals in these contaminated clothes. Of course, we often showered before leaving the plant, but these were just regular showers—nothing special. So often we'd come home still contaminated. Bed linens in the morning would often be green or black from the black oxide and greensalt.

Waste management practices were also pretty bad. Five ton hoppers of RT tails and yellowcake uranium frequently spilled, and dust would fly everywhere and eventually settle on the floor. At the end of the shift we would sweep it up into a dumpster along with the regular non-radioactive trash. All would be taken to the sanitary landfill just like regular household trash. I believe other contaminated material was also sent to sanitary landfills. When this contaminated stuff spilled outside, we'd hose it down into a ditch, usually at night.

I also worked on recycling metals, such as gold, from nuclear weapons. To my knowledge, none of this gold was ever surveyed for radiation before it was released. This was so even though the recycling operations took place in the same contaminated building where the plutonium contaminated RT tails were pulverized.

There was just no effective radiation protection. We were told that the uranium substances we were working with were safe and posed no threat to our health, or to the health of our families. We were told we were not getting any "dose". We were even told the materials were safe enough to eat. There were no health physics professionals present in the workplace. There were no radiation warning signs or markings, no restricted areas where entry was controlled, no radiation maps of buildings. We had film badges, but they weren't checked very often. There was no regular checking for uranium we might have breathed or consumed, and would still be on our bodies. Every other year or so a truck-mounted whole body counter would arrive at the Site to take whole body counts of some of the workers. I remember the technicians who ran the counter taking the readings over and over again, saying they didn't believe the numbers. But we were never told the results. I went to a special facility near Cincinnati once for a whole body count, and was assured afterwards that everything was fine.

All this about lack of safety precautions was true, even though, as I know now, the RT tails we were working with and breathing were contaminated with radioactive plutonium, neptunium, and technicium.

These are just some of my experiences at the Paducah Site. I'm not sure what radiation dose I received over the years. I'm now sure that it was extremely high. I certainly don't believe the contractor records, but even those show my dose exceeding federal limits. About five years ago, I had to have the lower part of my esophagus replaced surgically with a plastic tube because of corrosive damage there. I've been told by my doctor that there is a 99% chance that the situation will become cancerous.

I've always believed what I was doing at the Paducah Plant Site was important to the national defense. I'm proud to have played a small part in the Cold War and in protecting this great country from harm. But if I had to do it all over again, I'd be much less trusting of what my contractor bosses were telling me. I probably wouldn't have worked there at all, knowing what I now know. Many of my good friends are dead, or dying. I always wonder whether Plant conditions caused their sicknesses and deaths.

I want to do what I can to make sure that conditions at the Site are improved.

You know, we trusted the contractors when they told us everything was OK, that we weren't getting any dose, and that none of the RT tails or other stuff was dangerous. We trusted them to record our doses correctly and tell us if we were in trouble. I'm darn mad that these big corporations used us to earn huge fees from the Government for so-called good safety performance. I think we should make them pay some of this back. The whistleblowers have agreed to give half of any recovery we get in the qui tam lawsuit to the Natural Resources Defense Council for protection of the environment.

Thank you for listening to me.

Mr. UPTON. Thank you.

Mr. Fowler.

TESTIMONY OF RONALD B. FOWLER

Mr. FOWLER. Good morning. My name is Ronald B. Fowler. I am a Section Manager for Training and an Applied Health Physicist employed by the United States Enrichment Corporation at the Paducah Gaseous Diffusion Plant. I have worked at the site since 1991; most of that time for my previous employers, Lockheed Martin Utility Systems and its predecessor, Martin Marietta Utility Systems.

I am a health physicist. Health physics is the profession responsible for protecting workers and the public from excessive and unnecessary exposure to radiation. Health physics is supposed to be a rigorous part of every nuclear facility in this country. Prior to coming to Paducah, I worked as a health physicist for several commercial nuclear power plants. I am certified by the National Registry for Radiologic Technologists. I have extensive experience and training in applied health physics. I have trained numerous other health physicists throughout the nuclear industry. Earlier in my career, I developed a series of health physics and reactor training videos that have been widely distributed throughout the industry. I have received numerous awards, commendations, and promotions in my work. My resume is attached to my written testimony.

When I first arrived at Paducah in 1991, I was astounded. I discovered that there was essentially no health physics program at this site, and the situation had apparently persisted for 37 years.

This was all the more surprising in that the Paducah plant deals with extremely high levels of radioactive particulates compared to a commercial nuclear power plant. That generally means more protection is required, not less, especially to guard against the inhalation and possible ingestion. To protect workers and the public, there are certain things that are part and parcel of any proper health physics program—in these circumstances, access controls, placarding, radiation maps, airborne monitors, detailed exposure records, thermoluminescent dosimeters, effluent controls and monitors, radiation training, radiation protective clothing, and a trained health physics staff. These things, however, were virtually nonexistent or severely lacking at the Paducah facility.

I was hired to help Paducah develop a health physics training program. Needless to say, I was not a popular person among management. I kept pointing out many serious defects and infractions in the health physics area. For years, it was like scooping water out of the ocean. I was bucking a management culture that had told workers for decades there were no health risks at Paducah, the radiation will not harm you, and that you could eat radioactive particulate substances commonly used at the site; that regulations are for other facilities but not Paducah; that production takes place over precedence, over health.

What I was not told about at the time, and I only discovered much more recently, was just how widespread and significant the transuranic contaminants like plutonium and neptunium in the environment were in and around the site. I was unaware of tens of thousands of tons of plutonium-contaminated feedstocks that had been brought to the site for years for processing. Had I known this initially, my concerns would have been compounded manyfold, as they are today.

I became a whistleblower when I was told the plant security force had begun posting my picture with a bullet hole through my forehead. Security guards began following me wherever I went. They intentionally damaged my vehicle. This scared me and my wife to death. I had already been denied promotions, and management was taking other actions to harass and intimidate me for my continuing reporting of defects. I wanted to leave the facility, but I have a wife and a sick mother-in-law I have to support.

Last year, I went to a law firm in Washington staffed by nuclear engineer attorneys. They assisted me in preparing a complaint to the Department of Labor. This was not a health physics complaint but a plain white harassment and intimidation complaint. Ironically, we offered Lockheed and USEC to settle my complaint with me by my retiring early. They refused, calling my concerns insignificant. In retrospect, it is perhaps fortunate for all of the Paducah workers and residents that they did this, because later on I found documents showing significant offsite contamination of plutonium. My attorneys found this extremely curious and they contacted Dr. Cochran of the Natural Resources Defense Council. They also consulted with other technical experts. Plutonium was not supposed to exist in any significant quantities at a uranium enrichment facility. They visited me with Dr. Cochran and toured the site. They asked me to attempt to locate other documents showing onsite and offsite contamination. I searched some of the document files earlier this year, and I was truly astonished at what I found.

With the assistance of my colleague, Chuck Deuschle, I found the results of radiological surveys taken on- and offsite in the 1990's showing activity levels literally tens of thousands of times higher than background levels of radiation. There were dozens of samples of plutonium and neptunium found in ditches offsite, some more than 100 times the Nuclear Regulatory Commission's release limit. There were radiological surveys of common work areas showing radiation tens to thousands of times higher than the prescribed action levels, in areas like the cafeteria, the kitchen, locker rooms, storage rooms and the parking lots. There were indications of radioactive wastes going into sanitary landfills offsite, of lagoon-like sludge containing plutonium nearly 2,000 times the level of NRC release limits.

As a health physics training manager, I had never been told of these very serious radiological conditions. These findings were squarely at odds with annual environmental reports prepared by my superiors stating all laws, regulations, and DOE orders were fully complied with. Needless to say, most of the workers were also in the dark.

Now, like many of my colleagues and Paducah neighbors, I'm downright scared. I have shed real tears over the many friends and colleagues at the site who were deceived and now, like Mr. Jenkins, suffer real health consequences. I worry constantly about the recreational users of nearby Kentucky and Federal recreation areas who continue to engage in activities on contaminated land and waters. I recently asked for my radiation dose records from Paducah and received a supposed dose history reporting that I had received no dose whatsoever for all but two of the more than 30 quarters I have worked at the site. These records are clearly fraudulent.

On virtually a weekly basis, even now, I continue to report health physics and other safety infractions to management. Those infractions have continued, right up to the present month. Even last April, I noticed unplacarded trucks with uranium hexafluoride cylinders parked in downtown Paducah in an unsecured open lot, with children on bicycles riding freely among them. It is only recently that I view my reports as something less than futile.

I would like to thank Secretary Richardson for the safety standdown he ordered at the site. It was the very first sign that somebody in authority is finally paying attention to the workers and the people of Paducah. There is a long way to go. In my view, the government owes it to the Paducah workhorse to demand proper rad controls, to clean up the site and surrounding environs, and to monitor the workers' health. I believe those at fault should pay for these efforts and should compensate the workers.

Finally, the government owes it to the workforce to participate in the necessary cleanup so as to preserve the jobs. Thank you very much.

[The prepared statement of Ronald B. Fowler follows:]

PREPARED STATEMENT OF RONALD B. FOWLER

Good Morning. My name is Ronald B. Fowler. I am a Section Manager for Training and an Applied Health Physicist employed by the United States Enrichment Corporation at the Paducah Gaseous Diffusion Plant. I have worked at the site since

1991, most of that time for my previous employers, Lockheed Martin Utility Systems and its predecessor Martin Marietta Utility Systems.

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With the assistance of my college Chuck Deuschle, I found the results of radiological surveys taken on and off-site in the 1990s showing activity levels literally tens of thousands of times higher than background levels of radiation. There were dozens of samples of plutonium and neptunium found in ditches offsite, some more than 100 times the Nuclear Regulatory Commission's release limit. There were radiological surveys of common work areas showing radiation tens to thousands of times higher than the prescribed action levels for the plant, in areas like the cafeteria, the kitchen, locker rooms, storage rooms, and in parking lots. There were indications of radioactive wastes having gone into the sanitary landfills off-site, of lagoon sludge containing neptunium more than 2000 times the level of NRC release limits. As a health physics training manager, I had never been told of these very serious radiological conditions. These findings were squarely at odds with annual environmental reports prepared by my superiors stating that all laws, regulations, and DOE Orders were being fully complied with. Needless to say, most all of the workers were also in the dark.

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There is a long way to go. In my view, the government owes it to the Paducah workforce to demand proper radiological controls, to clean up the site and surrounding environs, and to monitor the workers' health. I believe those at fault should pay for these efforts, and should compensate all workers. Finally, the government owes it to the workforce to participate in the necessary cleanup, so as to preserve jobs.

Thank you for your interest in these matters.

Mr. UPTON. Thank you.

Mr. Graves.

TESTIMONY OF M. BRAD GRAVES

Mr. GRAVES. Good morning. My name is Brad Graves, I'm an employee with Lockheed Martin Energy Systems. Due to the timeframe of my invitation, a written statement had been waived in my case, so I will be reading from notes here. Please forgive me. It is important to note that I am not a relator in this particular action, however I am here to provide information relative to the radiological conditions at the Paducah site while I was there.

I have been nationally registered by the National Registry of Radiation Protection Technologists and I'm comprehensively certified by the American Board of Health Physics in this practice. As such, a lot of my information that I present to you will probably be technical in nature. If I use units that you don't understand or if I say things that you have confusion about, please ask me to repeat. I will be happy to.

Thank you for your invitation and your time gentlemen, ladies.

Mr. UPTON. Thank you.

Dr. Cochran.

TESTIMONY OF THOMAS B. COCHRAN

Mr. COCHRAN. Mr. Chairman, thank you for the opportunity to appear before your committee to discuss the health and safety problems at Paducah. My name is Thomas B. Cochran, I'm the Director of the Nuclear Program at the Natural Resources Defense Council.

After hearing from Mr. Jenkins and Mr. Fowler and the other witnesses, I don't think you need to hear from me, but I'm going to take this opportunity in any case. I have four brief messages I want to leave with the committee. As Mr. Jenkins had said, we are here because we are concerned about the health and safety of the workers at Paducah and the citizens living near the plant.

Second, the problems we are addressing are current. They are not just problems of the past. While the situation has improved in recent years, basic worker protection problems persist. Contractors are violating basic radiation protection regulations as we speak. The mind-set that has led to the deaths and illness of workers such as Joe Harding from past exposures persist at the Paducah plant and unnecessary deaths and illnesses will continue unless there is a radical change, a sea change, in the culture of plant management.

Third, the levels of exposure and contamination at the facility and offsite are not insignificant as some have suggested. The levels in some cases are well above regulatory limits. Moreover, it has been a basic tenet of the health physics profession since 1949 that for prudence, it is an obligation to keep radiation exposures as low as reasonably achievable in light of economic and technical and practicality considerations. This ALARA regulation is embodied in EPA regulations, NRC regulations, DOE orders, it is a basic tenet of the profession, and it is not being applied properly at the Paducah plant today.

Fourth, the Federal Government, the State of Kentucky, and its citizens and workers at Paducah have been lied to. As a consequence, we do not know how bad the situation really is. An independent investigation is needed.

In the Paducah case, the qui tam case under the False Claims Act and the issues before this committee involve four categories of health and safety issues. First, excessive exposure and poor or unlawful control of radiation exposure to workers; excessive releases and insufficient or unlawful control of radioactivity released offsite; third, unlawful disposal of radioactive wastes; and, fourth, improper recycling into commerce of scrap materials contaminated with radioactivity.

With regard to the first, there is an appalling lack of health physics protection for workers at the Paducah plant. Until the late 1980's, the plant had no professional health physics program. Workers were neither advised of the hazards of working with uranium nor monitored for exposure to uranium and other radioactive isotopes. The workplace was not properly monitored and lacked the proper controls over contaminated spaces. Clearly the plant managers were grossly violating DOE worker safety regulations.

This week I interviewed a former plant worker who left the site in 1992 after working there for 39 years. He was completely uninformed about even the most basic health physics concepts that workers are required to know. He said to me, "It's all Greek to me."

Most or some of these deficiencies were confirmed by a recent DOE audit which led to the Secretary of Energy ordering a 24-hour stand-down at the plant while the work force received additional health physics training. Indeed, my review of DOE's auditors' findings this week led me to believe that the factual allegations of our lawsuit are being affirmed in most of their key particulars. The audit also illustrates that the problem is a current problem and not just a historic one. The worker conditions would be bad enough had the uranium been the only significant radioactive element present at the plant. We now know that 100,000 tons of feedstock contaminated with fission products and transuranic elements were processed at the plant.

We respectfully request Congress to ensure that a competent, independent firm systematically search the historical records at Hanford, Paducah, Savannah River and Oak Ridge for information on the contamination levels of this recycled uranium feed, including how the contamination levels changed over time. We also respectfully request that Congress immediately demand that DOE order its staff and its contractors at the Paducah, Portsmouth, and Oak Ridge gaseous diffusion plants to maintain the integrity of any physical and electronic evidence at these plants as well as any documentation and electronic files that could be useful to reconstruct worker exposure and contractor and DOE culpability.

From my visit to the Paducah plant earlier this year, I found areas outside the security fence that were contaminated with radioactivity and not properly labeled. The public had access to areas that are or may be contaminated with radioactivity in excess of appropriate levels. These areas should no longer be used for recreational purposes without a comprehensive offsite characterization, access controls, proper placarding and marking and removal of radioactive sources at a minimum. The lack of protective measures I witnessed offsite, given what I presently know, was astounding. There is an inadequate effort by the Paducah Gaseous Diffusion Plant management to minimize the transport of radioactivity offsite by controlling the flow of contaminated water offsite via numerous ditches. We now know from DOE auditors that the sampling data reported to DOE by the contractors apparently omitted fugitive emissions from the plant which may have amounted to thousands of kilograms of contaminated material.

Together with the onsite conditions, these violations indicate that the contractors at Paducah have been and are today operating in callous disregard for the basic tenets of the health physics profession by failing to keep exposures to radiation as low as reasonably achievable, taking into account technical, practical and economic considerations. Uranium is a carcinogen. It is also chemically toxic. It will destroy your kidneys if you get too much uranium in your kidneys. It is unwise and unlawful to expose people to uranium unnecessarily, and one is not permitted to release it into the accessible environment indiscriminately.

Congress should investigate whether the cleanup contractor systematically performs and documents ALARA analyses before undertaking significant decontamination efforts at the site. According to workers at Paducah, including the other relators, the contractors illegally buried materials contaminated with radioactivity offsite, including what has been characterized as a sanitary landfill. The recent discovery of radioactive black ooze represents another unlawful offsite dump. Most importantly, and this is attached to my testimony, a Kentucky police investigator reportedly found criminal dumping activity at an around the site in 1991. And DOE contractor personnel were reportedly told by their contractor bosses that if they did not dump radioactivity wastes illegally onto Kentucky land, they would be fired.

This demands a thorough investigation. Was DOE aware of this? Was the report followed up? If not, why not? Is a new criminal investigation warranted? With DOE's approval, radioactive wastes that have been dumped offsite illegally are apparently now being shipped to a site, EnviroCare of Utah, that obtained its license to operate and amendments to its license during a time in which its owner paid the top regulatory official in Utah more than $600,000 in cash, gold coins and a ski condominium.

The Department of Energy apparently believes it is appropriate to continue to enrich this owner with taxpayer funds so long as he merely declines to participate in the day-to-day management of his company.

Apparently, enormous quantities of radioactively contaminated steel, nickel, aluminum and significant quantities of contaminated gold and possibly silver were recycled by the contractors into the streams of commerce. This problem persists today. The Department of Energy is subsidizing—subsidizing—the recycling of thousands of tons of radioactively contaminated scrap metal from the former nuclear weapons plant at Oak Ridge, one of the sister plants to the Paducah plant.

In a recent court decision, a Federal district judge expressed serious concern that the potential for environmental harm is great, especially given the unprecedented amount of hazardous materials the DOE contractor seeks to recycle. The DOE office responsible for the oversight of the Paducah plant is also overseeing this Oak Ridge recycling project. The last thing DOE should be doing is subsidizing the dumping of its nuclear wastes into commercial products.

I urge you, Congress should pass legislation that precludes the recycle of radioactively contaminated materials when they may come into imminent human contact. We have suggested and we believe the evidence does and will continue to show that DOE, notwithstanding its own shortcomings, was seriously misled by the contractors operating the Paducah facility and site. We hope the government will seize the opportunity to hold the contractors accountable for what surely will be a massive and massively expensive cleanup and worker monitoring and compensation project.

The taxpayers should not have to foot this bill. It is my understanding that DOE indemnity provisions for contractors do not apply in cases of contractor misconduct, such as the case here.

Thank you, Mr. Chairman.

[The prepared statement of Thomas B. Cochran follows:]

PREPARED STATEMENT OF THOMAS B. COCHRAN, DIRECTOR, NUCLEAR PROGRAMS, NATURAL RESOURCES DEFENSE COUNCIL, INC.

My name is Thomas B. Cochran. I am Director of the Nuclear Program and hold the Wade Greene Chair for Nuclear Policy at the Natural Resources Defense Council, Inc. ("NRDC"). NRDC is a national environmental public-interest organization with over 400,000 members that has been extensively involved in monitoring the environmental activities of the U.S. Department of Energy's ("DOE's") nuclear weapons complex. I am one of four relators in the civil action filed against Lockheed Martin Corporation, et al. under the qui tam provisions of the False Claims Act related to these DOE contractors' operation of the Paducah Gaseous Diffusion Plant ("Paducah GDP"). A summary of my qualifications are set forth in the front of my *qui tam* disclosure statement, which I submitted to the committee with exhibits in response to a subpoena *duces tecum.*

Summary of the Issues Surrounding the Paducah Case

The Paducah case involves four categories of health and safety issues:

a) excessive exposure and poor or unlawful control of radiation exposure of workers;
b) excessive releases and insufficient or unlawful control of radioactivity released off-site;
c) unlawful disposal of radioactive wastes; and
d) improper recycling into commerce of scrap materials contaminated with radioactivity.

In association with each of these categories of health and safety issues:

i) the contractors at the Paducah GDP have engaged in systematic falsification of reports to the Federal and State governments and to the public; and
ii) the Department of Energy ("DOE") relied too much on what its contractors were telling it, and obviously failed to provide adequate oversight of those contractors.

Finally, there is a need for Federal legislation to prevent similar abuses in the future.

Next, I will briefly summarize the health and safety issues.

Excessive Exposure and Unlawful Control of Radiation Exposure of Workers

There has existed at the Paducah GDP an appalling lack of health physics protection for workers. For many years, the plant apparently had no professional health physics program. Workers were not properly advised of the hazards of working with uranium, particularly uranium in particulate and gaseous form. Workers were not properly monitored for exposure to uranium and other radioactive isotopes. The workplace was neither properly monitored nor were there proper controls over contaminated spaces. Clearly, the plant managers were grossly violating DOE Orders and the basic health physics tenet to keep radiation exposures "as low as reasonably achievable" ("ALARA"). (*See* Appendix A of my Disclosure Statement) This week, I interviewed a former plant worker who left the site in 1992 after working there for 39 years. He had never heard of the terms "ALARA," "as low as reasonably achievable," "as low as practical," or "ALAP." "It's all Greek to me," he said of the concept.

Some of the more telling pieces of evidence of the appalling working conditions at the plant are:

a) reports that the bed sheets of workers turned green from the radioactive uranium tetrafluoride (UF4, or "greensalt") that was carried home on their clothing and bodies;
b) reports by workers of conditions in buildings where chemical conversion activities took place—where they worked without respirators in rooms densely filled with radioactive dust;
c) extremely high measurements of uranium deposited in the bones of Mr. Joe Harding, a deceased worker whose bone tissues was assayed after his death;
d) reports of lunchrooms, locker rooms, computers, and kitchens significantly contaminated with radioactivity; and
e) reports that uranium concentrations in sanitary sewage at the site were so high that a special project (Project GLIT) was instituted to recover uranium from sewage sediment.

While health physics conditions at the plant may have improved somewhat in recent years, my observations at the site, my review of documents, and my discussions with the other relators indicate that the Paducah GDP's managers still are not complying with DOE Order 5400.5, 10 C.F.R. Part 835, or following the rudiments of good health physics practices. In fact, based on my discussions with the other relators the following deficiencies are noted:

i) Monitoring of workers for internal exposure to radioactivity is inadequate. The frequency of urine, fecal and perhaps whole-body counts is inadequate to reliably establish worker exposure. Workers are not properly advised of their radiation exposure, and in any case, historical exposure records would be erroneous and incomplete because of the failure to adequately monitor for internal and external exposure. Documents reveal shocking inadequacies as recent as this month.
ii) Some areas within the security fence that are excessively contaminated with radioactivity are not properly marked and secured as radiation-controlled areas, and there is no health physics program in place to control adequately the movement of workers into and out of controlled areas.

iii) There is inadequate monitoring and control of personnel and vehicles leaving the site to prevent or limit the transport of radioactivity off-site.
iv) Radiation survey instruments are not adequately calibrated.
v) There are insufficient numbers of certified health physicists and trained health physics technicians on site and inadequate and in some cases inappropriate supervision of the technicians.

Some or most of these conditions appear to have been confirmed by a recent DOE audit that led to the Secretary of Energy ordering a 24 hour stand down at the plant while the workforce received additional health physics training. Sadly, if the Secretary thinks he can solve the worker health problems in 24 hours he is being very ill-advised by his staff, or is offering up a political rather than a substantive fix. Indeed, my review of DOE's auditors' findings this week lead me to believe that the factual allegations of our lawsuit are being affirmed in most of their key particulars. The audit also illustrates that the problem is a current problem, and not just a historic one.

These worker conditions would be bad enough had uranium been the only significant radioactive element handled at the plant. A report in Nuclear Fuel, March 16, 1992, summarizing from a Martin Marietta report, indicated that 101,268 tons of feedstock were brought to the Paducah GDP site principally from Hanford, but also from DOE's Savannah River Site. This feed was separated uranium recovered from processing at Hanford and Savannah River irradiated production reactor fuel. This uranium was contaminated with fission products as well as neptunium, plutonium and other transuranic isotopes.

This material, according to Martin Marietta, was found to be far more contaminated than commercially reprocessed reactor fuel—which itself is generally significantly contaminated. For example, the report notes that between 175 and 700 times the levels of technetium-99 that are found in commercially reprocessed fuel were found in the Paducah GDP feedstock material. Concentrations of transuranics (principally plutonium and neptunium) were measured at 20 to 450 times the levels normally found in reprocessed fuel.

There were four chemical separation plants (B, T, REDOX and PUREX) at Hanford. These used at least three separate chemical separation processes, each of which went through modifications and upgrades. Therefore, it is safe to assume that over the years there were improvements in the capability to separate out radioactive contaminants from the uranium. In fact, the first chemical separation technique did not even separate the uranium from the fission products. This was only done later when improved processing techniques became available.

We respectfully request Congress to ensure that a competent independent firm systematically searches the historical records at Hanford, Paducah, Savannah River, and Oak Ridge for information that could shed light on the contamination levels of this recycle uranium feed and on how the contamination levels changed over time, and who was responsible for sending highly contaminated and unfit recycled spent reactor fuel feedstocks to Paducah.

It would also be possible to obtain additional useful information by sampling the residual contamination in the most contaminated chemical processing buildings at the Paducah GDP. I was appalled to learn that Bechtel-Jacobs, DOE's cleanup contractor, may have destroyed some of the most valuable evidence by recently washing down some of the contaminated processing buildings' walls in order to avoid the inconvenience and expense of providing building workers with proper respiratory protection. Reportedly, outside personnel have recently been interviewed to assist in destroying some files at the site, although I do not know the relevance of these files to the issues we have raised. **In any case, we respectfully request the Congress to immediately demand that DOE order its staff and its contractors at the Paducah, Portsmouth and Oak Ridge GDPs to maintain the integrity of any physical and electronic evidence at these plants, as well as any documents and electronic files that could be useful in reconstructing worker exposures and contractor and DOE culpability. Congress should do the same with regard to the Nuclear Regulatory Commission ("NRC") in its regulatory oversight capacity over USEC.**

Excessive Releases and Unlawful Control of Radioactivity Off-Site

I visited the Paducah GDP site earlier this year, on February 24-25, 1999. This visit revealed the sub-standard circumstances that are in violation of DOE health and safety requirements. I found the following:

a) Areas outside the security fence that are contaminated with radioactivity were not properly labeled and the public had access to areas that are, or may be, contaminated with radioactivity in excess of appropriate levels.

b) Significant areas of the off-site environs around the Paducah GDP are generally contaminated with radionuclides and should no longer be used for recreational purposes without a comprehensive off-site characterization, immediate access controls for radiologically contaminated areas, proper placarding and marking, removal of radioactive sources, and remediation of streams, ponds, and sediment banks, at a minimum. The lack of protective measures I witnessed off-site (given what I know is present on-site) is astounding.

c) There is inadequate effort by Paducah GDP management to minimize the transport of radioactivity off-site by controlling the flow of contaminated water off-site via numerous ditches.

On February 25, 1999, I took radiation measurements and collected sediment samples in publicly accessible areas outside of the Paducah GDP security fence. Most of the radiation measurements that I took in the environs around the Paducah GDP, outside the security fence, were at or near background levels. A few readings were higher than background. Inside a section of concrete culvert sitting on top of the ground in an area accessible to the public, I measured radiation levels that were between 10 and 20 times background. I did not determine whether the radioactivity, the source of this radiation, was easily removable or fixed.

I also collected 12 sediment samples in areas accessible to the public. An analysis of these samples indicated that the U-238 (i.e., depleted uranium) concentration in various ditches in publicly accessible unmarked areas was found to be between 10 and 80 times background or between 0.3 and 2.5 times the Nuclear Regulatory Commission's ("NRC's") draft release criteria for decontamination of a site. The high end of this range is comparable to the concentration one might encounter in phosphate ores containing uranium.

The measurements I took are not inconsistent with earlier recorded off-site readings presented in the *qui tam* disclosure statement of Mr. Deuschle (See Deuschle's Exhibits 3 and 4), one of the other relators, though many substantially higher readings are recorded in past data. The data indicate contamination levels in off-site sediment (through at least 1994) that far exceed federal requirements for plutonium, neptunium, thorium, uranium, and technetium, at a minimum. The data show plutonium-239 measurements of up to 240 pCi/g, exceeding the NRC standard by a factor of 127, and neptunium-237 measurements of up to 63 pCi/g, exceeding the NRC standard by a factor of 335.

I regard the soil data for the actinide isotopes as particularly troubling in one respect, because these heavy isotopes like plutonium-239 and neptunium-237 are not generally mobile and do not generally migrate in water as easily as many other isotopes. The high readings off-site suggest to me that relatively large quantities of such isotopes must have been deposited through effluent releases. Slow migration would suggest such contamination may be present for many, many more years. The isotopes are generally very long-lived as well. Neptunium-237 has a half-life of 2.14 million years. Plutonium-239 has a half-life of 24.4 thousand years. While technetium generally passes relatively quickly through the body, plutonium is one of the more toxic isotopes, and is a bone and liver seeker in humans.

There is no question that readings of the levels disclosed by Mr. Deuschle would require immediate posting, and should have led to prompt removal or remediation in many circumstances. Had the contractors been in compliance with DOE Order 5400.5 pertaining to ALARA, it is unlikely that these contamination levels would have occurred. Even if significant releases had occurred due to some unforseen event, once detected through an adequate health physics program, immediate steps would have been undertaken to minimize further releases and obviate these high contamination levels.

I have reviewed numerous documents prepared by Lockheed Martin or Martin Marietta for DOE suggesting that the maximally exposed individual off-site from Paducah GDP operations could expect to receive no more than 100 millirems, and, indeed, a far lesser number (in some cases only 2 millirems) in any year. In my opinion, which I believe any respectable nuclear scientist would concur in, the actual measurements recorded, though not subsequently reported, suggest that the maximally exposed public individual could have received over 100 millirems per year. Moreover, the contractor is required by DOE Orders to maintain exposures as far below 100 millirems per year as is reasonably achievable. Lockheed Martin and the previous Paducah DGP contractors were clearly in violation of this ALARA requirement. We now know from DOE's auditors that the sampling data reported to DOE by the contractors apparently omitted "fugitive" emissions from the plant, which may have amounted to thousands of kilograms of contaminated material.

The risks to the general public due to these off-site releases are considerably less than the risks to the workers from on-site exposure to radioactivity. Nevertheless, these off-site releases are in clear violation of DOE Order 5400.5, which requires that radiation exposures be ALARA. Together with the on-site conditions these violations indicate that the contractors at Paducah have been and are today operating in callous disregard for the basic tenets of the health physics profession, and are failing to keep exposures to radiation as low as reasonably achievable taking into account technical, practical and economic considerations.

Uranium-238, the predominant radioisotope at Paducah, is not the most hazardous radioisotope either on the basis of mass (i.e., gram for gram) or specific activity (i.e., curie for curie). However, it is carcinogenic. It is unwise and unlawful to expose people to uranium unnecessarily, and one is not permitted to release it into the accessible environment indiscriminately. Congress should investigate whether an ALARA analysis was performed and documented, for example, before contaminated buildings were recently hosed down at the site. How did Bechtel-Jacobs dispose of the contaminated water? Was it processed, or dumped into the sewer or ditches?

There is the separate but related issue of off-site atmospheric emissions of radioactivity. Since I do not have firsthand knowledge of these matters I place the following in the category of issues that call for thorough investigation:

a) There are accusations that there were massive releases of radioactivity to the atmosphere that typically occurred at night.
b) Reportedly, the air monitoring stations around the Paducah GDP that were operated by the State of Kentucky were turned off during a recent period for lack of money. This also calls into question the adequacy of the State's monitoring of ditches and streams that received liquid effluent from the Paducah GDP.
c) There was reportedly a high and unexplained reading at an air monitor at a nearby high school as recently as last fall.

Unlawful Disposal of Radioactive Wastes

According to workers at Paducah, including the other relators, the contractors illegally buried materials contaminated with radioactivity off-site, including in what has been characterized as a "sanitary landfill."

In *The Washington Post*, August 29, 1999, it was reported that just outside the so-called "sanitary landfill" workers recently discovered radioactive "black ooze" seeping from the ground where a drilling rig had become stuck in the soft earth. DOE denies that this is related to the landfill. If that is true, it suggests a second unlicensed, unlawful, radioactive waste dump off-site in the area. There are probably more. Again, a thorough investigation is needed. The landfill should be adequately sampled with core samples.

Documents obtained by our attorneys (see Attachment No. 1) reveal that a Kentucky police investigator reportedly found criminal dumping activitiy at and around the site in 1992, and DOE contractor personnel were reportedly told by their contractor bosses that if they did not dump radioactive wastes illegally onto Kentucky land they would be fired. This demands a thorough investigation. Was DOE aware? Was the report followed up? If not, why not? Is a new criminal investigation warranted?

With DOE's approval, radioactive wastes that have not been dumped off-site illegally are apparently now being shipped to a site—Envirocare of Utah, Inc.—that obtained its license to operate during a time in which its owner payed the top regulatory official in Utah more than $600,000 in cash, gold coins, and a ski condominium. DOE apparently believe it is appropriate to continue to enrich this owner with taxpayer funds so long as he merely declines to participate in the day-to-day management of the company.

Unlawful Recycling into Commerce of Scrap Materials Contaminated with Radioactivity

Apparently enormous quantities of radioactively contaminated steel, nickel, aluminum, and significant quantities of contaminated gold (and possibly silver) were recycled by the contractors into the stream of commerce. This was apparently done a) without adequate monitoring of the radioactive contamination remaining in these recycled materials; b) without adequate DOE or national radiation protection standards for limiting the permissible volumetric contamination of the recycle material; and c) without an ALARA analysis and documentation of the same.

This problem persists today. As part of a $238 million contract with BNFL, Inc., the DOE is subsidizing the recycling of thousands of tons of radioactively contaminated scrap metal from a former nuclear weapons plant in Oak Ridge, Tennessee. Since last October BNFL has been recycling radioactive scrap metal and selling it for use in commercial products such as cookware, orthodontic braces, medical devices, and children's toys; some 100,000 tons of scrap metal will be recycled.

The DOE contract protects BNFL from fluctuations in market prices of scrap aluminum, copper, and nickel by requiring DOE to cover 80% of BNFL's losses when market prices drop below 95% of the contract baseline price for the metals. According to a BNFL estimate, under recent market conditions, this would result in a $9 million DOE subsidy for the recycling of 6000 tons of nickel alone.

DOE's subsidy violates DOE, Environmental Protection Agency, and Nuclear Regulatory Commission requirements that public exposure to radiation be "as low as reasonably achievable." DOE's artificial support of radioactive metals recycling not only unnecessarily increases the public's exposure to radiation—there are other options—but makes no sense economically. There is no justification for DOE to subsidize the recycling of nuclear waste into commercial products.

In a recent court decision, a federal district judge expressed serious concern that "[t]he potential for environmental harm [from the BNFL recycling project] is great, especially given the unprecedented amount of hazardous materials the Defendants seek to recycle."

The radioactive contaminants in the metals pose a long-term threat, as they remain hazardous for more than 200,000 years. The BNFL project poses significant risks because (1) surveying methods for radioactivity are imperfect and could result in the improper release of contaminated metals; (2) the recycling method for the Oak Ridge nickel is experimental and untested for large-scale production; and (3) the health effects of low-level radiation are the subject of significant scientific controversy.

The recent revelations about the failed environmental, safety and health oversight at DOE's facility in Paducah, Kentucky, which like the Oak Ridge facility is a gaseous diffusion plant, raises further concerns about the risks of the Oak Ridge scrap project. The DOE office responsible for oversight of the Paducah facility is also overseeing the Oak Ridge recycling project. After 50 years of demonstrated chronic mismanagement of the nuclear weapons complex, DOE claims that it can safely recycle radioactive materials for use in products for the general public. With so much evidence to the contrary, the last thing DOE should be doing is subsidizing the dumping of its nuclear waste into commercial products. **Congress should pass legislation that precludes the recycle of radioactively-contaminated materials when they may come into intimate human contact.**

The Contractors Have Engaged in Systematic Falsification of Reports to the Federal and State Governments and to the Public

The heart of the *qui tam* action against Lockheed Martin, et al., to which NRDC is a party, is that the contractors were aware of unlawful activities related to worker exposure, off-site releases, burial of radioactive waste and recycling of contaminated material, and yet proceeded to present false and misleading statements about these activities, representing that they were complying with DOE orders and all applicable laws and regulations. We assert that the DOE contractors were willfully, illegally, recklessly, in bad faith, imprudently, and /or negligently: (1) dumping significant quantities of radioactive and/or mixed waste in unauthorized locations; (2) exposing workers at the Paducah GDP site to unnecessary and unlawful levels of radioactivity through contact, proximity, contamination, inhalation, and ingestion, failing adequately to monitor worker exposures properly, and failing to report radiation hazards to the workers and to the authorities; (3) failing adequately to report accurately to the proper authorities regarding levels of radioactive contamination; (4) failing adequately to properly remove contamination in recycled materials, monitor for radiation prior to shipment of these materials off-site, or inform recipients of contamination; (5) failing to properly measure off-site contamination and control public access where necessary; and (6) failing to meet federally proscribed radiation protection standards. While engaged in these activities the contractors made numerous false statements to the DOE, the State of Kentucky and the public. We ask for Congress' assistance in ensuring that the full compendium of such false statements is found and preserved.

The Department of Energy Has Failed to Provide Adequate Oversight, Though This Does Not Excuse the Contractors

We understand that at most times the Department had no more than 6 to 12 personnel on site, to oversee contractor work force of nearly 2000. The improper and illegal activities at the Paducah GDP occurred throughout its 46 year history of operation. The failure of DOE and its predecessor agencies, the Energy Research and Development Agency and the Atomic Energy Commission, to prevent these activities demonstrates the quality of the Government oversight over the nation's uranium enrichment enterprise. One cannot of course presume that one's contractors are lying to you. But the fact that some of these improper and illegal activities have occurred right up until the present is a measure of the degree and quality of the DOE oversight even today.

NRDC Notification to DOE

On or about May 27, 1999, we informed the staff of DOE that in a matter of a few days we would be filing under seal a *qui tam* action related to activities at the Paducah GDP. The disclosure statements of the four relators were provided to the DOE staff at that time, and we briefed the staff on the technical and legal issues. On May 28, 1999, I hand-carried a second copy of the four disclosure statements together with a cover letter to the office of the Secretary of Energy. In the cover letter, I said,

> I am writing to inform you of the serious health and safety risks at the Paducah, Kentucky, gaseous diffusion plant. These violations require your immediate attention. Yesterday we presented our concerns and the facts supporting our proposed *qui tam* action against the Paducah contractors to members of your staff from the Environmental Management, Environmental Safety and Health, and Nuclear Energy programs and the General Counsel's office. We are providing you with copies of the relevant documents to ensure that you are fully informed of the gravity of the issues at the Paducah facility.We are grateful that finally, more than 14 weeks later, DOE's auditors have confirmed our findings and allegations. Sadly, however, the Paducah Manager of Projects for Bechtel-Jacobs—the contractor in charge of cleaning up the Paducah site—in anticipation of the one-day-long safety stand down at the facility last week, announced to his personnel: "More to come—I still have season's tickets to the circus for sale if anyone still needs one." Clearly, far more than a just a day will be required to change the culture of the Paducah contractors.

Who Should Pay?

We have suggested, and we believe the evidence does and will continue to show, that DOE, notwithstanding its own shortcomings, was seriously misled by the contractors operating the Paducah facility and site. We hope the government will seize the opportunity to hold the contractors accountable for what surely will be a massive, and massively expensive, cleanup and worker monitoring and compensation project. The taxpayers should not have to foot this bill. It is my understanding that DOE indemnity provisions for contractors do not apply in cases of contractor misconduct, such as is the case here.

MEMORANDUM

12 April 1991

To: Capt. J.W. Pennington, U/16
Special Operations, KSP

Fr: Investigator D. W. Senf, U/1903
Special Operations- Hazardous Devices

Sub: Alleged Criminal violations- Illegal dumping of toxic hazardous Uranium waste at the Paducah Gaseous Diffusion Plant location by federal agency contractor with the knowledge known by the U.S. Department of Energy.

Pursuant to my telephonic discussion on 10 Apr 91 at 0845 and 1150 hrs with Lt. Ken Hardin, Unit 91, I am submitting this source information at his direction, for your consideration, evaluation, and action. For approximately the past 14 months, I have been provided varying pieces of confidential source information regarding alleged illegal toxic waste disposal at the DOE-Paducah Gaseous Diffusion Plant location. This nuclear operation has been in production since 1955, with the most recent DOE independent contractors being Union Carbide, and Martin Marietta Energy Systems. Within the past three months, information provided to me had become greater in detail, and concerned me enough for my personal safety and fellow officers at the KSP Range, causing me to submit a memorandum to you on 4 Mar 91 detailing those concerns with attached supporting documentation.

Within the past week I have been provided additional confidential information which in my opinion, if true, constitutes gross criminal violations both under the United States Code and the Kentucky Revised Statutes, in that it jeopardizes the very lives of those residing and traveling through the Commonwealth of Kentucky. The gross violation is the allege illegal dumping of very hazardous toxic uranium waste substances outside the Dept. Of Energy compound onto public lands, much of which is controlled by the Commonwealth of Kentucky; which would encompass or possibly include the Kentucky State Police Firing Range.

It would appear at this juncture in time, this alleged information is so sensitive that for the purposes of safety and security, the names of witnesses, dates, and principals involved be withheld. It is my understanding affidavits and subsequent grand jury testimony would be forthcoming if the proper security is provided. I was remined that violations have occurred over a long period of time and DOE, EPA, OSHA, nor any other federal investigative agency has initiated an investigation into the following alleged elements constituting a criminal act.

ELEMENTS:

1. Contract employee(s) of the Dept. of Energy with more than 8 years experience have been given direct orders to dump hazardous uranium waste illegally.
2. Contract employee(s) were advised if they refused the order, they were no longer employed.
3. Direct verbal orders were given that the toxic hazardous waste be removed from the DOE compound(outside the fence) and placed outside the plant location on public grounds; which was done.
4. Solid toxic uranium hazardous waste was disposed of on a regular basis on lands adjacent to the DOE site, with exposure to the general public, wildlife taken as game, and aquatic life.
5. Said materials had to be moved through the Department of Energy Security Check Points to reach the outside area of the compound.
6. There are no known records identifying the illegal dump sites, permits for movement off site, nor authorization for that movement.

It was also noted there are continued toxic waste releases of radio active materials into the air; reportedly, on 18 Mar 91, 35 pounds was released. With the prevailing westerly winds, that product no doubt traveled across Paducah, and possibly into the direction of Owensboro, Louisville, or even Frankfort, Kentucky.

I have been requested that the Kentucky State Police conduct a comprehensive investigation into the foregoing alleged violations, due to the grave health risk to the citizens of the Commonwealth.

I would appreciate a timely reply to their request, in that their concerns have been expressed to me for sometime. Thank you for your attention to this matter.

Don Berry
Hazardous Devices Investigator
Special Operations
Kentucky State Police

MEMORANDUM

4 MAR 91

TO: Capt. J.W. Pennington, U/16
Special Operations KSP

FR: Investigator D. W. Senf, U/1903
Special Operations - Hazardous Devices

SUB: Employee exposure to hazardous substances at DOE-Paducah Gaseous Diffusion Plant location, ie; trichloroethylene and radioactive waste.

Pursuant to our discussion of 5-6 Feb 91 regarding the above captioned subject materal, I am submitting to you at your request the enclosed documents regarding the U.S. DOE operation adjacent to the Kentucky State Police firing range and explosive bunker location. This property was formerly controled by the Kentucky Ordnance Works during WWII; followed by the U.S. Dept. of Energy, who subsequently released certain land areas to State control on which the KSP firing range is now located.

In the spring of 1990, I received source information regarding both groundwater and airborne contamination of this area. At that point I became concerned with my health exposure, as wellass all KSP personnel using the range past and present, and requested Lt. Ken Hardin obtain the necessary instruments to check and monitor possible soil and air contamination. It should be noted, I must be at the bunker location at least every 7 days for a security check, or more frequently if explosives must be storred or removed; and personally maintain the area by cutting the grass and weeds as needed; not to mention the 13 years of mandated exposure for required firearms training. At some point later in the summer of 1990, I asked Lt. Hardin if he was able to secure the equipment, and he informed me via telephone that the proper authorities would check it for us. As of this reporting date, I have not been advised as to whether any tests have been made, or any results were received.

As you will see in the enclosed materials, there is a real health risk at the DOE Paducah location and surrounding area which is inclusive of KSP Range property.

In January, 1990, I attended a DOE public meeting in Paducah, Ky in which a 1985 DOE document styled TIGER TEAM REPORT sighted violations, yet we as state employees have never been informed of the risks or provided any health protective equipment. In fact, the meeting suggested there are very serious on going health exposure violations not only to State of Kentucky employees, but other governmental agencies who have used our rage.

Again, I am making a formal written request for the necessary instruments so that I might check and monitor the KSP location for hazardous substances. If that is not possible, I request an independent laboratory not affiliated with the US DOE or Ky State EPA to conduct those tests. I would appreciate a reply to this correspondence as soon as possible.

Thank you,
Don Senf

Attachments

1. US House of Rep. Subcommittee on Oversight & Invest. of the Committe on Energy & Commerce 6-3-88
2. Deadly Defense - Radioactive Waste Campaign 1988
3. US DOE Office of Environmental Audit- Paducah Jan 1989
4. ICF Technology Inc. Memo. Ky Ord. Wks. 2-2-88
5. Coalition for Health Concern US DOE PEIS Scoping Hearing Pad. Gaseous Diffusion Plant 2-22-91

Memorandum sent to
- HQS dated 4/12/91

Fr. D. W. Senf
KSP - Hazardous Devices Inves.

SENDER:
- Complete items 1 and/or 2 for additional services.
- Complete items 3, and 4a & b.
- Print your name and address on the reverse of this form so that we can return this card to you.
- Attach this form to the front of the mailpiece, or on the back if space does not permit.
- Write "Return Receipt Requested" on the mailpiece next to the article number.

I also wish to receive the following services (for an extra fee):
1. ☐ Addressee's Address
2. ☒ Restricted Delivery
Consult postmaster for fee.

3. Article Addressed to:
Capt. J. Pennington
Special Operations
Ky. State Police
~~[illegible]~~
Frankfort, Ky. 40601

4a. Article Number
P-681-559-451

4b. Service Type
☐ Registered ☐ Insured
☒ Certified ☐ COD
☐ Express Mail ☐ Return Receipt for Merchandise

7. Date of Delivery
APR 15 1991

5. Signature (Addressee)

8. Addressee's Address (Only if requested and fee is paid)

6. Signature (Agent)

PS Form 3811, October 1990 ✩U.S. GPO: 1990—273-861 DOMESTIC RETURN RECEIPT

P 681 559 451

Certified Mail Re
No Insurance Coverage P
Do not use for Internation
(See Reverse)

Sent to CAPT. J. Pennington. Special Ops, Ky State Po	
Street & No. 919 Versailles Rd	
P.O., State & ZIP Code Frankfort, Ky 406	
Postage	$ 2
Certified Fee	1
Special Delivery Fee	
Restricted Delivery Fee	2
Return Receipt Showing to Whom & Date Delivered	1
Return Receipt Showing to Whom, Date, & Address of Delivery	
TOTAL Postage & Fees	$ 4
Postmark or Date	MU[illegible] KY APR 12 1991

PS Form 3800, June 1990

Mailed:
From Murray, Ky
at 1200 hrs 4/12/91
FRIDAY

Ky S-[illegible]
Police Statute

board may adopt pursuant to the provisions of this section.

HISTORY: 1988 c 344, § 1, eff. 7-15-88
1978 c 154, § 2; 1974 c 74, Art V, § 25; 1966 c 255, § 12; 1952 c 57, § 2; 1948 c 80, § 5

16.055 Promotions; terms and conditions

(1) Promotions to sergeant within the department shall be on the following terms and conditions:

(a) The applicant must have served as a commissioned State Police officer for a period of five (5) years to be eligible for promotion to sergeant;

(b) Promotions shall be based on the highest cumulative score computed from thirty percent (30%) on personnel performance evaluation, twenty percent (20%) on oral examination, and fifty percent (50%) on a written examination;

(c) The promotional list shall continue in existence for one (1) year and promotions shall be made in consecutive order beginning with the highest numerical ranking to fill an interim vacancy. When two (2) or more applicants receive the same numerical score, the order of placement on the list shall be determined by seniority of service. Upon the determination of a new numerical ranking following a new examination, all previous rankings shall be null and void;

(d) The written examination shall be prepared and administered by an individual designated by the commissioner. The materials and textbooks will be selected by the commissioner and his staff. The commissioner will inform all applicants at least three (3) months prior to the examination date of the exact material from which test questions will be taken;

(e) The written test shall be administered to all applicants at the same time. Immediately upon completion of the written test the applicant will receive his numerical score. Such numerical score shall remain valid for a period of two (2) years following the date of examination unless the source material upon which the test is based is changed by more than thirty percent (30%);

(f) The oral examination shall be conducted by interview boards designated by the commissioner consisting of the commissioner or his designated appointee not lower than rank of captain, an officer from another police agency of the rank equal to the position for which the applicant is competing, an instructor from an accredited law enforcement education program, a personnel director from private industry, and an officer from the Kentucky State Police of the rank equal to the position for which the applicant is competing;

(g) The designated oral boards will perform all interviews under guidelines developed and approved by the commissioner; and

(h) Personnel evaluations shall be made by the appropriate supervisory personnel under procedures established and approved by the commissioner.

(2) Promotions from sergeant to lieutenant within the department shall be on the same terms and conditions as promotions to sergeant. In addition, any applicant for lieutenant must have completed at least one (1) year of continuous service in grade as sergeant.

(3) Promotions from lieutenant to captain within the department shall be on the same terms and conditions as promotions to lieutenant. In addition, any applicant for captain must have completed at least one (1) year of continuous service in grade as lieutenant.

(4) The department will develop and administer only one (1) test for each of the above ranks. All eligible applicants will be permitted to participate in the promotional process to the next highest position of responsibility wherever a vacancy exists.

(5) The provisions of KRS 16.140 to the contrary notwithstanding, all ranks above the grade of captain are temporary and shall not be subject to the provisions for selection and promotion as required herein. All officers in such temporary positions shall serve at the pleasure of the commissioner and shall revert to their previou permanent rank upon the termination of their tempo rary appointment.

(6) The total number of supervisory officers of all classifica tions shall be limited to a ratio not to exceed one (1 supervisor for every five (5) nonsupervisory officers.

(7) No officer of the department, other than temporar positions above the rank of captain, shall be promote to the next highest rank without competing with oth officers as prescribed by this promotional procedure.

(8) There shall be no discrimination based on race, se age, national origin, color, religion, creed, or politic affiliation with respect to the department promotion system. All personnel actions are to be based solely merit.

HISTORY: 1976 ex s, c 2, § 1, eff. 3-19-77
1976 c 39, § 1

16.060 Powers and duties of commissioner and officers

It shall be the duty of the commissioner and each officer of department to detect and prevent crime, apprehend crimin maintain law and order throughout the state, to collect, clas and maintain information useful for the detection of crime the identification, apprehension and conviction of crimi and to enforce the criminal, as well as the motor vehicle traffic laws of the Commonwealth. To this end the com sioner and each officer of the department is individually ve with the powers of a peace officer and shall have in all par the state the same powers with respect to criminal matters enforcement of the laws relating thereto as sheriffs, const and police officers in their respective jurisdictions, and

Ky State Police
Special Investigations | Special Operations – HQS.
Major Tom Rakestraw

Capt. James Pennington
Lt. Ken Hardin – Environmental | Hazardous Devices
Invest. Larry Henderson – Haz. Devices Field Supervisor

Post I Commander Captain John Witt (11 Counties to inc McCracken & Mars

Legal – Capt. Larry Forgness (now Deputy State Att. Gen

1 late 1987 | early 1988 approval to place (2) explosive bunke at KPS Pistol | shotgun | rifle range (state property) just west of main DOE plant in secluded area; formerly property held by I traveled to DOE Paducah to see if their activity could bring security risks or health risks to the bunkers or my Management personnel stated, "no", they only did Uran low enrichment, 7% or less.

2. summer 1988 placed bunkers on property = there 2-times weekly to check on bunkers & maintain grass (cut). Had been on range to qualify since 1978 at leas 4-5 times yearly, as had all P-1 units & other depts.

3. 1990/91 received info on possible violations at DO facility & so advised Lt. Hardin by telephone. Expressed concerns on my safety & those who also used the range on a regular basis. I borrowed a geiger counter DES, Mayfield, Ky & got readings at the range – s advising Hardin, indicating I wanted to move the bunkers, Capt. Witt was also advised of my finding I advised Hardin that there needs to be an investigation, & he advised me to reduce everyth to a memo and send it to Capt. Pennington. To this day (I retired 2-1-99) I never received a response, other than a call from Henderson advi me never to send a certified return receipt lett again, authority Capt. Pennington. There has n been inquiries as to my sources, or what evide exists.

4. after my readings at the range, I requested Lt Hardin send someone to the area to check the

ground. A female employee for the Ky Cabinet of Natural resources met us at the range, with 2 DOE contractor employees from their labor who she designated to take samples. It should be noted, I checked her geiger counter, & it had not been calibrated in over one year, which she admitted to.

5. In 1990-1991 I personally was engaged in explosive recovery, render safe procedures on IED & Bombs, training, & doing Haz mat, night surveillance & aircraft surveillance. Along with attendance at Haz mat trng. After this, and another high profile invest began to evolve, our unit was advised by Lt. Hardin that we would confine our activity to Haz. Devices invest, recovery, and render safe only.

6. At some point in 1991 or 1992 as I recall, KSP stopped using the range & I eventually moved my bunkers to the new P-1, Mayfield site of 19 Ac., with Capt. Witt's approval.

7. Sometime around 1993 Det. Sgt Steve O'Daniel transferred into Special Ops & became the Administrative Sgt. I asked him about the DOE invest & my memo; he could find nothing, nor knew nothing about it. I also told him about the HWD invest. He found the file, however all contents had been removed.

HEADQUARTERS
(502) 695-6380

OF
(606) 2

HAS RETIRED 1999

DON SENF
HAZARDOUS DEVICES INVESTIGATOR
UNIT 1003
SPECIAL OPERATIONS
KENTUCKY STATE POLICE
3672 IRONWORKS PIKE

Mr. UPTON. Thank you.

And thank all of you.

At this point we are going to go to 5 minutes of questions by each of us up here. I am stunned. I have to tell you that I have two nuclear plants, two nuclear energy plants in my district. I visit there fairly often. There has never been a time, whether I have been a Member of Congress or a staff member or as an interested party who lives pretty close to these folks, as they have a lot of tours that go through, you don't have one of those little detectors that they give you, they do a little readout at the end of the trip, they tell you what it is and everybody is fine.

As I listened to your testimony, particularly from the four of you, the first four that actually worked there for a number of years, I am just stunned that you didn't have anywhere close to that same type of protection or readout that virtually anyone involved in the nuclear industry has.

I guess my question for the first four, Mr. Key, Mr. Jenkins, Mr. Fowler and Mr. Graves, particularly Mr. Fowler and Mr. Jenkins: How often did you have one of these whole body radiation counts in the years that you've worked there? I'll start with Mr. Key. Did you ever have one?

Mr. KEY. Yes, Mr. Chairman, I had one during the period of time that I worked there.

Mr. UPTON. You worked there again how many years?

Mr. KEY. Since 1974.

Mr. UPTON. You had one?

Mr. KEY. Yes, sir.

Mr. UPTON. Even today do people have those little count—whatever they call those.

Mr. KEY. The whole body counter or the TLD?

Mr. UPTON. You put it on your lapel or something like that. Are there people today, Mr. Fowler?

Mr. FOWLER. You're talking about a TLD. That's what monitors your whole body dose.

Mr. KEY. I was confused, Mr. Chairman. I thought you meant monitoring by the mobile in vivo body counter that used to come from the Oak Ridge facility to Paducah. Yes, since I have been employed there in 1974, I have always possessed a TLD dosimeter or a type of radiation monitoring dosimeter.

Mr. UPTON. So you had one all along since you've been there?

Mr. KEY. The dosimeter, yes, sir.

Mr. UPTON. Mr. Jenkins, did you?

Mr. JENKINS. Yes, sir it was a film badge in the earlier years and then they changed it to a TLD.

Mr. UPTON. Mr. Fowler?

Mr. FOWLER. I've worn a TLD since I've been at the plant but never have I ever had a whole body analysis done, which at any other nuclear facility in the country is a standard health physics practice. A person such as myself who been there for 8 years would probably have had a minimum of eight if not more whole body counts done at a commercial site. I have never been offered or given the opportunity to have one.

Mr. UPTON. Mr. Graves.

Mr. GRAVES. Yes, I was issued a TLD when I came onsite. It's important to note that the TLD, thermoluminescent dosimeter, is for measurement of external exposure hazards. It's not for the measurement of internal intakes of radioactive material. That's done through bioassay methods such as in vivo counting or in vitro bioassay.

Mr. UPTON. Is that the whole body radiation then that measures?

Mr. GRAVES. Essentially the TLD measures outside influence of radioactive material, gamma and beta radiation, but the bioassays are what is more predominantly used for the measurement of internal uptakes of radioactive material.

Mr. UPTON. Mr. Jenkins and Mr. Key, have you ever had the whole body count?

Mr. JENKINS. Yes, sir, I've had approximately six in the time that I've been there. The first several—and the truck-mounted whole body counter, the technician would take it two or three times. He just couldn't believe the readings.

Mr. UPTON. He never told you what the readings were?

Mr. JENKINS. No, sir. Then I was sent to Cincinnati, right outside Cincinnati, for a special, one of the people that they sent up there. We went through it but I never was given my readings.

Mr. UPTON. Is there a way that you think you can find out your readings today?

Mr. JENKINS. Sir, I don't know.

Mr. UPTON. How do we find out what these readings are? As you all testified to how scared folks still are working there, it would seem the first line of defense, the first line of some appeasement is to try and look at what these readings were to in fact gauge exactly what you were exposed to and whether it was safe or not, period.

Mr. FOWLER. My answer to that is I was doing the initial posting of the facility in which I found areas that had to be posted as radiation areas according to the codes of Federal regulations. I was wearing their TLD. The areas were 10 to 20 millirem per hour. I worked in them for months, yet they gave me a zero dose. That is why that was fraudulent. If that were wrong, and I got a zero dose, then why aren't they still allowing the areas to be posted?

Mr. UPTON. Mr. Key, do you want to comment?

Mr. KEY. Yes, Mr. Chairman, back to the in vivo body counting measuring device that was routinely brought up very infrequently to the Paducah site, I did receive one of those body counts. At the end of completion of the count, the material was reviewed by the technician to me, though I was never handed a copy.

As recent as 2 months ago when the Washington Post broke the story, I began asking for known documents existing, that which is the in vivo whole body counting, which we sent 16 selected hourly employees from our facility. I've asked for those records. I've asked for the documentation concerning the 24-hour special simulated bioassay urine sampling for transuranics. I've also asked for the fecal sampling results of the current and involved hourly work force, whereby I can cross-reference those documents to ensure that all participants did in fact have the opportunity to participate and that we could take that data and turn it over to our health physics individual we have with the international union. As of this date, I have yet to receive any documents that I have requested.

I also requested that those documents be forwarded to the DOE oversight investigative team. I am unsure if they ever received those.

Mr. UPTON. Mr. Klink.

Mr. KLINK. Thank you, Mr. Chairman. It's hard to tell where to begin. First, from what Mr. Key and Mr. Fowler said in response to your questions, it appears—and I'm going to try and cover some territory—I ask you to bear with me, in brevity—it will be greatly appreciated.

What you seem to be saying is, No. 1, you're having a hard time getting questions answered. Mr. Fowler, you're saying you don't believe the answers when you get them; is that correct?

Mr. FOWLER. That's correct, sir.

Mr. KLINK. Mr. Key, you agree as well?

Mr. KEY. Yes, sir.

Mr. KLINK. Mr. Graves, according to your previous interview with committee staff, if you disagree with anything I'm saying, interrupt me if you would. You came from the commercial nuclear industry to Paducah as a health physicist for Martin Marietta in 1989. It was your job to get the plant in order so it would conform with DOE orders regarding worker exposure, radiation controls, et cetera. You told the staff when you arrived that there was no radiation control at Paducah. In fact, if I can quote from my staff's notes during their interview with you, you said they were noncompliant in all areas. RADCON was brand new to them. They didn't know what was present at the workplace.

The health physics program, they had one, but there were two technicians at the site for over 1,000 employees.

Is that an accurate picture of what you found?

Mr. GRAVES. I was initially hired by Martin Marietta to teach employees, the technicians that I spoke of. There may have been another technician but the staff was very, very small. I should say that.

Mr. KLINK. You think it was an inadequate number?

Mr. GRAVES. Yes. That was my initial job there, to teach them, as I had taught in the nuclear power industry where I had come from. After that I went to the field operations manager responsibility, and that responsibility was to look at all aspects of the program and try to determine the compliance status of that program with regard to current regulations.

Mr. KLINK. You say that RADCON or radiological control was new to them. What about contamination? Did they know what it was?

Mr. GRAVES. When I said in the statement that every fundamental area of the radiological control program at the time was noncompliant or inadequate, that is a true statement. Generally once I got to the site, coming from the Nuclear Regulatory Commission, regulated site, it was quite a shock to me; but as I understood once I got there, that for an extremely long period of time, and this was inferred to me by employees, that the plant was considered a chemical plant and that there was uniform contamination throughout the facility and we just had a lot of work to do.

Mr. KLINK. What does that mean if they treat it like a chemical plant?

Mr. GRAVES. Essentially my first impression is they were unaware basically of what they were working with or the hazards thereof. That was the thought process that I had. But this was a uranium facility, and I was aware of that coming in, because that's why I was brought on board.

Mr. KLINK. They were not aware that they were dealing with radioactive material?

Mr. GRAVES. No, I can't say that. But the general thought process——

Mr. KLINK. You're saying that you think they may have been aware but their thought process was not——

Mr. GRAVES. The overall culture of the facility as it was operated for a lot of years was that of a chemical processing facility. That's what was reported to me when I got there. I use that as an example.

Mr. KLINK. But they knew they were dealing with radioactive material?

Mr. GRAVES. Yes, sir.

Mr. KLINK. You told staff when you were surveyed you found technical contamination in every area you looked. Were any of those areas posted?

Mr. GRAVES. No, sir. There was widespread contamination across the facility, yes.

Mr. KLINK. Were the people at the site capable of monitoring uranium?

Mr. GRAVES. To the extent necessary to fulfill the regulations, no. We didn't have enough staff to adequately monitor the workplace.

Mr. KLINK. Tell me about the instrumentation that you found.

Mr. GRAVES. The instrumentation predominantly was beta gamma monitoring instrumentation.

Mr. KLINK. Was that the most modern?

Mr. GRAVES. The instrumentation that they had was up to date. It was contemporary in its use. There are some situations within the facility where alpha radiation is predominant over beta gamma. There were questions regarding the appropriateness of some of the instruments used with regard to the source term in the area, but they were in the process of getting more instrumentation and trying to eventually get up to speed to what they needed to be.

Mr. KLINK. Did you tell staff during the interview that the instrumentation was archaic, that the laboratory couldn't read your samples, that plus-or-minus error was sometimes 100 percent?

Mr. GRAVES. The instruments that you're speaking of now are different from the instruments I just addressed in the conversation.

Mr. KLINK. What's the difference?

Mr. GRAVES. The difference in the instruments are one is a handheld type instrument that is used by technicians to determine the gross alpha beta gamma activity at the site. What I made mention of to the staff person was that the radiochemical capability or the ability to discern between transuranics and uranium appeared to be process-oriented, archaic. The lower limit of detection was not sufficient to be of use to a health physicist in this regard.

Mr. KLINK. So you couldn't detect the transuranics at the site; is that correct?

Mr. GRAVES. We couldn't do that at a number that would be considered reasonable to provide radiological protection.

Mr. KLINK. Did anyone tell you that there was plutonium or other transuranics located at the site?

Mr. GRAVES. Not when I first came on board. I first became aware of the transuranics, I think I made the statement when I was doing a review of one of the buildings, and I came across large quantities of technetium 99 that was just identified through a walk-through. And asking questions as to where this stuff comes from—I came from nuclear power, I didn't understand why technetium was at a uranium enrichment facility. They said they did have processor reactor returns in the past. Based upon that response, I asked them about some other isotopes, CCM, being one because it has a relatively long half-life.

Then I asked the question about transuranics. At that time I was told that there were a number of drums, eight if I recall correctly, of transuranic waste at the facility, in a storage location that was a very well-defined storage location.

Mr. KLINK. What was the timeframe from the period you were told to come in here and fix it—and I assume that you were not told immediately upon arrival what you were dealing with—and the period of time at which you found out about the transuranics at the site?

Mr. GRAVES. It is important to note from a health physics concern, what transuranic waste is, is much different than what transuranic waste is from a CERCLA standpoint. The response that I got initially was based upon CERCLA standards, which is a large amount of activity per gram of substance. But from a health physics concern, minute quantities of transuranics, or small quantities of transuranics can be a problem or concern in the radiological workplace.

It wasn't until there had been a spill with a drum of one of these eight drums that I became aware of the amount of activity that they were talking about when they told me about the transuranic waste.

Mr. KLINK. Again, what was the period of time between when you first arrived there and this spill occurred and you found out about the transuranics?

Mr. GRAVES. About a year, sir.

Mr. KLINK. What was the response of management when you expressed your concern as a health physicist about these transuranics?

Mr. GRAVES. At which time, the time of the spill?

Mr. KLINK. Whenever you found out about it.

Mr. GRAVES. I was surprised at the numbers or the amount of transuranics in the drum that was spilled. I think the general thought process of management at the time was that, one, I didn't feel like they had an appreciation of the seriousness of this type of isotope in a uranium facility. And second, I think it was generally felt that true normal CIP-CUP project maintenance, removal of cascade, that a lot of the material that hadn't processed in the past had been removed from the system.

Mr. WHITFIELD [presiding]. Mr. Klink, I've let you go over a couple of minutes. I think we better proceed. We have a lot of questions to ask. Maybe we will have an opportunity for another round.

First of all, Mr. Key and Mr. Jenkins and Mr. Fowler and Mr. Graves, I want to tell you how much we appreciate your willingness to come up here and testify. I know that it is particularly difficult when you are in this situation. You are still employees and you are testifying on issues that you deem very important, and so we thank you for being willing to do that.

Mr. Key, in your testimony you had referred to a bioassay analysis study in 1990 conducted on employees at the plant. Did you indicate that those results were never released, or would you expand on that a little bit?

Mr. KEY. On the initial 24-hour simulated bioassay for transuranics at the plant, we were able to get approximately 30 volunteers to participate for that. However, the results came back and the contractor called a meeting and claimed that the independent laboratory had cross-contaminated all of his instrumentation and thereby they were going to invalidate the results. I have since asked specifically for those exact sample results and as of yet have not received that. In fact, a management representative discussed with me that management was very reluctant to release that information because of the unknown of how it would be used.

Mr. WHITFIELD. So it has been over 8 years and you still don't have that information?

Mr. KEY. That's correct.

Mr. WHITFIELD. Now, from all of the newspaper articles on this, I think there is an attitude out there right now that offsite or outside the production area that USEC has responsibility for, there are some real contamination problems, significant problems, over 90,000 drums out there, for example. There also seems to be a perception that inside the production plant today is safe.

Now, all of you have been involved in that plant, you've worked there now or you've had experience with it, like Mr. Graves. I would just ask you today, do you consider the production facility that is operated by USEC to be a safe place today? Mr. Key? Then go right down the line.

Mr. KEY. I believe that safety at the plant has drastically improved with respect to industrial safety and radiological control procedures and policies from the early 1990's to the present day. I believe there is always room every day for improved safety, including worker involvement. A very recent NRC internal investigation of USEC policies and practices, workers were not involved in that investigation, in the out-briefing. Unlike when OSHA comes onsite, there is dedicated worker involvement and walk-around with the OSHA inspectors, and really under OSHA we feel like now we have a voice to be heard and can any time file a formal complaint.

As one suggestion to the committee, I would suggest that NRC regulations adopt OSHA standards which include the worker involvement and participation.

Mr. WHITFIELD. Mr. Jenkins?

Mr. JENKINS. Sir, I agree with Mr. Key, but I have a hard time believing the records after 30 years of being falsified to. I'll put it that way.

Mr. WHITFIELD. Mr. Fowler?

Mr. FOWLER. Yes, sir, I know that problems persist to this day. The problems we are talking about are current still. They are not just problems of the past. Yes, things have improved somewhat. But, I'll give you four examples. Approximately 3 weeks ago, it was found that Bechtel Jacobs workers had been working in cylinder yards for months, nontrained, did not know what permits were. When this was caught, they sent these individuals to training. Ten of them failed. They retrained them. Three of them then failed. I started talking with these individuals. The problem was functional illiteracy. People were allowed to work in areas, they couldn't read the monitors, they couldn't read the permits.

Three weeks ago, a computer was tagged as radiation free and ready to be delivered to a local school and it was found to be significantly contaminated. Plant management had proved the system worked. They said we found it. But it wasn't found by them. One of the whistleblowers' wives did a second check on the survey readings and found it to be contaminated. If she had not done this, a student would be sitting at a computer terminal getting unnecessary radiation exposure.

Again, about 10 days ago, plant workers were sent into a contaminated building that required respiratory protection. Yet they had none. They were told to just wet down the areas and they could work without a respirator. A member of the safety department caught this, they halted the job, told the workers they would have to go to respiratory training. While these individuals were in that training, they let another group of workers go in without respirators and finish the job.

In the main cafeteria, to this day, there has never been any access monitoring, so a contaminated person could enter at will. In other eating areas around the site, there were some monitors put in place, but the alarms were going off frequently and it became a problem for health physics. So these monitors are taken out. The problems are not only in the past, they are current, and they affect the workers today.

Mr. WHITFIELD. Dr. Cochran, I have been told that you are quite an expert on nuclear issues. You were quoted in a peer-reviewed journal as saying, "The situation is as close to a complete lack of health physics as I have observed outside the former Soviet Union, which we know is horrible."

Did you make that statement?

Mr. COCHRAN. I did. And I stand by it. I had visited the Chelyabinsk 65 in what is now Russia, which is their Hanford, and toured a reactor that was shut down. The conditions—we left an auditorium, put on some smocks, walked around in the reactor, walked outside, back around through the auditorium, took the smocks off and hung them on the rack for the next person.

Based on my conversations with the other relators, particularly Mr. Fowler and Mr. Deuschle, Mr. Jenkins, I would say a similar attitude persists at the Paducah plant.

You are going to hear this afternoon, or later this morning, from the senior person at Bechtel Jacobs. I would urge you to also examine an e-mail message sent from the Paducah manager of projects, Mr. Jimmy Massey, on September 8. That is the day before the shutdown, the Richardson 1-day or 24-hour shutdown. This memo was sent to the gentleman that is going to testify before your committee, Mr. Nemec, Joe Nemec. At the end of his memo, he says, "More to come. I still have season tickets to the circus for sale if anyone still needs one." He is describing the events surrounding this case and the shutdown ordered by the Secretary as a circus. He described in the Paducah Sun the 24-hour shutdown as a family meeting. He describes as one of the activities that will be conducted in this 24-hour period, review and spruce-up of red postings.

When I visited the site in February, outside of the fence in ditches that I measured, contamination levels in excess of NRC limits, there were no red postings. That is why I am telling you there is a need for a radical change in the culture at that plant. You cannot run—you cannot have senior manager in the cleanup sending memos to his staff and his superiors pretending that this is not a big issue when in fact it is.

Mr. WHITFIELD. We have a copy of that e-mail. We will be asking about that.

Mr. KLINK. Mr. Chairman, can you yield to me for a second?

Mr. WHITFIELD. Yes.

Mr. KLINK. I would ask unanimous consent that we have that document made permanent in the record. I am told it is in the packet. We haven't seen it yet. Thank you very much.

[The information referred to follows:]

Massey, Jimmy C. (JCY)

From:	Massey, Jimmy C. (JCY)
Sent:	Wednesday, September 08, 1999 12 22 PM
To:	Paducah BJC personnel
Cc:	Pennington, G. Gregg (O8P) : Thiesing, Jim (O9Q); Houser, Steven M (O9D) , Shoemaker, John E. (O4J) ; Green, Steve W (O85) , Stevenson, Dennis (O9N) : Phelps, Andy K. (O9J) , Clay, Paul F. (O6P) : Nemec, Joe F (O9I)
Subject:	Safety Stand Down
Importance:	Hign

We anticipate that the DOE will announce a day long safety stand down for Paducah Project based on the two week DOE Investigation Team work sometime over the next few days. It will be on short notice and we are now trying to get ready tc respond. I would appreciate it if you do not communicate this to our subcontractors or the outside world at this time since it is unfirm. As soon as I get the go ahead and more details, we will contact the STRs so you can follow up.

The kinds of activities we will do during that day may include.

1. Review and spruce up rad postings in DOE areas both on buildings and on land masses.

2. Focus on NCS issues in DMSAs and look for solutions with DOE.

3. Review general RWPs and see if they really fit or if more job specific RWPs are necessary

4. Review for subcontracted as well as BJC performed (USEC) work the H&S work permits, the RWPs, the hot work permits, LO/TO, excavation permits, JHAs and AHAs etc for accuracy and fitness for intended work

5. Emphasize conduct of and rigor of operator with attention to detail thorough out with compliance with procedures

I need to meet with the "Project Team" this afternoon at 2:00 in the Small Conference Room to discuss. John Shoemake is here and is trying to arrange for some Portsmouth folks to come down to be part of the stand down day

More to come I still have season's tickets to the circus for sale if anyone has still needs one

Jimmy Massey
Paducah Manager of Projects

Mr. COCHRAN. Mr. Chairman, the DOE, you are going to hear from a DOE representative who says that the team that went down there said that they didn't find any imminent hazards to workers and the public. I think this was a very unfortunate statement. An imminent hazard would be a nuclear explosion, a criticality accident or meltdown of a reactor. We're talking about chronic exposures to workers and those issues persist.

Mr. WHITFIELD. Dr. Cochran, thank you for answering the question. We will be following up later on this.

Next is Mr. Stupak.

By the way, this is such an important issue that we are going to 7-minute questioning instead of 5.

Mr. STUPAK. Thank you. Let me again apologize. I have been up in the Superfund hearings, bouncing back and forth today here, Mr. Chairman.

Mr. Chairman, as you know we have had hearings in the short time I have been on this committee with DOE about Lawrence Livermore, the spy situation out there. Now west Paducah, now we have got the transportation of the plutonium. What I am really concerned about, not just the plants, as the doctor properly pointed out, but also just the culture, the attitude, the lack of trust and confidence in DOE in not just running plants but their whole makeup, their whole environment there. I'm not sure how we address it. We have really got to get their attention and not just a lot of assurances from them, but we have got to see changes in the Department of Energy.

It is not just this administration. When you talk about Lawrence Livermore, that went back over five administrations. The west Paducah stuff just wasn't recent, it has been going on, as we see.

Now we want to transport plutonium through my district and others, and we cannot even get a hearing on the darn thing. You wonder about trust and all that. As I listened and read the testimony, there has been a lot of discussion about what is happening outside, especially, Mr. Key, to workers, what is happening outside. But how about internally, biologically, what is happening when they breathe asbestos or uranium hexafluoride?

Mr. STUPAK. Let me ask you, Mr. Key, what can result from breathing uranium hexafluoride, do you know, as a worker?

Mr. KEY. Of course breathing uranium hexafluoride fumes, it is irritating to the throat and nasal mucous passages, and can result in bronchial, upper respiratory ailments. Beyond that I don't have the expertise to say.

Mr. STUPAK. You are basically ingesting uranium?

Mr. KEY. Correct.

Mr. STUPAK. Mr. Key, you also testified to what appears to be massive exposure to asbestos dust during the late 1970's and you said the early eighties. And since 1964, since 1964, it has been common knowledge that working without protection with asbestos can cause asbestosis, but it takes a long time for asbestosis to develop. Has DOE or the contractor done anything to monitor, to track workers for asbestos exposure internally?

Mr. KEY. Not to my knowledge. The international union has a mobile screening unit. When requested, it has came to the Paducah location twice at the request of the PACE Local Union President, David Fuller, and the chest X-rays are taken and they are read by the certified readers.

Mr. STUPAK. Is this mobile unit, is this something that the union does internally for its members, or does DOE contract to provide it when the union requests it? How does that go?

Mr. KEY. To my knowledge it is only a union-involved program.

Mr. STUPAK. Okay.

Mr. WHITFIELD Mr. Jenkins?

Mr. JENKINS. I would like to respond. Myself, the lower part of my esophagus, I had to have it surgically replaced with a piece of plastic. Whether it caused it or not, I can't testify. My doctor said that there is a 99 percent chance that it is going to turn into cancer. Whether it does, I don't know.

Mr. STUPAK. Mr. Jenkins, were you in the area where you would have breathed this uranium hexafluoride?

Mr. JENKINS. Yes, sir.

Mr. STUPAK. Thank you.

In your testimony, Mr. Key, you talk about working in clouds of fumes in the building. Did workers ever ask for respiratory protection so they could breathe?

Mr. KEY. The building that I was referring to was the C-410 and C-420 building which processed the rat tail uranium tails material. And the clouds of fumes that we walked through, there were times that I held my breath to get through those.

Respiratory protection was only provided in the form of a World War II gas mask. It was placed in a box throughout the building. You could pull it out and it was not necessarily clean. And because it was general use, if you did not get it tight enough, the fumes would still permeate around the seal. One day I took the exhalation valve cover off one of the respirators, and it had dry rotted to the point that it did not provide protection.

Mr. STUPAK. Did you ask the supervisors for masks?

Mr. KEY. No, sir. You have to understand the indoctrination process that the majority of workers at the plant went through. When I was hired by Union Carbide, it was frowned upon for you to ask any questions. If you raised safety issues, generally you were given the worst job assignments within your department. You were labeled a troublemaker, lazy, nonproductive to bring up safety as an issue. That later transpired into what was termed the "right to know," employee right to know. I could ask management a question and then management would decide if I needed that right to know on that issue.

Mr. STUPAK. Did you ask questions under the right to know?

Mr. KEY. Yes. In fact there were some general safety issues in the early and mid-eighties where I went to the safety department and I would say that OSHA regulation on this particular issue is this. The response was, We are not under OSHA, return back to your job.

Mr. STUPAK. Mr. Jenkins, Mr. Key, has there been any testing and monitoring to determine radiation exposure to the workers, do you know? Has there been any testing or monitoring?

Mr. KEY. Testing that I am aware of, of course you have heard testimony in relationship to the in vitro body counter which was a mobile unit out of Oak Ridge. There is a 1992 NOISH report which specifically points out the unreliable detection capabilities of that unit and the numerous mechanical breakdowns of it. That unit, as

I am aware, was only for uranium and only the group of 30 plant workers that were sent for nonjelly detectors, commonly referred to as the geranium-type detectors, has the ability to monitor the body for transuranics.

Mr. STUPAK. That is the only monitoring or testing that you are aware of?

Mr. KEY. That I am aware of.

Mr. WHITFIELD. Mr. Stupak, your time is expired.

Mr. STUPAK. Thank you, Mr. Chairman.

Mr. WHITFIELD. Mr. Bryant.

Mr. BRYANT. This is a question for Mr. Fowler and Mr. Graves. Were you aware of any occasion where a DOE nuclear safety inspector ever visited the plant or reviewed the safety procedures there in Paducah?

Mr. GRAVES. During my tenure at the site, there was a tremendous amount of DOE involvement from a Tiger team standpoint and independent oversight from HHS groups and program folks and folks out of the House. So yes, there was a lot of DOE involvement.

Mr. BRYANT. You are saying DOE personnel on the site?

Mr. GRAVES. We had a site office where DOE employees were housed. In addition to that, there were several different DOE representatives that came and did audits and assessments as a function of the new initiatives of Admiral Watkins.

Mr. BRYANT. And part of that audit function would be obviously safety?

Mr. GRAVES. Yes, sir. There was a lot of influence on safety.

Mr. FOWLER. After Mr. Graves left the facility, I never had the opportunity to meet one of these individuals in the field. I did discuss some issues with them in my office regarding interpretations of regulations, but I never had the opportunity to meet one again in the field after those days.

Mr. BRYANT. Help me distinguish between your office and the field.

Mr. FOWLER. I am the training manager for compliance at the facility and my office is—I am in charge of the OSHA and radiological protection training. I have had questions asked in regards to the regulations. But since Mr. Graves left, I have not seen a DOE auditor in the field.

Mr. BRYANT. On the date that Mr. Graves left, tell me when that was?

Mr. GRAVES. Early 1992.

Mr. BRYANT. Mr. Key and Mr. Jenkins, Mr. Graves made mention of a Tiger team review. I think that occurred in the early 1990's, maybe 1991. Would each one of you tell me, and Mr. Key, you go first, were you aware of that Tiger team audit review and if it found any safety concerns?

Second, were any steps taken by the contractor as a result of that to remedy any of these safety concerns?

Mr. KEY. Yes, sir. In my experience with the Tiger team, both when they were investigating and review of their findings, the contractor then developed action items for closure of those Tiger team findings.

Yes, there were a lot of safety findings within that and on the—on some of the industrial safety findings, I was asked as a representative of the union to go out and review some of the exact locations in which the union did sign off on some of the safety de minimis items. The others, the majority of them have validation for closure.

Mr. BRYANT. Mr. Jenkins, do you have any comments?

Mr. JENKINS. No, sir. Just about the same thing that Jim said. We worked real hard cleaning the place up. When they came in and made their inspections and everything, we did get a feedback on what they found and some of it was fixed.

Mr. BRYANT. Mr. Fowler, do you have any follow-up on that?

Mr. FOWLER. Yes, I do. I believe even to this day, there is only approximately 10 Department of Energy employees onsite I believe full time, and I have never seen an individual, an inspector out there at night, to this day.

Mr. BRYANT. And I know that we have—there is another side to this and we have witnesses coming in to testify on the second and third panels, probably a couple of other sides.

Mr. Fowler, you seem to sort of bridge this area in terms of timewise and in your capacity there at Paducah. From your perspective, who is to blame here? If you can—I know that you can probably talk for days on this, but I am concerned about the Department of Energy as well as the contractor or contractors and in terms of what I mentioned in my statement about the possibility of coverup or negligence and gross negligence and intentional acts and all kinds of things there from a legal perspective, where would you lay the fault?

Mr. FOWLER. I think it is clearly on the contractor. I didn't see their findings placed in any of the official environmental reports that I started finding. I don't believe they told the Department of Energy the real story.

Mr. BRYANT. Do you lay any fault with DOE on not having enough oversight and supervisory control?

Mr. FOWLER. Yes, that is an aspect that they were to look over. But again, the facts that were not given to them were by the contractor.

Mr. BRYANT. Mr. Chairman, I have concluded my questions.

Mr. WHITFIELD. Thank you. Mr. Strickland.

Mr. STRICKLAND. Thank you, Mr. Chairman. I want to thank each of you for coming here and for helping us more fully understand this.

I would like to take just a moment, if I could, to ask if there is anything that you have not shared with us this morning that you would like to share before your time is up, before this panel concludes? Is there any bit of observation, opinion, or information that you would like for us to know?

Mr. KEY. Mr. Strickland, I do have a concern with the number of DOE site employees at the site, only 10, and given its scarce oversight and budget and the capability, I think it demonstrates that the Oak Ridge office is trying to operate the Paducah site via telephone. And with the size and complexion of the plant, I do not believe that is appropriate, and feel that Congress needs to establish a Paducah site operations office with sufficient funding, staff and contracting authority in order to manage it correctly. And they may also include the Portsmouth into that.

Mr. STRICKLAND. Thank you, Mr. Key. All of the problems that we are talking about Paducah apply to Portsmouth, and I have been told that we do not know what materials came to Portsmouth or what amounts or from whence those materials came. So I just want to reemphasize once again that all of the employees need the protection of this government and that we are going to fail in our responsibilities, if for reasons of fear of liability or fear of setting a precedent of some kind, we were simply to limit this program to a pilot project and exclude hundreds, perhaps thousands of employees, that were just as faithful to this government and just as important in winning the cold war as the wonderful workers at Paducah.

In terms of who is responsible and who knew what when, Mr. Jenkins, did Union Carbide managers or Martin Marietta managers, to the best of your recollection, ever tell you that the ore or the recycled reactor tails and other materials that you were working with were safe?

Mr. JENKINS. Yes, sir. They told us that they were safe enough to eat. I have been told several times, "Guys, you could eat this stuff."

Mr. STRICKLAND. It would be interesting to gather those folks and offer them a good meal. I suspect that they would have a different kind of attitude.

Mr. Fowler, you spoke of having your picture posted on the wall with a bullet or a target on you. Can you just tell us briefly what that felt like?

Mr. FOWLER. My wife and myself have been extremely concerned. They used my picture for target practice, which when I turned in to upper management and they looked at the issues, they told me they considered that as a joke.

Mr. STRICKLAND. Do you recall the names? You don't have to give them here.

Mr. FOWLER. Yes, sir.

Mr. STRICKLAND. Do you recall the names of individuals who may have responded to you in that manner?

Mr. FOWLER. Yes, sir. I was told that it was a joke but they planned no disciplinary action for the employee that might have done it because it was awhile back.

Mr. STRICKLAND. Would you mind sharing the names of the person or persons who responded to you in that manner and who they worked for?

Mr. FOWLER. Mr. Howard Pulley, USEC; and Mr. Steve Seltzer, USEC Employee Concerns Manager.

It carried on to have my car intentionally damaged on plant site in which the ex-plant manager paid for the damages to be repaired out of his own pocket, writing me a check.

Mr. STRICKLAND. Do you have reason to believe that even perhaps today there are individuals who may be observing you more closely than they should or following you or in other ways trying to intimidate you?

Mr. FOWLER. Yes, sir. There is a pattern that when—I have an access pass for my vehicle anywhere onsite. It is routinely followed.

I will park my vehicle at my office and I am having security officers to come to me and say, move your vehicle. I ask the reasons why and they tell me because we want you to. My vehicle is routinely stopped and searched for no reason. Others that borrow my vehicle to enter the facility, they will stop it because it is my vehicle.

Mr. STRICKLAND. Thank you, Mr. Fowler. Mr. Key.

Mr. KEY. Mr. Strickland, the only other concern I have is a lot of documents relating to plutonium and reactor tails are viewed as trace amounts. There is a 1990, I believe, document which is put out by DOE and it is entitled Closing the Atom, "Closing the Circle of the Atom," and within that is a very vivid picture that I feel the committee members need especially to review. It shows one particle of plutonium inside of a lung eradicating 10,000 healthy lung cells and causing mutation, and that was published by the Department of Energy.

Mr. STRICKLAND. Thank you. Thank you all and thank you, Mr. Chairman.

Mr. WHITFIELD. Mr. Burr.

Mr. BURR. Mr. Graves, let me ask you, to your knowledge, did Martin Marietta ever falsify or withhold from DOE the level or existence of contamination or health hazards at Paducah?

Mr. GRAVES. I am not aware of that; no, sir.

Mr. BURR. Are you aware of any documentation or knowledge withheld from the worker or the legal team in this lawsuit upon their request by current contractors?

Mr. GRAVES. No, sir, I am not aware of that either.

Mr. BURR. Let me ask you with your degree of experience, in your opinion is there enough evidence of contamination that the alarm bells should have gone off and clearly earlier than today we should have known about the level of contamination at the Paducah site?

Mr. GRAVES. Yes, sir.

Mr. BURR. Do you believe that documentation exists today and did exist back even at your time at Paducah that clearly showed the evidence of contamination at the levels that are claimed today?

Mr. GRAVES. Yes, sir. Several documents existed that identified the levels of contaminant there.

Mr. BURR. When you raised questions of contamination and worker safety with your management at the time of your original employment at the Paducah site, did they approach it and follow up with the same passion that you displayed the concerns to them?

Mr. GRAVES. No, sir. As I said earlier, I don't think that they had an appreciation for—you have to understand that there was a lot of change going on at that time. Admiral Watkins came in and raised the bar, as was mentioned, as to what appropriate radiological control was. Those of us that entered the complex DOE-wide, that had experience in the areas of nuclear power, or the Navy that were used to that level of rigor, were met obviously with resistance. It was change and when there is change, it breeds certain conflicts. No, I don't think that they received my message with as much rigor as I provided it.

Mr. BURR. Mr. Cochran, you certainly have been active at the attempt to retrieve documents. I think in your document list, tab 8-

A is in fact an executive summary from 1991 and I will just highlight one thing. I am sure that you are familiar with this. That the results of that report suggest in a very clear way that plutonium is not present in offsite sediments. Are you familiar with that?

Mr. COCHRAN. Yes, sir. That is so stated in the executive summary of that Phase I report. There is no plutonium other than in the water.

Mr. BURR. Not only was it stated in the executive summary, was it not also stated that there was no plutonium contamination found in the Annual 1991 Environmental Report on Paducah?

Mr. COCHRAN. And in other environmental reports.

Mr. BURR. You have requested for some time, I think since last spring, or your legal team, documents that pertain to a reference about appendix 2 B-17 of the 1991 Phase I site investigation, which it was noted in the executive summary was to come; am I correct?

Mr. COCHRAN. That is correct. I think Mr. Fowler mentioned that earlier. My attorney, Mr. Egan, searched the public document room at Paducah in Karville for any references to onsite and offsite contamination. Those appendixes were missing from the Phase I report.

Mr. BURR. The request for those appendices was to whom?

Mr. COCHRAN. Well, there were various requests over a period of 3 months by Mr. Egan, primarily working through the librarian at the public document room, who was very helpful. She made inquiries——

Mr. BURR. Which contractor is in charge of the documents?

Mr. COCHRAN. I don't know who is in charge of the public document room or whether it is DOE or a contractor.

Mr. BURR. As it relates to offsite, I believe it is Bechtel Jacobs, am I correct? Based upon that request, when did you receive the appendix?

Mr. COCHRAN. I have never received the appendix. I have heard——

Mr. BURR. You have seen data from it, though?

Mr. COCHRAN. The other regulators, Mr. Fowler and Mr. Deuschle, found computer printouts of the data taken by a company hired by Martin Marietta, a company called CH2M Hill, and the computer printout data was in the health physics files at the U.S. Enrichment Corporation spaces, but it was only later that we discovered that that was the same data that was in the missing appendices in the public document room, and for that matter missing in every Phase II report that was publicly circulated, to the best of my knowledge.

Mr. BURR. Let me ask Mr. Egan to come forward. If you would just lean toward the mike. Let me just ask you, Mr. Egan, based upon your request for that appendix, when did you receive it?

Mr. EGAN. We have never received it. We pursued it from a number of different angles, as Dr. Cochran said. The first request was to the very helpful librarian in Karville, who herself said she never received a request for it, had never realized it was missing. She contacted Oak Ridge and apparently contacted Bechtel Jacobs over a 3-month period. Her final answer to us was that she was unable to locate it.

Mr. BURR. I have a copy of it. Do you find that surprising?

Mr. EGAN. I understand you do.

Mr. BURR. The Louisville paper has a copy of it, but you don't have a copy of it and you were the first one to request it?

Mr. EGAN. That is correct.

Mr. BURR. Mr. Graves, whose responsibility is it, based upon a contractor's obligation with a site like this, to make sure that the reports are fully conveyed to DOE?

Mr. GRAVES. I am not sure that I know the answer to that question. There are probably a number of individuals that are responsible for that.

Mr. BURR. Mr. Cochran, let me go back to you.

Clearly we have entered into the record this document which you have requested for some time, your legal team. But you have looked at data that was used to compile that appendix. Let me ask you, does that data substantiate plutonium contamination offsite at Paducah?

Mr. COCHRAN. Yes, it does, well in excess of regulatory limits in areas that when I visited the site were unposted and, to the best of my knowledge, are still unposted today in violation of DOE regulations.

Mr. BURR. When you were there in the 1991-1992 timeframe, were you aware of plutonium contamination?

Mr. GRAVES. I was only aware of it to the extent that I am aware of it today as a result of the spill. My main focus when I was at the plant was the health and safety of the radiological worker. In normal activities and duties of the work going on around the site, yes, I was aware that there was contamination out beyond the bounds of the site. The levels of transuranics versus uranium I don't recall right now, but I knew after research that they were certainly present.

Mr. WHITFIELD. Ms. DeGette.

Ms. DEGETTE. Thank you, Mr. Chairman.

Mr. Cochran, I know that you are one of the relators in the civil contam action, and I know that the Justice Department is looking at some of those civil issues. One thing that struck me hard listening to your testimony was that it was peppered with references to potential criminal activity at the site, including your testimony about illegal dumping of uranium waste offsite on public grounds.

I am wondering if it would be accurate to say that as well as the civil concerns and the concerns about remedying the situation for workers onsite, you have concerns about potential criminal activity as well?

Mr. COCHRAN. Well, first of all I am not an attorney.

Ms. DEGETTE. We will still listen to what you say.

Mr. COCHRAN. My reference to criminal activity derive from a police report that I attached to my testimony where you have the Kentucky State Police inspector in charge of investigating hazardous waste making these allegations of criminal activity in 1991.

My point is I think this needs thorough investigation to see whether those allegations were true. We certainly have evidence that there was illegal offsite dumping. What action was taken by the Department of Energy, if any, whether they were notified and so forth.

Ms. DEGETTE. Do you know whether any investigation was undertaken?

Mr. COCHRAN. No. I only became aware of this memorandum within the last week or 2.

Ms. DEGETTE. Are you aware of any other instances of employees, or any of the rest of you, of employees being told to hide data or other kinds of willful activity that we should be concerned about?

Mr. COCHRAN. Yes, I am aware of it from discussions with the other three relators.

Ms. DEGETTE. Can you give me some examples of that, sir?

Mr. COCHRAN. One was—Mr. Fowler can correct me if I'm wrong—I believe it was Mr. Deuschle when he found the computer records of the missing data, he was told by his management to bury the data and that it should not be made public.

Mr. Jenkins has referred to numerous truckloads of radioactivity that was illegally dumped, much of it at night offsite.

Ms. DEGETTE. Mr. Jenkins, do you want to expand on that?

Mr. JENKINS. Yes. I loaded out several trucks of slag, what is commonly called magnesium slag from the C-340 building and they were going to the dump. I said, Where are you guys taking this? He told me offsite to the dump. At that time, I didn't know if they had a permit for it or what.

Ms. DEGETTE. Did you later learn that they had a permit?

Mr. JENKINS. A couple of days ago I learned that they didn't have a permit.

Ms. DEGETTE. Did he know that they didn't have a permit?

Mr. JENKINS. I don't know. He was doing what he was told by, I presume, his boss.

Ms. DEGETTE. So you think that this was coming from high levels?

Mr. JENKINS. Yes, ma'am, I do.

Ms. DEGETTE. Dr. Cochran, something else that we were quite surprised to learn was that apparently a plume of contaminated groundwater is moving one foot a day toward the Ohio River, with no effective remediation underway or even planned. I am wondering if you know who is responsible for that and what we can do to get that remedied?

Mr. COCHRAN. I don't know who is responsible for that. And I don't know how to remedy it.

But I would correct your statement. It is in the river.

Ms. DEGETTE. Right.

Mr. COCHRAN. It is not just moving toward, it is into the river.

Ms. DEGETTE. It is in the river now?

Mr. COCHRAN. To the best of my knowledge. It is the technetium plume.

Ms. DEGETTE. Mr. Fowler, let me ask you a couple of questions. When you arrived at Paducah, did you have any interactions with John Hummer who was in charge of health and safety for the gaseous diffusion plants for Lockheed Martin?

Mr. FOWLER. No, ma'am.

Ms. DEGETTE. Mr. Graves told us there was no health physics program in 1989, and from what I hear of your testimony, it was still true that there wasn't in 1991; is that right?

Mr. FOWLER. I arrived at the plant in late 1991. My task was to develop radiological training for the work force in health physics. The majority of the work force did not know what ALARA stood for, and they didn't know how to implement any practices in radiological control.

Mr. GRAVES. As a point of interest, when I make the statement that there was no health physics program, there was one in place; but one that is reasonably capable of doing what it is supposed to be doing in a compliant fashion with regulations, that is a different story. So to say that there was no health physics program in place is an overstatement, but there was not one that was capable of dealing with the problems at hand.

Mr. WHITFIELD. Ms. DeGette, I am going to give you two more questions, and then we are going to take 5 more minutes.

Ms. DEGETTE. I have one more question, and I don't need the second 5 minutes.

It is almost worse to have a program in place that doesn't do the job than to have no program, I would think.

Mr. GRAVES. Well, it is important to understand that throughout the entire complex—of course, I can't speak specifically to the entire complex—but in talking with colleagues over the years, when the new regulations for contamination control came on board, nobody was ready to implement that. So you have to understand what the culture was at the time, and the culture then and what it was changing to.

The problem is if you take an extraordinarily long period of time to get one in place that knows what it is doing and that is relative to a function of what you are dealing with here.

Ms. DEGETTE. Thank you.

Mr. WHITFIELD. We are going to go 5 more minutes for anyone interested, and since I am the chairman, I will go first.

Mr. Graves, at one time you were the health and safety expert with Lockheed Martin at the Paducah plant. In that capacity you submitted observations and recommendations periodically through the annual internal audit of the situation at the plant. I have some copies of your handwritten notes during this time which are being shown to you right now.

In these notes, you make several observations that the current health physicist technician staffing level at Paducah was inadequate; the current health physicist position staffed with an individual with substantial operational health physics experience does not exist. Radiation area postings do not bear approximate dose rates; the current air monitoring system has too few locations to characterize work location airborne concentrations of radioactivity. And then in 1991 you talked about the work on the converter was performed without a work permit, the health physics program still not defined and enrolled by current procedures. And then you recommended a whole host of things that should be done to correct these problems.

Do you know at that time when you made those recommendations whether those were taken care of?

Mr. GRAVES. Well, from the things that I am reading here, you have to understand that as I understand this record, briefly looking at it, I was the company counterpart for this particular audit. This audit was conducted by Dr. Larry McKay, and I don't recall the other individual who was with him but I do remember the audit.

Yes, indeed they basically verified everything that we had been talking about and described deficiencies in. They pretty much substantiated all that; yes, sir.

Mr. WHITFIELD. Did they correct them from your knowledge?

Mr. GRAVES. Well, the process of change, we want to—correct them as far as the timeframe, I haven't been at the site for a very long time. I know that we were only marginally successful during my tenure at the site to change the inertia of the overall process.

Mr. WHITFIELD. Mr. Fowler has characterized that there was a culture of lack of concern regarding the problems. Would you agree with that?

Mr. GRAVES. Absolutely. There was a culture of doing business for many, many years and some of us who came from the Navy or the nuclear power influence when we got to these sites, it was very difficult to explain or to discuss the fundamental parts of health physics, controlling contamination at the source, ALARA. So yes, it was extremely difficult to get the ball turned in the other direction.

Mr. WHITFIELD. All of us may very well have additional questions that we will submit to you all, and I might also say there will probably be follow-up hearings on this. But at this time, Mr. Strickland, do you have additional questions?

Mr. STRICKLAND. Thank you, Mr. Chairman. I am just sitting here listening to this, and I am thinking some terrible things happened. Some person or persons must be responsible for having made either terrible judgments or purposeful decisions to engage in behavior that has caused human harm. And I am wondering and I assume that the contractors had an obligation to carry out certain safety procedures. If they did not do that and if they submitted information that was misleading or inaccurate or deceptive, it seems to me that that implies serious criminal behavior.

Like you, Mr. Cochran, I am not an attorney but one of the things that bothers me is that we oftentimes do not hold people responsible. And so consequently, there is not the motivation for appropriate behavior in the future. Someone is responsible and, Mr. Chairman, I would hope that using whatever mechanisms this committee has at its disposal, that we would consider encouraging a criminal investigation into what we have heard here today, because if decisions were made and contractual agreements were not kept and lies were told, we need to identify who is responsible for that and we need to hold them responsible. And unless we do that, my concern is that this kind of behavior and the mistrust of government which obviously this has caused to happen, will continue.

I am interested in those of you who are on the panel regarding whether or not, based upon your experience and what you do know, that you would like to see an investigation into whether or not criminal behavior occurred and if it did, whether or not it should be pursued?

Mr. FOWLER. I definitely would like to have that looked into, sir.

Mr. JENKINS. I agree, sir.

Mr. COCHRAN. I share your thoughts completely.

Mr. GRAVES. I have no comment in that regard.

Mr. KEY. The Presidential Report on Human Radiation Experiments, which I reviewed yesterday, which leads one to believe that the Atomic Energy Commission purposely starting in 1947 had a mission, and also decisions were made to deceive the workers and public to keep this information internally. I guess my question, Mr. Strickland, is when did this stop or has it stopped?

Mr. STRICKLAND. And just in closing, I would like to make this comment. There is reference here to some of this material information was kept from workers because of fear that they may require or expect hazardous pay. I don't know if it is possible, but quite frankly I would like to see if we can go back and identify all of those employees, calculate what the hazard pay would be, add interest to that and make whoever was responsible, government or contractor, compensate those persons and, if they are deceased, compensate their families.

It seems to me that this is just—it is just almost unbelievable and the frustration that you must feel I think is felt to probably a much more minimal degree by us but we appreciate—I appreciate the fact that you have come and you have shared and that you have been willing to take this step. Thank you, Mr. Chairman.

Mr. COCHRAN. Mr. Strickland, I would urge you to examine the ALARA requirement. This is a U.S. Government regulatory requirement to keep radiation exposures as low as reasonably achievable. The contractor had an obligation to meet that, and to meet that he has to have an entire program. Just like he has a financial officer and accountants keeping his business books, he has to have an entire program, a man in charge or woman in charge and a whole battery of people whose duty it is to look for ways to minimize the exposure to workers.

Had that been in place by Union Carbide and by Martin Marietta and Lockheed Martin and Bechtel Jacobs, you probably would not have the cancers and illnesses that occurred and you would not have them in the future and you would not have that technetium plume.

You are going to hear from Mr. Hummer who makes a statement in his written statement on page 5, "With respect to workers' safety, the radiation protection program at the Paducah plant during Lockheed Martin's management was developed and implemented to conform to standards of the International Committee on Radiation Protection, as well as the specific requirements of DOE."

That, sir, is a false statement.

Mr. WHITFIELD. Dr. Cochran we will be hearing from Mr. Hummer on the next panel. Mr. Bryant.

Mr. BRYANT. I have two additional questions.

Mr. Graves, let me ask you, if I could, an internal Environmental Compliance Review was done at Paducah by Martin Marietta in December 1990 and it identified compliance problems with respect to Martin Marietta's implementation of the National Environmental Protection Act. According to this document, the review found no system is in place to ensure that environmental impact assessments prepared in compliance with NEPA are honored by plant management.

However, in that same year's environmental report, Martin Marietta told DOE that "compliance with NEPA is maintained by following the guidelines set forth by CET, DOE, and Martin Marietta." Obviously these statements are in conflict. My question is, do you have any explanation from your position as to why these statements would be made?

Mr. GRAVES. Mr. Bryant, again my responsibilities there were for radiological protection. The construction or the dissemination of documents relative to NEPA review or any other environmental regulation, I was not privy to. I must say that I reviewed some documents from time to time, but as far as the actual execution of the process, I can't comment to, sir.

Mr. BRYANT. You have referred several times today, this was something in the culture?

Mr. GRAVES. Yes, sir.

Mr. BRYANT. Would this be consistent with that prior statement, the culture that you found in Paducah?

Mr. GRAVES. I suppose that they could be looked at like that; yes, sir.

Mr. BRYANT. I know that there are other witnesses that will follow on other panels that can more adequately address that question.

Let me ask, Mr. Fowler, if you know this answer. USEC made a commitment to the NRC to complete seismic upgrades at the Paducah uranium enrichment plants by December 1997 and this is a high-priority public health and safety project because the Paducah plant is near a fault line. However, USEC has pushed the completion date back and is not close to finishing the work.

According to the most recent update of the NRC—and this is September 15—the schedule for completing these upgrades slipped back to September of the year 2000. Apparently DOE has transferred more than $200 million to USEC to complete these upgrades. Do you have any knowledge of this?

Mr. FOWLER. I know that they are bringing in a massive amount of subcontractors to complete the project. I know that it is ongoing, but the reasons for the delay, I can't explain.

Mr. BRYANT. Again, I think we have other members of the later panel who will be able to address that issue. In the event that question is not asked, I would hope that they would address that question.

Mr. WHITFIELD. Ms. DeGette.

Ms. DEGETTE. Thank you, Mr. Chairman. Mr. Strickland and I were kind of wondering what some of the employees of the plant think about this statement. "With respect to worker safety, the radiation protection program at the Paducah plant during Lockheed Martin's management was developed and implemented to conform to standards of the International Committee on Radiation Protection as well as the specific requirements of DOE. Plant workers were advised of radiation hazards and other safety hazards associated with their work, both in general and for specific activities."

Mr. Key?

Mr. KEY. During that period of time there was a lot of change going on inside the plant. There were implementations of the contamination control program now. There were personal protection for workers that in order to perform their job had to adhere to. The whole work force was trying to absorb all the knowledge being thrown at them from various angles and some of that training that they received was not efficient or we had to go back and retrain on particular issues.

So to answer your question, some of the changes were viewed by the workers themselves as requirements that were needed by DOE and implemented, but as far as their knowledge of the international radiological committees and stuff, it was nonexistent because it was a complete culture change for us.

Ms. DEGETTE. Mr. Fowler?

Mr. FOWLER. The work force—at that time I was involved in direct development of training. They were not always informed, and I will make a reasoning, due to the management culture to support health physics. That was not there. They did not support it.

Ms. DEGETTE. Mr. Jenkins?

Mr. JENKINS. I agree with both Jim and Ron. Everything was in turmoil then. Some of it was never gotten out, I will put it that way.

Ms. DEGETTE. Thank you. Thank you, Mr. Chairman.

Mr. WHITFIELD. Thank you, Ms. DeGette.

Mr. Burr, 5 minutes.

Mr. BURR. Mr. Cochran, there has been a tremendous amount of interest not only by the Department of Energy but by EPA and State environmental regulators as well as HHS to determine worker safety, and I think DOE has done a preliminary report. HHS also finished a public health assessment done by the Agency for Toxic Substances and Disease Registry which was completed last month. It is still in draft form, I'm sorry. Let me read one of the areas of the draft form to you and I will ask a question about it.

"This means that although members of the public near the site may be exposed to low levels of contamination in the environment from the Paducah Gaseous Diffusion Plant facilities, concentrations are not at a level that would cause harm to humans." Based upon some of the new documents that we have seen about the level of contamination, how can an assessment be made in line with what we are reading in this draft?

Mr. COCHRAN. I think that is an inaccurate statement that you just read.

Mr. BURR. Let me ask you if you are aware of how in depth DOE, HHS, EPA, State environmental agencies, are at their reassessments? Are they actually going in, doing the testing, or are they using documentation that is available to come to a conclusion that has been provided by the contractors?

Mr. COCHRAN. I don't know. I do not have firsthand knowledge of their activities other than, for example, the 2-page DOE auditor statement or summary of the auditor—of the DOE audit and the public statements made by DOE officials and EPA and so forth.

I think there needs to be a change in the culture of these organizations as well. First there are levels—there are levels of contamination offsite that are above regulatory limits. The hazard to the public is less than the hazards to the workers. The main focus of your investigation I think should be on workers and culpability.

It is incorrect, though, to say that the levels offsite, for example, are at a level that would not cause harm.

Mr. BURR. Let me take you back through some of the documents that you and I have been through. We had an executive summary in 1991. We had an annual environmental report on in 1991 that was actually completed in October 1992. The executive summary was completed on March 22, 1991. That executive summary at that time stated that there was an appendix missing, that it was yet to come. That is the same appendix that your legal team has asked repeatedly to be produced. It has now been produced for the local paper and for the Congress but not for you. Let me draw your attention to the date of the appendix, January 4, 1991.

Clearly this Phase I site investigation was completed and printed in January 1991, 2 months prior to the completion of the executive summary that said site investigation to come and clearly a year, almost 2 years prior to the annual environmental report. Both the executive summary and the environmental annual report were written. The contractor had to have known of the existence of the Phase I site investigation written and completed on January 4, 1991. What would you conclude from that?

Mr. COCHRAN. My conclusion is that the contractor was aware of the contamination and covered it up and proceeded to make numerous false statements in environmental reports and reports to the DOE and the State of Kentucky with regard to the levels of contamination.

Mr. BURR. Clearly if the appendix had been included in the executive summary or the annual environmental report, those reports would have spelled out something totally different, would they not?

Mr. COCHRAN. If it had been in the executive summary, it would have been harder to lie in the annual reports, yes.

Mr. BURR. I thank you and I thank the rest of the witnesses. I yield back the balance of my time.

Mr. UPTON. Mr. Whitfield.

Mr. WHITFIELD. I would like to make one statement, Mr. Chairman. This panel has provided us with some shocking revelations and under your leadership it is our intent to obtain all of facts and correct this problem once and for all.

Mr. UPTON. As I excuse the panel, I want to thank you for your hours of testimony this morning and this afternoon. I can assure you that it is our intent to assure that all of the workers in all of the sites feel that they are safe as they go to and from their job and that the community that they live in, that those folks too will be proud of the operation that is in that community. We will accept nothing less. Thank you very much. You are formally excused.

Panel 2 includes Mr. John Jay Hummer, Director of Corporate Environment, Safety and Health for Lockheed Martin; Mr. Joseph Nemec, President of Bechtel Jacobs; and Mr. James Miller, Executive Vice President of USEC.

I would like to proceed with Panel II as we are close to having some votes on the House floor. As I understand, each of you also have counsel, as we had with the first panel. No? Mr. Hummer, do you have counsel?

If you could all rise and identify your counsel and have your counsel rise as well.

Mr. HUMMER. My counsel is Mr. Leon.

Mr. MILLER. Mr. Moore.

[Witnesses sworn.]

Mr. UPTON. Thank you very much. You are now under oath. As you saw with the first panel, we would like to limit your remarks to no more than 5 minutes. Your entire testimony will be made certainly part of the record.

Mr. Hummer, we will start with you. Thank you.

TESTIMONY OF JOHN J. HUMMER, DIRECTOR OF CORPORATE ENVIRONMENT, SAFETY AND HEALTH, LOCKHEED MARTIN CORP., ACCOMPANIED BY RICHARD J. LEON, COUNSEL; JOSEPH F. NEMEC, PRESIDENT, BECHTEL JACOBS COMPANY, LLC; AND JAMES H. MILLER, EXECUTIVE VICE PRESIDENT, USEC, INC., ACCOMPANIED BY ROBERT MOORE, COUNSEL

Mr. HUMMER. Mr. Chairman, members of the committee, on behalf of Lockheed Martin Corporation, I appreciate the opportunity to provide testimony and answer your questions regarding safety at the Paducah Gaseous Diffusion Plant during the period that Lockheed Martin operated that facility. After nearly 3 decades in the nuclear field, 20 years of which was an as an officer in the Navy nuclear submarine program, I was hired in 1991 by Martin Marietta Energy Systems as the Director of Safety and Health in Oak Ridge, Tennessee, with duties including programmatic responsibility for safety at the Paducah plant. Since 1994, I have served as a Director of Environmental, Safety and Health at Lockheed Martin's corporate level, with programmatic responsibility for the facilities it operates for the Department of Energy.

Owned by the Department of Energy, the Paducah facility was built in the early 1950's to produce enriched uranium for the Nation's nuclear weapons program. In the mid-1960's, its mission changed to include production of fuel for commercial nuclear reactors. Between 1964 and 1977, enriched uranium from reprocessed reactor fuel was introduced into that process. This reprocessed reactor fuel was known to be contaminated with small amounts of transuranic elements, including plutonium.

Lockheed Martin operated the Paducah facility from 1984 to 1989. Although introduction of the contaminated reactor fuel had ceased in 1977, some transuranic contamination remained. The worker and environmental protection programs that Lockheed Martin took over in 1984 were viewed by DOE as effective to address that contamination as well as the other safety risks inherent in the facility. In the late 1980's, however, the new Secretary of Energy, Admiral Watkins, instituted enhanced safety standards and programs at all DOE facilities in order to meet the ever-increasing expectations of the American people for protection of workers and the environment. Lockheed Martin, in coordination with DOE, improved the health, safety and environmental programs at Paducah.

Throughout the 15-year period that Lockheed Martin operated the Paducah facility, it worked very closely with the Department of Energy to fulfill DOE contract requirements and to ensure that DOE was fully informed of plant circumstances. To the best of our knowledge, the corporation did not mislead workers or DOE as to the state of worker safety, environmental protection or any other matter at the Paducah facility. To the extent that lawsuits have been filed to date which raise new, unresolved allegations of wrongdoing by present or former Lockheed Martin employees, Lockheed Martin intends to look into those allegations and deal with them appropriately.

In the meantime, however, Lockheed Martin will defend these suits vigorously and with every confidence that it will ultimately be vindicated in the courts of law. Lockheed Martin also remains committed to allay the concerns of the workers at the Paducah facility and their families. We will cooperate to the fullest extent possible with DOE and the Congress in their effort to protect the health and safety of these workers and their community.

Thank you, Mr. Chairman.

[The prepared statement of John J. Hummer follows:]

PREPARED STATEMENT OF JOHN J. HUMMER, DIRECTOR, CORPORATE ENVIRONMENT, SAFETY AND HEALTH, LOCKHEED MARTIN CORPORATION

Mister Chairman and Members of the Subcommittee, thank you for the opportunity to address this important matter on behalf of Lockheed Martin Corporation.

INTRODUCTION

I appear here today having worked in the nuclear field for nearly four decades. I graduated from the US Naval Academy in 1958 and from the Naval Nuclear Propulsion Program in early 1962. I later earned a Master of Science degree from the University of Southern California. I served 23 years on active duty in the Navy, principally operating nuclear submarines, but also commanding a major submarine training center. After retirement from the Navy as a captain, I spent ten years consulting and providing management support for nuclear public utilities. In 1991, I was hired as Director of Safety and Health for Martin Marietta Energy Systems in Oak Ridge, Tennessee. I served in that capacity for three years and had programmatic responsibility for safety at the Paducah Gaseous Diffusion Plant. Since 1994 I have been a Director on the Martin Marietta/Lockheed Martin Environment, Safety and Health staff at the corporate level with programmatic responsibility for the numerous DOE facilities operated by Lockheed Martin.

Lockheed Martin Corporation has been asked to appear here today to provide information to the Committee regarding its management of the Paducah facility from 1984 to 1999. We are pleased to do so. However, it is important to note from the outset that as a result of lawsuits that have been filed against us and other private contractors who managed the Paducah facility—two of which having been filed so recently that we have not had an opportunity to even answer them yet in court—there are legal and practical limitations to how much we can say, *at this time,* regarding our performance under the contract with the Department of Energy. Nevertheless, because of our ongoing concern for the health and peace of mind of those in the Paducah area and our desire to dispel as many as possible of the inaccurate and false impressions that have been advanced to the public, I am here today to help answer your questions. Before doing so, I believe some background information would be useful.

MANAGEMENT HISTORY

The Paducah Gaseous Diffusion Plant is an important part of our national nuclear infrastructure. The plant was built for the Atomic Energy Commission ("AEC") in the 1950's. It is still owned by the Department of Energy, the successor to the AEC. From its initial operation until 1984 the Paducah plant was operated by Union Carbide Corporation for the DOE. In April 1984 Martin Marietta Energy Systems Inc. succeeded Union Carbide as the plant operator. In 1993, pursuant to legislation from the Congress, the United States Enrichment Corporation ("USEC") was formed and leased the Paducah plant uranium enrichment facilities from DOE for operation. Martin Marietta Utility Services Inc. (later Lockheed Martin Utility Services Inc.) operated the plant for USEC from 1993 to 1999. DOE retained responsibility for, and control of, the remainder of the Paducah plant, including environmental management. Lockheed Martin Energy Systems continued as DOE's operating contractor for those activities. In early 1998, Lockheed Martin Energy Systems was succeeded by the Bechtel Jacobs Company as the DOE contractor. In May 1999 USEC took over direct operation of the production facilities, ending Lockheed Martin's direct involvement with the Paducah plant.

Located in western Kentucky, the Paducah plant sits on a 3500-acre site owned by the DOE. About 740 acres around the operating facilities are fenced, with the remainder forming an uninhabited buffer area. The buffer area is accessible to the public and is adjacent to a wildlife preserve. The uranium-enrichment facility includes huge multistory buildings with hundreds of electric motors consuming more than a thousand megawatts of power to move the process gas through the diffusion enrichment process. Support facilities for the plant are functionally equivalent to a small city. The plant employs about 2000 men and women, including about 10 DOE personnel.

URANIUM ENRICHMENT PROCESS

Although this hearing is not the place to describe in detail the scientific process for uranium enrichment, there has been considerable public discussion and concern about the presence of plutonium at the Paducah site and its hazardous potential to the employees and the public. Some additional background might help explain how plutonium was introduced into the Paducah facility and how safeguards implemented by contractor Lockheed Martin together with DOE helped protect workers and the environment against the hazards posed by plutonium and uranium.

The Paducah plant uranium-enrichment facility was initially operated as part of our country's nuclear weapons program. For more than three decades it has also played a critical role in enriching uranium for the commercial reactors that provide electricity to communities around the country. Both weapons and reactor uses of uranium require that the concentration of uranium 235 be increased from naturally-occurring levels. At Paducah, the initial step in the enrichment process, the principal input or feed to the process is natural uranium in a gaseous fluoride state. As a result of the Paducah process, uranium 235 concentration, or enrichment, is increased to about 2%.

During three extended periods from the early 1950's to the late 1970's, enriched uranium from reprocessed DOE reactor fuel was introduced into the enrichment process at the Paducah plant, as part of a DOE effort to make the best use of the unused enriched uranium. These "reactor returns" contained small amounts of transuranic elements such as plutonium and neptunium, and fission products such as technetium. Although the transuranic elements were present in very small proportion to the uranium, they posed special challenges to the radiation protection program at Paducah because by comparison they were far more radioactive. These challenges were recognized from the early days of the reactor return activities, and certain controls to limit worker exposure and radiation dose were in place when I joined Martin Marietta in 1991. The introduction of plutonium and other transuranic elements, however, had ended in 1977. Nevertheless, as a result of their earlier introduction between 1954 and 1977 Martin Marietta and Lockheed Martin and their successors have had to work with DOE to monitor and protect the workers and community against the residual presence of small amounts of those transuranic elements.

WORKER SAFETY PROGRAMS

To address the safety hazards at the Paducah plant, operating contractors developed and implemented programs based on DOE safety and environmental requirements. These programs were reviewed and approved by the DOE, and subject to periodic evaluation by the contractor and DOE. The worker protection and other safety programs in place in 1984, when Martin Marietta Energy Systems took over operation at Paducah, were considered appropriate by all parties at that time.

With respect to worker safety, the radiation protection program at the Paducah plant during Lockheed Martin's management was developed and implemented to conform to standards of the International Committee on Radiation Protection as well as the specific requirements of DOE. Plant workers were advised of radiation hazards and other safety hazards associated with their work, both in general and for specific activities. Orientation and refresher general training included a discussion of plant radiation hazards, radiation warning and information signs and requirements to obey posted warnings, and information about the radiation monitoring program. Individuals who worked in certain areas of significant radiation received additional training and met special qualification requirements before being assigned and performing the work. Employees were cautioned and trained to work in ways that minimize the radiation exposure, particularly to minimize the time spent in the radiation area, to stay as far from radiation sources as possible, and to use available shielding whenever possible.

Employee concerns programs were also instituted to offer an opportunity for workers to voice safety concerns and have them resolved. Concerns could be raised anonymously, and any retaliation against individuals raising concerns was strictly against our requirements. Potential safety issues that were identified by workers, DOE, external agencies or internal management assessment were investigated and resolved to the best of our ability, most in conjunction with the individual who raised the issue.

It is important to emphasize that radiation protection and some other health programs require monitoring to determine individual exposure levels and frequent area monitoring to determine levels of radioactive contamination. Radiation exposure monitoring serves two principal purposes: to assure that individuals are not exposed to amounts of radiation above established limits; and to help identify any need for additional controls. Limits for radiation exposure are implemented at administrative levels significantly lower than ICRP limits as part of the plan to limit exposures.

The potential for internal contamination of radiation workers was monitored through a bioassay program. Bioassay was a routine part of the radiation protection program at the Paducah facility (and the other gaseous diffusion facilities) because of the presence of uranium. Data on the bio-assays of personnel engaged in particular activities or working in areas with the potential for internal exposure is in DOE records.

In the late 1980's Admiral Watkins, the Secretary of Energy, recognized that safety standards and programs at all DOE facilities needed to be enhanced in order to meet the ever-increasing expectations of the American people for protection of workers and the environment. He instituted an aggressive audit program to identify and correct shortcomings, including shortcomings in the radiation protection programs. Improvements in DOE programs now include more detailed safety and environmental program direction and guidance, standardized training for radiological workers, and nuclear safety requirements enforceable under the Price Anderson Act.

In response to the increased safety standards, Lockheed Martin developed and implemented enhanced safety and environmental programs at the Paducah facility.

Indeed, when Admiral Watkins, in early 1990, advised Norm Augustine, then CEO of Martin Marietta, that the radiation control practices at its DOE facilities operated by Energy Systems were not satisfactory, Mr. Augustine responded with a description of actions already taken to improve the programs and a commitment to continue to provide his personal attention to the issue. He also provided a more detailed action plan to the DOE Manager of the Oak Ridge Operations Office.

MANAGING ENVIRONMENTAL HAZARDS

The standards for control of releases of radioactive materials to the environment, whether into the air, soil or water, from DOE facilities, including the Paducah plant, were established in DOE Orders and by the EPA. The Commonwealth of Kentucky authorities additionally oversaw compliance with environmental requirements established in permits issued through the Cabinet for Natural Resources. To assess radiological emissions from the plant, DOE elected to require Lockheed Martin to collect and analyze samples from the water, soil and air at the plant, and to compare the results to the standards established in DOE Orders. In addition, a number of off-site surface water sampling locations were established. Airborne emissions were regulated under the Clean Air Act through a permit system administered by the KDEP. To assure compliance with the Clean Air Act permits from the State of Kentucky, stacks were sampled, ambient monitoring was conducted at various off-site locations, and on-site meteorological data was collected. In addition, external gamma radiation was measured at a number of off-site locations, radiation surveys were conducted throughout and around the plant site, and periodic aerial surveys were conducted.

Data collected from the liquid and gaseous effluent monitoring programs described above were compiled, analyzed and reported each year in an annual environmental monitoring report for the Paducah plant. This report was distributed by DOE to the news media and the public. In many years a press conference was called to review the report and answer questions for the public and various environmental groups.

CONCLUSION

Lockheed Martin (previously Martin Marietta) operated the Paducah plant for 15 years, with responsibility for protection of employees, the public and the environment from hazards associated with the plant. Throughout that period the corporation worked very closely with DOE to fulfill DOE contract requirements and expectations, and to ensure that DOE was fully informed of plant circumstances. To the best of our knowledge, the corporation did not mislead workers or DOE as to the state of worker safety, environmental protection or any other matter at the Paducah plant. To the extent that the lawsuits that have been filed to date raise new, unresolved allegations of wrongdoing by present or former Lockheed Martin employees, Lockheed Martin intends to look into those allegations and deal with them appropriately. In the meantime, however, Lockheed Martin will defend these suits vigorously and with every confidence that it will ultimately be vindicated in the courts of law. It also remains committed to allay the concerns of the workers at Paducah, and their families. It will cooperate to the fullest extent possible with the Department of Energy and the Congress in their effort to protect the health and safety of those workers and their community.

Mr. UPTON. Thank you.
Mr. Nemec.

TESTIMONY OF JOSEPH F. NEMEC

Mr. NEMEC. Thank you, Mr. Chairman. I am Joe Nemec, President of the Bechtel Jacobs Company. We are the management and integration contractor for environmental restoration work at Paducah at Portsmouth, Ohio and Oak Ridge, Tennessee. We are a relatively new contractor, been there about 18 months. Our role began in April of last year. We are there specifically to clean up the site, to stop the migration of contaminants, to clean up contaminated areas both on and off the site, dispose of wastes from past operations, to maintain these inactive facilities until they can be decommissioned, and to manage the inventory of depleted uranium hexafluoride, the surveillance and maintenance on the cylinders. Our role does not include the conversion of that material to another form. We have 94 employees at Paducah and about 275 subcontractor employees.

In January 1998 through March 1998 we went through a phase-in period, a 3 month phase-in period where we reviewed existing programs and placed the transferring Lockheed Martin people at the appropriate point in our organization. With respect to the safety programs, we found an adequate set of procedures and process and programs in all elements of safety. However, we did find five separate programs for the five different sites that we oversee. And so we developed an integrated safety management system using the patterns that the Department of Energy had been developing over the previous few years. That system has, I think, two important components for these discussions:

One, worker involvement. Every task we do, we get the workers who actually have to do the work involved in the planning of that task. That is a key to our success. That is only way that we will really improve our safety record.

The second is management ownership of safety. It isn't the safety department's responsibility. It is my responsibility and those people who report to me, right down through our site manager and to the first line supervisors.

It is also important that we have a system where we can continuously improve our safety through continuous feedback on all the tasks. That is an important element of our entire safety program. A few weeks ago, we had a fairly large DOE team visit the site to look at a variety of things, including some of our operations. They identified some preliminary concerns, and as a result the Secretary of Energy called a 1-day stand-down and we conducted that stand-down; gave us an opportunity to discuss with the site personnel again our safety program and to elicit any suggestions or any concerns that they had.

We expect that we will get a final report from DOE. We will read and understand that report, develop a corrective action plan and get on with any changes that are required.

I think it is important to recognize that that investigative team found no imminent hazards to the workers, the public, or the environment and in fact we have what we believe is a fairly good safety program at Paducah. On average, the radiation exposure to our workers is less than 1 percent of the regulatory guideline, about the same as you would receive by two transcontinental flights across the country. We have had no environmental notices of violation, and our employees have worked for more than 500 days without a recordable injury.

I want to thank the chairman and the committee for inviting me here. I will be happy to answer your questions. Thank you.

[The prepared statement of Joseph F. Nemec follows:]

PREPARED STATEMENT OF JOSEPH F. NEMEC, PRESIDENT, BECHTEL JACOBS COMPANY LLC

My name is Joe Nemec, President of Bechtel Jacobs Company LLC, the management and integration (M&I) contractor for the Department of Energy's (DOE's) environmental management and uranium programs work at Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. About 80 percent of our work is at Oak Ridge, with about 10 percent each at Paducah and Portsmouth. Our role at Paducah is to restore the environment, dispose of the legacy waste in storage, and manage the stockpile of depleted uranium hexafluoride (DUF_6). We are not responsible for operation of the Paducah Gaseous Diffusion Plant (PGDP). That operation is the responsibility of the United States Enrichment Corporation (USEC). Bechtel Jacobs Company has 94 employees and about 275 subcontractor employees at Paducah, while USEC has about 1,600.

Recent events have focused attention on worker and public safety issues at the Paducah site, and I will discuss those issues today.

Bechtel Jacobs Company is a relatively new contractor at Paducah. We were selected through the competitive process as the M&I contractor in December 1997 and began a three-month phase-in on January 1, 1998. Eighteen months ago, on April 1, 1998, we assumed full responsibility for the DOE activities at the site from the predecessor contractor, Lockheed Martin Energy Systems. We took over cleanup activities that had been in progress at Paducah since the discovery of off-site contamination there in 1988. We have been making measurable improvements in all areas of that activity, including its associated safety and health program.

While we have made significant progress to date, I'll be the first to acknowledge that there is much left to do and always room for improvement. The safety review recently initiated by DOE, and last week's one-day stand down ordered by Secretary Richardson, provided additional focus on safety.

It is our understanding that this review team did not find any imminent threats to the health of workers, the public, or the environment. However, they have spoken to us about some areas for improvement, and we've initiated actions to address the issues they identified.

My remarks today will cover three major areas. First, I'll describe Bechtel Jacobs Company's role and tell how it differs from that of previous contractors. Second, I'll describe the environmental management and uranium programs work at Paducah for which we are responsible. And third, I'll review our safety and environmental programs, including actions we are taking in response to what we learned during the stand down.

ROLE OF BECHTEL JACOBS COMPANY

The scope of our work involves environmental management and uranium programs.

The environmental management portion of this assignment involves investigating, planning, and performing cleanup of numerous facilities, disposal sites, and waste materials that are left on-site from prior DOE operations; we refer to these wastes as legacy wastes. The uranium programs task involves managing 63,000 cylinders of DUF_6 stored at Oak Ridge, Paducah, and Portsmouth, with almost 38,000 cylinders at Paducah.

Our contract represents a major change in DOE's contracting strategy for these environmental management and uranium programs. Our predecessor had operated the DOE facilities for many years under a management and operations contract, which meant they performed most of the work with their own forces. Bechtel Jacobs Company was hired to complete the cleanup of the facilities as an M&I contractor. We plan, manage and integrate the work using primarily subcontractors to accomplish discrete individual tasks with a focus on project completion.

Our contract with DOE allowed us to bring in some new personnel and a new management approach, but it also required that we hire the majority of the Lockheed Martin Energy Systems workforce at substantially equivalent pay and benefits. The former LMES workforce is to be moved to subcontractors during a two-year transition period. We are 18 months into that two-year period. In another six months we will have completed the transition, at which time about 90 percent of the work will be performed by subcontractors.

By bringing us in as a new contractor, DOE has created the opportunity to review and revisit the way cleanup work is conducted at Oak Ridge, Portsmouth and Paducah. We have taken the opportunity to make changes where we can improve safety and efficiency. I will discuss some of these changes in greater detail. By keeping a substantial number of the prior personnel, however, DOE continues to receive the benefit of these employees' site experience and knowledge.

OVERVIEW OF ENVIRONMENTAL MANAGEMENT AND URANIUM PROGRAMS WORK AT PADUCAH

DOE owns the 3,556-acre PGDP reservation and leases the uranium enrichment facilities to USEC. DOE leases 290 buildings and facilities to USEC and retains 152 as "nonleased." The nonleased facilities include:

- inactive facilities under surveillance and maintenance
- waste storage and treatment facilities
- a permitted solid waste landfill
- storage yards for cylinders containing depleted uranium hexafluoride
- burial grounds and scrap yards designated for environmental cleanup
- closed landfills
- DOE material storage areas
- two groundwater extraction and treatment systems
- office and laboratory facilities
- roads and grounds both inside and outside the perimeter security fence on the DOE Reservation

A range of contaminants have been detected over the years in the DOE facilities at Paducah and in the environmental media around these facilities. Some of these contaminants are common to American industrial facilities, including trichloroethylene (TCE), a common industrial solvent, and polychlorinated biphenyls (PCBs), commonly used in oils in electrical systems. Others contaminants are found primarily at facilities dedicated to nuclear applications, such as uranium, plutonium, technetium and neptunium. The contamination that DOE is in the process of investigating and remediating resulted from historical operations and past practices no longer in use at PGDP.

The risks to workers, the public and the environment posed by these contaminants depend on both the toxicity of the substance and the quantity, form, distribution and mobility of the material. Thus, although low levels of plutonium are present at the site, it does not pose as much risk to workers, the public or the environment as does the uranium, which is present in much greater quantities, and TCE and technetium, which are both mobile in groundwater.

Bechtel Jacobs Company is responsible for planning and executing a variety of environmental restoration activities at Paducah. These activities are being planned and executed through the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process, which provides for federal [U.S. Environmental Protection Agency (USEPA)] and state regulatory oversight, and extensive public notification and participation. CERCLA remedies are being developed and will be implemented to address 211 solid waste management units, approximately 60,000 tons of scrap metal and approximately 50,000 drums of legacy waste. In addition, interim actions are already under way to address two groundwater plumes, and innovative technologies are being evaluated as potential final remedies for all groundwater contaminants.

The regulatory framework for environmental restoration at Paducah is the Paducah Federal Facility Agreement (FFA)—a triparty agreement among DOE, USEPA

Region 4, and the Commonwealth of Kentucky—that became effective on February 13, 1998. For several years before this date, Paducah environmental restoration was implemented pursuant to an Administrative Consent Order under Sections 104 and 106 of CERCLA, as well as the corrective action requirements of the Resource Conservation and Recovery Act (RCRA) permit. The FFA coordinates the CERCLA-required activities, which are administered by USEPA, with the RCRA corrective action program administered by the Commonwealth of Kentucky. PGDP was placed on the USEPA's National Priorities List on May—31, 1994.

Prior to the commencement of our contract, DOE, the Commonwealth of Kentucky and USEPA had identified 211 Solid Waste Management Units, and grouped these units into 30 Waste Area Groups. Most of these areas are on DOE property, either within the security fence or on the DOE Reservation. Historical contamination has affected groundwater between the plant and the Ohio River to the north, and two streams that receive surface water discharges from DOE property.

Our recent efforts have focused on streamlining the approach to remedial decision making by consolidating the Waste Area Groups based on affected environmental media. This approach will reduce the number of documents required to make cleanup decisions and will promote a comprehensive and coordinated approach to cleanup. The time and resources saved by streamlining the process will accelerate the cleanup process.

Under CERCLA, results from environmental investigations are submitted to the state and USEPA and maintained as the Administrative Record, which documents the environmental decision-making process. Since 1993, site environmental information and a duplicate Administrative Record have been available to the public at the Environmental Information Center in Paducah. Starting in 1989, public meetings have been held on approximately a yearly basis to inform the public of the status of environmental investigations and cleanup.

In addition to public meetings required by CERCLA, approximately 40 other public meetings and more than 100 other special events, tours and workshops have been documented since the late 1980s at which information was provided about contamination and related environmental cleanup activities at the site. As a further communications tool, an Environmental Advisory Committee was established in 1986 for quarterly updates about environmental issues. That group disbanded in 1996 when the Paducah Site Specific Advisory Board was formed under the Federal Advisory Committees Act. The SSAB monthly meetings are noted in the Federal Register and are open to the public.

As we move forward, the regulatory agencies and the public (including on-site workers) will continue to be fully informed of all identified environmental conditions and afforded the opportunity as required by CERCLA to participate in the cleanup decision-making process.

Environmental Restoration

In these days of limited federal resources, efficient use of available resources is being promoted by prioritizing cleanup actions based on risk. To facilitate efficient resource allocation and promote a logical environmental remediation of PGDP, five major factors for prioritizing environmental restoration have been identified by DOE:

- Mitigate immediate risks, both on- and off-site.
- Reduce further migration of off-site contamination.
- Address sources of off-site surface water and groundwater contamination.
- Address the remaining on-site contamination.
- Final decontamination and decommissioning of DOE facilities

With regard to environmental contamination, interim actions have been taken to address the known imminent threats, including providing an alternative water supply to affected residents, conducting off-site residential well monitoring, and implementing other institutional controls such as fish advisories and posting and fencing of creeks. In addition, several interim actions had been taken to help reduce off-site migration of contaminants. These included the construction and ongoing operation of two groundwater extraction and treatment systems to address the high concentration areas of the northwest and northeast TCE plumes, which have jointly treated approximately 600 million gallons of contaminated groundwater water since 1995. Several interim actions had also been taken for surface water such as using an enhanced treatment system for Tc-99 prior to discharge and rerouting plant effluent to control migration of contaminated sediment in on-site ditches.

However, while the site had undergone various degrees of characterization and there has been a strong emphasis on implementing interim actions to address imminent threats, it was apparent that limited actions had been taken at the source areas. There was a need to further integrate and assess existing data on a site-wide basis to support long-term solutions. Therefore, as part of our initial transition plan, the existing cleanup strategy has been revised to reflect a more aggressive focus on source areas and cleanup on a site-wide basis, with emphasis on long-term solutions. This new approach is projected to result in considerable efficiencies and expedite remedial actions for groundwater by approximately six years and surface water by approximately three years.

Additionally, fieldwork for the final characterization phase for groundwater was recently completed. A key technology demonstration is planned for FY 2000 to test an in situ, passive reactive wall for treatment of groundwater contamination. This information will be used to finalize the feasibility study and support the selection of a final cleanup action for groundwater in FY 2001. If this technology demonstration is successful, its use in conjunction with other source treatment technologies currently under consideration may prove to be considerably more effective and efficient than the existing groundwater pump-and-treat systems currently being used for the northwest and northeast plume.

During the first year alone, Bechtel Jacobs Company has made significant progress in the areas of both waste management and remedial action at Paducah. Examples include the disposal of approximately 982 tons of waste in the on-site DOE solid waste landfill, shipment of more than 81 tons of waste for off-site disposal, and on-site treatment of more than 19 tons of wastewater. Additionally, under the remedial action project, we treated approximately 200 million gallons of TCE-contaminated groundwater.

Scrap Metal

The approximately 50,000 tons of scrap metal currently stored at PGDP were generated as a result of numerous cascade upgrades and other activities conducted at the plant over the past 45 years. This scrap material is surface contaminated with uranium tetrafluoride, uranium hexafluoride, and trace elements of technetium. In addition to this scrap metal inventory, DOE also has approximately 9,700 tons of volumetrically contaminated nickel ingots in storage at PGDP. These radioactive nickel ingots are the result of cascade improvements and cascade upgrade programs conducted at the Oak Ridge and Paducah cascade facilities.

Cleanup at the scrap yard units has been delayed in the Accelerated Cleanup Plan due to funding reductions. This delay has impacted cleanup of the surface soils in the scrap yards, the buried radiological waste under the scrap piles, and the related surface-water units that receive runoff from the scrap yards. These units have been identified as potential sources of off-site surface-water contamination. Removal of these materials is necessary before scheduled FFA actions can be achieved. A listing of the scrap metal by metal type is:

Scrap Metal	Totals (tons)
Aluminum	3,277
Nickel	9,700
Copper	43
Iron	31,516
Stainless steel	29
Classified Scrap	15,713
Total	60,278

The Bechtel Jacobs Company initiated an engineering evaluation/cost analysis (EE/CA) in FY 1999 to support an action memorandum to address the scrap metal inventory

Waste Management

Wastes managed by Bechtel Jacobs Company at PGDP include legacy wastes that were generated prior to the leasing of production facilities to USEC July 1, 1993, and wastes generated from cleanup activities. These are classified into five major categories:

1. Mixed low-level waste (MLLW)
2. Low-level waste (LLW)
3. Hazardous waste
4. Sanitary/industrial waste; and
5. Transuranic (TRU) waste

As of 1999, PGDP legacy waste inventory includes 2,953 cubic meters of MLLW, 6,499 cubic meters of LLW, and 4.3 cubic meters of TRU waste.

With regard to waste disposal, the site has completed characterization of approximately 12,000 containers of waste to support waste classification and evaluation against various waste acceptance criteria in preparation for disposal. Additionally, an EE/CA for scrap metal disposition was also recently completed. A final decision selecting the preferred alternative is expected in the first half of FY 2000, with fieldwork proposed to begin during the second half of FY 2000. The Paducah FFA requires removal of all scrap metal by the end of FY 2003.

Decontamination and Decommissioning

A routine surveillance and maintenance program has been conducted at the DOE facilities since 1995. Currently, 74 Solid Waste Management Units (SWMUs) awaiting remediation, 68 active facilities, and about 107 off-site and 53 on-site monitoring wells are routinely inspected under this program. Maintenance consists of activities designed to ensure safe and compliant conditions.

The inactive facilities included within C-410 Feed Plant Complex and the C-340 Metal Reduction Plant comprise about eight acres of multi-story floor space. Both complexes were shut down in 1977. Both are contaminated with various levels of PCBs, asbestos, and uranium, transuranics, and uranium compounds. The Surveillance and Maintenance (S&M) program consists of activities necessary to minimize environmental, safety, and health vulnerabilities until actual decontamination and decommissioning (D&D) of the facilities takes place (currently scheduled to begin 2014). Current activities are limited to routine inspections of waste storage areas and facility inspections to identify needed maintenance and monitor facility integrity.

The Long Term Surveillance and Maintenance (LTS&M) Program maintains facilities and programs following interim or final remedial actions, and performs environmental and well sampling in compliance with the Paducah DOE environmental monitoring program.

These post-remedial actions include:

- maintenance of the Water Policy which provides city water to approximately 100 residents within the area affected by the contaminant plumes;
- operation and maintenance of the two active pump and treat facilities (Northwest Plume Groundwater System and Northeast Plume Containment System) operating to contain the high concentration zones of the respective plumes;
- maintenance of the eight institutional control fences and signs which provide public warnings of contamination affecting usage of Little Bayou Creek in off-site areas;
- maintenance of the approximately 4,000 feet of scrap yards silt fence; and
- operation and maintenance of the North-South Diversion Ditch.

Uranium Programs

In the uranium programs, Bechtel Jacobs Company is responsible for almost 38,000 cylinders of DUF_6; maintenance of approximately 400 acres of grounds and roads inside and outside the security fence; support of the lease agreement between DOE and USEC; S&M of inactive facilities; and management of approximately 16,000 troughs that collect oil drips contaminated with PCBs from the ventilation systems within the operating gaseous diffusion plants.

The uranium program is responsible for the management of all the DUF_6 generated since the start of enriched uranium production in 1952. Bechtel Jacobs Company also supports both DOE and USEC in maintaining the inventory of all uranium through the Nuclear Material Control and Accountability program and with receiving Russian uranium feeds in support of the Nuclear Non-Proliferation program. Management of the DUF_6 program is monitored by the Commonwealth of Kentucky and operates in accordance with the Safety Analysis Report for the cylinder storage yards. Negotiation of an Agreed Order with the Commonwealth of Kentucky for the management of the DUF_6 inventory at Paducah is under way.

The management of 38,000 DUF_6 cylinders requires that cylinder integrity be maintained by a program of periodic inspections; movement to prevent ground contact, which contributes to accelerated corrosion; grit blasting and painting of severely corroded cylinders to arrest further corrosion; construction of concrete yards to support improved storage conditions; and radioactive contamination monitoring to protect employees and the environment.

DOE is aggressively pursuing a program to convert the existing DUF_6 inventories from its current uranium hexafluoride form to an oxide form. This program will eliminate the chemical hazard by removal of the fluorine component and result in a more stable uranium form suited to long-term storage or disposition. The Programmatic Environmental Impact Statement was completed in July 1999, and the final Record of Decision was issued in August 1999. Award of a contract by DOE for the design and construction of uranium conversion facilities is scheduled for early 2000.

Facilities managed by uranium programs at Paducah are all in the inactive category and are being monitored to ensure structural integrity, adequate access control, maintenance of fire protection systems, and containment of contamination until the facilities can be transitioned to the Decontamination and Decommissioning program. All inactive facilities are periodically monitored and routine maintenance conducted to ensure protection for personnel and the environment.

The internal ventilation ductwork installed to cool the process electrical motors in the gaseous diffusion plant building were originally constructed with PCB-impregnated gaskets. Over time, PCBs leached from the gaskets, requiring installation and management of a PCB drip collection system and spill containment program. The PCB drip collection system and spill containment program will continue as long as USEC or its successor operates the gaseous diffusion plants.

OVERVIEW OF BECHTEL JACOBS COMPANY ENVIRONMENT, SAFETY AND HEALTH PROGRAMS

The terms of our contract required us to hire about 1,600 incumbent Lockheed Martin employees performing the scope of work at Oak Ridge, Portsmouth, and Paducah. Bechtel Jacobs Company brought in a management team with experience in the commercial sector and at other DOE sites. We brought in our own, non-incumbent Environment, Safety and Health (ESH) managers, including our overall ESH program manager and discipline managers for Industrial Safety, Industrial Hygiene, Radiation Protection, and Environmental Compliance. We also designated an ESH manager to focus solely on the ESH programs of our subcontractors. During the three-month phase-in period of our contract, these managers reviewed the existing ESH policies, procedures, practices, and environmental permits. They also assessed and interviewed the incumbent Lockheed Martin ESH staff to satisfy Bechtel Jacobs Company that they were qualified. In general, we found that existing policies, procedures, and personnel qualifications were adequate to ensure safe continuity of operations when we assumed full responsibility for operations at the Oak Ridge, Paducah, and Portsmouth sites in April 1998.

We also determined that a number of significant changes were needed to accomplish the full transition to an M&I contract over a two-year period. I'll highlight two of these: Radiation Protection and Environmental Protection.

Radiation Protection

Our review of the radiation protection procedures revealed that, in effect, five separate programs existed at the five separate sites (three sites at Oak Ridge, plus Paducah and Portsmouth). Our Radiation Protection Manager determined that it would not be efficient for one company to operate with five separate sets of procedures. We also determined that the procedures needed to change because of the fundamental differences between a management and operations approach using in-house workers, and an M&I approach where the work is done by subcontractors. Because it would have been disruptive and unnecessary to implement an entirely new program on the first day of our contract, we made appropriate changes in the existing radiation protection procedures so we would be able to operate on April 1, 1998, and began a process of evolving to an integrated program.

From April 1, 1998, through September 30, 1998, a single set of Bechtel Jacobs Company radiation protection procedures was developed. Suggestions for improvements were solicited from the workers using the procedures. The staff was trained to the procedures, and the newly-developed radiation protection procedures were fully implemented by October 1, 1998.

We are currently revising both these procedures and our Radiation Protection Program Plan to reflect the November 1998 changes to 10 CFR 835, "Radiation Protection for Workers."

We conduct our radiation protection program using the procedures, an operations manual, and technical basis documents for external and internal dosimetry. The operations manual contains guidance needed by radiation protection personnel to authorize entry and work in radiological areas; to properly post radiation warning signs on areas and labels on containers; to conduct surveys for radioactivity on buildings and equipment; to conduct air monitoring for radioactivity; to control use of industrial radioactive sources; to maintain radiation exposures of personnel as low as reasonably achievable; and to conduct the routine radiation monitoring in active and inactive work areas to ensure personnel are appropriately apprised of the radiation hazards in their work space.

Our technical basis document for external dosimetry describes the types of radiation fields expected to be encountered in the work place, which ensures that the proper types of radiation monitoring badges are being worn by the workers. Our technical basis document for internal dosimetry describes the technical rationale for testing individual workers for any radioactive material they may have inhaled or ingested.

In 1998 and 1999 (through June 30) at Paducah, 530 and 311 workers, respectively, were monitored for external radiation exposure. The average exposure in each year was less than 10 millirem (mrem), equivalent to the radiation exposure received in one or two transcontinental airplane flights. The maximum individual exposure was 459 mrem in either year, which is about one-and-one-half times the amount of radiation received by a member of the public from natural background radiation, and well below the applicable Federal regulatory limit of 5,000 mrem.

In 1998 and 1999 (through June 30) at Paducah, 163 and 107 workers, respectively, were monitored for internal radiation. We found that for both years only one person had a dose above 10 mrem from uranium. This dose (12 mrem) is well below the applicable Federal regulatory limit.

In 1998 and 1999, we also checked for plutonium, americium, and neptunium in six Bechtel Jacobs Company subcontractor workers. We checked these workers because, based on available characterization data, they performed work in areas where these radionuclides could possibly have been present. We found no positive results.

The preceding data covers only employees of Bechtel Jacobs Company and our subcontractors, since USEC performs monitoring for their employees.

As work is transitioned to subcontractors, Bechtel Jacobs Company will require that all subcontractors work under our radiation protection plan. All radiation safety monitoring will be done by a single radiation protection subcontractor to ensure consistency throughout our projects.

Environmental Protection

During the early months of our contract, a due diligence assessment and management review was conducted to assess existing environmental conditions, regulatory compliance, and cleanup strategies. The evaluation included a review of all existing environmental permits and agreements, the compliance history, current status, adequacy of environmental actions taken to date, remedial priorities, and cleanup schedules.

Based on the results of that effort and information collected to date, the environmental permits and agreements were determined to adequately address the scope of site conditions. While the facility did have some limited history of minor violations, none were considered to be associated with imminent threats to human health and environment, and all have been resolved to date with only one Notice of Violation, which involved administrative record keeping, issued at Paducah since 1995.

BECHTEL JACOBS COMPANY ES&H PROGRAM IMPROVEMENTS

Our work during the phase-in and transition periods of the contract also resulted in the identification of several overall ESH program areas for improvement that I would like to briefly highlight.

First, Bechtel Jacobs Company embraces a Zero Accidents Policy. This means that we believe all accidents are preventable. Our goal is an injury- and illness-free workplace, zero unpermitted discharges to the environment, and no noncompliance with environmental permits or laws. While we have yet to reach the zero goal in all areas, we believe that our policy reinforces to our workers that accidents or unpermitted releases to the environment are unacceptable. One measure of the impact of this policy is that since we became the M&I contractor, we reduced the lost workday away case rate by 37% and the Occupational Safety and Health Administration (OSHA) recordable injury/illness rate by 47%. Our current rate for OSHA recordables is 70% below the published Bureau of Labor Statistics (BLS) rate for private industry. Our lost workday case away rate is 76% below the published BLS rate. At Paducah, the Bechtel Jacobs Company staff has worked more than 500 consecutive days without a recordable injury case. Since April 1998 at Paducah, there have been 11 first aid cases, and six radiation contamination cases, one radiation uptake case above 10 mrem, no environmental Notices of Violation, and one nonconformance with the Kentucky Pollutant Discharge Elimination System permit.

Second, we have made it clear that line management is accountable and responsible for ESH performance. Our ESH managers establish the policies and procedures, but the people who manage the work are accountable for performing the work safely. To ensure safe performance, we have deployed our ESH subject-matter experts to the projects so that they are directly involved with work planning and execution in the field. We have also implemented a safe work operations training course for first-line supervisors and ESH safety leadership workshops for our project managers. The safe work operations course is scheduled at Paducah within the next 30 days.

Third, we recognized our workers as being in the best position to identify the hazards of a job and as having the training, skills, and experience to safely mitigate those hazards. As a result, we routinely involve our most skilled workers in the "work planning" process and obtain final reviews and feedback from affected crew members during pre-job briefing prior to work execution. We also monitor our subcontractors' work planning processes to ensure compliance with requirements for worker involvement.

Finally, I have made it clear that *each and every* worker is empowered to stop work, without fear of reprisal, if he or she believes that safety, health, or environmental protection will be compromised by a work activity. We initially experienced some worker skepticism about this empowerment, but several discussions between DOE staff and our workers during the recent stand-down at Paducah confirmed that my message has been heard.

All of these improvements are consistent with our Integrated Safety Management System, our system by which each work activity undergoes a rigorous five-step process by both workers and management team. These steps are:

1. Define scope of work.
2. Analyze hazards.
3. Develop and implement controls to mitigate the hazards.
4. Perform work within the established controls.
5. Collect feedback for improvement.

SUBCONTRACTOR ES&H PERFORMANCE

With our contract goal to subcontract more than 90 % of the work, the safety and environmental protection performance of our subcontractors is critical. Before subcontractors can bid on our work, they must meet a safety and environmental protection criteria based on their past performance. Ten percent of potential subcontractors have not met our criteria, which are rigorous. In fact, there have been a few complaints about how rigorous they are from the subcontracting community. But we know that safety and environmental excellence exists in the subcontractor community because there has been no lack of qualified bidders meeting our safety and environmental protection criteria. We are fully committed to selecting subcontractors who have demonstrated the ability to perform work in a safe and environmentally sound manner.

Once on the job, the qualified subcontractors continue to perform safely and compliantly, in accordance with approved ESH plans, using a graded approach based on job hazards, adhering to their contractual requirements, and under our observation. Failure to perform safely and compliantly is grounds for subcontract termination for cause. Because we want our subcontractors to be successful, we have implemented a Safety Advocate program under the direction of a Bechtel Jacobs Company ESH Subcontractor Manager. Each subcontract is assigned a Bechtel Jacobs Company Safety Advocate (a professional ESH subject-matter expert) who works directly with the subcontractor's ESH staff to ensure that expectations and requirements are understood and met.

CONTINUING IMPROVEMENTS IN SAFETY AND ENVIRONMENTAL PROTECTION

We believe our actions in the areas of industrial safety, radiation protection, industrial hygiene and environmental protection are effective in protecting our workers, the public, and the environment. We also recognize that there is always room for improvement.

A few weeks ago, a DOE Environment, Safety and Health team performed a review at Paducah. The team did not uncover any imminent hazards to the workers or the public but did have some preliminary verbal comments related to opportunities for improvement in radiological protection, procedures and conduct of operations. The team shared these comments with us at a meeting on September 3.

Based on the team's input, Secretary Richardson ordered a one-day safety stand down at the Paducah Site on September 9 to strengthen and enhance safety programs. He noted that while significant improvements have been made over the last several years, the stand down affords an opportunity to further build upon existing safety programs. The Secretary also said the stand down would give employees and managers an opportunity to raise any concerns they may have, get questions answered and make suggestions for improved operations. My General Manager for operations and our company ESH Manager participated in the stand down.

Over the years, the DOE and its contractors have found that stand downs are an excellent management tool to reinforce the importance of safety. By stopping all but the most essential activities, we have been able to focus on one very important subject. We have also found that in the course of stand downs, employees usually come up with several excellent suggestions for improvement.

The agenda for the one-day stand down included:

- Distribute and review an information sheet on plutonium and other transuranics at Paducah with each Bechtel Jacobs Company and subcontractor employee.
- Emphasize use of safety suggestions program as a mechanism to relay anonymous concerns or suggestions.
- Distribute and review fact sheet on rules (dos and don'ts) for DOE Material Storage Areas to each Bechtel Jacobs Company and subcontractor employee.
- Survey the site for degraded, missing, or inappropriate postings and barriers.
- Survey all standing Radiation Work Permits for accuracy, compliance, and currency. Inventory those that should be cancelled or modified.
- Dedicate a team of subject matter experts to work exclusively on resolving the DOE Material Storage Area nuclear criticality concerns.
- Walk down and review each ongoing Bechtel Jacobs Company or subcontractor project. Ensure presence of proper permits and other safety documents such as Radiation Work Permits, Hot Work Permits, Lock Out/Tag Out, Job Hazards Analysis, etc. and re-emphasize requirements for compliance and conduct of operations for each project with the project staff, both salaried and hourly.

We believe the stand down met its intended purpose. All the agenda items were completed successfully with good involvement by the workforce. In the process of discussing the stand down with our employees and subcontractors, we heard:

- Workers wanted more frequent information on dosimetry and air monitoring.
- Workers understand that they have stop-work authority.
- Workers feel they can change the system and be part of safety success.

In summary, since taking over the environmental management and uranium programs at Paducah 18 months ago, Bechtel Jacobs Company has made measurable improvements in safety, radiation protection, and environmental protection, but continuous improvement is our goal. The recent visit from the DOE Headquarters ESH review team, and last week's stand down, are an integral part of making those improvements. No imminent hazards were identified, but we noted several areas for improvement and we're taking action. We will continue to work with DOE, our employees, and our subcontractors to ensure that we protect workers, the public, and the environment.

Mr. UPTON. Thank you.

Mr. Miller.

TESTIMONY OF JAMES H. MILLER

Mr. MILLER. My name is James H. Miller. I am the Executive Vice President of USEC Inc., and am responsible for the operations at the gaseous diffusion plants located in Paducah, Kentucky and Portsmouth, Ohio. USEC leases and operates certain portions of the plants in Kentucky and Ohio from the U.S. Department of Energy and employs approximately 4,000 people with headquarters located in Bethesda, Maryland. I am pleased to have the opportunity to provide the subcommittee with information concerning USEC's operations.

We are committed to ensuring that USEC maintains a safe work environment for our employees and that our operations protect the public and the environment. We have committed significant resources to improve the operation of the gaseous diffusion plants, and we believe that our efforts thus far have been successful.

You have been provided with advance copies of my complete testimony. My intention today is to provide you with some brief introductory comments on that testimony and to give you an opportunity to ask any questions about USEC's operations that you may have.

The Energy Policy Act of 1992 established the U.S. Enrichment Corporation as an interim step to the privatization of the uranium enrichment enterprise. In accordance with that act, USEC leased portions of the GDPs from DOE and assumed responsibility for the management of uranium enrichment activities at the GDPs commencing July 1, 1993.

The Nuclear Regulatory Commission assumed regulatory jurisdiction over USEC operations from the Department of Energy on March 3, 1997. In accordance with the 1996 USEC Privatization Act and the Energy Policy Act, the U.S. Government privatized USEC on July 28, 1998. In 1993 USEC initiated programs to upgrade nuclear safety, radiologically characterize he leased areas at the GDPs, reduce the potential exposure of workers to radiation, improve worker safety, implement pollution prevention and mitigation activities and ensure proper treatment and disposal of wastes.

Our nuclear safety upgrade program consisted of many projects to bring GDP equipment and programs into full compliance with NRC requirements and to enhance safety at the GDPs. USEC initiated a comprehensive site radiological characterization project which was completed in 1998. This project surveyed all accessible areas of the GDPs leased by USEC to obtain complete information on the extent and the level of contamination that might be present. As the survey was completed for each area, the postings for the area were reviewed in light of the survey results and were adjusted as appropriate. USEC also decontaminated areas throughout the site. We now conduct routine radiological surveys to ensure radiological hazards are identified and communicated to employees and that areas are properly posted. Procedures and training are in place to ensure proper protection of individuals entering radiological areas.

Our radiation protection program is designed to achieve the goal of keeping exposures to radiation from all sources as low as reasonably achievable. The doses received by USEC workers at the GDPs are in fact very low.

USEC also undertook immediate action to address industrial safety problems. Since taking over the operation of the GDPs, we have reduced worker injury rates and lost workdays due to injuries to less than half the 1993 rate. USEC has fully characterized its waste streams at the GDPs and instituted new pollution prevention initiatives. We also initiated waste minimization efforts and achieved significant reductions in low-level radioactive and hazardous and mixed wastes. We share your concern for the health and safety of our workers, their families and our community.

USEC is prepared to assist the committee in any way we can. I would be pleased to respond to any questions that you may have.

[The prepared statement of James H. Miller follows:]

PREPARED STATEMENT OF JAMES H. MILLER, EXECUTIVE VICE PRESIDENT, USEC INC.

My name is James H. Miller. I am the Executive Vice President of USEC Inc. and am responsible for USEC's operations at the gaseous diffusion plants located in Paducah, Kentucky, and Portsmouth, Ohio. USEC Inc. is the world leader in production and sale of uranium fuel enrichment services for commercial nuclear power plants. With headquarters in Bethesda, Maryland, the Company leases and operates portions of the plants in Kentucky and Ohio from the U.S. Department of Energy and employs approximately 4,000 people.

I am pleased to provide the Subcommittee with information concerning USEC's operation of the gaseous diffusion plants (the "GDPs"). USEC is committed to ensuring that it maintains a safe work environment for its employees and that its operations protect the public and the environment. To that end, USEC has committed significant resources to improve the operation of the GDPs. As I will point out during this testimony, the record demonstrates that our efforts have succeeded.

My testimony today is comprised of four parts. First, I will provide some background describing the transition from a government enterprise into a private corporation regulated by NRC, OSHA, EPA and other federal and state agencies. Second, I will generally describe the state of the GDPs on July 1, 1993, when USEC as a government corporation took over management of the uranium enrichment enterprise. Third, I will outline the actions taken by USEC from 1993 until today to improve and enhance the operation at the plants in the areas of worker safety, radiological protection, nuclear safety, and environmental protection. Finally, I will describe the results of these actions to date.

BACKGROUND

Built in the 1950s to produce enriched uranium for national defense and, later, for nuclear fuel for commercial reactors, the GDPs were operated by the U.S. Department of Energy (DOE) and its predecessor agencies. DOE and its predecessors contracted with private companies to manage and operate the GDPs under the agency's direction and regulatory oversight. In June 1993, the GDPs were managed and operated for DOE by Martin Marietta Energy Systems, a subsidiary of Martin Marietta Corporation.

The Energy Policy Act of 1992, Pub. L. 102-486, established the United States Enrichment Corporation, a wholly owned government corporation, as an interim step to the privatization of the uranium enrichment enterprise. In accordance with the Energy Policy Act, commencing July 1, 1993, USEC leased portions of the GDPs from DOE and assumed responsibility for the management of uranium enrichment activities at the GDPs. USEC, as a government corporation, contracted with Martin Marietta Utility Services, later to be Lockheed Martin Utility Services, to operate and maintain the GDPs. The Energy Policy Act mandated that the GDPs be independently regulated by the U. S. Nuclear Regulatory Commission (NRC) and the Occupational Safety and Health Administration (OSHA), in addition to the U.S. Environmental Protection Agency (EPA) and applicable state agencies.

The NRC assumed regulatory jurisdiction over USEC operations on March 3, 1997. Prior to that time, USEC operations were regulated by DOE under a Regulatory Oversight Agreement between DOE and USEC which was based upon the existing nuclear safety, safeguards, and security requirements of DOE.

In 1996, the USEC Privatization Act, Pub. L. 104-134, was enacted. In accordance with the USEC Privatization Act and the Energy Policy Act, the U.S. Government privatized USEC through an initial public offering of stock on July 28, 1998. After privatization, USEC initiated steps to assume full and direct responsibility for the operations of the GDPs. Accordingly, on November 18, 1998, USEC provided notice to Lockheed Martin Utility Services as required by contract that USEC was terminating its contract to operate the GDPs. On May 18, 1999, USEC assumed direct control of the operations of the GDPs.

THE STATE OF THE GDPS ON JULY 1, 1993

The Energy Policy Act directed that DOE complete an environmental audit of the GDPs prior to the July 1, 1993, transition to USEC. DOE's environmental audit documented that the GDPs were contaminated by a number of hazardous and radioactive materials including polychlorinated biphenyls (PCBs); organic compounds such as Trichloroethylene; metals such as lead, nickel and chromium; asbestos; and radionuclides including uranium and technetium. The GDPs were also undergoing cleanup and environmental remediation activities under the Resource Conservation and Recovery Act (RCRA) and the Paducah GDP was listed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. The presence of contamination from transuranics was known as a legacy of past operations at the GDPs and the lease with DOE specifically indemnifies USEC for any liabilities as a result of contamination from transuranics such as plutonium.

On July 1, 1993, there was incomplete information concerning the extent or level of contamination that might be present in the process and support buildings or in outside areas. There also was only limited characterization of wastes generated. It was assumed that all process buildings and most support buildings were potentially contaminated. In general, it was also assumed that wastes generated and stored on site were mixed wastes, both hazardous and radioactive.

In addition to the environmental audit, DOE also performed an assessment of the condition of the GDPs with respect to industrial safety. Under DOE, the operations of the GDPs were not subject to OSHA regulation. DOE's assessment identified many problem areas related to industrial safety. In 1993, the worker injury rates at both GDPs were above industry norms.The USEC Privatization Act provided that any liabilities associated with the operation of the uranium enterprise (including the operation of the GDPs) prior to July 28, 1998, would remain direct liabilities of the U.S. Government and DOE.

USEC'S ACTIONS SINCE JULY 1, 1993

USEC has made protection of our workers, the public and the environment a priority and has committed significant resources to improve and enhance the operation of the GDPs. In 1993, USEC initiated programs to upgrade nuclear safety, radiologically characterize the leased areas at the GDPs, reduce the potential exposure of workers to radiation, improve worker safety, implement pollution prevention activities and ensure proper treatment and disposal of wastes.

USEC initiated a comprehensive Nuclear Safety Upgrade program to bring the GDPs into full compliance with NRC requirements and to enhance safety at the GDPs. DOE funded approximately $220 million of this Nuclear Safety Upgrade program.

USEC also initiated a comprehensive site radiological characterization project which was completed in 1998. This project surveyed all accessible areas of the GDPs leased by USEC to obtain complete information on the extent and level of contamination that might be present. The survey included outside areas with miles of roadways, millions of square feet of building walls, floors and lockers, over a million tools and parts, and millions of document pages. As the survey was completed for each area, the postings and markings for the area were reviewed in light of the survey results and were adjusted as necessary. USEC decontaminated areas throughout the site including over 5.5 million square feet of building floor space. This project significantly reduced workers' potential exposure to radioactive materials.

USEC undertook immediate action to address the industrial safety problem areas. DOE funded $35 million to correct problem areas identified in DOE's assessment and other potential safety issues identified by USEC. USEC also initiated an effort to improve work practices and procedures bringing them in line with industry best practices.

USEC fully characterized its waste streams at the GDPs and instituted new pollution prevention initiatives to reduce the amount of waste generated and to change waste streams to more benign forms. USEC identified and approved commercial licensed offsite waste treatment and disposal facilities and began shipping low-level, hazardous and mixed wastes off site for proper treatment and disposal at licensed commercial facilities.

RESULTS TO DATE

USEC's radiation protection program is in compliance with NRC regulations. The radiation protection program is designed to achieve the goal of keeping exposures to radiation from all sources including transuranics as low as reasonably achievable. The effectiveness of USEC's program is demonstrated by data showing that the average annual dose for all GDP monitored personnel is less than 5 millirem per year compared to the federal limit of 5000 millirem per year. The doses received by USEC's workers at the GDPs are also well below the averages for other NRC licensees. Procedures and training are in place to ensure proper protection of individuals entering radiological areas. USEC conducts routine radiological surveys to ensure radiological hazards are identified and communicated to employees and that areas are properly posted. All employees are provided training regarding the potential hazards associated with exposure to radioactive materials.

USEC continually assesses its radiation protection program to assure that it is effective and to seek opportunities for improvement. USEC's Health Physics organization conducts periodic reviews of the radiation protection program. USEC's Safety, Safeguards and Quality organization, which is independent of the radiation protection program and production, also conducts an audit program of the radiation protection program, reviewing different elements of the program throughout the year.

Most recently, during the week ending September 3, 1999, NRC conducted a confirmatory inspection of the Paducah plant's radiation protection program, specifically examining measures used to protect workers and the public from hazards of transuranics. NRC has provided USEC with preliminary information that it has found that our program adequately protects workers and the public.

USEC's commitment to protect its neighbors and the environment is equally clear from the results it has achieved. USEC monitors its air emissions and water discharges to assure that it meets all applicable regulatory limits. USEC maintains a number of air monitors offsite and conducts additional portable sampling and monitoring onsite. Air emissions from USEC's operations at the GDPs have been well below the regulatory limits for radionuclides. During USEC's operation of the GDPs, air emissions each year typically have resulted in a total of less than one-tenth of the EPA standard. Water discharges are monitored for uranium, technetium and transuranics either weekly or quarterly depending on the nature of the discharge. All USEC water discharges have been below regulatory limits.

USEC's efforts to reduce other industrial safety hazards and improve practices also has succeeded in improving worker safety. In July 1995, the Paducah GDP reached a significant milestone with two million man-hours worked without a lost workday case. Since taking over the operation of the GDPs, USEC has reduced worker injury rates and lost work days due to injuries to less than half the 1993 rate and well below the national average for our industry. USEC also has an aggressive pollution prevention program. Low level radioactive waste generation was reduced by 36% at the Paducah GDP and 32% at the Portsmouth GDP between FY 1996 and FY 1999. USEC achieved similar reductions in the amount of hazardous and mixed waste generated. The Paducah GDP achieved a 42% reduction in generation of hazardous and mixed waste between FY 1995 and FY 1999, and the Portsmouth GDP reduced generation by 70% between FY 1994 and FY 1999.

In 1998, the National Safety Council recognized the Paducah plant as successfully improving production processes while achieving significant safety gains.

Finally, as you know, NRC is required to prepare periodic reports to Congress on the GDPs' performance. The NRC provided Reports to Congress in December 1997 and in January 1999. Both reported that USEC's operation of the GDPs has provided adequate protection of the public health and safety and the environment and generally has been in compliance with NRC regulatory requirements. On January 29, 1999, the NRC renewed the GDP Certificates of Compliance for a period of five years—the maximum period permitted by the USEC Privatization Act.

CONCLUSION

Congress provided USEC with the mandate to improve the operation of the GDPs and to enhance the protection of its workers, the public and the environment. USEC is committed to carrying out that mandate. Safety is paramount at USEC. We believe that safety and business success are intertwined—safe workers and safe facilities are necessary to achieve quality performance. USEC has committed significant resources and has taken significant strides to ensure safe operation of the GDPs. The record demonstrates that our efforts have succeeded. We are proud of the dedication and hard work our employees and the results we have achieved. We are committed to building upon our success and continuously striving to improve.

Mr. UPTON. Thank you.

You heard those buzzers. We have a series of votes on the floor. I know Mr. Burr has a speech at 1:30. I am going to let him go first with 5 minutes of questions. When he is done, we will adjourn temporarily until 2 o'clock.

Mr. BURR. I thank the chairman.

Mr. Nemec, let me ask you, I think it was Mr. Egan who was the attorney who had requested documents, specifically the Appendix 2B-17 from Bechtel. That has since found its way to this committee and also the Louisville paper. Can I ask you as a representative of Bechtel, has that been provided to Mr. Egan, or do you plan to?

Mr. NEMEC. Congressman, I am not aware of any request that Bechtel Jacobs received from the attorneys regarding that. We did receive a request from the committee and we did—and we were notified that the appendix was not in the document room. We found it, we put it in there, we provided a copy to the committee. I'm not aware that we received any request from the attorneys.

Mr. BURR. I'm sure if you didn't, they will follow up with you.

Mr. NEMEC. I'm sure they will and they will get a copy.

Mr. BURR. Mr. Hummer, if I may spend a second with you. To your knowledge has DOE ever asked Martin Marietta or a representative of Martin Marietta to alter or to lose data as it related to contamination or worker safety at the Paducah, Kentucky plant?

Mr. HUMMER. To my knowledge, that has never happened, Mr. Burr.

Mr. BURR. Has Martin Marietta ever falsified or withheld documents from DOE or any regulatory agency with oversight over Paducah?

Mr. HUMMER. No, sir.

Mr. BURR. Has DOE ever requested the appendix missing from the 1991 executive summary from Martin Marietta when they were the main contractor?

Mr. HUMMER. I don't know the answer to that question.

Mr. BURR. Are you familiar with the appendix 2B-17?

Mr. HUMMER. Only in the most general terms as it has been referred to in this hearing.

Mr. BURR. As a representative of Martin Marietta, do you find it unusual or strange that an appendix that was completed in January 1991 was not included in the executive summary produced in March of the same year or in the annual environmental report that was completed in October 1992 for the year encompassing 1991?

Mr. HUMMER. On its face, yes, I do find it strange. I would have to look into it further to see if there were reasons for it.

Mr. BURR. You don't have an explanation or a reason as a representative of Martin Marietta today?

Mr. HUMMER. I do not.

Mr. BURR. What is Martin Marietta's position as it relates to their contractual obligation to the Department of Energy in 1991 as it relates to their assessment of contamination, worker safety? Were you the sole contractor responsible for it?

Mr. HUMMER. Martin Marietta was the sole contractor at that time, yes, and we were responsible for providing a comprehensive report on an annual basis.

Mr. BURR. To your knowledge, did any of the annual environmental reports ever include the existence of plutonium contamination at the Paducah facility?

Mr. HUMMER. Yes, sir, they did.

Mr. BURR. As it related to offsite sources?

Mr. HUMMER. Yes.

Mr. BURR. When was that included?

Mr. HUMMER. I personally have seen a 1996 report that included that. I haven't seen others.

Mr. BURR. Clearly you wouldn't question the existence of appendix 2B-17 produced by Martin Marietta that in 1991 found offsite contamination of plutonium?

Mr. HUMMER. No, sir.

Mr. BURR. Do you find it odd that it would take until 1996 for any official report to the Department of Energy to conclude that there was contamination?

Mr. HUMMER. I don't know that there was not—that that contamination was not reflected in earlier reports. I do know that I saw it in a 1996 report. I did not look at earlier reports to determine if it was in those.

Mr. BURR. Well, I know that all the members have votes to get to. My plans are to be back for some point of this. I appreciate the witnesses' time. I would yield back, Mr. Chairman.

Mr. UPTON. Thank you. We will come back at 2 o'clock.

[Brief recess.]

Mr. UPTON. We are ready to start.

I just want to apologize to all the witnesses that we have today, because we had to change the—Congress was not in session last week on Thursday, I know that it changed your plans. It changed our plans, too. At the time the decision was made, the eye of the hurricane was expected to pass right down Pennsylvania Avenue. That is why I thought it would be best to delay the hearing until this week, but obviously we all had full schedules as well, and so we are all jockeying things, including other subcommittees that are meeting. That is one of the reasons why members are in and out. Normally that doesn't happen to the degree that it is happening today. We apologize in advance. Blame it on Mother Nature and me.

We will resume with the 5 minutes. I know that the Democratic side will be back soon. I know that Mr. Whitfield has questions. I know Mr. Burr had a speech. Because of the votes it was delayed. But he intends to come back for this panel before we start the third one as well.

Mr. Miller, it is my understanding that a number of years ago, the DOE had transferred more than $200 million to USEC to prepare the site in Paducah for the event of a possible earthquake. And it is my understanding that the work that was intended to be done is still—initially the seismic upgrades were promised to be done by 1997? It is my understanding that you all have delayed the seismic upgrades until next year, September of next year, 2000? Seismic upgrade?

Mr. MILLER. Yes, Mr. Chairman, I might make one clarification. The $200 million that was funded by the Department of Energy was to cover in their entirety all nuclear safety upgrades to make the transition from DOE regulation to NRC regulation. A portion of that funding, specifically $23 million, was designated for the seismic work.

Mr. UPTON. At Paducah?

Mr. MILLER. At Paducah.

Mr. UPTON. $23 million of the $200 million?

Mr. MILLER. That is correct, sir, for the seismic project at Paducah.

Mr. UPTON. What has happened to that money?

Mr. MILLER. That money has been expended. The project is ongoing, with the expected completion date as you have indicated, September of 2000. In addition to that $23 million, USEC has been funding the additional funding required to complete that seismic upgrade project.

Mr. UPTON. Mr. Nemec, in DOE's testimony, they state, a little bit later, that in order to address the gaps in the company's radiation protection program, DOE will initiate an independent and detailed review of Bechtel Jacobs company's radiation protection program and its implementation at Paducah.

Do you believe that the radiation program is broken?

Mr. NEMEC. No, I do not.

Mr. UPTON. And needs to be fixed?

Mr. NEMEC. No, I do not, Mr. Chairman. I believe we have a good radiation protection program. But we welcome the review. I am sure that through that review, we will find some opportunities for some enhancements. But we believe we have a good program.

Mr. UPTON. In the earlier panel, a number of the folks that testified talked about the full body review—the full body count. They had a feeling that, in fact, the readings were never given to them. Who has access to that? Do you have those records or does DOE?

Mr. NEMEC. I have no knowledge who has those records.

Mr. UPTON. Would you know, Mr. Hummer?

Mr. HUMMER. In general, Mr. Chairman, those records are Department of Energy records. Frequently they are maintained by the contractor as part of the contract, but the records belong to the departments of energy.

Mr. UPTON. But they are Martin Marietta's studies, right? They conducted the review. Would they not have been provided up the line from the years before?

Mr. HUMMER. I had thought that you were referring specifically to the individual results of whole body counts, which is an ongoing process. The specific volunteer studies that were referred to by the earlier panel, yes, the results of those studies would have been provided to the Department of Energy. The studies should be in Martin Marietta, Lockheed Martin records as well as Department of Energy records. But fundamentally since—from this Congress, the Department of Energy funds all these activities at these facilities, essentially all records, reports, surveys, that sort of thing, all belong to the Department of Energy.

Mr. UPTON. Do you know why they would not have been provided to the individuals at the time that they were tested?

Mr. HUMMER. No, sir, I do not. During the period I was at Oak Ridge as the Director of Safety and Health for Martin Marietta Energy Systems, it was a standard practice to discuss the results of whole body counts and bioassay results which also were for internal contamination with the individual at the time those results were received.

Mr. UPTON. Were you aware at all that in fact the counts might have been misrepresented or denied to the folks who actually undertook the tests?

Mr. HUMMER. No, I was not.

Mr. UPTON. Mr. Whitfield.

Mr. WHITFIELD. Thank you, Mr. Chairman.

Mr. Hummer, Martin Marietta, of course, was the successor company to Lockheed Martin. When did Martin Marietta become responsible for the offsite part of USEC, of the plant?

Mr. HUMMER. When Martin Marietta became the contractor in 1984, it had responsibility for both the operation of the facility and the environmental management aspects of the facility.

Mr. WHITFIELD. Now, in 1990, the Tiger team came in and did an assessment, setting out deficiencies for the facility. They were pretty explicit in those deficiencies. Then the Department of Energy came in with their Phase I assessment which went back to 1990, and they set out deficiencies in the facility. And down in Paducah when we asked Mr. Sadler the question, had the deficiencies set out in 1990 been corrected, I don't want to put words in his mouth, but he said there were many things that had not been corrected. In fact, I remember him inferring that most things had not been corrected. But why, during that period, when your company was responsible, were those corrections not taken care of?

Mr. HUMMER. Martin Marietta and Lockheed Martin were responsible for the environmental management aspects at the Paducah plant until the spring of 1991 when Bechtel Jacobs was awarded the contract—I am sorry, the spring of 1998 when Bechtel Jacobs was awarded that contract. During that period, essentially all of the findings from the Tiger team report were corrected. My understanding is that of the almost 200 findings from that report, all but one have been corrected. I'm not sure of the specific nature of that one.

Mr. WHITFIELD. So out of the 200 deficiencies, your testimony is that all but one of the deficiencies was corrected by the time that Lockheed Martin relinquished its responsibility?

Mr. HUMMER. Yes, sir. The long duration, talking in years, to correct what might seem like fairly specific deficiencies may be a little hard to understand at first, but many of these deficiencies required additional funding through the budget process to provide resources in the form of either people, equipment or even facilities. Many of them required extensive rewriting of program documents, retraining of individuals to understand the issues that they were dealing with and what their specific responsibilities were. These were not simple things to fix.

Mr. WHITFIELD. But it's your contention that all of them were taken care of except that one?

Mr. HUMMER. Yes, sir.

Mr. WHITFIELD. We have heard a lot of testimony today and in the newspaper and with individuals personally that indicates that there was a culture within the management of this facility that I would describe as lackadaisical, lapsing in judgment sometimes, not being as up to date on the issues as they should have been.

Would you say it is correct that even though management changed in name—Union Carbide, Lockheed Martin, Martin Marietta, Bechtel Jacobs—that some individuals just transferred from one company to the other? Would you say that is correct?

Mr. HUMMER. Absolutely. The vast majority of the people were the same people. And in fact the people who operated the operational plant for the United States Enrichment Corporation were the same Lockheed Martin people that transferred from Energy Systems.

Mr. WHITFIELD. So it would be correct that even though companies changed, individuals were the same?

Mr. HUMMER. Absolutely.

Mr. WHITFIELD. When you relinquished responsibility for your company, who was the project manager for the cleanup at Paducah?

Mr. HUMMER. I'm sorry, I'm not sure I understand the question.

Mr. WHITFIELD. When Lockheed Martin lost its contract for cleanup, who was the project manager at that time?

Mr. HUMMER. I'm not sure. Mr. Nemec is indicating it might have been Mr. Massey.

Mr. NEMEC. The site manager at Paducah at that time was Jimmy Massey. Jimmy is also the site manager at Paducah today.

Mr. WHITFIELD. Mr. Chairman, my 5 minutes is up.

Mr. UPTON. I will let you have some more time at the end. We will go to Mr. Strickland. Are you ready?

Mr. STRICKLAND. Yes, sir.

Thank you, gentlemen, for trying to help us understand what is happening here.

I have a memo, I don't know if anyone has asked about this or not because I arrived just a moment ago. It is a memo from Jimmy Massey. It was sent to a number of individuals, regarding the safety stand-down. It says, We anticipate that DOE will announce a day-long safety stand-down, and on and on. The kinds of activities we will do during that day include review and spruce up rad postings in DOE areas both on buildings and on land masses and so on and so forth. It concludes by saying, I need to meet with the project team this afternoon at 2 in the small conference room to discuss, and so on and so forth, but it concludes with this statement:

"and more to come. I still have season tickets to the circus for sale if anyone still needs one." That last statement is very puzzling to me. I'm not sure what it means. Is it the Barnum and Bailey circus? I'm just not sure what they are talking about there. What I hope it doesn't imply is that this matter is being taken lightly, and the implication being we're engaged in some kind of frivolous activity with this stand-down. Would anyone have any insight into what that may mean?

Mr. NEMEC. Congressman Strickland, that statement was an inappropriate statement by Jimmy Massey. We take this stand-down very seriously. We take this investigation very seriously. I personally discussed that statement with Mr. Massey after I received it. He received—he agrees that it was an inappropriate and it won't happen again. We do take it very seriously.

Mr. STRICKLAND. Thank you, Mr. Nemec. I very sincerely appreciate that response from you and thank you for your opinion. I concur with it certainly.

There seems to be differences of opinion between some of the witnesses that we heard earlier and some of the statements that are contained in the testimonies that have been submitted to us. I suppose it is possible that there are just legitimate differences of interpretation. But some of this seems to be material that would be rather difficult to interpret and have such a broad difference of opinion.

For example, in the statement by Mr. Hummer, there is this comment:

"The potential for internal contamination of radiation workers was monitored through a bioassay program. Bioassay was a routine part of the radiation protection program at the Paducah facility and the other gaseous diffusion facilities because of the presence of uranium."

Then there are others who indicate that this was not a routine activity, that there may have been very limited numbers of employees that were ever monitored or tested in this way. And so the discrepancy between that statement and this other information is troublesome to me. I guess I would like to ask, was there routine bioassay monitoring? If so, how many employees were involved and during what period of time? Could you answer that for me, sir?

Mr. HUMMER. Yes. During the period of time that I was Director of Safety and Health for Energy Systems, routine bioassay programs were in place for workers who had significant potential for ingestion of radioactive contamination. I can't tell you exactly how many people were involved. I can get that information for you if you like. That program had been in place for some time before I arrived. Exactly when it started and how it evolved, I would have to get additional information. Some of the witnesses this morning, I believe, were responding to questions related to whole body counting, which is a support system for bioassay. But bioassay is the actual collection of biological samples from the individuals and their analysis for contamination.

Mr. STRICKLAND. But that information regarding the number of individuals, who they were, when the testing was done, what the results were, would that be available to us or would that be data that you could put your hands on and make available to the committee?

Mr. HUMMER. We should be able to get them from the Department of Energy.

Mr. UPTON. Thank you.

Mr. Hummer, it was alleged, it was indicated in the testimony from the first panel from at least two of the witnesses, that your companies or subsidiaries knowingly disposed of radioactive contaminated waste in offsite landfills that were not permitted for such waste. Do you know if your company—can you affirm or deny whether that happened?

Mr. HUMMER. Mr. Chairman, to the best of my knowledge, that did not happen. These are new allegations to the company. To the extent that this and other allegations are raised by the lawsuits and other activities that are current, Lockheed Martin will do everything in its power to fully investigate these matters and resolve them appropriately.

Mr. UPTON. Could you keep us posted of that activity?

Mr. HUMMER. Yes, I will.

Mr. UPTON. There was no way that DOE would have approved such a transfer. I can't believe that that would have happened.

Mr. HUMMER. And to the best of my knowledge, there is also no way that plant management, Martin Marietta or Lockheed Martin plant management, would have approved that activity.

Mr. UPTON. Mr. Miller, we heard from Mr. Fowler sort of an ongoing saga of retaliation and harassment. You heard—I think you were here for his assessment?

Mr. MILLER. That's correct.

Mr. UPTON. Do you plan on doing anything—even today, I think he indicated that he still was followed from stop to stop. Are you planning any directive, any meeting? Is there any help that you can provide us? What were your thoughts as you listened to his riveting testimony?

Mr. MILLER. Mr. Chairman——

Mr. UPTON. I know it disturbed a lot of us up here.

Mr. MILLER. I think first and foremost, speaking for our corporation, it is totally appropriate to state in total sincerity that our corporation does not tolerate, I do not tolerate and will not tolerate harassment, intimidation of any nature, whether it be nonmanagement or management employees. USEC has pursued these issues, as any corporation should and would, vigorously through its tenure taking over these facilities wherever and whenever it was found. We have administered disciplinary action up to and including discharge. I think certainly in this instance, which dates back prior to any of these relevant issues that are being raised here today by the committee, there are some differences in opinion regarding the facts pertaining to vehicle searches. We have vigorously researched these issues. The vehicle searches were at no greater frequency than other vehicle searches which are mandated on our site for security reasons. And we investigated the sources of the alleged utilization of pictures, ID pictures, in the wrong fashion and have found them not to be substantiated, but by an employee in an inappropriate, joking manner, and that employee was in fact reprimanded for that conduct. I might add, that goes back significantly in time during his first years of tenure in the facility.

But I think it is totally appropriate to say that any type of behavior along those lines is not tolerated by our corporation and will not be tolerated.

Mr. UPTON. We may just put in the record a number of current whistleblower complaints. I guess they are in the record. A person alleged he was removed from management, I don't know if you know about these or have any comment on these that are open. Investigator indicated he is in settlement negotiations. We might ask you to respond to these in writing.

[The information follows:]

Pursuant to discussions with assigned investigators on this date, the following information is available on currently open Paducah OSHA discrimination inquiries:

Lockheed MArtin Utility Services (Currently U.S. Enrichment Corp.)/[redacted]/1167089
(Investigator is currently on extended leave status until December 1999 with file unavailable for transfer. Specifics of allegation not ascertainable at this time)

Lockheed MArtin (U.S. Enrichment Corp)/[redacted]/1110097
Complainant alleges that he was removed from a management position and subjected to ongoing harassment because he was suspected of filing nuclear safety condition reports & contacting NRC. The assigned investigator has indicated that he is in settlement negotiations with Respondent, and absent settlement, he expects to recommend findings in favor of Complainant.

Lockheed MArtin (USEC)/[redacted]/1167121
Complainant alleged he has been harassed and passed over for promotion in reprisal for engaging in nucler safety complaints. The assigned investigator advises that writeup on the case will be forthcoming shortly, with findings against Complainant (dismissing complaint).

Lockheed Martin (USEC)[redacted] (2 complainants) / 1168483
Complainants allege that they have been harassed and threatened with adverse job actions because they raised ongoing security issues and brought concerns to the attentionof NRC. Complainants are still employed and the investigator opines that damages are minimal although a hostile working environment is alleged, however the investigator is currently in the process of writing up this case and recommending a finding in favor of Complainants.

Lockheed Martin (USEC)/[redacted]/1168889
Complainant alleges that following his bringing up numerous safety issues to managerial personnel, he was retained at his pay level but transferred out of his department in reprisal. C. desiring to be brought back to his prior job. The investigator indicates that writeup is in progress, recommending a finding in favor of Complaiannt.

Mr. UPTON. Mr. Whitfield, do you have additional questions?

Mr. WHITFIELD. Yes, I do, Mr. Chairman.

Mr. Miller, we have heard testimony this morning from Mr. Fowler and also Dr. Cochran that they today do not consider the plant totally safe, that they view it with some significant problems still at the production facility. How would you characterize the workplace today?

Mr. MILLER. We would definitely not agree with the characterization that the employees in the work force today are not protected safely and adequately. We feel very comfortable and confident that we have very vigorous health and safety programs, both from radiological controls, utilizing the ALARA program which was referred to earlier, keeping the dose rates to our employees as low as reasonably achievable. We have made documented, significant improvements since 1993. We have essentially cut the average dose rate of our radiation workers in half, down to less than 4 millirems on an annual basis against the Federal standard of 5,000 millirems as an annual limit.

We have additionally lowered the number of workers that at any one point in time received greater than 10 millirems and have cut those numbers basically in half since 1993 to 1998.

We have focused heavily on contamination control. We have surveyed all accessible leased areas of the facility and implemented not only dose rate control but contamination control which was required under our transition to the regulations under 10 CFR 20 for NRC certification.

So I think, Congressman Whitfield, in a very brief, concise summary, the programs that we have in place we feel very comfortable, do protect our workers. At the same time we constantly look for areas of improvement. We can always improve and will continue to carry forward with that attitude.

Mr. WHITFIELD. Is there plutonium in the plant today?

Mr. MILLER. I think the answer to that would be there are certainly trace amounts as a result of the past practices of reprocessing reactor tails. So yes, there would be trace amounts.

Mr. WHITFIELD. Do you consider that harmful to the workers?

Mr. MILLER. Not when we implemented and have implemented our protective measures. We take it very seriously, as we do take any radiological emission source and, where necessary, we have people placed into respirators if the need arises. If there is a posted area or a radiological work area where an employee is going to enter, the postings are designed to understand—so that the individual understands the type of activity and the protective equipment necessary to work in that, and that the monitoring that is done exiting the facilities and in combination with our monthly bioassay or urinalysis that is done on all rad workers, we feel very comfortable that we have protected our employees and will continue to do so in the future.

Mr. WHITFIELD. When USEC assumed responsibility for the production facility, it is my understanding that an assessment was done of the facility to determine deficiencies and that 55,000 square feet was decontaminated at that time because of what turned up in the assessment. Now, if that is true, that would indicate, at least at the time USEC assumed responsibility for it, that there were serious problems there. Would you agree with that or not?

Mr. MILLER. It is very difficult for me to speak to practices and conditions that existed prior to USEC coming on, but I do—it is correct that when we implemented our contamination control programs and our surveys that there were significant areas that required immediate attention.

Mr. WHITFIELD. Mr. Nemec, back in April, you conducted some readings when workers were around the cylinders with the uranium hexafluoride. The readings were quite low. Then when the assessment was conducted by the Department of Energy, they came in in August and did readings there and there was quite a discrepancy in the readings. In fact, they noted that that was a significant problem for them at that time. I know that Mr. Massey was quoted in the paper as saying that he wanted an answer to how that discrepancy occurred. So how did it occur?

Mr. NEMEC. In actuality, the readings that were taken in April were consistent with the Department of Energy readings in August. They both indicated a level of radiation dose that were consistent with one another. Those levels, then, and those readings in April were used as a basis whether the employees, the subcontractor in this case, would be required to wear a dosimeter. We concluded that they would not be required to wear one because they would get less than 100 MR of dose during the lifetime of the project.

We revisited that decision after we got the DOE readings, because at that time we were not sure as to the accuracy of our April reading, and we decided—we set the job down immediately and we decided that it would be a prudent approach to put all of the workers in dosimeters since we were unsure of what went on, and to launch an investigation into what had happened. I had our health physics manager, certified health physicist from Oak Ridge, come up to the site the day after the incident. I happened to be there the night of the incident and was involved in making these decisions. He started the investigation which ultimately concluded that our initial readings were consistent with the DOE readings. But a prudent measure here would have been to put the people in dosimeters and we did.

We have since changed our procedures to not allow that much flexibility in the field with regards to use of dosimeters.

Mr. WHITFIELD. I understand you to say that your readings were consistent with DOE?

Mr. NEMEC. Yes, they were.

Mr. WHITFIELD. May I ask one other question, Mr. Chairman? Then I will be finished here.

There has been a lot of discussion about the D&D funds for the cleanup. We all recognize that there is not enough money there, but out of the $240 million appropriated each year for D&D funds, the largest portion of that goes to Oak Ridge, of course. In fact, more goes to Oak Ridge than what you add up for Portsmouth or Paducah together.

It is my understanding that of the money that goes to Paducah, $37 million a year, that maybe $25 million a year, is simply meeting compliance standards, doing testing, and that that money does not actually go for cleanup. I know that is because of various environmental regulations. But is it possible that more money would go for cleanup if you were exempted from some of these requirements, assuming you could be exempt and still not further endanger the community?

Mr. NEMEC. I suppose it might be possible, but I certainly couldn't quantify it. I think many of the things we do under our compliance program, we would have to continue in any case. We have to monitor our offsite releases and surface water. We have to understand the groundwater plume and where it is going and continue our pump and treat operations. We have to do the surveillance and maintenance on the facilities and the upkeep, whether the regulation is there or not, to prevent the spread of contamination.

So I'm not convinced that trying to remove some regulations would solve the issue. I think we can, however, work within the regulatory environment to streamline some of the up-front decisionmaking process and thus use less time and money on that which we can then use for cleanup. And we are working on that with the regulatory bodies.

Mr. WHITFIELD. Mr. Chairman, if we have additional questions, we can obviously submit it.

Mr. UPTON. All members will have that opportunity here.

Mr. Strickland.

Mr. STRICKLAND. Yes, sir. I have basically two questions. One I would want to direct to Mr. Hummer. According to testimony from Mr. Key, in 1990 there was a voluntary program established to test volunteer employees for transuranics, some 30 people volunteered. As you know, those results were analyzed by a contract laboratory, a decision was made that they were invalid, and then there was an opportunity for employees to resubmit. According to his testimony, only seven elected to participate in the retesting. Those results were looked at by a DOE-controlled operation. The results were that there was no problem, I guess, with contamination of these employees.

The question I have is, some employees have indicated to me, and I think to others, that they are rather suspicious, they have lost some faith, some confidence, that their records were handled appropriately. According to his testimony, the results from those original samples and the written analysis and an explanation as to why they were rejected and what the findings were have not been forthcoming.

And then he has this paragraph, and I would like to share it with you. "If management is correct that the contract laboratory simply erred in its performance, there should be nothing to fear from the full and free examination of this data. However, such needless secrecy breeds mistrust." And then he says, "Perhaps the Commerce Committee could assist in securing this data for the workers."

I guess what I would like to ask you is: Is there a reason why this data is not made available so that we can look at the difference which may have existed and so that we can determine, based upon objective observers, whether or not the contract laboratory that did the initial analysis erred in their results?

Mr. HUMMER. There is no reason that I know of, Mr. Strickland. The reports should be available, although this was somewhat before my time. Basically the reports should be available and the report of the quality assurance review to determine that that reported information was not accurate should also be available.

Mr. STRICKLAND. Mr. Chairman, I would ask that we request this information be made available to the committee.

Mr. UPTON. I think that is a very good idea. We will do so.

Mr. STRICKLAND. The second and my final question has to do with the testimony of Dr. Cochran. He alleges in his testimony—and I will direct this to you, Mr. Nemec—that Bechtel has been interviewing outside contractors to assist in the destruction of files at the Paducah plant. I don't know what kind of files he may have been alluding to. But I would like to ask you if this is true, and if so, what kind of files may he be talking about?

Mr. NEMEC. I'm not familiar with what Dr. Cochran was referring to. We may have hired a contractor to shred paper that we generate in our operation and recycle it. But there is no intention to shred any documents or destroy any documents that pertain to this or to any other, future or past.

Mr. STRICKLAND. Mr. Chairman, I would like to request that the committee contact past and future contractors and DOE and ask that no documents which may have any relevance to this investigation at all be destroyed until such time as the investigation is completed.

Mr. UPTON. That is fine.

Mr. STRICKLAND. Thank you. I yield back my time.

Mr. UPTON. Mr. Burr.

Mr. BURR. I thank the Chair.

Mr. Hummer, Martin Marietta did a number of internal audits on their state of compliance. One that specifically sticks out is the compliance as it relates to the National Environmental Protection Act. The internal audits as I understand those within Martin Marietta said, and I quote, No system is in place to ensure that environmental impact assessments prepared in compliance with NEPA are honored by plant management. Under the current structure, NEPA assessment documents can be altered by plant management under a conflict-of-interest situation. Yet the 1990 environmental report for the Department of Energy stated that Martin Marietta was in compliance with all NEPA guidelines.

Do you care to comment on that?

Mr. HUMMER. Yes, sir, Mr. Burr. I don't find those two statements in contradiction. One of them says that there was no system in place to ensure that the assessments were honored by plant management. That does not say that noncompliances were found. It says that there was no system in place to ensure that they were honored. Our contention is that the requirements of NEPA were being met and we were in compliance during 1990 and other years.

Mr. BURR. Let me go on in the October 1992 internal audit, and I quote your auditors. The auditors found, quote, The NEPA program is headed in the right direction but all programs have not been implemented to keep projects' activities from not getting proper NEPA review. Some projects have been initiated without NEPA review.

I would suggest to you that that part of the audit suggests that you are not in compliance.

Mr. HUMMER. That says that; that activities not in compliance were identified, yes.

Mr. BURR. What currently does Lockheed Martin have in the way of DOE cleanup contracts?

Mr. HUMMER. Lockheed Martin has a contract to operate the river protection program for the River Protection Office of DOE at the Hanford facility formerly known as the tankways remediation system.

Mr. BURR. That's in the form of a subcontractor at Hanford, isn't it?

Mr. HUMMER. No, sir. Right now it is. As of the October 1 we will be a prime contractor to the River Protection Office.

Mr. BURR. It is a little over $300 million to Martin Marietta currently on that contract?

Mr. HUMMER. Yes, sir.

Mr. BURR. Where else?

Mr. HUMMER. We do environmental cleanup work at Sandia National Laboratory as part of our M&O contract there. We do extensive environmental management and cleanup activities in Idaho National Engineering Environmental Laboratory as part of our contract which ends on the 30th of this month there.

We also participate with Bechtel Jacobs in the environmental management in making sure that things are properly identified at the Oak Ridge facility, Y-12 and ORNL so when materials are turned over to Bechtel Jacobs for further disposition, they are properly identified.

Mr. BURR. To your knowledge, did Martin Marietta ever receive a performance bonus based upon any of the years that they represented Paducah under a DOE contract?

Mr. HUMMER. We received award fees during those periods for those operations.

Mr. BURR. Were those award fees ever based upon safety?

Mr. HUMMER. Safety was one of the several evaluation criteria used by the Department of Energy to determine the award fee, yes, sir.

Mr. BURR. Given the documents that have made their way to the forefront in the last month, as a representative of Lockheed Martin, do you believe that Martin Marietta was entitled to the qualification of those performance bonuses?

Mr. HUMMER. Yes, I do. None of those performance bonuses or award fees was predicated on 100 percent perfect performance. Therefore, there is no reason, based on what I have heard, to suspect that these particular individual items would drive that assessment significantly lower.

Mr. BURR. I would tell you, Mr. Hummer, in any way, shape or form, anybody ever finds that there was an intentional effort to withhold documents, that without reading specifically that contract with DOE, I think that it would nullify not only the performance bonus, but it would probably nullify the contract, and I would certainly ask that we look at that contract that was in existence then to see if in fact with the information we have today it was breached.

I thank all of our witnesses. This is an extremely important process for us to go through, and once again as it relates to cleanups that deal with DOE, an extremely difficult hearing to present all of the facts.

I am not yet convinced, Mr. Chairman, and colleagues, that in fact we have all of the documents that are available. I only hope that Mr. Strickland's request is in fact one that can be honored and in fact has not already happened in the case of some of the documents that I think exist. I thank the chairman and I yield back.

Mr. UPTON. Thank you, panel. As I noted earlier we have other members that were not able to be here and we would like to have the opportunity to submit additional questions in writing to you. If you could respond to that in a fairly prompt way, that would be terrific.

I appreciate your time regarding the delay that we had from last week. You are excused, thank you.

Our final panel includes Dr. David Michaels, Assistant Secretary for Environmental Safety and Health at the Department of Energy; Mr. Richard Green, Director of Waste Management Division, EPA, Region 4; Mr. Malcolm Knapp, Deputy Executive Director of Operations for Materials, Research and State Programs from the NRC; Mr. Robert Logan, Commissioner of the Kentucky Department of Environmental Protection, accompanied by Mr. John Volpe, Manager of the Radiation Control Branch at Kentucky Cabinet for Health Services.

Do any of you have counsels or colleagues that are going to be helping you in this? If you can identify them by name at this time and we will have them sworn in as well.

Mr. MICHAELS. This is Mr. Jimmy Hodges who is the manager of the Paducah site office for the Department of Energy. This is Mr. Jim Olendorf who is the Deputy Assistant Secretary in the Environmental Management Office of DOE; and this is Dr. David Statler, who is senior manager for the ongoing DOE investigation conducted by my office in Paducah.

Mr. UPTON. Anybody else?

Mr. RICHARD GREEN. This is John Johnston who is chief of our Federal Facilities Branch at EPA Region 4.

Mr. UPTON. Mr. Knapp?

Mr. KNAPP. This is Mr. Robert Pierson who is chief of the responsible branch within the Nuclear Regulatory Commission for the Paducah facility.

Mr. LOGAN. This is Mr. Michael Haynes and Mr. Downs with our Office of General counsel.

Mr. UPTON. At this time if all witnesses and identified counsel would stand and raise your right hand.

[Witnesses and counsel sworn.]

Mr. UPTON. Dr. Michaels, we will start with you. You know the order here. Your entire testimony will be made part of the record, and if you can limit your remarks to about 5 minutes as timed by this fancy timer, that would be terrific.

TESTIMONY OF DAVID MICHAELS, ASSISTANT SECRETARY FOR ENVIRONMENT, SAFETY AND HEALTH, DEPARTMENT OF ENERGY; RICHARD D. GREEN, DIRECTOR, WASTE MANAGEMENT DIVISION, ENVIRONMENTAL PROTECTION AGENCY, REGION 4; MALCOLM R. KNAPP, DEPUTY EXECUTIVE DIRECTOR OF OPERATIONS FOR MATERIALS, RESEARCH, AND STATE PROGRAMS, NUCLEAR REGULATORY COMMISSION; AND ROBERT W. LOGAN, COMMISSIONER, KENTUCKY DEPARTMENT OF ENVIRONMENTAL PROTECTION, ACCOMPANIED BY JOHN VOLPE, MANAGER, RADIATION CONTROL BRANCH, KENTUCKY CABINET FOR HEALTH SERVICES3

Mr. MICHAELS. Thank you, Mr. Chairman and members of the subcommittee. I am pleased to be here today to discuss the actions being taken by the Department of Energy in response to allegations of current and historical environment safety and health problems at Paducah and other DOE gaseous diffusion plants.

I am joined here by Jimmy Hodges, Jim Olendorf and David Statler. My complete testimony has been provided to the committee for record.

To begin, I would like to associate myself with the opening remarks of the members of this committee. I have spent much of my career raising safety and health concerns of Department of Energy workers, and before coming to DOE, I was one of its strongest critics. In the past year, Secretary Richardson and senior management have worked very hard to change the safety culture at DOE facilities, and we greatly appreciate the bipartisan support the committee is giving us. Clearly though, they have a lot of work to do.

Let me also say at the outset that from the time these concerns were brought to his attention, Secretary Richardson has made it clear that he would get to the bottom of the issues and do what is needed to be done to resolve them. We are especially concerned that until 1990, workers at the gaseous diffusion plants may not have been fully aware of transuranics nor trained in work practices designed to protect them from the potential health impacts from exposures to these materials.

When the Secretary was in Paducah last week, he spoke directly with workers and community members. He listened to their concerns and apologized to members of the community who felt that in the past the government has not been forthcoming about the health risks they faced. The Secretary also announced that the Clinton administration will propose legislation to establish a pilot program for compensating current and former workers at Paducah who have cancers caused by job exposures to radioactive contaminants.

As the Secretary said when announcing a proposal to help DOE workers who have disease, this administration believes that if our workers are ill because of exposure to hazards at the workplace, they deserve fair and equitable compensation. I understand that there is concern that the proposed program at this point is limited to workers at Paducah, but I want to make clear that the Secretary's overall commitment applies to all DOE workers. It is the intent that it will be a pilot program and inform our understanding of possible health impacts at other gaseous diffusion plants. The details of the proposed pilot are actively being discussed within the administration and we expect a legislative proposal will be finalized shortly. We look forward to working with members of this committee as we develop final legislation.

The independent oversight team is conducting its investigation in Paducah in two phases, the first phase focused on environment and health safety practices at Paducah over the past decade; the second on historical issues. The team has completed its initial Phase I assessment. Their preliminary observations were released last week and identified that some improvements need to be made in the areas of radiation protection, environmental management and oversight.

In the area of radiological protection, the team observed that the Paducah radiological protection program had been significantly improved in the early 1990's. At the same time, they found that a greater degree of discipline, formality and oversight is still needed to ensure that worker exposure is maintained as low as reasonably achievable.

With regard to environmental protection, the team reviewed progress under the compliance agreement and examined potential sources of continuing groundwater and surface water contamination which have not been fully isolated or effectively mitigated.

To address these concerns, the Department hopes to sit down with its regulators to reexamine the priorities and pace of cleanup activities as called for under the compliance agreement. The team will return to Paducah this October, early October, to begin the second phase of its investigation. This will focus on historical issues at Paducah and will rely largely on interviews and review of documents. We will be looking to current and former workers and supervisors who have specific knowledge of plant operations between the 1950's and 1990. The team will begin its work in Portsmouth in mid-December, to be followed at an investigation at Oak Ridge in early 2000. This investigation is being supplemented by two other assessments of past practices.

One will try to clearly identify the flow and characteristics of recycled uranium within the DOE complex over the last 50 years and help us understand exactly where and how much of these materials were at various DOE sites and at what times.

The second will seek to establish potential worker radiation exposures at the gaseous diffusion plants, especially where records are less than complete or where worker exposure has not been well characterized.

Another important part of the Secretary's plan is support for expanded medical monitoring for current and former workers at all three gaseous diffusion plants in the program managed by the workers' union. Over the next year we expect to provide complete medical exams for 6,000 workers in Paducah, Portsmouth, and Oak Ridge. To support these actions, Secretary Richardson announced that the administration will propose a $21.8 million amendment to the fiscal year 2000 budget. This will include $7 million for expanded medical monitoring and $10.7 million to accelerate environmental cleanup activities at Paducah and Portsmouth.

It also includes $4.1 million to accelerate cleanup of inactive DOE facilities at Paducah and Portsmouth in order to reduce or eliminate chemical hazards, radiologically contaminated material, and exposure to workers.

In addition to these activities, the Secretary has indicated that he will hold all DOE contractors, past and present, responsible for their actions. To help make that determination, the DOE Office of General Counsel is assessing the contractual responsibility of DOE's contractors in the areas of environment safety and health.

In closing, Mr. Chairman, our actions to date serve notice that the DOE, under the leadership of Secretary Richardson, will not tolerate unresolved concerns about worker health and safety or unfair treatment to sick workers. I know the Secretary is committed to righting any wrongs that may have been committed in the past to the work force at this plant, and your support of these efforts is critical to our success.

We appreciate the opportunity to be here today and would be pleased to answer any of the committee's questions.

[The prepared statement of David Michaels follows:]

PREPARED STATEMENT OF DAVID MICHAELS, ASSISTANT SECRETARY FOR ENVIRONMENT, SAFETY AND HEALTH, U.S. DEPARTMENT OF ENERGY

Thank you, Mr. Chairman. I appreciate the opportunity to discuss the Department of Energy (DOE) response to allegations of current and historical environment safety and health problems at the Paducah plant in Paducah, Kentucky. Let me say at the outset that from the time these concerns were brought to his attention, Secretary Richardson has made it clear that he would conduct a complete and independent investigation to determine if any of these concerns were true. He further committed to determine if workers were made ill because of inadequate worker protections, and that if they were, to seek to provide them with fair compensation.

As the Committee knows, DOE is currently responsible for environmental cleanup from waste generated prior to lease of the facilities to the Uranium States Enrichment Corporation (USEC) in 1993 and for the management of the inventory of depleted uranium hexafluoride stored at the gaseous diffusion plants, including the Paducah plant. This work involves approximately 94 employees of Bechtel-Jacobs, the DOE current contractor for cleanup at the Paducah site, a transient subcontractor work force of up to 300 workers, and a small number of workers for USEC that support site cleanup or management of the inventory of depleted uranium hexafluoride.

Because Paducah is a designated Superfund site, cleanup of hazardous substances other than uranium hexafluoride is being conducted in accordance with a Federal Facilities Agreement among DOE, the Environmental Protection Agency, and the Commonwealth of Kentucky. This agreement establishes milestones and a schedule for meeting them. Uranium enrichment activities were transferred to USEC in July 1993 in accordance with the Energy Policy Act of 1992. Uranium hexafluoride and worker safety issues are covered under the authority of the Atomic Energy Act with appropriate oversight by DOE. Additionally, USEC currently operates under a Nuclear Regulatory Commission certificate and is subject to NRC regulation.

In May 1999, the Department became aware that a *qui tam* case would be filed under the False Claims Act in U.S. District Court. This suit alleges fraud on the part of contractors at the Paducah Gaseous Diffusion Plant, based on current and past environment, safety and health violations. Once the case was filed, it was placed under a court seal that prohibited DOE from acknowledging or discussing the case with any party outside the federal government. While the allegations could not be discussed, the Secretary felt it important to ensure that there were no imminent threats to the environment, public health or safety. From June 18 to 21 of this year, a technical team of health physicists and environmental engineers, led by the Oak Ridge field office and supported by my staff, conducted an on-site review of the areas currently under DOE's control. This team concluded that there were no imminent health or safety threats to DOE's workers. No public dialogue could be initiated at that time because of the restrictions imposed by the court seal.

In August, many of the allegations became widely reported in the national media. Shortly thereafter, Secretary Richardson called for a comprehensive response to the public allegations. Subsequently, the court seal was lifted allowing the Department to proceed with that response. My testimony today will describe these activities and our progress to date in meeting the Secretary's commitments.

Many of the concerns regarding worker safety and health that have been reported to DOE stem from the presence of plutonium and other radioactive materials at Paducah, and the question of whether workers were adequately informed or prepared to handle such materials. These materials resulted from the recycling of uranium from weapons production plants to toxic gaseous diffusion plants during the 1950s, 1960s, and 1970s. After irradiation in a reactor, spent fuel containing unused uranium, fission products and transuranics was reprocessed at the Hanford, Savannah River, or Idaho sites to separate the plutonium and remaining uranium from the fission products. The uranium was converted to a transportable form, and was recycled for use at the gaseous diffusion plants at Paducah and Portsmouth. Preliminary analysis also indicates that recycled materials may have also been transferred to the Fernald Feed Materials Production Center and the Y-12 Plant at Oak Ridge. The gaseous diffusion plants converted the incoming uranium to uranium hexafluoride for enrichment in the cascade. The concerns that have recently been expressed focus on the transuranic elements and fission products that were and are present in this recycled uranium. It is estimated that approximately 100,000 tons of recycled uranium was fed to the Paducah plant.

Environmental concerns alleged in the suit include both on-site and off-site contamination from legacy radioactive or hazardous materials, and potential for harm to workers or public health and safety. Issues raised include:

- possible improper disposal of hazardous or radioactive materials both on- and off-site in publicly accessible areas;
- apparent inappropriate release of materials that were radioactively contaminated, release of contamination into site streams and drainage ditches, claims of inadequate control and posting of offsite contaminated areas, and
- suspected exceedences of radiological air emission standards.

Independent Investigation

The comprehensive investigation into environment, safety and health concern, at Paducah is being conducted by a senior team of investigators and technical experts from my staff in the Office of Environment, Safety and health (EH). The investigation is being conducted in two phases. The first phase, now underway, is focused on the adequacy of levels of protection provided to workers, the public and the environment today and over the past ten years. The second phase will focus on the longer-term, more complex environment, safety and health issues over the plant's entire history. This phase will involve a comprehensive document review as well as interviews with former workers. The team will also conduct investigations at the gaseous diffusion sites in Piketon, Ohio and Oak Ridge, Tennessee.

The team of investigators arrived at the Paducah site on August 17 to begin the first phase of the investigation and to examine information on health and safety programs. Over a two-week period, team members reviewed documents, conducted numerous interviews with officials and workers, conducted radiological surveys, inspected the site and collected extensive environmental samples. Samples were collected from onsite and offsite groundwater, surface water, and soil and sediment, as well as buildings onsite. The samples are being analyzed by an independent laboratory to determine the full range of chemicals and radionuclides that may have been released into the environment as a result of site operations. Some of these samples have been split with the Commonwealth of Kentucky. The efforts are being closely coordinated with both the Commonwealth of Kentucky and the Nuclear Regulatory Commission.

Additionally, Secretary Richardson has directed that this investigation be conducted in close coordination with current and former workers and their union representatives. Concurrent with this investigation, the Nuclear Regulatory Commission conducted a review of radiation protection in the USEC-operated areas and the State of Kentucky has increased offsite monitoring.

The DOE investigatory team is currently in the process of analyzing and validating its initial findings and preparing a final report to the Secretary. After being briefed on the team's initial observations, Secretary Richardson ordered a one-day safety stand down at the Paducah Site. While the team found that there had been safety improvements in recent years, some practices needed to be further improved and the Secretary felt that the cessation of activities would provide an opportunity for both workers and managers to focus on safety, raise concerns and make suggestions for improved operations.

In its initial observations, the investigatory team verified earlier findings that DOE operations at Paducah do not present imminent hazards to the workers or the public. As is the practice in the Department's Safety Management Evaluations conducted by the EH Oversight staff, the team also identified areas which would benefit from improvement in radiological protection, procedures and conduct of operations.

In response to the on-site investigation's preliminary results, DOE field and program management has identified initial actions to respond to these concerns.

Preliminary Phase One Findings

- *Radiological Protection.* The team observed that the Paducah radiological protection program was improved in the early 1990s. At the same time, a greater degree of discipline, formality and oversight is still needed to fully protect workers to assure that worker exposure to legacy radiological hazards is maintained as low as reasonably achievable (ALARA). For example, the team found that 25 subcontractor employees working on a project in the uranium hexafluoride (UF_6) cylinder yard since May could be subject to radiological exposure of greater than 100 millirem in one year and should have worn dosimetry badges. While this level of exposure is not a health hazard in itself, DOE ALARA regulations require that such workers wear personal dosimetry badges at this level of exposure. As a result of this finding, the site stopped work, conducted appropriate training, and issued dosimetry badges to the workers.

  The team also identified a number of radiologically contaminated areas on DOE property that were not adequately controlled in accordance with DOE requirements. Workers have not received training on the hazards associated with working with transuranics since 1992 and such training is not part of the site safety training courses. Workers were also seen handling drums that contained uncharacterized waste and quantities of concentrated Technicium-99. Finally, the team observed weaknesses in the controls that are essential to radiological protection, such as radiation work permits, procedures and procedure adherence, and air monitoring.

To address these findings, DOE field management will initiate an independent and detailed review of the Bechtel Jacobs Company radiation protection program and its implementation at Paducah. They will also work with the State of Kentucky and EPA Region IV to assure that site postings of contaminated areas, as called for in approved CERCLA or RCRA decision documents, are adequate.

- *Enviromental Protection.* The cleanup of Paducah is covered under a legally enforceable agreement with the Commonwealth of Kentucky and the EPA Region IV. The agreement assigns cleanup priorities and schedule for completing work. Over the last several years, work has been performed in cooperation with the State and EPA to address the immediate risks to public health and environment, and the site is currently in compliance with that agreement. Activities have included providing an alternate water supply to off-site residents and the construction of groundwater collection and treatment facilities to control offsite groundwater contamination. The investigatory team reviewed progress under the agreement and focused on numerous potential sources of continuing groundwater and surface water contamination covered under the agreement that have not yet been fully isolated or effectively mitigated. These include unlined contaminated landfills, scrap yards, burial grounds and spill sites.

  Under the requirements of the cleanup agreement signed in 1998, characterization and cleanup of hazardous facilities and materials has been ongoing at the site in accord with a prioritized schedule that contemplates completion of cleanup in 2010. Nonetheless, the team has identified potential hazards that it believes should receive greater priority. For example, material storage areas (DMSA) contain significant volumes of uncharacterized scrap equipment and materials that are potential hazards to workers. Further, process buildings that have been shutdown for more than 20 years contain significant amounts of uncharacterized hazardous materials including uranium in ventilation ducts and piping, receiver ash, and transuranic contamination. Although surveillance and maintenance is conducted, these buildings continue to deteriorate and are not included in the 2010 cleanup schedule. The team recommended that the hazardous materials should be removed, and that these buildings be maintained in a condition that protects workers and the public and minimizes the risk and cost of eventual decommissioning.

  As observed in previous site reviews, many of the 30,000 55-gallon drums of low-level waste onsite are stored outside in the elements or on unpaved ground while awaiting shipment. Because of the need to address competing priorities, the planned disposal date for these wastes is not until 2012. As also previously identified, the nearly 37,000 uranium hexafluoride (UF_6) cylinders are also stored onsite in the open, and constitute long-term radiological and chemical exposure hazards to workers and the public.

The team reviewed detailed sample results from cascade-processing equipment that was transferred to private industry in 1997 and 1998. Approval of these transfers was based on the site policy of using DOE's uranium release criteria, rather than DOE's more restrictive criteria for release of transuranic-contaminated material. Samples indicated that the equipment contained very small, but detectable, quantities of plutonium, neptunium, and americium. The team noted that had appropriate criteria been applied, the release might not have been approved.

Pending completion of the final investigation report, the Department officials responsible for the Paducah site have identified a number of steps they will take immediately in response to these issues. First, the Department will examine existing State of Kentucky and USEC site air monitoring systems to confirm that these systems would record any significant DOE contribution to overall site emissions. Second, the roofs of several shutdown but yet to be decontaminated buildings will be sampled to support fugitive-emissions calculations. Third, as required under CERCLA and the site's cleanup agreements, regulators are now reviewing the Engineering Evaluation and Cost Analysis for the scrap metal piles and Drum Mountain. Characterization and concurrent disposal of these materials are scheduled to begin late in the summer of 2000. Finally, additional sampling and analysis of off-site areas will be carried out.

As a further step to address hazards, the Bechtel Jacobs corporate "Safe Work Operations Workshop," initially developed for the Oak Ridge site, will be adapted for Paducah-specific issues and presented at Paducah. Bechtel Jacobs will also delelop and present a detailed radiation safety and environmental protection program training module to all personnel who oversee the safety performance of subcontractors. Finally, DOE will station two full-time Facility Representatives at Paducah to oversee field activities that affect environment, safety and health.

The investigation team will present its full report to the Secretary by September 30. In the meantime, DOE managers will continue to identify responses to the team's findings. We expect to complete the second phase of the Paducah investigation by the end of the year. The team will initiate its work at the Portsmouth plant in mid-December, to be followed by the investigation at Oak Ridge.

Determine Flow of Recycled Materials Through the DOE Complex

DOE and its predecessor agencies produced more than 100,000 metric tons of recycled feed or waste streams containing trace quantities of fission products and plutonium. This material was sent not only to Paducah, but also to other sites in the DOE complex. Today, our understanding of where that material went is limited. Secretary Richardson requested a study that would provide a clear understanding of the flow and characteristics of this recycled material.

The first figure attached shows the historical flow of recycled uranium throughout the Department of Energy complex, as we currently understand it. Typically, the spent fuel from the production reactors was reprocessed in separations facilities that recovered the plutonium and uranium, while also separating out almost all of the fission products. The separated uranium was converted to uranium oxide (UO_6) and shipped to Paducah or other sites. The figure also shows an interaction with foreign military and commercial sources.

We are concerned not only with the flow of this material, but also its characteristics such as the level of residual plutonium and fission products. Past DOE studies have suggested that no consistent or generally-accepted specification existed for the maximum allowable amounts of transuranics and fission product elements in the recycled material, although specifications were generally low (i.e. in the range of 10 parts per billion (ppb) plutonium). Occasionally, specifications could be exceeded, and for certain other recycled uranium bearing materials, we know that level of plutonium was higher.

The figure also shows that Paducah would send uranium-bearing ash to Fernald for recovery. A 1985 DOE review revealed that in June 1980, the level of plutonium in some of the ash was between 67 ppb and 7,757 ppb (average about 1123 ppb). Other processes associated with the flow of recycled uranium may have also contained higher concentrations of transuranics, e.g. plutonium, neptunium and americium. One of the waste streams on the figure is shown in color to reflect that the operation of washing uranium feed cylinders produced waste that may have been higher in transuranics. The material mass flow review we have initiated will look into this aspect of the uranium stream.

The second figure shows the operating periods of the facilities involved in recycling uranium. As you can see, recycle activities began in the early 1950s, and there were many sites and facilities involved in this work. Among these 13 sites, several facilities have been decommissioned, making records retrieval more difficult. The data on this chart is preliminary. We will have a more complete and accurate picture as the mass flow project progresses.

The mass flow project will address the flow and characteristics of recycled uranium over the last fifty years. The specific goals are to:

- Identify the mass flow of recycled uranium throughout the DOE complex from early production to mid-1999 and create a publicly-available unclassified intersite flowsheet.
- Identify the characteristics of, and contaminants in, the major uranium streams, including the technetium, neptunium, plutonium or other radioactive content of concern to worker or public health and safety.
- Conduct site mass balance activities to identify any significant concern for potential personnel exposure or environmental contamination.

We expect this work to be complete by June 2000.

Worker Exposure Assessment Project

An important paint of the Secretary's response to concerns at Paducah is to fully address health concerns of current and former Paducah workers, especially where records are less than complete, or where worker exposure to plutonium and other materials has not been well characterized. To address this gap, an aggressive and exhaustive search of records will be conducted at Paducah for the time period ranging from the early 1950s to the present. Assessments will then be performed by analyzing the exposure records of current and former workers to determine the extent and nature of exposures, focusing on exposure to transuranics. The activity will include identifying, retrieving and reviewing exposure records. Should records prove to be poor or non-existent, DOE would perform detailed reviews of relevant plant process and monitoring data as well as extrapolations based on available exposure information.

The goal of this effort, managed by the DOE Office of Environment, Safety and Health and conducted by a team from the University of Utah, is to establish the potential ranges of worker radiation exposures and identify, document and communicate the radiological issues that may have affected worker health at the Paducah site since its opening. This work will help inform Paducah workers of their potential radiation exposure and will help determine whether there may be any potential for adverse worker health impacts from radiation exposure while working at the Paducah plant.

The project began the week of September 13, 1999 when the University of Utah team began to interview workers and conduct an on site records search. The project is expected to take six months and consists of the following subtasks:

- Mapping the various processes conducted at Paducah and identifying the associated potential radiological hazards, over time. This will include identification of any events, such as equipment modernization, accidents, etc., that may have presented potential radiological hazards to the workers;
- Identify, retrieve and evaluate radiological and worker exposure records to determine what the available records tell us about radiological conditions and worker radiation exposure data at the site;
- Establish the feasibility of conducting a bioassay program for workers that would measure actual individual radiation dose taken in the person;
- Establish the feasibility for and possibly conduct a radioassay, of residual materials at Paducah that would determine the radiological content of those materials and be useful in determining hazards workers were exposed to.
- Develop occupational exposure profiles. This subtask will compile all information gained in previous subtasks to develop "bounds" or ranges of possible radiation exposures of workers at Paducah.
- Conduct a worker communication program to ensure that workers understand and accept the process use and the results obtained.

With the possible exception of the bioassay program, this project is expected to be complete by April 2000.

Medical Monitoring for Current and Former Workers

Under an ongoing DOE program being conducted at a number of DOE sites, medical monitoring is being provided to 1200 former workers at the gaseous diffusion plants (400 workers per year per plant). As part of the Secretary's action plan, the program will be expanded to include additional former employees at each site as well as current worker at each site. The program provides an objective, independent and expert evaluation of the health status of workers. The accompanying educational program will help workers understand prior exposures and current health risks.

As in the current program, medical screening will be conducted for health hazards associated with exposure to a wide range of hazards related to a participant's work at the facility. The actual screening tests conducted will be tailored to a worker's exposure history and will generally include a physical examination, blood tests, and chest x-rays. Where warranted by a worker's exposure history, specialized tests and other specialized screenings will be conducted. Physicians will review individual test results from the screening program and communicate results to program participants. They will call patients to communicate any urgent findings based on examinations and inform them of any need for follow-up. Project personnel will also advise participants whom need medical follow up about possible sources of health care.

The DOE-funded medical monitoring program will be independently implemented by a consortium of organizations and staffed by highly qualified physicians and other health professionals specializing in the field of occupational health.

Compensation for Sick Workers

Although the use of recycled reactor tailings was discontinued by the 1970s, plutonium and other transuranic residues are still present in small quantities at each facility. Concerns have been expressed that, until 1990, workers may not have been adequately informed about the contamination or trained in work practices designed to protect them from the possible health impacts of such exposures. Enhanced worker protection programs for the protection of workers from the hazards of plutonium and other radioactive materials were required after 1990.

Secretary Richardson recently announced that the Administration would propose legislation to establish a targeted pilot program to provide compensation for Paducah workers who have cancer as a result of job-related exposures. It is the intent that this be a pilot project that will be able to inform our understanding of possible health impacts at the other gaseous diffusion plants. At the same time, the White House National Economic Council is leading a study of the relationship between occupational disease and work at all DOE sites and the adequacy of workers' compensation programs. The details of the proposed Paducah pilot are being discussed within the Administration and we hope to propose legislation shortly.

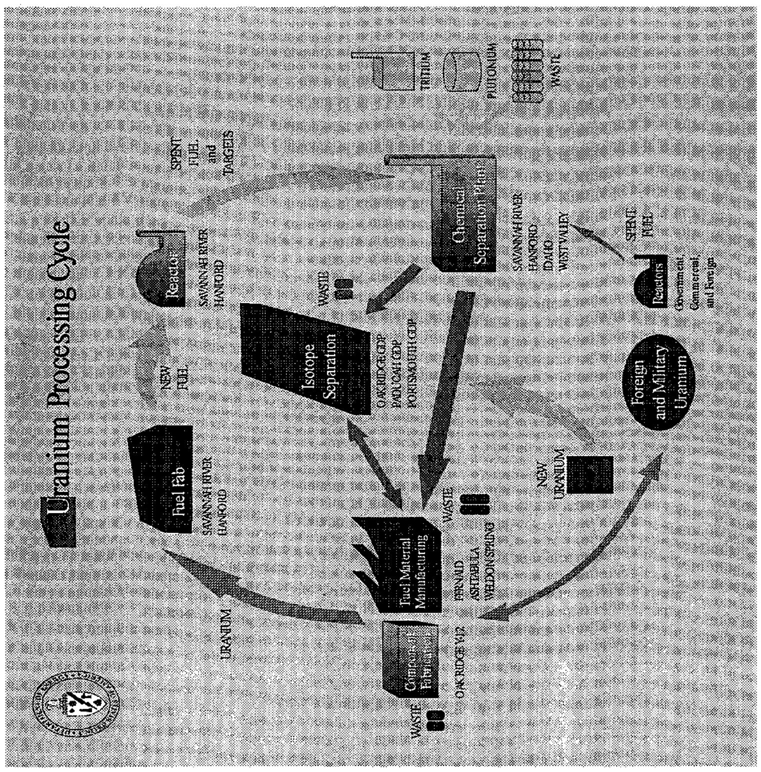
Conclusion

Finally, Mr. Chairman, I want to emphasize that Secretary Richardson, on behalf of the entire Administration, takes the concerns that have been raised seriously and is committed to investigate and resolve them. The investigation is both independent and comprehensive. As you have seen, it has already begun to serve to get out the facts and correct any current safety shortcomings. The existing environmental compliance agreement that guides remedial actions and schedules at the site has been agreed to by DOE, the State of Kentucky and the Environmental Protection Agency. Where the investigation team's initial observations suggest that modifications to this agreement, including adjustments in priorities, may be warranted to protect the public and worker health and safety, we will pursue them.

We need to determine whether the Department has known of the presence of plutonium and other transuranics at Paducah and other sites. We also need to determine how well the workers knew of the hazards they were working with, and how well they were protected from these hazards—even in very small amounts. We will learn much more as our investigation moves ahead and seeks to confirm—in today's regulatory environment—whether the presence of these materials represented a potential health risk at Paducah or any other DOE plant.

We will continue our efforts in a manner that is forthright and responsive to the public's need for timely information, while at the same time being careful that our answers are correct. We will also continue to work in a cooperative and transparent way with the workers, their representatives, the public, and the Congress. Secretary Richardson has made it clear that the days of secrecy and hiding information are over. We are committed to getting accurate information and doing so in a responsible manner. We are also committed to treat the veterans of the Cold War with dignity and with fairness.

Thank you for the opportunity to testify. I would be happy to answer questions from any of the Subcommittee members.


Uranium Processing Cycle
Fuel Fab
SAVANNAH RIVER
HANFORD
NEW FUEL
Reactors
SAVANNAH RIVER
HANFORD
SPENT FUEL and TARGETS
TRITIUM
PLUTONIUM
WASTE
Chemical Separation Plant
SAVANNAH RIVER
HANFORD
IDAHO
WEST VALLEY
SPENT FUEL
Reactors
Government, Commercial, and Foreign
Foreign and Military Uranium
NEW URANIUM
Isotope Separation
OAK RIDGE GDP
PADUCAH GDP
PORTSMOUTH GDP
WASTE
Fuel Material Manufacturing
FERNALD
ASHTABULA
WELDON SPRING
WASTE
Component Fabrication
OAK RIDGE Y-12
URANIUM
WASTE

Mr. UPTON. Thank you, Mr. Michaels.
Mr. Green.

TESTIMONY OF RICHARD D. GREEN

Mr. RICHARD GREEN. Mr. Chairman and members of the subcommittee, thank you for the opportunity to talk about Paducah today. I am Richard Green, Director of EPA's Waste Management Division in EPA's Region 4 office in Atlanta. I am responsible for our programs dealing with hazardous substance regulation and cleanup, primarily under the Comprehensive Environmental Response Compensation Liability Act, CERCLA, or Superfund, and the Resource Conservation Recovery Act, or RCRA.

EPA's role at DOE's Paducah plant and my remarks focus on EPA's oversight role as overseers of DOE's cleanup. EPA also has regulatory responsibilities for facility compliance with permits for its industrial operations which are governed by a variety of other environmental laws which did not apply until relatively recently in the plant's operation history.

The Commonwealth of Kentucky is authorized as the primary environmental regulator in lieu of EPA under many EPA statutes and we work closely with Kentucky in providing oversight of DOE's activities pursuant to those authorities.

I want to preface my comments about the cleanup at Paducah by saying that EPA takes the concerns of current and former workers regarding possible exposures in the DOE workplace very seriously. My focus on the cleanup program does not imply any disinterest in those concerns whatsoever. Personally, I was moved by testimony that we heard earlier today on Panel I. However, my remarks will address efforts under EPA's authorities to effect cleanup and to protect nearby populations.

I continue to follow the news reports about Paducah and the efforts by DOE's team investigating health and safety issues. There is so much to do at the site that it was difficult to even determine where to start several years ago. We have been actively working to require cleanup to take place. In fact, EPA Kentucky and DOE facility representatives are ready now to reprioritize cleanup activities to address issues such as the removal of the scrap metal piles. We welcome the opportunity to work with DOE and Kentucky to identify other cleanup activities that can be accelerated.

In November 1988, EPA issued a CERCLA 104/106 administrative consent order by which DOE agreed to protect nearby homeowners from contaminated groundwater and to clean up any related contamination serving as the source for that problem. Under this order, DOE has supplied drinking water to private residences, continues to conduct monthly sampling of drinking water and has completed an initial investigation to determine all sources of the contaminants, including radionuclides which exceed Safe Drinking Water Act requirements. The DOE immediately agreed to provide bottled drinking water to nearby residents. Working with EPA and Kentucky, DOE extended water lines to homes in the area of contamination and initiated an environmental study to determine the nature and extent of the contamination that caused the offsite release as well as to identify other problem areas.

The outgrowth of this initial work under the administrative order resulted in two key Superfund Records of Decision or RODS having to do with the northwest plume and the northeast plume, the two major groundwater contamination plumes which are advancing from the site to the Ohio River reportedly at about a foot a day. These decisions require the Department to extract and treat the most contaminated groundwater that is underlying the site. They represent EPA's requirement for early action under Superfund whenever possible, and they are operating right now but they are not the final remedy.

While these initial cleanup actions were underway, the site was proposed for the National Priorities List, the Superfund list in 1993, and finalized on that list in May, 1994. Here is a summary of what we have required under the order and the NPL listing so far: EPA Kentucky and the facility have identified areas of known or suspected contamination. We have set priorities for study and cleanup and implemented detailed studies of the highest priority sites. These include additional areas of groundwater contamination that have been identified, water and sediments of streams near the facility, soils onsite and across the plant for disposal. Six remedial actions have been selected and implemented addressing groundwater, sediments in ditches, and surface soil at areas within the industrial complex. Two removal actions have been taken, one for a radiologically contaminated rubble pile off the complex and a second for PCB contaminated soils within the complex.

Several detailed remedial investigations are underway and more are set to begin as early as this month. We signed a Federal facilities agreement with DOE and Kentucky in February 1998. It helps coordinate the actions of the three parties and sets milestones. It requires the three agencies to coordinate with the public about cleanup efforts and to participate in a site-specific advisory board which consists of 18 or 20 local representatives.

The actions taken thus far, while significant and appropriate, are by no means sufficient to address all of the known or potential contamination associated with the facility. EPA's context for approaching its oversight of the facility's cleanup is that Paducah, just as the rest of the nuclear weapons complex, was self-regulated throughout much of its operational history. That leads us to expect to find additional areas of contamination, such as the landfills referred to by Mr. Garland in the Panel I testimony.

Setting priorities between response to known problems and searching for unknown or suspected problems is a challenge but it must be done. We take the community's concerns extremely seriously, and we are pleased that DOE has expressed interest in developing a strategy to investigate offsite areas that may contain hazardous waste.

The environmental priorities at Paducah should be reconsidered in light of new concerns being raised. EPA supports a differently balanced response to known problems as well as a broad-based search for any areas that may be contaminated but not presently known. We have done a lot here, but a lot remains to be done. Paducah has been constrained not only by the DOE budget, but in our opinion by DOE's allocation of that budget, particularly regarding cleanup funding. Indeed we have been told by DOE that they will not be able to meet even the baseline commitments in the FFA beginning in about the year 2001. EPA does not accept this explanation and we have refused to renegotiate the FFA down. DOE and Kentucky are ready to reallocate priorities, add additional actions, and accelerate response at the site. Thank you.

[The prepared statement of Richard D. Green follows:]

PREPARED STATEMENT OF RICHARD D. GREEN, DIRECTOR, WASTE MANAGEMENT DIVISION, U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION IV

Mr. Chairman, members of the Subcommittee, thank you for the opportunity to be here today. I am Richard D. Green, Director of EPA's Waste Management Division in the Agency's Region 4 office, Atlanta, Georgia. I am responsible for our programs dealing with hazardous substance regulation and cleanup, primarily under the Comprehensive Environmental Response, Compensation and Liability Act, and the Resource Conservation and Recovery Act. EPA's role at the Department of Energy's Paducah Gaseous Diffusion Plant in Kentucky, and my remarks, focus on EPA's oversight role as overseers of the Department of Energy's cleanup. EPA also has regulatory responsibilities for facility compliance with permits for its industrial operations governed by a variety of other environmental laws. The Commonwealth of Kentucky is authorized as the primary environmental regulator in lieu of EPA under many EPA statutes, and we work closely with Kentucky in providing oversight of DOE's activities pursuant to those authorities.

I want to preface my comments about the cleanup at Paducah by saying that EPA takes the concerns of current and former workers regarding possible exposures in the DOE workplace very seriously. My focus on the cleanup program does not imply any disinterest in those concerns. Rather, my remarks will address efforts under EPA's authorities.

I continue to follow the news reports about Paducah and the efforts by the DOE's team investigating health and safety issues. The cleanup of Paducah is a large and complex task and has been receiving priority attention. In fact, EPA, Kentucky, and DOE facility representatives stand ready to reprioritize cleanup activities to address issues such as the removal of the scrap metal piles. EPA welcomes the opportunity to work with DOE and Kentucky to identify other cleanup activities that can be accelerated.

On November 23, 1988, EPA issued a CERCLA 104 /106 Administrative Consent Order by which DOE agreed to protect nearby homeowners from contaminated groundwater and to cleanup any related contamination serving as the source for that problem. Under this order, DOE has supplied drinking water to private residences, continues to conduct monthly sampling of drinking water, and has completed an initial investigation to determine all sources of the contaminants, including radionuclides, which exceed Safe Drinking Water Act requirements. The Department immediately agreed to provide bottled drinking water to nearby residents. Working with EPA and Kentucky, DOE extended water lines to homes in the area of contamination and initiated an environmental study (known as the Phase I study) to determine the nature and extent of the contamination that caused the offsite release, as well as identifying other problem areas.

The outgrowth of the initial work required by the Administrative Order resulted in two key CERCLA Records of Decision: Interim Remedial Action of the Northwest Plume, and the Interim Remedial Action of the Northeast Plume. These two cleanup decisions require the Department to extract the most contaminated groundwater underlying the site. While these initial cleanup actions were underway, the site was proposed for the National Priorities List in 1993, and in May 1994, EPA finalized the addition of the facility to the Superfund National Priorities List.

EPA, Kentucky and the facility have identified areas of known or suspected contamination, set priorities for study and cleanup and implemented detailed studies of the highest priority sites. These include additional areas of groundwater contamination, water and sediments of streams near the facility, soils on-site, and areas the Plant used for disposal. Six remedial actions have been selected and implemented addressing groundwater, sediments in ditches, and surface soil at areas within the industrial complex. Two removal actions have been taken, one for a radiologically contaminated concrete rubble pile off the industrial complex and a second for PCB contaminated soils within the complex. Several detailed remedial investigations are underway and more are set to begin as early as this month.

While these actions were being planned and implemented, a Federal Facility Agreement pursuant to CERCLA Section 120 was negotiated and signed February 13, 1998. The FFA helps coordinate the actions of DOE, EPA, and Kentucky and sets milestones for DOE's cleanup program. The Agreement also requires the three agencies to coordinate with the public about cleanup efforts and to participate in the Site Specific Advisory Board formed in August 1996.

The actions taken thus far, while significant and appropriate, are by no means sufficient to address all of the known or potential contamination associated with the Paducah facility. EPA's context for approaching its oversight of this facility's cleanup is that Paducah, just as the rest of the nuclear weapons complex, was self-regulated throughout much of its operational history. That leads us to expect to find additional areas of contamination, both on and off-site. Setting priorities between response to known problems and searching for unknown or suspected problems will always be a formidable challenge. The community's concerns regarding additional unknown areas of contamination are taken very seriously by this Agency.

The environmental priorities at Paducah should be reconsidered in light of new concerns being raised. EPA supports a differently balanced response to known problems as well as a broad-based search for any areas that may be contaminated but not presently known.

Mr. WHITFIELD [presiding]. Dr. Knapp.

TESTIMONY OF MALCOLM R. KNAPP

Mr. KNAPP. Thank you for the opportunity to discuss the NRC's responsibilities regarding Paducah. I will briefly summarize our responsibilities, the risks posed to workers and the public, and our current regulatory actions.

The Energy Policy Act of 1992 assigns the NRC responsibility for regulating the safety, safeguards and security of the gaseous diffusion plants, and we take these responsibilities very seriously. We certified the plants in November 1996 and assumed regulatory responsibility in March 1997. As stated in our reports to Congress in 1998 and 1999, we have determined that both plants are operating safely and in accordance with our requirements.

Under the USEC lease agreements, certain areas are not included within the leased areas and these remain under DOE, not NRC regulatory responsibility.

In the figure posted at my left, the blue areas in the Paducah plant remain under DOE's authority and responsibility. The cream areas are the responsibility of USEC, regulated by NRC. The light olive areas are areas of shared responsibilities by USEC and DOE for access, and NRC regulates the USEC activities in those areas.

Prior to our assumption of regulatory oversight in 1997, USEC performed a site-wide survey of indoor and outdoor areas of the plants to identify any contaminated areas. They placed placards in those contaminated areas which USEC was releasing from DOE to identify them clearly, and they control these areas in accordance with their radiation protection program.

Based upon our review of their records since 1997, worker radiation exposures at Paducah in NRC-regulated areas are very low and in compliance with NRC requirements. With respect to the public and the environment's exposure, the report which USEC provided as part of its application for certification and a subsequent report in 1997 show that with respect to USEC responsibilities, concentrations of transuranic radionuclides in airborne emissions, water samples, soil samples and sediment samples are within regulatory limits.

With respect to current NRC regulatory actions, we maintain a staff of 2 full-time onsite resident inspectors at each plant who are tasked with monitoring day-to-day plant operations, including radiological control practices in the area of the facility for which we have responsibility. In addition, inspections by both headquarters and regional specialists are conducted on about a monthly basis to assess performance of plant operations.

An NRC inspection team comprised of health physics specialists conducted a confirmatory inspection of USEC's radiation protection program during the week of August 20 at Paducah. While the team is reviewing the results of that inspection, it tentatively concluded that the USEC radiation protection program at Paducah is effective in identifying and controlling worker exposure to contamination. The team did identify two areas that require further investigation: the methodology USEC uses to assess transuranic uptakes, and the methodology USEC uses to determine the percentage of transuranics in the sites' contamination.

To conclude, USEC is operating the Paducah Gaseous Diffusion Plant safely and in accordance with NRC requirements. Nevertheless, the recent series of articles has prompted additional scrutiny by the NRC to ensure continued protection of workers and the public from exposure to uranium and other radioactive materials.

Although our ongoing inspection at Paducah raises several issues which require additional information and assessment, based on our reviews to date we have found existing exposures to USEC workers are well within NRC regulatory limits.

That concludes my prepared testimony. I will be happy to answer questions.

[The prepared statement of Malcolm R. Knapp follows:]

PREPARED STATEMENT OF MALCOLM KNAPP, EXECUTIVE ASSISTANT, OFFICE OF THE EXECUTIVE DIRECTOR FOR OPERATIONS, NUCLEAR REGULATORY COMMISSION

Good morning, my name is Malcolm Knapp and I am an Executive Assistant in the Office of the Executive Director for Operations. Thank you for providing me the opportunity to discuss the NRC responsibilities regarding the Paducah gaseous diffusion plant and associated current issues. I will briefly summarize these responsibilities, risks posed to workers and the public, and NRC's current regulatory actions related to the Paducah plant.

NRC Responsibilities

The Atomic Energy Act (AEA), as amended by the Energy Policy Act of 1992, assigns NRC the responsibility for regulating the safety, safeguards, and security of the gaseous diffusion plants, which are owned by the Department of Energy (DOE) but leased and operated by the United States Enrichment Corporation (USEC), now a non-Government corporation. The NRC takes this responsibility for worker and public health and safety very seriously. NRC promulgated requirements in 10 CFR Part 76 on September 23, 1994, that provide the regulatory basis for NRC certification and inspection of USEC's operation of the gaseous diffusion plants. A 1997 Memorandum of Understanding (MOU) between DOE and NRC further clarifies NRC's and DOE's interactive roles for safety, safeguards, and security in those areas leased by USEC.

NRC certified the gaseous diffusion plants in November 1996 and assumed regulatory responsibility in March 1997. As stated in NRC's reports to Congress in 1998 and 1999, the NRC has determined that both plants are operating safely and in accordance with NRC requirements.

Areas Not Under NRC Responsibility

Under the USEC-DOE lease agreement, certain areas within the plants are not included in the leased areas, and these areas remain under DOE, not NRC, regulatory responsibility at Paducah. These are areas containing material from operations conducted by DOE to support defense program activities (also known as legacy material) and areas containing significant quantities of high enriched uranium. DOE retains responsibility for environmental protection, safety, safeguards, and security for these excluded areas, and DOE retains responsibility for environmental restoration activities and waste management of the legacy material. Some areas within USEC leased buildings are not part of the leased USEC space, these areas were retained by DOE and are used to store or contain DOE legacy material. These areas are physically delineated as DOE space and are not subject to NRC regulation. Under the Atomic Energy Act, unless expressly stated otherwise by statute, the NRC does not regulate DOE activities.

Contamination

Prior to NRC's assumption of regulatory oversight in March 1997, USEC performed a site-wide survey of indoor and outdoor areas of the plants to identify any contaminated areas. USEC placed placards in those contaminated areas which USEC was leasing from DOE and which were to be under NRC jurisdiction to identify clearly these contaminated areas. In addition, any USEC areas which become contaminated as a result of USEC operations, for example, maintenance activities, are decontaminated or marked by USEC as contaminated areas. In each of these cases, USEC controls these areas in accordance with its Radiation Protection Program as described in the Safety Analysis Reports.

Areas under NRC jurisdiction are routinely surveyed for contamination. USEC surveys the lunchrooms and breakrooms in the cascade building area control rooms daily during the work week to verify that any contamination levels are below limits that ensure public and plant staff safety. In addition, onsite NRC resident inspectors regularly assess contamination controls to determine the effectiveness of the plant Radiation Protection Program. In general, these assessments which are reported by the resident inspectors in their monthly reports, have found that USEC's contamination controls in place on USEC leased space are consistent with the plant Radiation Protection Program and are, therefore, acceptable.

Worker Exposure

Worker exposure occurs from the inhalation or ingestion of radioactive material (internal dose) and exposure to radiation from sources outside the body (external dose). Both doses are added together to calculate total dose.

Based on NRC review of USEC records since 1997, worker radiation exposures at Paducah in NRC-regulated areas are very low and in compliance with NRC requirements. The program uses personnel dosimetry (badges) for monitoring and recording external radiation exposures and analysis of urine samples to monitor and estimate worker internal radiation exposures. Radiation doses are reported in units of rem or millirem (1000 millirem equals 1 rem). The NRC annual dose limit for a worker from NRC licensed operations is 5 rem.

In 1997, those Paducah workers who did receive a dose had an average annual total dose of 0.051 rem, while the average annual total dose at an NRC-licensed power reactor was 0.202 rem and at an NRC-licensed fuel cycle facility was 0.236 rem. The largest total dose recorded in 1997 for any worker at the plant was 0.365 rem. Less than 2% of that dose was estimated to be from internal radiological contamination.

For 1998 the largest total dose recorded for any worker at the Paducah plant was 0.382 rem. Again less than 2% of that dose was estimated to be from internal radiological contamination. To put these doses into perspective, the average dose from natural sources to a person in the United States is 0.300 rem per year and, as noted previously, the NRC annual limit on total dose from NRC licensed operations to a radiological worker is 5 rem.

Public/Environmental Exposure

USEC provided to NRC and other regulatory agencies an environmental compliance status report containing then current environmental and effluent monitoring data as part of its application for certification. The report for 1997 is publically available and shows that concentrations of transuranic radionuclides in airborne emissions, water samples, soil samples, and sediment samples are within regulatory limits.

Since NRC assumed regulatory oversight of the gaseous diffusion plants on March 3, 1997, NRC is not aware that any disposal by USEC of radioactive waste from Paducah has occurred at other than authorized disposal facilities. Although portions of the USEC-leased areas are contaminated with radioactive materials and will remain contaminated during enrichment operations, these areas will be decommissioned by DOE after the USEC lease is terminated and prior to release of the site in accordance with criteria established by DOE.

No Current Activities Involving Recycled Uranium or Precious Metals

The reactor tails program, which enriched recycled uranium recovered from reprocessed defense reactor fuel, was conducted by the Atomic Energy Commission (AEC) and DOE before USEC took over plant operations and before NRC assumed regulatory oversight of the gaseous diffusion plants on March 3, 1997. The recycling of precious metals also was conducted at Paducah by the AEC and DOE before NRC assumed regulatory oversight of the gaseous diffusion plants. Although both the reactor tails and precious metals recycling programs were completed before USEC took over plant operations, USEC's worker protection programs are required to assess the potential impacts of contaminants from both historical and current operations that may impact the work environment.

Current Regulatory Actions

The NRC maintains a full-time staff of two onsite resident inspectors at each plant who are tasked with monitoring day-to-day plant operations, including radiological control practices, in those areas of the facility for which NRC has regulatory responsibility. In addition, inspections by both Headquarters and Regional specialist inspectors are conducted on about a monthly basis to assess performance of plant operations.

An NRC inspection team comprised of health physics specialists conducted a confirmatory inspection of USEC's Radiation Protection Program at the Paducah plant during the week of August 30, 1999, and conducted a similar inspection at the Portsmouth plant the week of September 13, 1999. Following a review of the results, the team expects to close the inspection in mid-October. The objectives of the inspection are to confirm the adequacy of USEC's: (1) understanding of the radiological contamination on site; (2) controls for worker protection for transuranics such as neptunium and plutonium, technetium and uranium radionuclides; (3) internal and external dose assessment program for these radionuclides; (4) characterization methodology for measuring these radionuclides; and (5) environmental and effluent monitoring practices for these radionuclides.

Although the NRC inspection team is still reviewing the results of the Paducah and Portsmouth inspections, they have tentatively concluded that the USEC Radiation Protection Programs at Paducah and Portsmouth are effective in identifying and controlling worker exposure to contamination. Air sampling and work controls in areas where workers could possibly get exposed to plutonium contamination are effective and no internal exposures were indicated. The team identified two issues which require further investigation: (1) the methodology USEC uses to assess transuranic uptakes; and (2) the methodology USEC uses to determine the percentage of transuranics in the site's contamination. USEC is preparing information to respond to these issues, and some members of the NRC inspection team returned to Paducah this week to follow up. Although the methodology used by USEC to assess internal dose is being evaluated further, the NRC has not found any indication that the annual dose to any worker or member of the public has approached NRC safety limits in portions of the facility that are regulated by NRC. Inspection exit meetings which are open to the public are anticipated to be held near the two sites in early October 1999.

Conclusion

In conclusion, USEC is operating the Paducah gaseous diffusion plant safely and in accordance with NRC requirements. Nevertheless, the recent series of articles has prompted additional scrutiny by the NRC to ensure continued protection of workers and the public from exposure to uranium and other radioactive materials. Although our ongoing inspection at Paducah raises several issues that require additional information and assessment, based on our reviews to date, we have found that existing exposures to USEC workers at the plants are well within NRC regulatory limits.

Mr. UPTON. Mr. Logan, I didn't have an opportunity to talk to you, but I am delighted to see you and Dr. Volpe here and appreciate you taking time to come. You may proceed.

TESTIMONY OF ROBERT W. LOGAN

Mr. LOGAN. Thank you. My name is Robert Logan, and I am Commissioner of the Department for Environmental Protection in Kentucky, and with me I have Dr. Volpe who is Manager of the Radiation Control Branch in the Cabinet for Health Services. We appreciate the opportunity to speak before the committee about Kentucky's efforts to address environmental issues at the Paducah Gaseous Diffusion Plant.

The Commonwealth is deeply concerned about the worker exposure to citizens in the area, but today my comments are focused on environmental issues.

The Paducah Gaseous Diffusion Plant is situated in western Kentucky, located in McCracken County, approximately 9 miles west of Paducah and 3 miles south of the Ohio River on a 3,422-acre Federal reservation. DOE has had exclusive regulatory authority for radionuclides on their property. From 1952 until the mid-1970's, DOE has had exclusive control over the waste generated and disposed at the facility. The Kentucky Cabinet currently has regulatory authority for air quality, water and waste management. The State authority to regulate these concerns comes from the delegation of Federal environmental programs including the Clean Water Act, the Clean Air Act, the Resource and Conservation and Recovery Act, RCRA.

The NRC, the U.S. Environmental Protection Agency, and the Cabinet for Health Services has primary jurisdiction for radioactive air emissions. EPA did not grant authority to address radioactive emissions to our air program until July 14, 1999. Based upon this grant authority, Kentucky has adopted subpart H of the Radionuclide Emission Standard for Hazardous Air Pollutants. The Cabinet is currently reviewing the USEC Title 5 operating air permit application.

In water, Kentucky began permitting the facility for water discharges in 1984 after delegation of the national pollution discharge elimination system.

Under the NPDS program, the Cabinet has issued two permits. One permit focuses on discharge associated with plant operations, cleanup of groundwater plumes and contaminated soils and stormwater runoff from the storage areas and multiple landfills. This permit is issued to DOE and its operating contractor.

The second permit is issued to USEC and addresses the process water from uranium enrichment, stormwater runoff from processing and storage areas, cooling water and sanitary waste water.

The DOE and USEC permits contain monitoring requirements and limitations for toxicity, metals, organics, radioactive materials, including uranium, technetium-99 and alpha beta particles and conventional pollutants. Kentucky performs quarterly inspections of both discharge permits. DOE performs monthly monitoring for conventional and quarterly monitoring for radionuclides. We have issued six Notices of Violations on these permits. These NOVs, as we call them, have been obtained for the corrective actions for the violations, and subsequent inspections of the plant have revealed that corrective actions were completed.

In the area of waste, Kentucky has issued four waste management permits to the facility. In 1991, a hazardous waste permit was issued under subtitle C requirements under RCRA to DOE. This permit requires DOE to characterize and remediate contamination at over 200 contaminated areas at the facility. In April 1991, Kentucky's Cabinet issued a solid waste disposal permit for the disposal of residential waste generated at the facility. In February 1985, we issued a solid waste disposal permit for the disposal of inert solid waste generated at the facility. The residential and inert landfills were capped in 1995 and 1992 respectively.

In November 1996, Kentucky issued a solid waste disposal permit for the disposal of solid waste generated at the facility. DOE has appealed certain conditions contained if the permit. DOE is challenging Kentucky's ability to require characterization of DOE's solid waste prior to disposal and challenges the Cabinet's authority to set limits on the level of radioactivity associated with solid waste that can be disposed of in a solid waste landfill.

These challenges are currently pending in State and Federal court. These three permits were issued under subtitle D of the Solid Waste Disposal Act. Quarterly monitoring was required at these subtitle D landfills. This monitoring has identified chromium, technetium-99 and TCE as contaminants of the groundwater. Kentucky has required DOE to increase the frequency of its groundwater monitoring and to provide an assessment of the source of the groundwater contamination. DOE has advised Kentucky that contamination is not coming from these landfills.

In addition to its regulatory authority, in 1991 the Commonwealth entered into an Agreement in Principle with DOE in which the Commonwealth conducts oversight of environmental remediation. Under the Agreement in Principle, Kentucky has conducted 18 separate studies at the facilities concerning the fate and transport of contaminants and their associated environmental impacts.

Under health and safety, the Cabinet for Health Services' efforts at the Paducah Gaseous Diffusion Plant have been redirected toward radiation monitoring and oversight of the DOE activities in order to ensure protection of public health and the environment. The Cabinet of Health Services provides technical advice for onsite and offsite radiation issues at Paducah.

For example, in CHS's activities during the period 1995 to 1999, they include the collection of over 4,500 samples from surface water, groundwater, soil sediments and vegetation in the vicinity of the plant.

CHS has regulatory authority over radiological issues outside the facility boundary. The Department of Energy has regulatory authority under the Atomic Energy Act with respect to nuclear safety issues, including worker health and safety. We have also entered into Federal facilities agreement, a site management plan. In May 1994 the facility was placed on EPA's Superfund national priority list under CERCLA. Therefore, as a result of this listing, the Commonwealth of Kentucky, the Department of Energy and U.S. EPA have entered into a Federal facilities agreement in 1998 which addresses the overlapping responsibilities of the U.S. EPA under the State and RCRA and CERCLA. This establishes a cleanup time line for the facility of 2010.

Kentucky has concerns about DOE's ability to meet this deadline considering its current funding levels. The State is also concerned about the extent of remediation that DOE has proposed for the facility, and in previous correspondence Kentucky has expressed these concerns to DOE management and members of the congressional delegation. We have placed correspondence in the record, and we want to note that on September 14, the Department of Energy press release has acknowledged our concerns. We hope DOE will in turn acknowledge this into action.

Soils at the site are collected and analyzed by DOE. Kentucky ensures the quality and accuracy of sampling by a protocol to split samples with the Department of Energy. Over 5,000 soil samples have been collected by Kentucky and DOE since 1990. The samples were tested for over 400 chemicals on the hazardous waste constituent list.

Mr. WHITFIELD. Mr. Logan, we have your entire statement. If you would summarize.

Mr. LOGAN. In summary, Mr. Chairman, Kentucky has several major issues that it wants to discuss. First and foremost is concern over soils contamination at the site. We have concerns about the groundwater contamination in the plume. We want to make sure that all of the information that has been developed we have received, and we are very concerned regarding the recent allegations that radioactive waste may have been disposed of at locations previously unknown to the State, and we continue to urge DOE to provide full accounting of its past disposal practices. And Kentucky is concerned that DOE is not receiving the funding necessary to conduct the cleanup in a timely manner.

Mr. Chairman, we believe Congress must provide adequate funding to DOE to ensure the protection of the citizens and the environment of the Commonwealth of Kentucky.

[The prepared statement of Robert W. Logan follows:]

PREPARED STATEMENT OF ROBERT W. LOGAN, COMMISSIONER, KENTUCKY DEPARTMENT OF ENVIRONMENTAL PROTECTION

Mr. Chairman and members of the committee my name is Robert W. Logan. I am Commissioner of the Department for Environmental Protection in the Kentucky Natural Resources and Environmental Protection Cabinet (NREPC). I have with me today Dr. John Volpe, manager of the Radiation Control Branch in the Kentucky Cabinet for Health Services. We are here to speak before the Subcommittee on Oversight and Investigations concerning the Paducah Gaseous Diffusion Plant (PGDP). The PGDP is a large, industrial complex situated in western Kentucky. It is located in McCracken County approximately nine miles west of Paducah and three miles south of the Ohio River on a 3,423 acre federal reservation. Seven hundred forty-eight acres are fenced and contain most of the areas used by the PGDP. Surrounding the plant is the West Kentucky Wildlife Management Area, composed of 2,781 acres and managed by the Kentucky Department of Fish and Wildlife Resources. The PGDP is a uranium enrichment facility owned and operated by the U.S. Department of Energy (DOE) from 1952 until 1993. On July 1, 1993, United States Enrichment Corporation (USEC) assumed operations at the plant. The main function of the plant is the enrichment of uranium.

REGULATORY AUTHORITY

DOE historically and currently has had exclusive regulatory authority for radionuclides on their property. From 1952 until the mid-1970's, DOE had exclusive control over the waste generated and disposed at the facility.

The Kentucky NREPC currently has regulatory authority for air quality, water, and waste management. The state authority to regulate these areas comes from the delegation of federal environmental programs including the Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act (RCRA).

Air

Kentucky does not have complete authority for Title V of the Clean Air Act, however, Kentucky has issued a series of 21 permits to DOE and its contractors since March 18, 1980. Air permits have generally not regulated radioactive emissions. The Nuclear Regulatory Commission, U.S. Environmental Protection Agency (USEPA), and Kentucky Cabinet for Health Services (CHS) have had primary jurisdiction over radioactive emissions. USEPA did not grant authority to address radioactive emissions to air until July 14, 1999. Based upon this grant of authority, Kentucky adopted Subpart H, the radionuclide National Emission Standard for Hazardous Air Pollutants (NESHAPS). The NREPC is currently reviewing the USEC Title V operating permit application.

Water

Kentucky began permitting the facility for water discharges in 1984 after delegation of the National Pollutant Discharge Elimination System (NPDES) permitting program to Kentucky in September 1983. Under the NPDES program, Kentucky NREPC issued two permits. One permit focuses on discharges associated with plant operations, cleanup of groundwater plumes and contaminated soils, and storm water runoff from storage areas and multiple landfills. This permit is issued to the DOE and its operating contractor. The second permit is issued to the USEC and addresses process water from uranium enrichment, storm water runoff from processing and storage areas, cooling water, and sanitary wastewater.

The DOE and USEC permits contain monitoring requirements and limitations for toxicity, metals, organics (PCB and TCE), radioactive materials (Uranium and Technetium-99 and Alpha and Beta Particles), and conventional pollutants.

Kentucky performs quarterly inspections of both discharge permits. DOE performs monthly monitoring for conventional pollutants and quarterly monitoring for radionuclides. Six Notices of Violations (NOVs) have been issued by Kentucky on these permits. These NOVs contained corrective actions for these violations. Subsequent inspections revealed that corrective actions were completed.

Waste

Kentucky issued four waste management permits to the facility. In 1991, a hazardous waste permit was issued under the subtitle C requirements of RCRA, to DOE. This permit requires DOE to characterize and remediate contamination at over 200 contaminated areas at the facility.

In April 1981, Kentucky NREPC issued a solid waste disposal permit for the disposal of residential waste generated at the facility. In February of 1985, Kentucky NREPC issued a solid waste disposal permit for the disposal of inert solid waste generated at the facility. The residential and inert landfills were closed in 1995 and 1992, respectively. In November of 1996, Kentucky issued a solid waste disposal permit for the disposal of solid waste generated at the facility. DOE has appealed certain conditions contained in the permit. DOE is challenging Kentucky's ability to require characterization of DOE's solid waste prior to disposal and challenging the Cabinet's authority to set limits on the levels of radioactivity associated with solid waste that can be disposed in a solid waste landfill. These challenges are currently pending in state and federal court. These three permits were issued under Subtitle D of the Solid Waste Disposal Act.

Quarterly monitoring is required for the three subtitle D landfills. This monitoring has identified chromium, Technetium-99 and trichloroethylene (TCE) as contaminants of groundwater. Kentucky has required DOE to increase the frequency of its groundwater monitoring and to provide an assessment of the source of the groundwater contamination. DOE has advised Kentucky that the contamination is not coming from these landfills.

Oversight

In addition to its regulatory authority, in 1991 the Commonwealth of Kentucky entered into an Agreement in Principal with DOE in which the Commonwealth conducts oversight of environmental remediation. Under the AIP, Kentucky has conducted eighteen separate studies at the facility concerning fate and transport of contaminants and their associated environmental impacts.

Health and Safety

The Cabinet for Health Services' efforts at the PGDP have been directed toward Radiation Monitoring and Oversight of DOE activities in order to ensure protection of public health and the environment. CHS provides technical advice for on-site and off-site radiation issues at PGDP. For example, CHS's activities during the period of FY1995 through FY1999 included the collection of over 4500 samples from surface water, groundwater, soils, sediment, and vegetation in the vicinity of the PGDP. In this time frame, CHS conducted 13,094 radiochemical analyses on the samples collected at PGDP and 15,773 quality control analyses to ensure the accuracy and precision of PGDP sample results.

CHS has regulatory authority over radiological issues outside the facility boundary.

The DOE has regulatory authority under the Atomic Energy Act with respect to nuclear safety issues including worker health and safety.

Federal Facilities Agreement—Site Management Plan

In May of 1994, the facility was placed on USEPA Superfund National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Therefore, as a result of this listing, the Commonwealth of Kentucky, the DOE and the USEPA, entered into a Federal Facilities Agreement (FFA) in 1998 which addresses the overlapping responsibilities of USEPA and Kentucky under the Resource Conservation and Recovery Act (RCRA) and CERCLA.

The FFA established a clean up time line for the facility of 2010. Kentucky has concerns about DOE's ability to meet this deadline considering its current funding levels. Kentucky is also concerned about the extent of the remediation DOE has proposed for the facility. In previous correspondence Kentucky has expressed these concerns to DOE management and members of our congressional delegation. We would like to place this correspondence into the record today. We want to note that a September 14 DOE press release has acknowledged our concerns. We hope DOE will turn its acknowledgements into action.

SITE CONTAMINATION

Soils

Soil samples are collected and analyzed by the DOE. Kentucky assures the quality and accuracy of sampling by a protocol to split samples with DOE. Over 5,000 soil samples have been collected by Kentucky and DOE since 1990. Over 400 chemicals on the hazardous waste constituent list, as well as gross alpha and beta particles, PCBs, Technetium-99 and other radioactive elements.

Over 200 waste management units have been identified in the RCRA permit. Contamination at these units includes inorganics, metals, and radionuclides. The FFA requires DOE to submit a report detailing the overall soil contamination at the facility by November 1999. Characterization and remediation of the soil is one of Kentucky's highest priorities.

Surface Water

The USEC facility withdraws approximately 10 million gallons of water from the Ohio River daily for the uranium enrichment process. Process discharges are to Little and Big Bayou Creeks through permitted outfalls. These outfalls from the facility are monitored monthly by the NREPC and by the facility. Surface water and sediment samples are collected semiannually along Little and Big Bayou Creeks. Soil in the discharge water (sediment) and process water are contaminated with low levels of PCBs, metals, and radionuclides. DOE has been notified about these contaminants.

Further, CHS performs a risk assessment of the radionuclides levels and where elevated levels are identified, DOE is notified by CHS.

Groundwater

Approximately 9 billion gallons of groundwater are contaminated in three groundwater plumes. Trichloroethylene (TCE) was detected in off-site residential wells in 1988. Trichloroethylene (TCE) and Technetium-99 (99Tc) were discovered in private water wells north of the plant in August 1988. Kentucky notified potentially impacted residents and DOE. This prompted DOE to provide municipal water service to residences and businesses within the projected area of migration of the contaminated groundwater. Ensuing investigations confirmed that TCE and Technetium-99 (Tc99) were traveling off-site via two massive groundwater plumes, the Northeast Plume and Northwest Plume. The Drinking Water Policy Area was recently enlarged to accommodate a new plume (southwest plume). Most of the groundwater contamination is confined about 60 to 100 feet below the surface. Actions have been taken to monitor the progression of the groundwater plumes and to assure that no one is drinking and/or using impacted groundwater: (1) sealing and capping groundwater wells within the Drinking Water Policy Area, (2) converting residences to a municipal water supply, (3) conducting door-to-door surveys, (4) publishing a newsletter, (5) conducting well-record searches, (6) sampling outside the Drinking Water Policy Area, (7) notifying local drilling companies about the Drinking Water Policy. DOE is also monitoring outside the Drinking Water Policy Area and has installed pumps. They are treating wells to slow the progression of the plume.

Since 1991 over 250 groundwater wells located at various depths have been monitored on a biweekly basis. Over 400 chemicals on the hazardous waste constituent list, as well as gross alpha and gross beta particles, Technetium-99 and other radioactive elements such as Uranium, are routinely monitored. Other radioactive elements such as Thorium, Plutonium and Neptunium have been detected in a few groundwater wells at extremely low concentrations on an irregular basis. These include wells located on DOE reservation and property off-site. Over 10,000 groundwater samples have been collected by Kentucky and DOE since 1990.

Interim corrective actions have already been implemented to slow down the progression of the Northeast and Northwest Plumes

To effectively clean up the groundwater, all sources of groundwater contamination must be identified and remedial actions designed to address the dense nonaqueous phase liquids (DNAPLS). Remediation of groundwater is also one of Kentucky's highest priorities.

Air

The CHS installed and calibrated eight (8) continuous air samplers in the vicinity of the PGDP during FY 1997 to FY 1999. The CHS operates the eight air samplers to monitor airborne radioactive emissions from PGDP activities. Seven air monitoring stations are located on the DOE reservation in the vicinity of plant. One air monitor is located approximately 5 miles southeast of the PGDP to determine background activity.

The CHS began collection and analyses of continuous air samples in January 1997 following a start-up and calibration period during which field operational problems with the samplers were corrected and laboratory methods for analyzing the sample filters were developed. Filters from continuous air samplers are collected on a weekly basis. In excess of 300 samples have been collected from January 1997 to present. The CHS conducted 645 radiochemical analyses on the samples.

Analytical results from all continuous air sampler locations indicated that radiation activities were less than the maximum daily allowance, MDA, and, therefore, were below the background levels. In the event of exceedences, DOE is notified.

Fish and Wildlife

The West Kentucky Wildlife Management Area (WKWMA) surrounds the facility. The NREPC and Kentucky Department of Fish and Wildlife have worked since 1992 to evaluate any adverse impact on the environment or wildlife in the WKWMA.

Kentucky currently monitors deer, fish, and other wildlife in the WKWMA for contamination from the facility. PCBs found in fish collected and analyzed from the Little Bayou Creek prompted Kentucky to issue a fish consumption advisory in 1988. Low levels of plutonium were found in two samples of deer taken from the WKWMA in 1994. The levels did not pose a threat to health. Since that time, subsequent sampling has not revealed the presence of plutonium contamination in deer. Low levels of PCBs, metals and radionuclides have been found throughout the ecosystem in all levels of the food chain. Remediation of the site will be the only cure for these problems.

Community Relations and Outreach

Since 1993, the NREPC, DOE and EPA produce a quarterly newsletter, "Kentucky Environmental Oversight News." Over 2,300 individuals receive copies of the newsletter statewide. However, outreach is focused on the Paducah area.

The NREPC, DOE and EPA began the process of development of a citizens' advisory board in January 1995. The site specific advisory board (SSAB), created in 1996, is composed of 12 board members from the community and five state and federal regulatory agency representatives. The board meets periodically to discuss issues related to the permitting and corrective action.

Additionally, in response to recent allegations about the facility, Kentucky has established a toll free number for citizens to obtain information about the facility and to voice their concerns.

Summary

Kentucky is concerned with the recent allegations that radioactive wastes may have been disposed at locations previously unknown to the NREPC. Therefore, we continue to urge DOE to provide a full accounting of its past waste disposal practices. As noted Kentucky is concerned that DOE is not receiving the funding necessary to conduct the clean up in a timely manner. Therefore, we believe that Congress must provide adequate funding to DOE to ensure protection of the citizens and environment of the Commonwealth of Kentucky.

Mr. WHITFIELD. Thank you, Mr. Logan.

Dr. Knapp, in your opening statement toward the end, you were talking about the safety of the production facility operated by USEC. In closing, you said several other issues have been raised which we are looking at in more detail. What issues are you referring to there?

Mr. KNAPP. I was principally referring to the two that I mentioned in the latter part of my testimony. They have to do with the methodology that USEC is using to assist transuranics uptakes and the methodology that they are using to determine the percentage of contamination which is transuranics.

In both cases, the percentages are low enough that we are very comfortable that workers are properly protected. That is contamination—that is, uptakes in general, as you heard from USEC earlier, are very low. They are less than 10 percent of NRC's limits for worker exposure. A small fraction of those exposures result from transuranics.

We want to better understand the methodology they use to calculate that fraction. So these are not significant issues but we simply want to pursue them. It is an area where we want more comfort with what is going on. We anticipate having this resolved by the time we formally close our inspection in October.

Mr. WHITFIELD. Since USEC has had responsibility for the production facility, have they been cited or fined by NRC?

Mr. KNAPP. They have received a number of violations. They have received, I believe, 38 noncited violations, 62 Level 4, that is our lowest level of violation. They have been involved in 4 of what we call Level 3 violations, one of which did result in a civil penalty of $55,000.

For perspective—and this is a comparison that it is difficult to make, this is a somewhat higher level of violation than we might find, say, for a 2-unit commercial plant regulated by the NRC, but I think it is also fair to say that this is a different kind of plant and they are coming under NRC regulation, which tends to result in a somewhat higher number of violations than we would expect after a few number of years.

Mr. WHITFIELD. Is there a significant difference between NRC's and DOE's health and safety requirements?

Mr. KNAPP. They are fundamentally identical. The bottom line, the requirements that we have for exposures to workers and the public, full body dose, dose to parts of the body, are identical.

Mr. WHITFIELD. Mr. Green and Mr. Logan, if the site at Paducah was owned by a private company with the same problems, would you be treating them the same way?

Mr. RICHARD GREEN. Congressman, we probably would have done things similar to the way we have done them. We entered into early action with DOE. We asked them to provide bottled water. We do that on the private side regularly. We asked them to take interim action on the groundwater. We do that, too. They did it.

We have an enforceable—we entered into an order with them, yes. Of course, the main difference in treating a Federal facility is we really cannot say to them on the commercial—as we would to a commercial polluter and Superfund, if you don't do this, we will do it and then we will send you the bill and we will cost-recover the money. However, sites this big are rare. We have nothing on the commercial side, at least in Region 4 that approaches this in terms of size or really seriousness.

Mr. WHITFIELD. Would you have any ballpark figure of what you think it would cost to clean this up?

Mr. RICHARD GREEN. We have identified over 200 solid waste management units. We don't have a handle yet on the extent of contamination offsite, and not even all of it onsite, as recent newspaper reports showed.

Based upon what we know, however, DOE is saying—and we have no real reason to dispute it—that the total cost could reach over $200 billion.

Mr. WHITFIELD. $200 billion?

Mr. RICHARD GREEN. Yes, sir.

Mr. WHITFIELD. Is that DOE-wide or is that just Paducah?

Mr. RICHARD GREEN. No, sir, I believe it is just Paducah. Let me confer with Mr. Johnston. (Mr. Owendoff comes forward and states that $200 billion is the estimated cost of cleaning up the entire DOE complex.)

Mr. WHITFIELD. Do you agree with that?

Mr. OWENDOFF. I am Jim Owendoff. It is for the entire complex: Oak Ridge; Ridgeland in Washington; and Rocky Flats in Idaho.

Mr. WHITFIELD. Mr. Logan, do you want to respond?

Mr. LOGAN. Had this been a private corporation or private business, we would have not been as sensitive to the budget requirements and the financial impact. We would have entered into similar agreements and a plan of action for characterization and remediation and a timeframe for cleanup, but we would have probably accelerated the schedule.

Mr. WHITFIELD. Dr. Michaels, we have talked a little bit today about the Tiger team report and you have just completed your Phase I assessment back to 1990; and at least my memory was that some of the same problems today were there back in 1990. A significant number of them were the same; is that correct?

Mr. MICHAELS. It is correct, and at the same time it is not correct. They can be characterized the same way, but the severity is quite different. You heard about a situation that is some ways is out of control. What we saw in a recent investigation on which I presented the preliminary findings, we found some concerns that we take very seriously, but they were in the area of discipline and ALARA, the lowest allowable exposure that we can reasonably achieve. And we want to reach that, and that is why we took it very seriously. You can't say that it is the same extent of problems that the Tiger team saw.

Mr. WHITFIELD. More severity than anything else?

Mr. MICHAELS. Yes, but the areas in health physics or environmental contamination certainly were the same.

Mr. WHITFIELD. Did you agree with Mr. Nemec's statement that his reading and DOE's reading on the cylinders were consistent with each other?

Mr. MICHAELS. I haven't looked at that carefully. I don't think that they were necessarily inconsistent, but we took it seriously enough that we thought that people should be badged.

Mr. WHITFIELD. Mr. Logan—well, to be fair about this, you have 5 minutes, Mr. Strickland.

Mr. STRICKLAND. Thank you, Mr. Chairman.

Dr. Michaels, I have lots of questions to ask you and I will try to ask them succinctly, and if you can give me an abbreviated response.

First of all, I have a document here sent by the Deputy Director of Naval Reactors, T.J. Glothier, regarding the pilot project, and it troubles me greatly. It argues against this effort. It says it would set a precedent for compensation of occupational radiation injury claims. The draft pilot program could establish an inappropriate precedent for other DOE and DOD activities where plutonium is handled. It says that the DOE proposal sets a precedent without identifying the full potential scope of the problem.

And what this sounds like to me is an attempt to avoid responsibility and a fear of setting a precedent and accepting liability.

Now I understand the need for caution, but we are talking about human lives and human health and safety, and it really troubles me that any part of our government would take such a cautious approach. The benefit of the doubt ought to go to workers who have been inappropriately exposed to dangerous materials. That ought to be the position of this government.

I have written the White House saying that the workers at Portsmouth and the workers at Oak Ridge should not be excluded from this. I know that there was a facility that operated briefly at Portsmouth—for I don't know how long. It was shut down because they couldn't contain the contaminants. Could you tell me how long that conversion facility at Portsmouth was operational?

Mr. MICHAELS. I am sorry, I didn't come prepared with that information. I don't think any of our staff here has it either.

Mr. STRICKLAND. Can you provide that?

Mr. MICHAELS. Yes.

Mr. STRICKLAND. So you can't tell me how much radiation was not contained and for how long it was not contained?

Mr. MICHAELS. That's correct. Even knowing how long it operated, knowing what our records look like, I don't think that I would be able to give you those answers.

Mr. STRICKLAND. So you can't tell me what level of exposure workers at Portsmouth may have received while that plant was operational?

Mr. MICHAELS. That is correct. We have this large investigative study that will look at that issue, among the other issues, but the best we will do is try to estimate what the exposures were.

Mr. STRICKLAND. I understand, and I have confidence in your efforts. But I am just trying to get some things on the record here.

Now, material came to my plant that was dangerous. Workers handled it. There was exposure. The operational facility was shut down, and yet apparently this administration is prepared to send to this Congress legislation asking that workers at Paducah be covered and that the workers at Portsmouth and Oak Ridge not be covered. Is that your understanding?

Mr. MICHAELS. That is my understanding. The Secretary's commitment is to make sure that every affected worker is covered. We are just trying to figure out how to get there.

Mr. STRICKLAND. I have total confidence in the Secretary's efforts. My statement is directed toward the administration and the fact that they are prepared to send to this Congress legislation that would exclude workers who have been exposed potentially to the very same conditions as the workers at Paducah. I do not see how that can be justified.

Can any of you there at that table give me a rationale for why such behavior should be undertaken by this administration?

Mr. STRICKLAND. Mr. Chairman, I yield back the balance of my time.

Mr. WHITFIELD. That's the first time I have ever seen a panel speechless.

Mr. Bryant, you have 5 minutes.

Mr. BRYANT. Thank you. I don't think I can say it any better than my colleague Mr. Strickland has said it, but certainly in terms of Oak Ridge, which is not in my district, but I do know that our congressional delegation from Tennessee is extremely concerned that any exposure—and certainly there appears to have been some—that we go in through all these locations and make sure that the workers are adequately treated.

I had a couple of more immediate concerns beyond the workers, off the site. I would ask Mr. Knapp, I had asked the question earlier to one of the first members of the panel about the work that you are doing in terms of improvements to the site in the event there were an earthquake there. And my understanding, they were 3 years behind schedule. And my question was essentially why is it taking so long to get these improvements made? In the event there were an earthquake, you know, you're risking an awful lot of people around the Paducah area.

Mr. KNAPP. I can't give you all the reasons for the time that it takes, but I'll try to say a few things. I have visited the site. The improvements are extensive. They involve putting a great deal of steel in to brace the structures at two of the buildings which are susceptible to earthquakes. The NRC received an application from USCC to extend that deadline.

We looked at it with considerable care. We did a risk analysis of it based on, among other things, the fact that they have derated the cascade in those buildings to run them at below atmospheric pressure which will reduce the consequences should a severe earthquake occur. Based on the amount of time it would take them to do the work that they have to do, we considered that it was acceptable for them to extend that period through June 30, 2000.

We now understand informally, they may come in for a few months beyond that and we are considering whether it will be acceptable to continue further this delay. I don't have an answer to that.

With respect to other reasons why it is taking so long, a part of this, as I mentioned in the early part of my testimony, there are areas even within the buildings which USEC has which remain under the control of DOE because they have legacy material in them. And in some cases, the presence of this legacy material, we understand from USEC, makes it difficult for them to get into parts of the buildings to be able to complete the construction of this bracing.

And at this time, we understand that when DOE is able to release some of these areas, may have an effect on when the job will be done. We understand that DOE is working on it aggressively. That's the best answer I can give you.

Mr. BRYANT. Thank you.

Mr. Green, you or Dr. Knapp mentioned this water that's going toward the Ohio River. Dr. Cochran, on the first panel, indicated it had already arrived. Were you the one that mentioned it just a few minutes ago between the two of you?

Mr. RICHARD GREEN. Yes, sir.

Mr. BRYANT. Why is there this disagreement?

Mr. RICHARD GREEN. I noted what Dr. Cochrane said earlier and we have no evidence that it has reached the river, haven't seen any data to say that it has. We have slowed the migration of the plumes significantly. And I am told that there is a chance that based on what we see so far, that we could intercept them completely. The EPA has not seen any data that says they've reached the Ohio.

Mr. BRYANT. That's encouraging. Because certainly I think we all agree that what needs to be done there—is it that big a problem?

Mr. RICHARD GREEN. Yes, sir.

Mr. BRYANT. Is it being overstated?

Mr. RICHARD GREEN. No, sir, it's not being overstated.

Mr. BRYANT. It seems to me it would be a big problem.

Mr. RICHARD GREEN. It is. We don't want it to reach the river. I do want to emphasize that these remedies that are in place, that we're calling pump and treat remedies, extraction, physically extracting water and treating it and discharging treated water, these are interim remedies to stop or slow the plume. This is not the final remedy.

Mr. WHITFIELD. Mr. Burr.

Mr. BURR. Mr. Green, I honestly think from your comments that you are engaged in this in a very positive way, and I thank you for that and for the EPA. And you said something that piqued my interest just a little bit. You said when you got involved in the site, and I quote you, "There is so much to do, we didn't know where to start."

Mr. RICHARD GREEN. Yes, sir.

Mr. BURR. When was that?

Mr. RICHARD GREEN. Well, that was in the mid-eighties, actually, when the site was no longer—well, it lost its sovereign immunity really, and became subject to the Federal Facilities Compliance Act. And then we, State Health Department, saw the data and issued the order. And it's not that we issued the order on high to DOE; DOE was very cooperative in implementing the order. And that's how we—that's the beginning of our involvement.

Mr. BURR. The appendix that we've talked about today in the executive summary was in fact part of a Superfund investigation, am I correct? Or it was a requirement under Superfund? Later I guess, 1994, it officially was a Superfund site, correct?

Mr. RICHARD GREEN. Later it was, yes. In 1994 it was final on the NPL.

Mr. BURR. That executive summary required EPA approval prior to its release, did it not?

Mr. RICHARD GREEN. I need to know, Mr. Burr, if you mean the worker health and safety appendix?

Mr. BURR. It's the Phase I results of site investigation, Phase I, done by Martin Marietta, March 22, 1991. It's my understanding that to release that, it required EPA approval.

Mr. RICHARD GREEN. Yes, sir, that's correct.

Mr. BURR. To your knowledge—were you involved in it in this site at that time?

Mr. RICHARD GREEN. No, sir.

Mr. BURR. Okay. Given that that required EPA approval, do you have any knowledge of EPA ever going back to request that appendix 2B-17 that has been missing for 9 years?

Mr. RICHARD GREEN. I personally don't.

Mr. BURR. Has EPA requested of the current contractor, Bechtel, 2B-17 appendix?

Mr. RICHARD GREEN. I don't know, Mr. Burr.

Mr. BURR. I would take from that, that you don't currently have a copy of the appendix 2B-17.

Mr. RICHARD GREEN. That's correct.

Mr. BURR. Would you like a copy?

Mr. RICHARD GREEN. I would.

Mr. BURR. I think our good friends in the front row are probably making that note as we go through.

Dr. Michaels, does DOE have a copy of 2B-17 appendix?

Mr. MICHAELS. I'm told we do.

Mr. BURR. When did you receive that?

Mr. MICHAELS. Let me request Jimmy Hodges, manager of the Paducah site, to answer this.

Mr. HODGES. We have a copy of the appendix B that you talked about and I don't know the exact date that we actually—it was received. But when we did note that it was missing from the reading room, we were able to find that within a day's time and put that back in the reading room. So it did exist. It was available. It was just not in the reading room at that time.

Mr. BURR. You were at the site; am I correct?

Mr. T4Hodges. Yes, sir.

Mr. BURR. Was this document really missing for 9 years?

Mr. HODGES. In my opinion, it was not. It did not appear in the reading room, I can't give you an explanation for that. But the data was available. It was used in the production of other reports that were generated as a result of that site characterization. So the data did exist. Why it was not in that particular document in the reading room, I don't have a good explanation for it.

Mr. BURR. As a matter of fact the data did not exist in a report until 1996 is I think the first indication that we were given by Martin Marietta. Can you shed any light on how that appendix could be completed in January 1991, the executive summary was then completed on March 22, 1991, approved by the EPA, and a year later in October 1992, the annual environmental report required by DOE was compiled by Martin Marietta and neither one, the executive summary nor the annual report, referenced to a plutonium contamination?

Mr. HODGES. I don't know the answer to that sir. I can certainly research that and give you a better opinion of what might have happened there.

Mr. BURR. Mr. Logan, does the state of Kentucky have a copy of 2B-17 appendix?

Mr. LOGAN. Yes, sir we recently received a copy of that on a request to DOE. We didn't have, until we read in the paper that it was missing. We made a request for it and we did receive a copy of it.

Mr. BURR. I'll be very quick, Mr. Chairman. In that document, it states that as much as 240 picocuries per gram of soil of plutonium contamination was found. Mr. Knapp, I have no idea about this stuff. Is that a lot of plutonium contamination?

Mr. KNAPP. Sir, I'm not a health physicist. I'll be delighted to provide that answer for the record, but I don't know off the top of my head. Let me check quickly with my staff. I'm just not sure we know that right here.

Mr. WHITFIELD. Mr. Burr, I think what we'll do is we'll each take another round not to exceed 5 minutes.

Mr. BURR. Can we reverse the order we were in?

Mr. WHITFIELD. Do you have to go out somewhere?

Mr. BURR. Mr. Bryant and I have another hearing downstairs that we've patiently—I will wrap up in——

Mr. WHITFIELD. Are you asking unanimous consent that——

Mr. BURR. I would be happy to ask unanimous consent that we go in reverse order.

Mr. STRICKLAND. Can I take 1 minute to ask a question? Then I'll be finished.

Mr. BURR. If the gentleman will allow Mr. Knapp the answer to this one, I'll be happy to yield.

Mr. KNAPP. According to my staff, that concentration is approximately 10 times allowable release limits by the NRC.

Mr. STRICKLAND. Go ahead.

Mr. BURR. Let me ask it this way.

Mr. WHITFIELD. We're going to give you another 5 minutes, Mr. Burr.

Mr. BURR. If this amount of plutonium contamination was found onsite, which you have responsibility for, correct—NRC has oversight on——

Mr. KNAPP. If it were found onsite, yes, within the USEC areas, yes, we would be responsible for it.

Mr. BURR. Would you require it to be cleaned up?

Mr. KNAPP. Yes.

Mr. BURR. Would it be a worker safety issue?

Mr. KNAPP. At a concentration that low, I'm not sure I would call it a worker safety issue, but an environmental protection issue, and it would have to be cleaned up to NRC standards.

Mr. BURR. Mr. Logan, several times in the press, I think the Commissioner of Public Health has recently stated, and I quote, "Exhaustive State tests did not show a health threat to anyone living in the area around the plant," end quote. Now that you have available to you appendix 2B-17, is this something that the State of Kentucky is going to look at a little more seriously as it relates to offsite contamination?

Mr. LOGAN. Yes, sir.

Mr. BURR. In most cases, can this committee assume that a lot of the investigations that have happened in the last several years are investigations that have used the prior data available to determine contamination?

Mr. LOGAN. I would think a number of the investigations that have been submitted have relied on historical data, but also there has been State data that has been generated concurrently with that, sir.

Mr. BURR. And Mr. Green, my last question: Would the EPA agree that this level of plutonium contamination is in fact a threat?

Mr. RICHARD GREEN. Yes, sir. I'm not—ordinarily I would have to consult other people to say yes, but I have a chart in my briefing book that leads me to say yes.

Mr. BURR. I thank all of you for your willingness and openness to be here and I yield back, Mr. Chairman.

Mr. WHITFIELD. Thank you.

Mr. Strickland.

Mr. STRICKLAND. Thank you, Mr. Chairman.

Dr. Michaels, you went through in your testimony some information that I would like to make sure that I have recorded accurately. Did you say that you would be at the Portsmouth site to begin your investigation by mid-December?

Mr. MICHAELS. Sir, we plan to begin the scoping of it in November, and we'll be onsite in January.

Mr. STRICKLAND. Onsite in January. And then you indicated a figure of 6,000 workers would be medically monitored or screened. And could you tell me where those workers would be from?

Mr. MICHAELS. That—that's a budget request. The budget amendment that the Secretary has asked is for additional money to support the expansion of our former working screening program to include current workers as well as more former workers at the three gaseous diffusion plants, and that would be in Portsmouth, Paducah and Oak Ridge.

Mr. STRICKLAND. And more specifically, my understanding is that at Paducah the Department is going to conduct medical screenings which are likely to be helpful in detecting early health effects from potential exposure to radioactive materials, thereby extending the lives of those who may be discovered to have problems at an early stage.

Mr. MICHAELS. We certainly hope that will be the outcome.

Mr. STRICKLAND. And that being the case, do you plan to do such screening, these lung examinations, for example, at Portsmouth and Oak Ridge as well?

Mr. MICHAELS. It's my understanding we'll use the same protocol at three sites, with variation based on what we know about exposure histories. But any expansion to Paducah would be the expansion to Portsmouth and Oak Ridge as well, sir.

Mr. STRICKLAND. Has the Department requested the necessary funding in order to make sure that this rather costly operation will be adequately funded?

Mr. MICHAELS. I believe we've announced the request. I don't know if the amendments—yes, I'm told the amendment has been sent by the White House to Congress. And we look forward to your support on that.

Mr. STRICKLAND. You have it. I'm looking forward to your coming to Portsmouth.

Mr. MICHAELS. And as far as you know, I'll be coming to Portsmouth before the investigation as well to meet with the workers as I promised you.

Mr. STRICKLAND. Thank you, Dr. Michaels. Thank you, Mr. Chairman.

Mr. WHITFIELD. Yes, sir. Mr. Bryant.

Mr. BRYANT. Thank you, Mr. Chairman. As Mr. Burr said, we're shuttling back and forth between this hearing and another hearing. And I know this has been a long day. I spent most of my time in here. And I too want to thank all of you, especially on this third panel for being so patient and waiting for us.

Dr. Michaels, same questions in terms of Oak Ridge, and you mentioned Portsmouth, and you have the same protocol in line for both of the facilities that you would have for Paducah. What kind of timeframe are we talking about for Oak Ridge?

Mr. MICHAELS. Mr. Bryant, we haven't set a schedule for Oak Ridge. We'll be going to Portsmouth next. As we complete that, which we see completing in late winter, we'll then go to Oak Ridge to look at the specific issues around the transuranics. However, at the same time, I didn't really address this in terms of Portsmouth directly, but there's a process that President Clinton has requested in the memo in July to have us look at—have the White House and all the agencies look at occupational illness across the DOE weapons complex. And we'll be going out, and I specifically will be going out to both Oak Ridge and to Portsmouth as well as to other sites to gather data about the potential health effects of our exposures there to report to the White House in order to understand how we can best provide compensation to workers across the complex.

We have been tasked to finish that entire investigation by the end of March. We'll be coming to Oak Ridge probably within the next few months to gather more information on that as well.

Mr. BRYANT. It would seem to me in the overall plan by the President, Oak Ridge and Portsmouth and Paducah would be very high priority since there probably is known damage there. I think one of the—Mr. Green mentioned earlier about trying to weigh the balance between the known onsite versus the unknown offsite and knowing that there's probably something out there, but you have to look for it. But we know—we know there are things there in Oak Ridge and Portsmouth and Paducah. And I would urge you to make that your highest priority as opposed to going elsewhere and finding out what the situation might be.

Let me go back to—and you may have been asked this question earlier—but back to Kentucky, I know offsite—when your folks first went there, they had to wear protective clothing on some of the offsite areas. Are there warnings for the general public out there now in those locations? I think they were tested and actually some indication of radiation was found and the workers did need—not have, but need—protective clothing. Is that premise true?

Mr. MICHAELS. Dr. David Statler, he's our Deputy Assistant Secretary for Oversight who's heading the team down there.

Mr. STATLER. It's important to note the definitions that define offsite and onsite at Paducah. You have an area inside the secured fence that belongs to DOE. You have almost as large or a larger area outside the fence that belongs to DOE, that is really DOE property but outside the fence. And then beyond that, you have public property or offsite property that borders that. There's no fence between that and the DOE property.

We found through our surveys, we took both surveys, radiological surveys as well as independent groundwater sediment and surface water samples, and those samples are not analyzed yet. They're in the process. But the surveys, we found contamination on DOE property beyond the security fence, not on public property, that exceeded the limits in 835—10 CFR 835 for posting, and they were not properly posted. In some cases, there were signs of contamination, the levels were not posted. There are contaminated ditches and lagoons and properties. And in one case where the team went in to a small creek or stream to take a sample, they did a survey first, and it required booties and gloves and it was not posted as such. So we contend that 835 should be applicable to DOE property beyond the fence and the postings place.

Mr. BRYANT. The bottom-line question on this is, is there any property, whether it's government-owned or public property, that the public has access to that would be dangerous that's not posted?

Mr. STATLER. The public does have access to that DOE property offsite. In most cases it's not fenced. There are a few signs saying DOE property, but they have access.

Mr. BRYANT. Is that posted warning?

Mr. STATLER. Not posted adequately in our——

Mr. BRYANT. That's something I'm sure our folks from Kentucky will be aware of. Thank you.

Mr. WHITFIELD. Mr. Chairman.

Mr. UPTON. Thank you, Mr. Chairman.

Sorry that I—lots of meetings. It all telescoped, our schedules, now we have votes that are going on. I have two questions.

One, Dr. Michaels, it's my understanding that your nuclear safety inspectors have never conducted a comprehensive compliance inspection at Paducah; is that right? Comprehensive, everything.

Mr. STATLER. The Office of Nuclear Safety, between 1991 and 1995, conducted investigations or assessments there, including in 1994 a radiological assessment that identified many of the same concerns. We had also performed event investigations at that locality in Paducah. Since the transition to NRC and DOE of the USEC facilities, other priorities, staffing have prevented us from sending a team there. So we have not actively done a complete assessment of Paducah since 1995.

Mr. UPTON. But that's going to change now, is that not right?

Mr. STATLER. It's already changed. We're doing an investigation, yes, sir.

Mr. UPTON. Are we going to see posting—I've known about this recreation area that's close by, and I think Mr. Bryant was just touching on that now in terms of his question. Is that going to change pretty quickly in terms of the warning signs to all residents of Paducah not to—and what will those signs say?

Mr. STATLER. The requirements on DOE property on- or offsite are defined by 10 CFR 835 and how they should be posted. I believe the site has submitted a corrective action plan and they are reviewing those postings. We identified more than just signs that needed painting. We identified areas onsite and offsite on DOE property that were contaminated and not posted, or posted improperly. And so I would hope that those would be fixed rather quickly, if not already.

Mr. UPTON. Well, again, I apologize for being in and out during this hearing but I guess, Mr. Whitfield, if you have no further questions.

Mr. WHITFIELD. I do. Just one.

Mr. UPTON. I yield back my time.

Mr. WHITFIELD. Thank you, Mr. Chairman.

Mr. Logan, there was a quote from you or Mr. Volpe in the Paducah Sun on August 11, 1999 that said if you followed the effluent ditch from the plant, "it leads to Little Bayou Creek toward the Ohio River. We have an automatic sampler that samples the creek every 6 hours and we have never found plutonium." Is that correct?

Mr. VOLPE. That's correct. Since we've had that in place, it collects a sample every 6 hours. There's detection of plutonium at this offsite location.

Mr. WHITFIELD. And how long have you had that?

Mr. VOLPE. We have had that in place, I believe it's about 2 years. We've had to take it out because of vandalism and then we put it back in in cages.

Mr. WHITFIELD. At any of the other locations, have you found traces of plutonium at a level——

Mr. VOLPE. Not with our automatic samplers.

Mr. WHITFIELD. Okay. Dr. Michaels, it's my understanding that there is some new technology now in which you are able to detect lung cancer by using CAT scans. As we go into this monitoring program—and I know that dollars are an important part of that—I would urge the Department and I would like to work with you to see if we can include this CAT scan screen as a part of this monitoring process. I hope that you all would work with us at least in exploring that.

Mr. MICHAELS. Yes, sir. It's certainly one of the things under consideration right now. We would be pleased to work with you.

Mr. WHITFIELD. Well, I want to thank all of you. This has been a complex subject and I thank the staff for the tremendous job in the short period of time in putting this all together. As you know, there may be follow-up hearings on this on the House side. We know there will be on the Senate side. And we will be following up with some questions for you to answer as well. But thank you for your time. Thank you for coming up here. And we look forward to working with you and solving the problem. Thank you. The hearing is adjourned.

[Whereupon, at 4 p.m., the subcommittee was adjourned.]

[Additional material submitted for the record follows:]

RESPONSES FOR THE RECORD OF RICHARD D. GREEN, DIRECTOR, WASTE MANAGEMENT DIVISION, U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 4, ATLANTA GEORGIA

Question 1. Based on current institutional controls at the Paducah gaseous Diffusion Plant (Paducah), are visitors, workers and residents surrounding the Paducah site adequately protected from radiological and chemical releases from the Paducah site?

Response: The protection of area residents and visitors to the perimeter of the facility, until such time as remedial actions for past releases are completed, is in part accomplished by access restrictions and postings of warning signs. These postings have been improved and expanded since September 1999, but cannot provide a level of protection equivalent to removal of the source of the hazard. Threats to residents from drinking water contamination have been controlled by requiring the Department of Energy (DOE) to provide clean water to residents in the area of the DOE's groundwater releases. Institutional controls on withdrawal of contaminated groundwater are currently adequate to protect residents. All such institutional controls will be regularly reviewed by the EPA, the Commonwealth of Kentucky (KY) and the DOE for adequacy.

Worker safety and the protection of visitors within the perimeter of the facility is the responsibility of the DOE for non-production areas and of USEC for areas leased from DOE for the production of enriched uranium.

Question 2. During its recent Phase I investigation at the Paducah site, the Department of Energy (DOE) sampled environmental media for chemical and radiological analysis. Did DOE plan this sampling effort with the Environmental Protection Agency (EPA), or share these data with EPA in a timely fashion?

Response. DOE did not plan this sampling effort with the EPA, nor did DOE submit the standard pre-investigation work plan to EPA. EPA received a copy of this report just prior to its public release. After the September 22, 1999 hearing held by the House Commerce Committee, EPA requested sampling results from the investigation team. Upon Completion of the analysis of most samples and the assessment of the data by the investigation team, sampling data was provided to EPA Region IV by the State of Kentucky staff on October 8, 1999. An EPA project manager was briefed on the final results of the investigation on October 14, and the investigation report was published formally on October 20. EPA has contacted Dr. David Michaels and Dr. David Stadler, of DOE's Environmental, Safety and Health Office of Oversight, who have pledged full cooperation with EPA in any subsequent work they undertake at the Paducah facility.

Question 3. Please explain why plutonium contamination in offsite sediments was not identified in the Executive Summary of the DOE report "Phase I Results of the Site Investigation, March 22, 1991."

Response. This Report was prepared as required by EPA's consent order, and was reviewed and approved by the Agency. The Executive Summary noted those contaminants that were determined by risk assessment to pose the principal threat to human health and the environment. Because the risk assessment of offsite contamination was based on a recreational rather than a residential exposure scenario, plutonium was not a principal threat contaminant. Therefore, it was not included in the Executive Summary. Its presence was included in the text of the Report.

Question 4. At the hearing, DOE indicated that areas offsite have been identified with radiological contamination high enough to require sampling technicians wear protective clothing. Why have these contaminated areas remained uncontrolled for public access? Are there other areas offsite with similar amounts of contamination that are also uncontrolled?

Response. The area in question is one of the outfall ditches at the boundary of the fenced perimeter of the facility. The area is known to be contaminated and was posted with warning signs prior to the investigation. Other areas offsite that are contaminated are also posted with seaming signs, primarily along Big and Little Bayou Creeks. If DOE had submitted a work plan before the sampling, EPA would have informed them of the need for adequate worker protection measures in these areas. Postings in the areas in question have been expanded since the hearing, and were inspected by personnel from EPA on November 10, 1999. DOE is reviewing the adequacy of its postings at all areas of contamination, and EPA is participating in that effort.

Question 5. Please describe how the public around Paducah could be impacted from contaminated surface waterways around Paducah.

Response. The public may be exposed to contaminated surface waterways through recreational uses, such as fishing and swimming, of Big and Little Bayou Creeks. Risk assessment based on such recreational use assumes frequent use over a long period of time. Fish have been found to be contaminated with levels of PCB's that are not safe for human consumption, and those areas of the Creeks have been posted with advisories against such consumption.

Question 6. In light of DOE's recent findings, please describe what efforts the EPA is taking to fully characterize offsite contamination and ensure the public is adequately protected from offsite releases.

Response. The Agency sponsored a meeting on November 8-10, 1999 with DOE, KY and site contractor Bechtel-Jacobs to set priorities for response actions in FY 2000, 2001 and 2002. Removal or control of known areas of offsite contamination was set as a priority for DOE. Investigation of any reports of further offsite contamination was set as a priority for all participants. EPA has inspected the DOE postings at areas of known offsite contamination for adequacy, and will require further postings if necessary. Each participating agency is represented on a work group that will prepare a site management plan to remediate all areas of contamination by 2010. This Site Management Plan will be used in developing DOE's annual budget submittal for cleanup of Paducah as required by the Federal Facilities Agreement. All participants agreed to streamline their procedures for documenting, submitting and approving response actions while still allowing full participation by the public.

Question 7. Why has DOE failed to adequately assess sediments, soils, surface water, and other environmental media in areas outside the security fence to ensure public safety in these areas?

Response. Priorities for response at Paducah have been balanced between assessment and response to known hazards within a constrained budget. Highest priority has been set on groundwater contamination beneath the facility and within the Water Policy Area and removal of the areas of highest soil/sediment contamination onsite to prevent further offsite migration of contamination.

Question 8. Please list and describe any enforcement actions EPA has taken against the United States Enrichment Corporation (USEC) for non-compliance with environmental regulations.

Response. The Commonwealth of Kentucky is fully authorized to implement environmental programs in lieu of EPA. EPA is not aware of violations of permits by and has thus not taken enforcement action against the USEC.

Question 9. What efforts are currently underway to control "hot spots" contributing to groundwater contamination around Paducah. Specifically, please include a description of your efforts to remove TCE stored in the C-400 building. Please also identify any proven technologies that may address the problem more effective[ly].

Response. Trichloroethene (TCE) is not stored in the C-400 building to the best of EPA's knowledge. Releases and spills within the building in the past have resulted in TCE contamination underneath the building. In response to EPA's order, two groundwater withdrawal systems are in place within the on-site hot spots to recover TCE. DOE, KY and EPA are participating in a panel to evaluate innovative technologies and test them on-site, particularly to address "deep" contamination of geologic strata with TCE. Deployment of these and other technologies, such as iron filing "gates" to remove TCE as groundwater flows through them, are a high priority for FY 2000 and 2001 at the facility.

RESPONSES FOR THE RECORD OF JOHN J. HUMMER, DIRECTOR OF CORPORATE ENVIRONMENT, SAFETY AND HEALTH, LOCKHEED MARTIN CORP.

Question No. 1: Please explain why plutonium contamination in offsite sediments was not identified in the Executive Summary of the Department of Energy (DOE) report "Phase I Results of the Site Investigation, March 22, 1991."

Response: The report entitled "Results of the Site Investigation, Phase I" at the Paducah Gaseous Diffusion Plant was prepared by CH2M Hill in accordance with the August 1988 Consent Order between the United States Department of Energy (DOE) and the United States Environmental Protection Agency, Region IV (USEPA), and pursuant to a contract with Martin Marietta Energy Systems, Inc. (MMES).[1] Environmental sampling, laboratory analysis, and reporting of test results were performed by and/or on behalf of CH2M Hill. MMES, DOE, USEPA, and the Commonwealth of Kentucky were given the opportunity to comment on the draft report. To my knowledge, the report provides an accurate summation of CH2M Hill's findings and the Executive Summary highlights issues considered significant by CH2M Hill. CH2M Hill has responded to a number of questions from Congressman Bliley about the information in the Report and its Summary, and I have nothing to add to their response.

Question No. 2: According to the October 1999 Phase I Independent Investigation report, DOE identified radioactive "black ooze" in areas close to offsite landfills that were not permitted for radioactive wastes. These offsite residential and sanitary landfills were managed by Martin Marietta pursuant to its contract responsibilities with DOE.

a. Did Martin Marietta at any time dispose of radioactive wastes at offsite landfills, including the C-746-S residential landfill and the C-746-T industrial landfill?

b. Did Martin Marietta know that DOE Orders require that radioactive waste only be disposed of at licensed facilities?

c. Did anyone from DOE ever approve the disposal of radioactive wastes in facilities not licensed for such wastes?

Response: Both the "black ooze" described in the DOE Phase I Independent Investigation and the C-746-S landfill to which it is adjacent are on the DOE property, and it is my understanding that they are considered onsite for purposes of CERCLA

[1] Now, Lockheed Martin Energy Systems, Inc. (LMES). Hereafter, I will refer to the company as MMES/LMES.

cleanup and for state permitting purposes. MMES/LMES was not operating the Paducah facility at the time the so-called "black ooze" was discovered. It is my understanding, however, that the "black ooze" may have emanated from certain roofing materials which were used as fill for a drainage ditch relocation project, prior to MMES assuming responsibility in 1984. I do not know the extent to which DOE approved and/or participated in the disposal of such materials. With regard to the specific questions above, I offer the following responses:

a. I have no information indicating that radioactive wastes (meaning wastes with radioactive contaminants above limits allowed by DOE) were placed in either the C-746-S residential[2] landfill or the C-746-T industrial landfill. The C-746-S and C-746-T landfills were managed by MMES/LMES from 1984 until their closure in 1992 and 1995. The landfills are located onsite—meaning that they are on DOE property. As far as I know, these landfills were operated by MMES/LMES in accordance with state requirements.

b. MMES/LMES was certainly familiar with the DOE orders that were applicable to it through its contract with DOE. Further, my understanding is that DOE requires that the disposal of any radioactive waste, as defined by DOE, at a location that is off DOE property must conform to applicable state and federal regulations.

c. I am not aware of any DOE approval to dispose of radioactive waste off DOE property at facilities not licensed for such waste.

Question No. 3: According to the internal Environmental Compliance Audit Report by Martin Marietta dated October 1992—and discussed at the hearing—Martin Marietta auditors found "the NEPA program is heading in the right direction, but all programs have not been implemented to keep projects/activities from not getting proper NEPA review . . . some projects have been initiated without NEPA review." However, Martin Marietta informed DOE in its 1992 Paducah Environmental Report "compliance with NEPA is maintained by following guidelines set forth by the CEQ, DOE, and Energy Systems." Please explain why Martin Marietta reported to DOE it was in compliance with NEPA requirements in 1992 if Martin Marietta auditors found projects "initiated without NEPA review."

Response: Based upon my review of the relevant environmental report and audit report to answer this question, the statement regarding NEPA compliance presented on page xvi of the 1992 Paducah Environmental Monitoring Report appears to be a general program description of the guidelines used to implement NEPA requirements. It was not intended to be a statement of compliance status. The audit report to which you refer was an observation regarding weaknesses in implementation of the internal NEPA review procedure, which, if not corrected, could have resulted in failure to review a project or activity. It was not a finding of non-compliance with NEPA.

Question No. 4: Was the health physics program in place at the time Martin Marietta and later Lockheed Martin were operating the Paducah site fully adequate? Did the health physics program provide workers the type of protection required by as low as reasonably achievable (ALARA) standards?

Response: It is my understanding that the health physics program in place when MMES took over the management of the Paducah facility in 1984 was considered adequate under the DOE expectations at that time. As DOE expectations changed, the health physics program underwent changes to bring it into conformance with changing expectations. However, based on the information that was available to MMES, the health physics program was fully adequate to maintain radiation exposures well below established limits.

It is also my understanding that the radiation doses at Paducah were historically low in comparison to other facilities within the DOE complex. As a result, the ALARA program at Paducah at the time MMES took over the facility management was considered consistent with that expected for a low dose facility. However, when the DOE expectations changed, the ALARA program also changed.

Your question about the health physics program providing the type of protection required by "ALARA standards" suggests that specific standards are associated with the ALARA principle. To my knowledge, ALARA does not set standards, rather it is a principle: to maintain radiation doses as low as reasonably achievable. Thus no specific standards are associated with ALARA. It is up to an organization implementing ALARA to identify sources of radiation in their facilities, determine the reasonably achievable methods to limit the radiation exposure to workers from those sources, then implement those methods. Continuous review and improvement are implicit in implementing ALARA. As described in the preamble to 10 CFR Part 83

[2] Although the C-746-5 landfill is referred to as "residential," this is probably because it was used for sanitary wastes. The landfill is on DOE property and to my knowledge has only been used for DOE wastes.

5, DOE does not intend to establish ALARA as a duty of care for purposes of tort litigation.

Question No. 5: Did ALARA protections extend to eating areas within the plant? Were employees routinely monitored for contamination before they were allowed to enter eating areas? Were the eating areas routinely monitored?

Response: As the ALARA principle was introduced into DOE directives, it was implemented at all areas in the Paducah plant. Again, radiological control requirements and practices instituted to keep radiation doses ALARA evolved with time. At one time, hygiene practices (i.e., handwashing, showering, changing clothes) were thought to be sufficient to minimize the spread of contamination. When DOE established requirements to monitor employees leaving potentially contaminated work areas, those requirements were implemented over time at the Paducah plant as funding and resources allowed. Associated with this action, workplace monitoring, to include eating areas, was increased to ensure that contamination was not being spread from radiological areas into non-radiological areas.

Question No. 6: Did Martin Marietta keep full and adequate records of the individual exposure of every plant worker for whom such records are required?

Response: To my knowledge, MMES/LMES generated and maintained the necessary records for those employees for whom monitoring was required by DOE during the time MMES/LMES managed the Paducah facility.

Question No. 7: Please describe the monitoring system Martin Marietta and later Lockheed Martin had in place to detect contamination on people and vehicles leaving the Paducah site?

Response: The monitoring activities to detect external contamination on people and vehicles evolved during the time MMES/LMES managed the Paducah facility. To my knowledge, little monitoring to detect external contamination was done when MMES began managing the facility. Over time, as part of the upgrades to the site contamination control program, more monitoring for external contamination was done. Vehicles were characterized to determine their radiological status. Vehicles with loose contamination were supposed to be removed from service and decontaminated prior to returning to service. Once the initial characterization was complete, a routine monitoring program was established consistent with the potential for becoming contaminated, and contaminated vehicles were marked to facilitate control. Once a routine monitoring history was established, along with increased contamination control at the source, the marking was stopped. The monitoring program for items, material, and equipment/vehicles being released from radiological areas became the primary method for ensuring that no contamination was being spread to non-radiological areas.

As stated in an earlier response, the radiological control program evolved so that those employees in areas where contamination could be present were monitored before leaving the potentially contaminated work area. I am not aware of any monitoring of individuals upon leaving the facility.

Question No. 8: Was Martin Marietta and/or Lockheed Martin cited for health and safety violations while operating the production and environmental programs at the Paducah plant?

Response: Lockheed Martin Utility Services, Inc. (LMUS) was cited by the Occupational Safety and Health Administration (OSHA) for health and safety violations while operating the production programs at Paducah. MMES/LMES were not subject to OSHA regulation, and thus not subject to OSHA citation.

Question No. 9: When did Martin Marietta know that transuranics were contained in the recycled spent nuclear fuel sent to Paducah from Hanford and the Savannah River Plant?

Response: I have no reason to believe, and consider it unlikely, that DOE or the prior contractor provided information to MMES during the 1984 contract transition that transuranics were contained in the recycled spent nuclear fuel returns. I also have no reason to believe, and consider it even more unlikely, that this type of information was given to potential bidders for the contract at the time the request for proposals was issued back in the 1980s. Given the information I have seen since the transuranic issue was raised in these proceedings, the presence of transuranics was clearly known to the managing contractor and DOE employees when the materials were sent to Paducah in the 1950's and in the years that followed. By the time MMES took over the management of the site in 1984, the shipments had ceased, and a facility upgrade had been finished which was thought to have removed most of the transuranics from the processes. Most of the employees of the prior contractor transferred to MMES, with some either retaining or assuming management positions with MMES. In addition, in 1985, DOE produced a Report Of The Joint Task Force On Uranium Recycle Materials Processing, which discusses the presence of transuranics at Paducah, as well as at other DOE facilities. One MMES employee was a Task Force member, and MMES was on distribution for that report. Thus, MMES probably knew in 1984 and certainly knew in 1985 that trace transuranics had been contained in the spent nuclear fuel processed in the Paducah plant years earlier.

VORYS, SATER, SEYMOUR AND PEASE LLP
December 14, 1999

Mr. DWIGHT CATES
Investigator
U.S. House Commerce Committee
316 Ford House Office Building
Washington, DC 20515

DEAR MR. CATES: I am writing in response to your recent inquiry seeking clarification regarding Jay Hummer's letter of November 22, 1999 to Chairman Upton.

We have reviewed the responses in the letter carefully and can verify, as I indicated when we first spoke, that Mr. Hummer answered the Chairman's questions both individually and in his capacity as a representative of Lockheed Martin Corporation, and past and present affiliated corporations, which had responsibilities at the Paducah Gaseous Diffusion Plant. The responses, therefore, also represent the knowledge Lockheed Martin has to date on the matters in question, but as you know, Lockheed Martin is currently engaged in an ongoing process of investigating the issues. Nevertheless, we have tried to provide you with answers that are as complete and responsive as possible at this time.

I hope this adequately responds to your concerns. Please do not hesitate to contact me at your earliest convenience if you should have any questions. Until then, I remain,

Very truly yours,

RICHARD J. LEON

RESPONSES OF JOSEPH F. NEMEC, PRESIDENT, BECHTEL JACOBS COMPANY, LLC, TO QUESTIONS FROM THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

Question 1. According to the Department of Energy (DOE) Phase I Independent Investigation at the Paducah Gaseous Diffusion Plant (independent investigation), there is an "absence of DOE or Bechtel Jacobs oversight of radiological work practices." Why has there been an absence of Bechtel Jacobs oversight at Paducah?

Response. Bechtel Jacobs provides oversight to work activities at Paducah. This is accomplished by our line managers, subcontractor technical representatives, safety advocates, as well as independent oversight by Performance and Quality Assurance, and Environment, Safety, and Health. In the M&I approach, oversight is expected and enhanced by each subcontractor's responsibilities for oversight of their work activities. This combination provides a defense in-depth approach to oversight and managing safety activities for work planning and performance.

The Bechtel Jacobs Company Management and Integration (M&I) contract requires us to perform the majority of work utilizing subcontractors. It also dictates that we "flow down" DOE requirements to our subcontractors, including provisions for them to be responsible for complying with those requirements, including self-assessment and oversight. Accordingly, oversight of work practices is accomplished by both Bechtel Jacobs staff, as well as subcontractor Environment, Safety, and Health (ES&H) staff. In addition, we are implementing, as required by contract, our Integrated Safety Management System (ISMS). The ISMS places more emphasis on "up front" worker involvement in planning and hazard analysis. This approach builds in safe work practices to the planning process by those performing the work and reduces reliance on "back end" oversight to ensure compliance.

Collectively, the increased responsibility of subcontractors for performing their own oversight, the implementation of ISMS, and oversight of the subcontractors by the Bechtel Jacobs Company provides equivalent oversight when compared to a self-performance management approach. Bechtel Jacobs Company is committed to providing the appropriate level of oversight to our subcontractors and ensuring that they, in turn, are living up to their responsibilities and contractual obligations to perform their own measure of oversight for all ES&H areas.

Question 2. According to the independent investigation, "Bechtel Jacobs radiological work permits (RWP) lack information required by procedure to control radiological work effectively." Please explain why Bechtel Jacobs RWPs lack adequate safety information.

Response. The RWPs referred to were originally designed to be generic in nature to support routine work. Bechtel Jacobs Company has implemented appropriate action to ensure that the procedure governing RWPs is followed rigorously. We have already undertaken the following actions:

All RWPs identify the training requirements to enter the area as required by procedure. Radiological survey data are attached to the permit, or the permit identifies where the data are located.

Job specific RWPs are based on the work to be performed, the contaminants and levels of contaminants, and existing data. Work scope is provided to the health physics department by the task lead. This information is reviewed by the health physics dosimetry group and RCT supervisors during a pre-job as low as reasonably achievable (ALARA) review. Information from the pre-job ALARA review is used to develop the RWP. This information is reviewed with the RCT by the RCT supervisor. Information on the RWP is reviewed by the work crew during a pre-job briefing. All workers must sign the RWP prior to entering the work location.

Question 3. According to the independent investigation, a Bechtel Jacobs employee received a 24 mrem dose in 35 days at the cylinder yard. Why are Bechtel Jacobs dose rate measurements two to three times lower than the dose rate measurements the investigation team has observed in the cylinder yard?

Response. The cylinder yard is a large area, approximately 4.5 acres. Based on this work activity, a worker normally receives an exposure typical of the average from the entire yard. The dose rate readings collected by the independent investigation team were obtained in areas with higher dose rates. Subsequent to the investigation teams survey, the Bechtel Jacobs Company performed a study consisting of 54 measurements taken systematically at grid points over the entire cylinder yard. The Bechtel Jacobs measurements in the higher dose rate areas were similar to those taken in the same areas by the investigation team and in the April 1999 Bechtel Jacobs Company measurements taken prior to the job. The Bechtel Jacobs measurements in their totality are representative of the average dose rate on the entire yard and are therefore representative of the exposure conditions for workers. Despite these facts, the degree of conservatism applied in this case was not consistent with my expectations. As a result, additional controls will be established to require an independent review by our Environment, Safety, and Health manger or designee whenever radiation exposure rates could result in a worker exceeding the approved monitoring threshold in 10 CFR 835, regardless of the duration of the job.

Question 4. According to the independent investigation, "Bechtel Jacobs cannot adequately demonstrate that the unconditional release of equipment from the site is consistent with DOE requirements." Why is Bechtel Jacobs unable to demonstrate unconditional release of equipment consistent with DOE requirements?

Response. Bechtel Jacobs Company has an established program for unconditional release of excess equipment and materials including technical basis and guidance that is rigorous, detailed, and complies with DOE requirements. The Bechtel Jacobs Company program requires a Survey and Release Plan to be prepared for equipment release. The Survey and Release Plans are used to document how material is surveyed for unconditional release to demonstrate consistency with DOE requirements. The independent investigation report noted this on page 38: "While Bechtel Jacobs does have a procedure for unrestricted release of equipment, they did not apply it during the process of releasing the fluorine cells." What the independent review team found was that the required plan for the release of the fluorine cells was not prepared in accordance with the unconditional release procedure and all approvals for release were not obtained.

Radiation surveys were performed by Bechtel Jacobs Company on the fluorine cells and samples of the solution in the cells were collected and analyzed. The results of the radiation surveys demonstrated that the DOE requirements and appropriate release limits (uranium versus transuranic) were used. The results of samples of the solution in the cells were used to demonstrate that the exposure to the solution would not be harmful to health or the environment. DOE approval from the Paducah Site Office was obtained for the release, however, DOE Headquarters approval was not obtained in accordance with requirements. Line management has been directed that an additional independent review will be conducted prior to unconditional release of excess equipment and materials to ensure required Survey and Release Plans and all required approvals have been completed in accordance with requirements.

Question 5. The independent investigation found several problems with subcontractor safety practices. How will Bechtel Jacobs correct these deficiencies?

Response. The Bechtel Jacobs Company subcontract language in Exhibit G—Environment, Safety and Health, holds the subcontractors fully accountable for ES&H and DOE requirements. Prior to commencement of work, all subcontractors are required to prepare and submit a comprehensive ES&H plan that includes a crosswalk of all activities in the subcontract to the DOE requirements in the Bechtel Jacobs Company prime contract and applicable environmental regulations. We agree that in a number of instances, some procedures have not been followed by subcontractors. Bechtel Jacobs Company has filed occurrence reports indicating that we have been vigilant in overseeing subcontractor work and in self-reporting. Further, there have been several follow-up formal and informal discussions with the involved subcontractors' senior management to reinforce the importance Bechtel Jacobs places on ES&H compliance and the safety of all workers. We have clearly communicated to our subcontractors that poor performance in the ES&H arena is grounds for termination.

The Bechtel Jacobs Company LLC Management and Integration (M&I) contract requires implementation of an Integrated Safety Management System (ISMS). Bechtel Jacobs Company has implemented the system and provided a description of the process in BJC/OR-87, Revision 2, Integrated Safety Management System Description, September 1999. A further definition of the flow-down of requirements to the work execution level, including subcontractors, is discussed in the BJC/OR-146, Revision 1, Integrated Safety Management System Supplement, July 1999. As mandated by regulation, we have placed the responsibility for the safety and health of their employees directly on subcontractors and will maintain an oversight role to ensure compliance. The requirement to include qualified ES&H staff as part of the subcontractor project team is included in our Exhibit G subcontract language. Subcontractors may adopt our health and safety plan or work to their own equivalent plan. All subcontractors work to the Bechtel Jacobs Company Radiation Protection Plan. Oversight, including the use of radiation control technicians under contract to Bechtel Jacobs Company, is an integral part of the Radiation Protection Program.

The ISMS process defines the oversight role of the Bechtel Jacobs Company Subcontract Technical Representative (STR), the Safety Advocate, and the Bechtel Jacobs project team ES&H members. These personnel work directly to review subcontractor programs and performance and provide feedback and direction. The STR provides day-to-day direction to subcontractors and ensures that they comply with all of the terms and conditions of their subcontracts, including requirements for ES&H performance. The Safety Advocate function was specifically created by Bechtel Jacobs Company to assist our subcontractors in understanding and implementing DOE ES&H requirements. The Safety Advocate provides an additional "set of eyes" on subcontractor safety performance and augments the presence of the Bechtel Jacobs Company ES&H subject matter experts who provide project-specific oversight working with subcontractor ES&H personnel.

In addition, we implemented on November 1, 1999, additional awareness training for our Safety Advocates to enhance their knowledge of radiation safety, environmental protection, industrial hygiene, and industrial safety. This training will be completed at Paducah by December 31, 1999.

Question 6. To date, has Bechtel Jacobs been cited for any violations of DOE orders or regulations governing health and safety at the Paducah plant?

Response. No.

Question 7. You currently provide radiation exposure data to employees only once a year. During the stand-down, those employees indicated that they wanted to receive the data more often. Have you agreed to their requests?

Response. Yes. Bechtel Jacobs Company will develop and implement a communications initiative to provide more frequent exposure data to employees and subcontractors.

RESPONSES OF JAMES H. MILLER, EXECUTIVE VICE PRESIDENT, USEC, INC., TO QUESTIONS FROM THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

Question 1. Please describe the current status of each outstanding issue with respect to the United States Enrichment Corporation's (USEC) Nuclear Regulatory Commission (NRC) Compliance Plan for the Paducah site (Compliance Plan).

a) Please identify the original completion date for each outstanding issue in the Compliance Plan.

b) For those outstanding issues that have missed the original completion date, please provide an explanation of why a delay has occurred, as well as an explanation of when each outstanding issue will be completed

Response. The NRC issued the initial Certificate of Compliance (Rev. 0 of GDP-1) for the Paducah Gaseous Diffusion Plant (PGDP) in September 1996 and assumed regulatory oversight of PGDP in March 1997. In connection with the initial certification, NRC approved Revision 3A of the Compliance Plan, dated August 1, 1996 that was prepared by the Department of Energy. The Compliance Plan identified 57 issues that required actions to bring PGDP into full compliance with NRC regulations, established a plan of action and schedule for completion and established the parameters for continued operation until the actions were completed. To date, actions have been completed for 51 of the 57 issues identified in the Compliance Plan. The following provides the information requested for the six outstanding issues:

Issue 2—Upgrade the Application Safety Analysis Report

Original Completion Date: August 17, 1997

Current Approved Completion Date: August 17, 1997

Status: On February 14, 1997 DOE provided USEC with the updated safety analysis report. On August 18, 1997 USEC provided a portion of the information required by Issue 2 to the NRC and submitted the remainder by October 31, 1997. NRC review has been ongoing since that time.

Reason for Delay: The two month delay in USEC's submittal to NRC was due to the unanticipated complexity involved in the review of DOE's updated safety analysis report. This Issue will remain open until NRC review is completed.

Issue 8—Exceptions for Criticality Accident Alarm System

Original Completion Date: Submitted on April 9, 1996 prior to approval of Compliance Plan

Current Approved Completion Date: Not Applicable

Status: USEC has provided criticality accident alarm coverage in all areas of the plant required by NRC regulations to have such coverage. Prior to approval of the Compliance Plan, USEC submitted technical analyses required by the Compliance Plan to demonstrate that areas identified in the Compliance Plan do not require criticality alarm coverage. NRC review has been ongoing since that time. This Issue will remain open until NRC review is completed.

Reason for Delay: Not Applicable

Issue 27—Procedures Program

Original Completion Date: March 3, 2002

Current Approved Completion Date: March 3, 2002

Status: USEC has completed all actions for this Issue except for the action which requires that the Plant Operations Review Committee (PORC) complete a review of all In-Hand and liquid UF6 handling procedures within 5 years from the date that the NRC assumed regulatory authority for PGDP (March 3, 1997). This action is on schedule to be complete prior to that date.

Reason for Delay: Not Applicable

Issue 36—Seismic Capability of Buildings C-331 and C-335

Original Completion Date: December 31, 1997

Current Approved Completion Date: June 30, 1999

Status: USEC submitted a certificate amendment request in January 1999 to request an extension of the completion date until June 30, 2000. Although NRC has not yet approved this extension, they did issue a Notice of Enforcement Discretion on June 30, 1999 which permits USEC to continue plant operations until such time as they complete their review and issue a certificate amendment. More recently, USEC, DOE and NRC met to discuss the issue of removing material from certain DOE Material Storage Areas (DMSAs) to support completion of the seismic modifications in those areas. USEC is currently on schedule to have all the seismic modifications completed by June 30, 2000 except for those DMSAs which have not been cleared sufficiently to allow work to be completed. USEC has informed NRC that additional time past June 30, 2000 will be necessary to complete the seismic modifications in areas affected by the DMSA issue. USEC, DOE and NRC are currently examining this issue and USEC hopes it will be resolved shortly

Reason for Delay: The Seismic Upgrade Project is a large scale steel construction project. The overall project involves 723 steel installation locations, 2,530 tons of steel, and 12,000 individual steel pieces. In order to install this steel, the demolition of 4,000 pieces of steel are required. Initially, three Unreviewed Safety Questions associated with the installation of the proposed modifications were identified, which required NRC review and approval prior to beginning actual construction work. Once work was begun in the buildings, additional factors delayed the project. The temperatures inside the cascade buildings had a greater impact on worker productivity than initially projected. In addition, the process of removing the existing concrete and steel in preparation for the installation of the new steel bracing was much more labor intensive than expected. Further, the original design did not identify all of the interferences with existing equipment which needed to be relocated or resolved. Finally, it has taken much longer than expected to begin removal of material from the DMSA locations which must be cleared in order for the modifications to be completed.

Issue 46—Criticality Accident Alarm System—Horn Audibility and Issue 50—Criticality Accident Alarms for Nearby Buildings

Original Completion Date: December 15, 1998

Current Approved Completion Date: January 18, 2000

Status: This project is on schedule to meet the current approved completion date. The upgraded CAAS system has already been placed into operation in several facilities on site.

Reason for Delay: The conceptual design to satisfy the requirements of these Compliance Plan actions originally required installation of additional air powered CAAS horns and upgrading the existing air system to supply the air necessary to power these additional horns. During the detailed design process, further reliance on the existing plant air system to support the CAAS system was determined to be undesirable. As a result, a new system was designed to improve CAAS horn reliability by providing a dedicated air system and air accumulators to supply the new CAAS horns. To enhance reliability of the sitewide CAAS system, this same concept is being applied to all CAAS air horns on site. The change in design and increase in scope required a delay of approximately one year to complete the entire upgrade but will result in an improved system.

Question 2. Please explain why DOE material storage areas at Paducah have not been characterized, analyzed or resolved even through they were identified more than two years ago.

Response. DOE is responsible for characterizing, analyzing or resolving the DOE material storage areas (DMSAs) at Paducah. USEC has limited responsibilities with respect to the DMSAs as set forth in the agreement, "USEC and DOE Agreement for DOE Material Storage at the Gaseous Diffusion Plants" which was signed by DOE and USEC in May 1996. This agreement specifies that, to the extent required by NRC, USEC will perform the following tasks: (1) visually inspect process equipment to identify enriched uranium deposits, (2) segregate equipment containing such deposits, (3) establish and maintain DMSA boundaries and signage, and (4) maintain necessary documentation concerning such activities. USEC has met its responsibilities to the extent permitted by DOE. Because of an unreviewed safety question (USQ) raised by DOE's subcontractors in early 1997, access to the DMSAs for further visual inspections has not been permitted until the USQ is resolved by DOE.

In addition, as requested by DOE, USEC performs services for DOE on a reimbursement basis. DOE from time to time has requested USEC to perform some services in connection with the DMSAs. In order for DOE to resolve the USQ and safely remediate the DMSA areas, the appropriate Nuclear Criticality Safety Evaluation (NCSE) and associated procedures required development. USEC began this work for DOE early in January 1998. NCSE development was a complex effort requiring significant engineering development work. This NCSE to support DOE DMSA work was completed and delivered to BJC in November 1998. DOE/BJC Readiness Assessment Team Approval was received in May 1999. DOE/BJC are responsible for scheduling the remaining work to address the DMSAs.

Question 2 (continued) Please explain what schedule or cost impacts may occur with USEC's effort to complete seismic upgrades at Paducah due to DOE'S failure to characterized, analyze, and resolve DOE material storage areas.

Response. The Seismic Upgrade Project is a large scale steel construction project. The overall project involves 723 steel installation locations, 2,530 tons of steel, and 12,000 individual steel pieces. In order to install this steel, the demolition of 4,000 pieces of steel are required. Total project cost will be on the order of $70 million.

The Seismic project has been planned and scheduled in an assembly line fashion to gain efficiency and maintain project control of the contractor. The DMSA delays have caused the Seismic project to "skip" locations. These "skipped" locations have been added to the end of the project schedule due to uncertainty as to when the DMSA areas would be free of DOE material to allow construction work to occur. The "skipping" of locations requires rescheduling, duplication of Health Physics surveys, duplication of welding and burning permits, scaffolding construction, etc. In addition, working skipped locations later in the scheduling is far less efficient due to the loss of assembly line construction techniques.

The current estimate as to the cost impact of these delays is approximately $11 million. The current estimate as to the schedule impacts of these delays is approximately 3 months. These estimates were formulated prior to the most recent DOE concern with criticality safety and therefore are likely to change. Schedule revisions are in process to determine the optimum integration of seismic work and required DMSA work. The goal is to complete Seismic work in the shortest period of time.

An important decision point will occur in February 2000. Up until this point, other Seismic construction work will be available for USEC's contractor. Beginning in February 2000, if the DMSA areas are not available for work, initial demobilization of the contractor work force (approx. 25% to 50%) would begin. Remobilization of this skilled work force (i.e., hiring, training, clearances, etc) would add significantly to the DMSA schedule and costs.

Question 3. Is USEC responsible for funding the characterization and movement of DOE material storage areas? If so, what is the estimated cost of this effort, and how will USEC provide the necessary funds to complete characterization in a timely manner?

Response. No, USEC is not responsible for funding the characterization and movement of DOE material storage areas (DMSAs). DOE and USEC responsibilities are described in an agreement, "USEC and DOE Agreement for DOE Material Storage at the Gaseous Diffusion Plants" was signed by DOE and USEC on May 28, 1996. DOE is responsible for ensuring that DMSAs are maintained in accordance with DOE requirements. This agreement specifies that, to the extent required by NRC, USEC will perform the following tasks: (1) visually inspect process equipment to identify enriched uranium deposits, (2) segregate equipment containing such deposits, (3) establish and maintain DMSA boundaries and signage, and (4) maintain necessary documentation concerning such activities. USEC has met its responsibilities to the extent permitted by DOE. Because of an unreviewed safety question (USQ) raised by DOE's subcontractors in early 1997, access to the DMSAs for further visual inspections has not been permitted until the USQ is resolved by DOE. In addition, as requested by DOE, USEC provides services to DOE on a reimbursable basis. DOE has from time to time requested services from USEC in connection with the DMSAs. USEC has performed these services as requested.

Question 4. According to testimony provided by Mr. Key, USEC's training manuals for employees make no reference to plutonium and neptunium in the workplace. Is this true, and, if so, why is there no such reference?

Response. Formal training modules regarding transuranics were developed and presented to the site personnel in 1992. The training was not, however, incorporated into the new employee training and the continuing training for site personnel until 1999. The training did address the hazards associated with exposure to radioactive material and the precautions and procedures to minimize exposure to radioactive materials as required by 10 CFR 19.12, Instructions to Workers. The activity levels of transuranics in the work place are below the thresholds requiring their inclusion in radiation exposure assignment. Never-the-less, the current site training programs have been revised to include transuranics.

Question 5. Will the delay in completing seismic upgrades cause a delay with USEC's request to NRC to increase uranium enrichment assay levels at Paducah from 2.75 percent to 5 percent?

Response. No. The increase in enrichment assay level to 5 percent at PGDP can be accomplished independent of completing the seismic upgrade. In a meeting with the NRC on August 3, 1999, USEC informed the NRC of its plan to request an increase to the authorized assay limit at PGDP in early-2000. USEC has developed a detailed project plan and currently intends to submit a Certificate Amendment Request (CAR) to increase the assay limit at PGDP by May 2000. NRC must approve the CAR prior to USEC implementing changes in operations to support higher assay production.

RESPONSES OF ROBERT W. LOGAN, COMMISSIONER, KENTUCKY DEPARTMENT OF ENVIRONMENTAL PROTECTION TO QUESTIONS FROM THE SUBCOMMITTEE ON OVERSIGHT AND INVESTIGATIONS

Question 1. At the hearing, DOE indicated that areas offsite had been identified with radiological contamination high enough to require sampling technicians wear protective clothing. Why have these contaminated areas remained uncontrolled for public access? Are there other areas offsite with similar amounts of contamination that are also unposted?

Response: As a U.S. Nuclear Regulatory Commission Agreement State, Kentucky's posting requirements can be found in 902 KAR 100:019, Sections 23, 24 and 25. In addition, Radiation Dose Limits for Individual Members of the Public (902 KAR 100:019, Section 10), and Compliance with Dose Limits for Individual Members of the Public (902 KAR 100:019, Section 11) are identical to U.S. Nuclear Regulatory Commission regulations.

Kentucky has a Field Sampling and Analysis Plan (FSAP) for Environmental Monitoring Activities which includes a Health and Safety Plan and a Quality Assurance Program Plan.

All Kentucky activities are conducted according to these plans. Monitoring staff are required to have the proper dosimetry and all are subject to bioassays. Personnel monitoring data for Commonwealth employees are well within the requirements of 902 KAR 100:019.

Question 2. Why has DOE failed to adequately assess sediments, soils, surface water, and other environmental media in areas outside the security fence to ensure public safety in these areas?

Response: DOE's progress in complete characterization of environmental media outside the security fence is directly related to available funding from Congress. To the best of our knowledge, U.S. DOE/PGDP has sampled and characterized those areas outside the industrial boundary sufficiently to determine if imminent threats to human health and the environment exist. Those areas that the Cabinet believes to be a potential threat to public safety were posted with warning signs. The Cabinet is aware that contamination exists outside the security fence. These contaminated areas and the sources that feed contaminants to the surface water system will be investigated under review by the Commonwealth and U.S. EPA.

Question 3. What is the State of Kentucky doing to identify radiological contamination at other offsite areas accessible to the public?

Response: The Commonwealth reviews all data and reports provided by DOE to determine potential restricted areas, as well as on-site and offsite impacted areas. In addition, as indicated above the Commonwealth has a FSAP which it utilizes to sample impacted areas.

The FSAP was designed based upon known release patterns from the facility. The FSAP is a dynamic document that can be modified based on suspected or known areas of contamination.

The Commonwealth's efforts are documented by the more than 4,000 samples collected since 1995.

Question 4. Based on current institutional controls that inform the public and restrict access to offsite contaminated areas, are visitors, workers, and residents surrounding the Paducah site adequately protected from radiological and chemical releases from the Paducah site?

Response: Based on the information to date, the Natural Resources and Environmental Protection Cabinet believes that, adequate institutional controls and/or removal actions have been implemented outside the security boundary to assure adequate protection of visitors to the wildlife management area and residents surrounding the PGDP. The Cabinet has not evaluated worker health and safety since the Cabinet has no regulatory authority over that issue. U.S. DOE and the USEC are obligated to assure worker health and safety.

Question 5. Illegal dumping activities were reported in Spring 1991 by Kentucky police investigator Mr. D.W. Senf in memoranda sent to Kentucky policy captain J.W. Pennington. Please explain what the State of Kentucky did with this information, and whether Mr. Senf's findings were resolved.

Response: Kentucky collected surface soil samples from the area of concern in May 1991. The soil samples were analyzed for gamma emitting radionuclides and ^{99}Tc. All radionuclides analyzed for were below detection limits.

In June 1991, a gamma ray dose rate survey was conducted for the area of concern in the presence of Mr. Senf. No "hot spots" or levels above background were observed during the gamma ray dose rate survey.

Based on the results of the gamma ray dose rate survey and the soil sample data, no further action was taken. Mr. Sent did not provide any information to suggest further action was necessary. The investigation is summarized in a June 17, 1991 memorandum.

Question 6. The State is authorized or delegated the authority to administer several federal environmental laws, including the Clean Water Act and the Solid Waste Disposal Act. In addition to permitting and monitoring requirements with respect to these programs, does the State of Kentucky have any financial obligations with respect to clean-up activities at the Paducah site?

Response: No.

Question 7. In your written testimony, you indicate Kentucky has collected over 4,500 samples of surface water, groundwater, soils, sediment, and vegetation around the Paducah Plant between 1995-1999. In addition, over 13,000 radiochemical analyses and over 15,000 quality control analyses have been conducted to ensure the accuracy of DOE and contractor results. Based on all the tests the State has performed at Paducah, do you think the workers at the Plant and the people who live and recreate on lands outside the Plant are safe?

Response: The Commonwealth as a U.S. Nuclear Regulatory Commission Agreement State does not have regulatory authority in regard to DOE worker health and safety.

DOE under the Atomic Energy Act of 1954 is self-regulating for radioactive materials.

Based on available data, there is no immediate threat to public health from releases from the site.

This conclusion is supported by the results of DOE's Phase I investigation.

Question 8. Please list each environmental permit violation administered by the State of Kentucky at the Paducah site. Please also describe how each violation was corrected.

Response: See attachment.

PADUCAH GASEOUS DIFFUSION PLANT—HAZARDOUS WASTE VIOLATIONS

RESOLUTIONS OF VIOLATIONS POST 1990 HAZARDOUS WASTE VIOLATIONS KY8-890-008-982

I. 8/22-24/1990 NOV issued, 6 violations written.

Violations documented were: Insufficient employee training, manifests incomplete, restricted wastes stored beyond 1-year period, three drums of hazardous waste over 90-day accumulation period, facility not operated to prevent releases (based on high number of spills).

Manner in which violations were resolved: All but one violation were resolved during an inspection conducted on June 23, 1992. The violation involving restricted wastes was resolved with the issuance of a Federal Facilities Compliance Agreement that listed guidelines for handling waste streams at TSDs.

II. 11/27/91 NOV issued, 11 violations were written.

Violations documented were: The wastewater stored at building C-733 from the sump of the same building did not have a "Waste Container Label". The field inspection log used for buildings C-733 and C-746-R Storage Facilities were not consistent with the Part B Permit, Part II.B.4, Attachment V, Section F. The inspection log for the Lime Precipitation Unit C-400-D lacked the time of inspection in violation of 401 KAR 35:020, Section 6. Waste D002, D006, D007, D008 was stored beyond 90 days at the Nickel Stripper Unit in violation of 401 KAR 32:030, Section 5, and KRS 224.866. Weekly container inspections and/or daily tank inspections were not conducted during storage of the D002, D006, D007, D008 hazardous waste at the Nickel Stripper Unit in violation of 401 KAR 35:180, Section 5 and/or 401 KAR 35:190, Section 6. The C-400-C waste location logs did not describe the storage of the D002, D006, D007, D008 hazardous waste in violation of 401 KAR 35:050, Section 4. Employees were not completely trained in violation of 401 KAR 35:020, Section 7, 401 KAR 34:020, Section 7, and the Part B Permit Part B.Il.B.5. Manifest Document Number 140 dated 8/22/91 did not have a handling code on it in violation of 401 KAR 32: 100. Arrangements of response actions during an emergency were not made with the State Emergency Response Team in violation 401 KAR 35:030, Section 7. A copy of the Contingency Plan was not distributed to the State Emergency Response Team in violation of 401 KAR 35:040, Section 4. The Land Disposal Restriction Forms accompanying Manifest Document Number 133 and 135 states that the waste D008, D009 has a capacity variance until May 8, 1992, which was not correct due to the presence of D008, lead, which was restricted from land disposal as of August 8, 1990. This constituted a violation of 40 CFR 268.7.

Manner in which violations were resolved: Inspection completed on June 23, 1992. This inspection also served to resolve all but one of the August 22-24, 1990 violations.

III. 6/9/92 NOV issued, 2 violations were written.

Violations documented were: Waste soil contaminated with dioxins was stored at an inappropriate location.

Manner in which violations were resolved: A June 16th and 17th inspection documented that the waste soil was containerized and that it had been moved to an acceptable location. All violations corrected.

IV. 10/30/92 NOV issued, 1 violation was written.

Violations documented were: Wastes were stored in an underground storage tank in excess of the 90-day allowed holding time.

Manner in which violations were resolved: Underground tank was certified closed on January 4, 1993.

V. 10/7/93 NOV issued, 3 violations were written.

Violations documented were: Failure to develop and implement a written schedule for inspecting monitoring equipment, safety, and emergency equipment important to detecting and responding to environmental or human health hazards. Failure to document monitoring, safety, and emergency equipment maintained by Chemical Operations and the Fire Department Failure to test and maintain all Contingency Plan equipment.

Manner in which violations were resolved: A financial penalty was assessed which was paid on 6/8/94.

VI. 2/22/95 NOV issued, 2 violations were written.

Violations documented were: Failure to manage waste mercury from line recorders removed from the enrichment process. Storage of waste mercury over 90-days without a permit.

Manner in which violations were resolved: There was a disagreement in regulatory interpretation between DOE and the Commonwealth. DOE agreed to accept the Commonwealth's interpretation of the regulations and the matter was dropped.

VI. 8/30/99 NOV issued, 1 violations were written.

Violations documented were: Failure to provide notification of activity to be performed inside a Solid Waste Management Unit (SWMU).

Manner in which violations were resolved: Sampling of uncharacterized soil was completed in accordance with the Commonwealth's sampling plan. Results were submitted to the Commonwealth within the prescribed time limit.

PADUCAH GASEOUS DIFFUSION PLANT—SOLID WASTE VIOLATIONS

Chronology of NOV's at the #073.14 Landfill

08/08/90 **Noted Violations**—NOV Issued 09/04/90. Communication system not operational (401 KAR 47:120-1); interim cover eroded (401 KAR 48:090-7); litter (401 KAR 48:090-9); inadequate daily cover (401 KAR 48:090-3).

12/12/90 Re-inspection: Communication system repaired, interim cover erosion repaired, daily cover applied to working face. All violations resolved.

01/30/92 **Noted Violations**—NOV Issued 02/13/92. Entrance sign didn't indicate operating hours (401 KAR 48:090-14); erosion and ponding water observed in ditch.

02/26/92 Re-inspection: Entrance sign corrected, erosion repaired, ponding water and drainage problems corrected.

01/27/93 **Noted Violations**—NOV Issued. Failure to notify within 48 hours of receiving groundwater sample results which indicate contamination; failure to arrange for a split sampling event; failure to sample for all required parameters. All violations are of 401 KAR 48:300.

05/19/93 Letter sent discussing notification requirements. DOE submitted revised method of dealing with ground water sample results. NOV resolved.

08/31/93 **Noted Violations**—NOV Issued. 401 KAR 40:010-4—Failure to comply with instructions to demonstrate compliance with groundwater maximum contaminant levels.

09/09/93 Letter sent rescinding violation due to DOE submitting adequate data and results.

Chronology of NOV's at the #073.15 Landfill

08/08/90 **Noted Violations**—NOV Issued 09/04/90. 401 KAR 48:060—Communication system inoperative; waste not spread or compacted; waste not covered within one week; interim cover is eroded; water ponding in one area.

12/12/90 Follow-up Inspection. Communication system operable, waste compacted and spread, interim cover erosion repaired, and ponded water area regraded. All previous violations corrected.

05/07/91 **Noted Violations**—NOV Issued 05/20/99. 401 KAR 48:060—Interim cover eroded; water was ponded in interim area.

06/26/91 Follow-up Inspection. Interim cover repaired, ponded water area regraded. All previous violations corrected. No violations noted.

01/30/92 **Noted Violations**—NOV Issued 02/14/92. 401 KAR 48:060—Water ponded east of interim area; entrance sign did not contain operating hours, both violations.

02/26/92 Follow-up Inspection. Re-inspection: Ponded water regraded, entrance sign corrected, All previously noted violations have been corrected.

09/02/93 **Noted Violations**—NOV Issued. 401 KAR 40:010-3—Failure to comply with written instructions to prove non-contamination.

09/09/93 Same letter sent for 073-014. NOV resolved.

Chronology of NOV's at the #073.45 Landfill

11/08/94 **Noted Violations**—Inspected by Donna Shartung: NOV issued 11/08/94. 401 KAR 40:020—Failure to notify the cabinet prior to well drilling.

11/24/94 Letter sent to DOE noting regulation requires notification. NOV considered resolved.

PADUCAH GASEOUS DIFFUSION PLANT—WATER QUALITY VIOLATIONS

KPDES PERMIT NO. KY0004049 AND KY0102083

Numeric violations of KPDES permit limits for conventional pollutants have generally been corrected by process control changes which resulted in more effective treatment. Corrections of numerical limit violations have generally occurred quickly, so there has not been formal Quarterly Non-Compliance Report (QNCR) action since 1994, other than the issuance of a Notice of Violation (NOV). Normally, if the problem persisted, a Demand Letter would be issued for the subsequent quarter, unless the problem were successfully addressed. (In 1997, for example, a Total Residual Chlorine exceedance was cited in one quarter and corrected before the next quarter. That was the most recent violation of a permitted effluent limit.) Currently, the facility is conducting a Toxicity Reduction Evaluation (TRE), to address toxicity problems which were identified in 1998.

PADUCAH GASEOUS DIFFUSION PLANT—AIR QUALITY VIOLATIONS

1. May 24, 1999 NOV from May 18, 1999, Inspection

May 24,1999 NOV for noncompliance with 401 KAR 58:040 Section 3(1) mailed to United Thermal Industries Incorporated a subcontractor engaged in asbestos removal for USEC. NOV required written response from contractor within fifteen days stating actions taken or to taken correct and prevent future violations.

United Thermal Industries, Inc. failed to have a current KY certification before engaging in the removal of asbestos. Reply to NOV received June 2, 1999, from United Thermal Industries, Inc. Application submitted to Kentucky Division for Air Quality for certificate did not contain requests for Supervisor certifications.

United Thermal Industries, Incorporated submitted applications for Supervisor Certification on May 18, 1999. The Kentucky Division for Air Quality issued Supervisor certifications 1500 hours on the same day.

NOV reply and actions taken by United Thermal Industries Incorporated were sufficient to resolve violation. No further enforcement action deemed necessary. No further violations cited against company.

2. NOV issued on August 28, 1997 from August 7, 1997 Inspection.

NOV issued to USDOE on August 28, 1997 for noncompliance with permit conditions as follows.

USDOE did not record pressure drops for the baghouse that controlled particulate emissions at the uranium hexafluoride cylinder grit blasting operation on September 9, 1996 and October 28, 1996.

USDOE did not promptly notify the Kentucky Division for Air Quality of the above deviations from the permit.

USDOE did not submit notification of start of construction of the vitrification of low level radioactive soil project to the Kentucky Division for Air Quality within thirty days.

NOV required written response from contractor within fifteen days stating actions taken or to taken correct and prevent future violations.

Reply from DOE received on September 11, 1997. DOE will specifically address the permit conditions in new contractor contracts after June 5, 1997. DOE states that they had notified the Cabinet that construction started on October 3, 1996. The Permit condition clearly states that the Kentucky Division for Air Quality is to be notified in writing. No such notification was received by the Division until after the NOV was issued. DOE requested that the violations be withdrawn. Violations were valid and were not withdrawn as requested. Inspections made in 1998 and 1999 found no further violations of these permit violations. No further enforcement action was taken as the violations did not repeat.

3. April 5, 1996 inspection report cites possible violation of 401 KAR 50:035 Section 5 for operating the northwest plume air stripper without a permit. Possible violation cited as DOE claims CERCLA exemption from permitting. More information requested.

April 26, 1996 letter from USDOE states that the project is subject to CERCLA and exempted from state permitting.

Letter of August 16, 1996 from Mr. Roger Cook, of the Kentucky Division for Air Quality Permit Review Branch to Jimmy Hodges, Site Manager, stating no permit is required for the NW plume project.

4. NOV issued on July 27, 1993 to USEC for violations of 401 KAR 61:015 and 401 KAR 5 0:06 Sections 2(2) and 4(1). Noncompliance with regulatory and permit opacity emissions limitations for #2 coal fired indirect heat exchanger.

NOV required written response from contractor within fifteen days stating actions taken or to taken correct and prevent future violations.

Reply received on August 18, 1993 from USEC. Number two indirect heat exchanger taken out of service on July 28, 1993. To ensure future compliance PGDP will switch to alternate indirect heat exchangers fuels when opacity is in excess of the standards.

Letter of September 1, 1993, from Ken Frye, Regional Supervisor, Kentucky Division for Air Quality, to Mr. Charles W. Martin, USEC, stating that August 18, 1993, reply was not totally satisfactory. Taking the #21 indirect heat exchanger off line was the proper action to take but more information on problems with the emission control units was required.

Problem ultimately resolved through repairs and improved operation of the heat exchanger and its control equipment.

5. NOV issued based on August 19, 1992 inspection cited denied access, refusal to release coal samples, and fugitive emissions.

Through several meetings with cabinet management, credentials and access problems were satisfactorily resolved. Coal samples were ultimately received after the cabinet asserted its authority to require them. Fugitive emissions were reduced through better controls, including more thorough and frequent watering of stockpiles and haul roads.

6. NOV issued June 7, 1991 for fugitive emissions from a coal stockpile.

Problem ultimately resolved through enhanced controls, mainly wet suppression.

RESPONSES FOR THE RECORD OF DAVID MICHAELS, ASSISTANT SECRETARY FOR ENVIRONMENT, SAFETY AND HEALTH, DEPARTMENT OF ENERGY

QUESTIONS FROM COMMITTEE ON COMMERCE

Question 1: Please provide one copy of the Department of Energy's (DOE) Phase I independent investigation report (independent investigation).

Answer: A copy of the independent investigation is provided for your information and use.

Office of Oversight
Environment, Safety and Health

Phase I
Independent Investigation
of the

Paducah Gaseous Diffusion Plant

Environment, Safety, and Health Issues

October 1999

Table of Contents

OVERSIGHT

Executive Summary

EVALUATION:	Office of Oversight Investigation — Phase I
SITE:	Paducah Gaseous Diffusion Plant
DATES:	August-September 1999

Background/Scope

In August 1999, in response to a number of environment, safety, and health (ES&H) allegations and concerns, the Secretary of Energy initiated an independent investigation at the Paducah Gaseous Diffusion Plant (PGDP or Plant). These ES&H concerns centered on areas such as improper onsite and offsite disposal of hazardous and radioactive materials, release of contamination into site streams and drainage ditches, inadequate posting and control of contaminated areas, exposure of workers to uranium and transuranic elements, and ineffective communication of hazards to workers.

To provide timely feedback to the Secretary on the current status of environmental protection, worker and public health and safety, and the status of legacy issues, this Department of Energy (DOE) Office of Oversight investigation was divided into two phases. Phase I, the subject of this report, covers the period from 1990 to the present. Phase II, which will begin in October 1999, will evaluate ES&H performance and concerns about Plant operations prior to 1990. Various assessments in the early 1990s, including a DOE Tiger Team and the initial investigation under the DOE Environmental Protection Agency Consent Order, identified numerous concerns about environmental contamination, radiological protection, and the presence of transuranic materials.

This first phase of the investigation focused on legacy areas and activities – those that remain the responsibility of DOE and its current management and integrating contractor, Bechtel Jacobs, which took over operation of the DOE-controlled activities at PGDP in 1998. The investigation did not examine areas leased by the United States Enrichment Corporation (USEC) that are under Nuclear Regulatory Commission (NRC) jurisdiction. NRC has undertaken a separate confirmatory inspection to assess worker safety in those areas of the PGDP under NRC control.

Rather than separately investigating each of the many specific allegations and concerns, the Office of Oversight investigation team independently examined the implementation of PGDP ES&H programs within which the allegations and concerns fell. These programs include public and environmental protection, radiation protection, worker safety, and line management oversight. This approach was chosen to identify issues and programmatic weaknesses that need to be corrected and help DOE to implement long-term and effective improvements in ES&H performance, rather than merely addressing symptoms.

Results

Although weaknesses remain, significant corrective actions and improvements have been implemented in PGDP ES&H programs since the early 1990s. The PGDP site is being cleaned up under enforceable agreements established with the Commonwealth of Kentucky and the Environmental Protection Agency. The site is currently in compliance with the terms of Federal Facility Agreements. Compensatory measures have been taken to protect the public and to mitigate the impact of radiological and chemical contamination, such as connecting homes that are in the path of contamination plumes to public water. In the worker safety arena, the radiation protection program has been enhanced, radiation exposures to employees have been low, and injury and illness rates at PGDP are lower than at many other DOE sites.

Despite the improvements since 1990 and actions to clean up the site, this investigation identified a number of weaknesses in each of the areas reviewed. While the investigation team found no immediate threat to health and safety that would require immediate cessation of site activities, the cumulative impact of a number of deficiencies is cause for concern.

Public and Environmental Protection. Extensive efforts have been undertaken at PGDP to characterize major sources of groundwater contamination, and the extent of that contamination, as a result of the 1988 discovery of contaminated offsite residential drinking wells. Limited progress has been made, however, in accurrately isolating or remidiating the numerous sources of offsite contamination. Groundwater contamination plumes now extend over two miles offsite and continue to grow at approximately one foot per day, and, in some areas, PGDP has not adequately characterized the plumes, including defining the leading edges. Most of the site's funding has been devoted to characterizing contamination, operating and maintaining the site infrastructure, meeting regulatory requirements, and implementing compensatory measures in reaction to immediate threats. The funding available for cleanup and remediation has been much less than requested, and little progress has been made. As a result, two of PDGP's early major cleanup milestones under the Federal Facility Agreement, to remediate Drum Mountain (also known as Barrel Mountain) and to characterize the waste unit beneath it, are in significant jeopardy of not being met. Examples of other deficiencies in environmental and public protection include:

Several thousand tons of nickel and aluminum ingots were produced. These materials are currently stored outside with no protection.

- Large quantities of scrap metal and low-level and mixed waste (equivalent to approximately 50,000 barrels) are stored in conditions that cause degradation of the containers (e.g., drums stored outdoors without protection from the weather) and the potential for spread of contamination.

- Numerous contaminated areas and shutdown process facilities have not been adequately characterized and analyzed to identify potential exposure pathways and have not been controlled and maintained to prevent the spread of contamination.

- Information provided to stakeholders, including workers, the public, and the Site Specific Advisory Board, has not been comprehensive or presented in a manner that is easy for a non-technical audience to understand (e.g., annual environmental reports do not reflect data resulting from site remediation investigations).

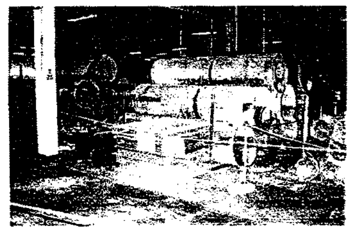
Radiation Protection. Since the early 1990s, the PGDP radiological protection program has been enhanced by adding radiation protection staff and establishing numerous controls, such as dosimetry (monitoring radiation exposure by means of a film badge), bioassay (monitoring radiation exposure by sampling body fluids), and contamination controls. Despite these improvements, the PGDP radiation protection program is not implemented with the level of discipline, formality, and rigor required for DOE facilities. Examples of deficiencies in radiological protection include:

- Insufficient radiological postings and barriers for contaminated areas, some of which are outside the security fence and could be accessible to the public

- Inconsistent implementation of radiological control mechanisms including radiation work permits, procedures, surveys, and air monitoring

- Subcontractors working in radiological exposure areas without the required training or dosimetry.

[illegible] safety and health since the early 1990s when the DOE Tiger Team assessment identified numerous [illegible] safety programs significant improvements [illegible] occupational and worker exposure hazards have been identified and analyzed, they are adequately controlled, and workers are more involved in work planning. However, improvements are needed in establishing, maintaining, and following procedures, particularly for work performed by subcontractors. Deficiencies in worker safety practices and controls indicate the lack of a disciplined, rigorous, and consistent approach to safety management. Other deficiencies were evident in such areas as:


DOE Material Storage Area

- Criticality safety hazards in DOE material storage areas (DMSAs) have not been characterized, analyzed, and resolved even though they were identified more than two years ago.

- Medical personnel have not been sufficiently involved in evaluating hazards to ensure the effectiveness of medical surveillance programs, particularly those for subcontractors.

- Worker training programs do not ensure familiarity with workplace hazards and have not adequately addressed the presence of transuranics (elements, such as plutonium, that have a higher atomic number than uranium). This shortcoming in training may have exacerbated workers' fear of exposure and contributed to instances of mistrust by workers.

Line Oversight. The operating gaseous diffusion facility was leased to USEC in 1993, and NRC's regulatory oversight of these leased facilities began in 1997. DOE retains regulatory oversight responsibility only for non-leased portions of the facilities. Line management oversight of ES&H by the DOE Oak Ridge Operations Office (OR) and the Paducah Site Office has been limited. DOE Headquarters ES&H oversight, including the program offices and the Office of Environment, Safety and Health, has also been very limited. Further, Bechtel Jacobs oversight of subcontractors' ES&H performance has not assured compliance with ES&H requirements. The lack of sufficient line oversight has contributed to situations in which previously identified problems and weaknesses have resurfaced and have remained uncorrected for extended periods.

Conclusions

Many improvements in ES&H programs have been made in the past ten years, and current operations do not present an immediate risk to workers or the public. However, the current radiation protection program and some elements of worker safety programs do not exhibit the required levels of discipline and formality. Further, there has been little progress in reducing or mitigating site hazards or sources of environmental contamination. Weaknesses in hazard controls are evident, ES&H oversight has not been sufficient, and communication with stakeholders and workers has not been comprehensive and responsive to stakeholder needs. In combination, these weaknesses undermine workers' and stakeholders' confidence and perpetuate the risks and hazards of legacy operations.

A key to regaining stakeholder, worker, and public support and confidence, reducing hazards and risks to as low as reasonably achievable, and ensuring the continuing operation of the PGDP is to begin to accelerate progress in the cleanup effort, including compliance with impending initial major cleanup milestones such as Drum Mountain and the waste buried beneath it. Timely progress in cleanup and remediation will require a reevaluation of priorities and funding allocations within the DOE Office of Environmental Management and OR and/or additional cleanup funding from Congress. Systematic progress needs to be demonstrated in key cleanup and hazard reduction efforts such as the elimination of the many sources of contamination, characterization and disposition of the DMSAs, including resolution of criticality safety concerns, the proper storage or shipment offsite of low-level waste, and the removal of hazards and proper upkeep or demolition of shutdown hazardous facilities. Other areas where timely improvement is needed include:

- Establishing a high level of discipline and rigor in the radiological protection program and other programs affecting worker safety, such as criticality safety. This effort should emphasize strict compliance with posting and barrier requirements, improved radiation work permits, comprehensive radiological training, strict use of and compliance with procedures, characterization of materials to improve effective hazard analysis, and the use of engineered hazard controls whenever possible.

- Strengthening communications and outreach to workers, the public, and stakeholders to ensure understanding, confidence in site operations, and empowerment in contributing to cleanup strategies, priorities, and decisions. This effort is particularly important for the Site Specific Advisory Board, whose charter is to contribute to site cleanup through involvement in establishing priorities and milestones and achieving public support.

- Restoring a reasonable level of DOE and contractor oversight of ES&H performance to ensure adequate subcontractor safety performance, accountability for compliance with DOE requirements, and continuous improvement.

Continued improvements in safety management will be particularly important as the PGDP initiates additional site cleanup and remediation activities. This work presents unique hazards (e.g., handling material that contains radioactive and chemical carcinogens and that has not been fully characterized) and has already resulted in several occurrences of workers being contaminated in the limited remediation efforts to date. The need for effective safety management is further highlighted by the fact that, under the management and integrating contractor concept, a large fraction of the potentially hazardous work will be performed by subcontractor employees, some of whom do not have a long-term knowledge of site hazards or controls. As subcontractors' cleanup and waste management activities increase, Bechtel Jacobs and DOE personnel who are knowledgeable of DOE requirements will need to increase their level of oversight.

OVERVIEW OF ISSUES

1. There has been limited progress in remediating and characterizing environmental contamination, low-level wastes, and stored hazardous materials that were produced by past industrial activities, and major cleanup milestones under the Federal Facility Agreement are jeopardized by funding constraints.

2. There are continuing weaknesses in the radiation protection management of known environmental contamination areas by both Bechtel Jacobs and DOE.

3. Radiological exposure pathways for DOE operations have not been fully assessed or documented.

4. Groundwater contamination has not been adequately characterized in some areas.

5. Unclear assignment of responsibilities and weaknesses in the integration and interpretation of environmental information have adversely impacted the understanding of environmental conditions.

6. Information to the public has sometimes been delayed and is in forms not clearly understood by the general public and other stakeholder groups, contributing to a perception that DOE and the contractor are withholding information from the public.

7. Incomplete radiological characterization of the workplace adversely affects the ability of the radiological control organization to identify hazards and institute controls as necessary to ensure consistent and appropriate radiological protection for workers.

8. There is a lack of rigor, formality, and discipline in the development, maintenance, and implementation of the Bechtel Jacobs radiation protection program.

9. Criticality safety deficiencies in DMSAs have not been resolved by DOE in a timely manner, posing an unnecessary hazard to workers in surrounding areas.

10. Safety and health procedures are not consistently applied and followed, and in some cases, hazards are not adequately addressed by those procedures.

11. **Bechtel Jacobs has not assured that subcontracted medical personnel are sufficiently involved in the identification, evaluation, and integration of workplace hazards to ensure effective worker medical programs.**

12. **Bechtel Jacobs training programs do not ensure that all workers are knowledgeable of hazards and protection requirements, including those associated with transuranic contamination.**

13. **DOE has not conducted effective oversight of ES&H or ensured that Bechtel Jacobs and its subcontractors effectively implement all DOE and regulatory requirements.**

14. **Bechtel Jacobs has not conducted fully effective oversight of ES&H performance or ensured that its subcontractors effectively implement all DOE and regulatory requirements and are held accountable.**

1.0 Introduction

1.1 Purpose and Scope

The Department of Energy (DOE) Office of Oversight, within the Office of Environment, Safety and Health, conducted an investigation of the Paducah Gaseous Diffusion Plant (PGDP or Plant) during August and September 1999. The purpose of this investigation was to determine whether current work practices for DOE-controlled areas of the site are sufficient to protect workers, the public, and the environment. This investigation was performed at the direction of the Secretary of Energy, who instructed the Office of Environment, Safety and Health to examine recent employee concerns with past operations and work practices, and current management of legacy materials at PGDP.

This investigation is being conducted in two phases. The first phase, the subject of this report, addressed DOE and site contractor activities and environment, safety, and health (ES&H) issues arising since 1990. The second phase will address legacy ES&H issues that occurred prior to 1990. This investigation is being coordinated with other organizations that have regulatory authority at PGDP, including the Commonwealth of Kentucky, the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA). Excluded from this investigation is any activity currently under NRC jurisdiction (i.e., the portions of the Plant leased to the United States Enrichment Corporation, or USEC).

The scope of the investigation includes: (1) facilities and properties under DOE jurisdiction; (2) ES&H issues associated with these facilities and properties from 1990 to the present, including interactions between DOE and stakeholders; and (3) ES&H issues associated with uranium enrichment facilities from 1990 to March 3, 1997 — the point when NRC assumed regulatory oversight of the gaseous diffusion processes, facilities, and personnel. The DOE-controlled operations that were examined include: landlord infrastructure; treatment, storage, and disposal of legacy waste remaining from past operations and newly generated waste; site remediation; uranium hexafluoride (UF_6) cylinder storage; facility decontamination and decommissioning; and polychlorinated biphenyl (PCB) collection, treatment, and cleanup. Consistent with the memorandum of understanding between the NRC and DOE regarding PGDP operation, any activities, operations, or facilities shared by USEC and DOE or its contractors were examined as part of this investigation.

1.2 Site Background, Operations, and Hazardous Materials

The PGDP is located in McCracken County, Kentucky, approximately 10 miles west of the city of Paducah and 3 miles south of the Ohio River. The site occupies about 3,425 acres, of which 750 acres are within a security fence and contain uranium enrichment process equipment and support facilities. The mission of the Plant is to "enrich" uranium for use in domestic and foreign commercial power reactors. Enrichment involves increasing the percentage of the uranium-235 isotope in the material used for creating reactor fuel (UF_6). Uranium-235 is highly fissionable, unlike the more common isotope uranium-238. The PGDP enriches the UF_6 from roughly 0.7 percent uranium-235 to about 2.75 percent uranium-235. This slightly enriched material is shipped to the Portsmouth Gaseous Diffusion Plant, where currently it is further enriched to 5 percent uranium-235. Figures 1, 2, and 3 are site maps and an aerial view of PGDP.

The PGDP was constructed in the early 1950s, and the first product cylinders with enriched uranium were shipped to Oak Ridge in late 1952. Carbide and Chemicals Company (now Union Carbide) was the original site contractor and operated the Plant for the Atomic Energy Commission. In the mid-1960s, the mission of the Plant shifted from military to commercial applications, and the Plant began enriching uranium for use in nuclear power plants. In 1975, the Energy Research and Development Administration assumed responsibility for regulatory oversight of the uranium enrichment program from the Atomic

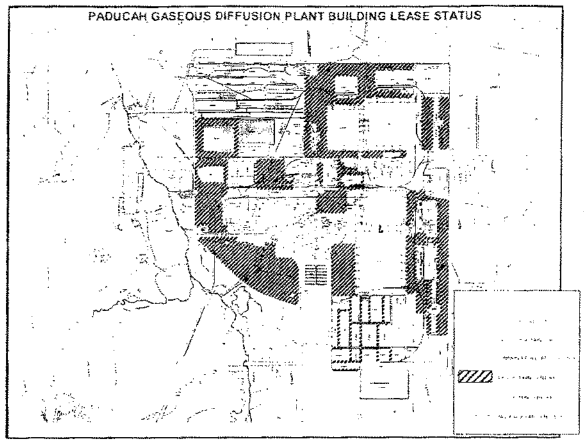


Figure 1. Map of Paducah Gaseous Diffusion Plant. Leased and Non-Leased Areas

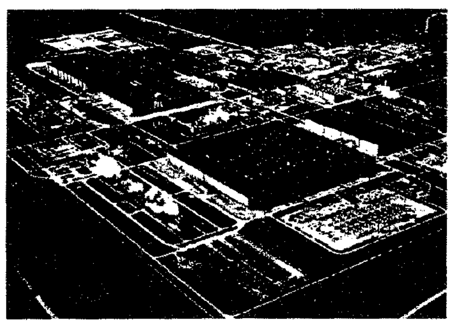


Figure 2. Aerial View of Paducah Gaseous Diffusion Plant

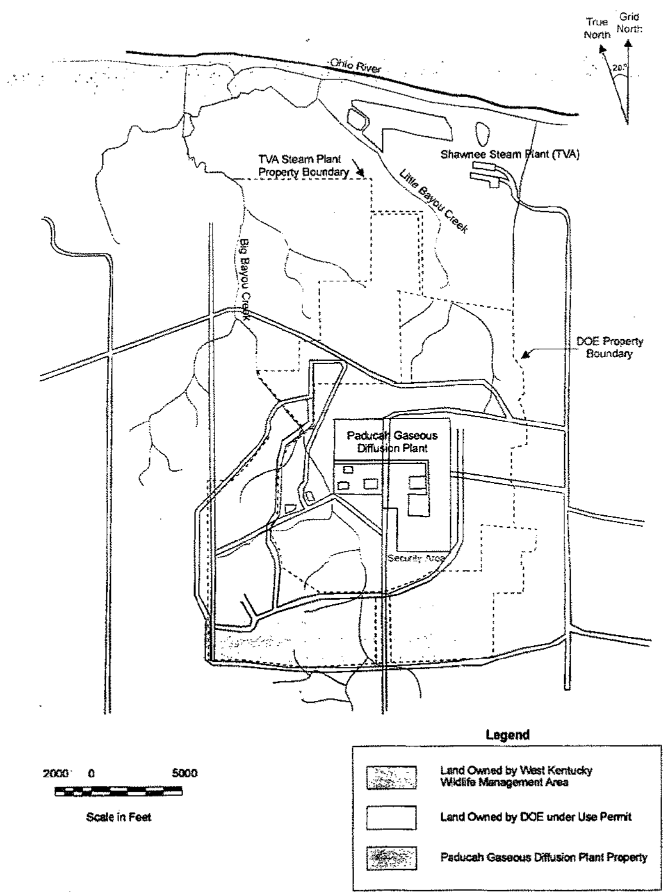


Figure 3. Map of Paducah Gaseous Diffusion Plant, Major Boundaries and Features

Energy Commission, in 1977, these functions were transferred to DOE. Martin Marietta became the operating contractor for the Plant, replacing Union Carbide, in 1984.

The Energy Policy Act of 1992 created USEC and was a first step in the process of privatizing the government's uranium enrichment enterprises. In July 1993, USEC leased portions of the Plant from DOE, assumed responsibility for uranium enrichment activities, and contracted with Martin Marietta Utility Services, a subsidiary of Martin Marietta, for operation and maintenance of enrichment activities. Through a June 1995 corporate merger, Martin Marietta Utility Services became Lockheed Martin Utility Services. NRC granted a certificate of compliance to the Plant in November 1996 under 10 CFR Part 76, and regulatory oversight of enrichment operations was transferred from DOE to NRC in March 1997. As a result of an initial public offering, USEC was privatized as an investor-owned corporation in July 1998. USEC took over direct operation of all enrichment activities at the Plant in May 1999, with most Lockheed Martin Utility Services personnel becoming employees of USEC.

DOE is the site "landlord," owns the physical plant, and is responsible for operation of the Northwest Groundwater Treatment Facility and three inactive landfills. DOE retains responsibility for the environmental restoration program, most elements of the waste management program, and all waste materials generated by past DOE activities. Bechtel Jacobs is the management and integrating contractor for DOE, having been awarded this contract in April 1998. Bechtel Jacobs relies on subcontractors to conduct environmental restoration and waste management functions. Simplified organization charts for the DOE Paducah Site Office and Bechtel Jacobs are shown in Figure 4.

USEC facilities consist of process buildings, electrical switchyards, a steam plant, a water treatment facility, a chemical cleaning and decontamination facility, and maintenance and laboratory facilities. Over its operating lifetime, PGDP has processed more than 1,000,000 tons of uranium. The process of enriching uranium at PGDP involves conversion of UF_6 to compressed gas, which is in turn fed through a series of diffusion stages; PGDP has over 1,800 diffusion stages. The diffusion process generates enriched uranium product and tailings. The product is then shipped to the Portsmouth Gaseous Diffusion Plant in Ohio for further enriching. The tailings, containing less than 0.5 percent uranium-235, remain on site in cylinders.

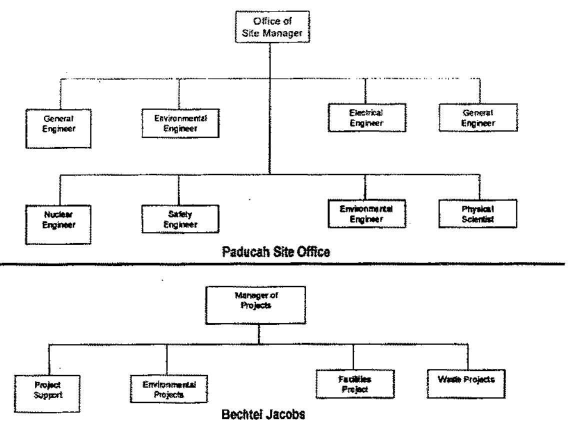


Figure 4. Simplified Organization Charts for the DOE Paducah Site Office and Bechtel Jacobs

During the Plant's operating history, the process of enriching uranium for military and commercial applications has in addition to the product and the tailings — generated other radioactive and non-radioactive wastes, and has introduced other materials to the Plant not associated with naturally occurring uranium. These waste materials include transuranic elements (isotopes with atomic numbers greater than uranium) such as neptunium-237 and plutonium-239, fission products such as technetium-99, PCBs, and volatile organic compounds such as trichloroethene (TCE). These waste materials present differing levels of risk to workers and to the public depending upon their concentration, pathway of release, and method of exposure. Figure 5 shows the historic process of uranium enrichment and its byproducts. Characteristics of selected hazardous materials (i.e., radioactive and non-radioactive) at the Plant are described on the page following Figure 5.

1.3 Past Worker Safety, Public Safety, And Environmental Protection Assessments

Since the mid-1980s, there have been a number of assessments and regulatory actions related to PDGP operations. These events resulted in the identification of issues in worker safety, public safety, and environmental protection and established a series of actions required of DOE and contractor management to ensure resolution of the issues. Corrective actions were developed to address some of the issues and concerns identified in the studies discussed below. The investigation team did not individually evaluate the effectiveness of each corrective action.

The Report of the Joint Task Force on Uranium Recycle Materials Reprocessing. In April 1985, a DOE task force evaluated the adequacy of practices to support handling of radioactive contaminants in uranium recycle materials at the Oak Ridge Y-12 Plant, the Fernald Materials Production Center, and at the RMI Company (in Ashtabula, Ohio), and examined past operations at the PGDP and the Portsmouth Oxide Conversion Facility. The task force concluded that an in-depth examination of handling and processing practices at PGDP was warranted, that quantities of recycle materials with undetermined levels of contaminants were present at PGDP, and that PGDP was periodically receiving commercially-produced UF_6 containing trace levels of transuranic elements. This study recommended that PGDP line management assess worker exposures to transuranic elements and fission products from processing of recycled materials and recommend a feasible method for disposing of uranium recycle material.

Identification of Groundwater Contamination and Development of Administrative Consent Order. In 1988, concerns over residential water quality led to sampling of residential wells north of the Plant and discovery of TCE, an industrial degreaser, and technetium-99, a product of fissioning nuclear fuel. This discovery prompted the government to provide municipal water free of charge to all residences and businesses in an area bounded by the Ohio River to the north, by the DOE property to the south, by Metropolis Lake Road to the east, and by Bethel Church Road to the west. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE and the EPA developed an Administrative Consent Order, effective November 23, 1988, that established a schedule to investigate and remediate offsite groundwater contamination. Phase I, conducted in 1989 and 1990, identified contaminants of concern and solid waste management units (SWMUs) that could have contributed to offsite contamination, outlined the physical characteristics of the SWMUs, and described the risk of offsite contamination. Phase II, conducted in 1990 and 1991, further assessed the risk of offsite contamination, characterized SWMUs that could have contributed to offsite contamination, and identified migration pathways for contaminants. A summary of key SWMUs, as characterized in Phase II, is provided in Appendix B.

Office of Environment, Safety and Health Assessments. In the late 1980s and early 1990s, the DOE Office of Environment, Safety and Health conducted a number of assessments of ES&H activities and programs at PGDP. These assessments examined such areas as radiation protection, health physics, industrial hygiene, and industrial safety. Among the weaknesses identified were inadequacies in construction area hazard posting and control, failure to consistently use personal protective equipment, limitations in the systems and equipment used to measure potential exposures to transuranic elements, and the absence of monitoring of stack effluents and waterborne pathways for the presence of transuranic activity. (e.g., neptunium). Improvements were noted in such areas as the process for conducting frisking for contamination and the hazard communication labeling program.

Drum Spill. In March 1990, an accident during routine waste handling operations in Building C-746-Q Warehouse resulted in the breaching of one drum waste controlled under the Resource Conservation and Recovery Act (RCRA). High levels of alpha contamination were present at the spill site, and review of storage records prompted radiological control personnel to conduct transferable contamination surveys for isotopic analyses. Transuranic contaminants in the spilled material included americium-241, plutonium-239, plutonium-240, and neptunium-237. These results led

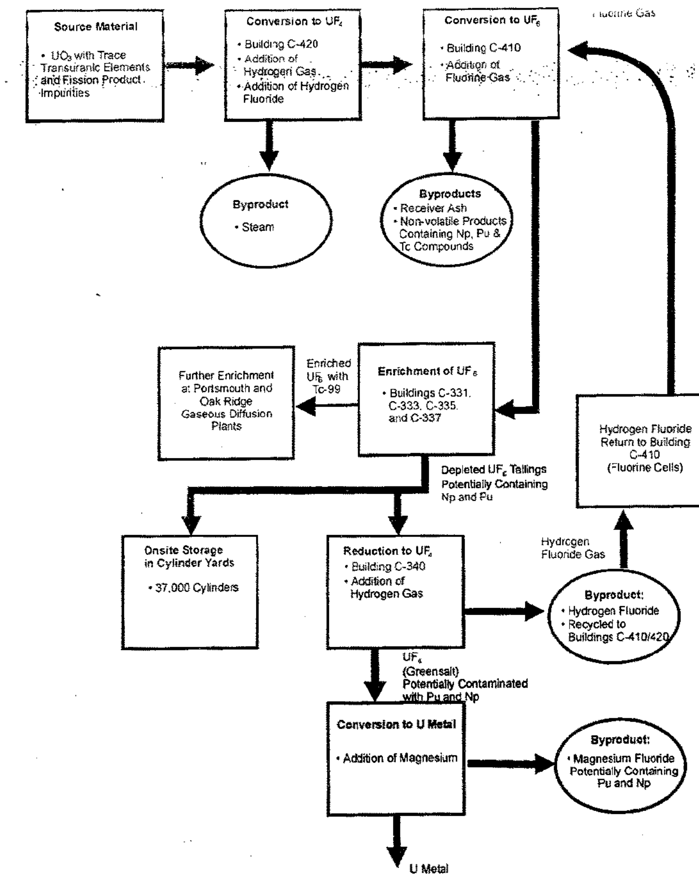


Figure 5. Schematic of Historic Uranium Enrichment Process

CHARACTERISTICS OF SELECTED HAZARDOUS MATERIALS AT PGDP

Radioactive Materials

- ***Uranium*** *– An element that naturally occurs in the earth and is mined for commercial purposes. Natural uranium is 99.3 percent U-238 and 0.7 percent U-235; U-235 is used as nuclear reactor fuel. Enriched uranium contains more U-235 and depleted uranium contains less U-235 than natural uranium. U-238 has a radioactive half-life of 4,470,000,000 years (the period of time for material to decay to half of its initial radioactive amount). Once in the body, uranium may concentrate in the kidneys and bones or lungs, depending on its solubility. As a heavy metal, uranium is toxic and can damage the kidney. At enrichments less than 10 percent (PGDP's maximum enrichment is less than 5 percent), uranium's chemical toxicity to the kidney predominates over its radiological hazards.*

- ***Transuranic Elements*** *– A series of elements whose atomic numbers are greater than 92 (i.e., greater than uranium) and can be produced when U-238 absorbs neutrons as part of a nuclear reaction. Among the transuranic elements are neptunium and plutonium. Transuranics were introduced to the Plant when spent reactor fuel was processed.*

  - ***Neptunium-237*** *– Np-237 has a radioactive half-life of 2,140,000 years. Once in the body, Np-237 concentrates in the bones and liver.*

  - ***Plutonium-239*** *– Pu-239 has a radioactive half-life of 24,065 years. Once in the body, Pu-239 concentrates in the bones.*

- ***Fission Products*** *– A series of elements that are created when U-235 is split by neutrons as part of a nuclear reaction. The products of this splitting are typically elements with atomic mass numbers in the range of 80 to 108 and 125 to 153. Among the fission product elements are technetium and strontium. Fission products were introduced to the Plant when recycled uranium from spent reactor fuel was received from other DOE sites.*

  - ***Technetium-99*** *– Tc-99 has a radioactive half-life of 213,000 years. Tc-99 is highly mobile in groundwater and is readily absorbed throughout the body, contributing relatively little radioactive dose compared to transuranic elements. If deposited in the lung, Tc-99 would only remain in the lung for a period of weeks.*

  - ***Strontium-90*** *– Sr-90 has a radioactive half-life of 29 years. Similar to Pu-239, Sr-90 concentrates in the bones. However, if inhaled, Sr-90 would only remain in the lung for a period of days.*

Hazardous Materials

- ***Trichloroethene*** *– TCE is a colorless liquid with a chloroform-like odor that is often used as an industrial degreaser. TCE is a mild irritant to the respiratory tract and the skin. Critical exposure pathways are inhalation, ingestion, and skin or eye contact. When humans are exposed, TCE concentrates in the respiratory system, heart, liver, kidneys, central nervous system, and skin.*

- ***Chlorodiphenyl or Polychlorinated Biphenyl*** *– PCB is colorless to lightly-colored, viscous liquid with a mild odor that is generally used as a cooling medium in transformers and at PGDP in ventilation system gaskets as a fire retardant. The critical pathways of exposure are inhalation, ingestion, and absorption. When humans are exposed, PCBs concentrate in the skin, eyes, and liver.*

to surveys of other Plant areas. Several transuranic areas were posted as hazards, and controls commensurate with the potential hazard were established

DOE Tiger Team Assessment. A concern regarding ES&H conditions at all DOE sites led a Tiger Team assessment of PGDP in June-July 1990. The assessment concluded that ceasing PGDP operations was not warranted, that compliance issues were known by Federal and State agencies issuing permits, and that the following ES&H and management issues required prompt attention:

- Environmental monitoring and evaluation programs were not being effectively implemented due to a lack of technical direction, formal procedures, and a coordinated quality assurance program.
- Formal procedures for implementing environmental protection activities were lacking, and quality assurance programs had not been implemented for many environmental activities.
- Compliance with DOE orders and mandatory standards for worker safety and health was deficient, as was the system for managing administrative control documents.
- Training and certification programs did not meet site needs.
- Instrument calibration practices did not always meet minimum standards
- There was no long-range plan for safe storage of UF_6 cylinders.
- No integrated sitewide management system was available to track and correct identified deficiencies.
- DOE was not performing effective oversight to ensure that ES&H initiatives were being implemented.
- The site contractor did not have a corporate strategic plan to accomplish DOE's ES&H objectives.

DOE Office of Nuclear Safety Radiological Oversight. In 1994, DOE's Office of Nuclear Safety evaluated the PGDP radiological protection program. The evaluation identified two strengths and five programmatic issues. The strengths included a highly competent and experienced contractor management team that was aware of the elements of effective radiological control. The programmatic issues included (1) the need to establish standards for the sitewide radiological control program, (2) the need for substantive improvement in management systems that affect contamination control, (3) the need to improve radiological control technical bases, and (4) the need to improve the radiological control training program.

Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 95-1. In May 1995, the DNFSB issued recommendation 95-1 in response to a concern over the deteriorating conditions of cylinders housing solid UF_6 across the DOE complex. At PGDP, there are more than 37,000 cylinders. The DNFSB concluded that poor maintenance and storage conditions, combined with mechanical damage suffered during handling, led to corrosion and subsequent breaching of several cylinders. It was the DNFSB's view that prompt remedial actions should include: (1) a program to renew the protective coating of cylinders; (2) an evaluation of additional measures to protect these cylinders from the damaging effects of exposure to the elements; and (3) a study to determine whether a more suitable chemical form should be selected for long-term storage of the depleted uranium.

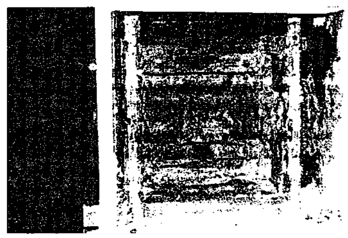
DOE Office of Occupational Medicine and Medical Surveillance "Needs Assessment." In 1996, the Paducah Site Office asked the Office of Occupational Medicine and Medical Surveillance, within the Office of Environment, Safety and Health, to determine whether the available occupational medicine services were sufficient to meet the needs of the DOE Office of Emergency Management and USEC contractor and subcontractor personnel at PGDP. The assessment concluded that the occupational medicine program provides good medical services to workers, although services were more oriented to family practice than to occupational health. Advanced life support services were judged to be sophisticated and of high quality. Occupational health services were found to lack formal linkage between the health and safety organization and the onsite medical department of DOE and USEC. The lack of information sharing among health professionals was also cited as a weakness.

Department of Health and Human Services (DHHS) Public Health Assessment. DHHS completed a draft public health assessment of PGDP in the fall of 1999, which is required for all sites on the EPA's National Priorities List; the Plant was designated as such in May 1994. A draft of the assessment concluded that, under normal operating conditions, PGDP does not currently pose a health hazard to offsite populations, although members of the public near PGDP may be exposed to low levels of contamination. This conclusion assumes that access restrictions and fish advisories remain in effect. DHHS also concluded that a future groundwater pathway could exist if new wells are drilled into plumes northeast and northwest of PGDP by future landowners. Contaminated surface water, soil and sediment, and biota surrounding the Plant were judged to pose no health hazard due to the low levels of exposure. Offsite transportation of cylinders containing depleted uranium was examined as a potential public health hazard. DHHS concluded that a transportation accident involving a fire and rupture of a cylinder would pose an urgent public health hazard to individuals within 70 meters of the ruptured cylinder, although the probability of this event is very low.

1.4 Recently Identified Concerns

There have been recently identified concerns associated with prior operations, past work practices, and the management of legacy materials (those remaining from past operations) at PGDP. These concerns, described in more detail in a series of disclosure statements made by three current and/or former Plant employees and one member of a private interest group, can be characterized as follows:

- Information provided to DOE, the Commonwealth of Kentucky, and the public regarding the nature of occupational risks and levels of offsite contamination was incomplete and/or not fully accurate.
- Safety-related roles and responsibilities were not clearly assigned, so key safety responsibilities are not being properly addressed.
- Contractor management discouraged personnel from raising safety issues, and/or concerns that were raised were not addressed in a timely manner.
- Information on site hazards was not communicated to workers in a timely manner and/or training programs were not sufficient or rigorous enough to convey these hazards to workers.
- Hazard controls (administrative and engineering controls, and use of personal protective equipment) for workers in radiation areas did not ensure adequate protection.
- Occupational radiation exposures were not accurately communicated to workers.
- Radioactive and hazardous materials were disposed of in unapproved onsite and offsite locations, were improperly shipped, and/or were not surveyed before leaving the site.


Quantities of uranium materials are clearly evident at product handling points in Building 340.

1.5 Investigative Approach

To support the overall objective of determining whether current work practices are sufficient to protect workers, the public, and the environment, the Office of Oversight investigation team interviewed personnel; observed work activities; performed walkdowns of facilities, work areas, and the site grounds; sampled and analyzed groundwater, surface water, sediment, and soil; conducted radiological surveys; and reviewed documents. Issues identified by the investigation team are summarized in Appendix A of this report.

Over 100 interviews were conducted with DOE Headquarters, Oak Ridge Operations Office (OR), and Paducah Site Office personnel; Bechtel Jacobs and subcontractor managers, supervisors, and workers; selected USEC personnel; and stakeholders. USEC personnel were interviewed to clarify the nature of DOE activities conducted in USEC-controlled space and to better understand how USEC performs work for Bechtel Jacobs under a subcontracting arrangement. To ensure that an accurate record of interviews was maintained, 25 formal interviews with DOE and Bechtel Jacobs personnel were captured in transcripts.

The investigation team observed numerous facilities and work areas to familiarize themselves with Plant operations, work practices, and hazard controls. Essentially all DOE-controlled Plant facilities, waste and material storage areas, and site grounds were visited by the investigation team. Many facilities and storage areas were examined multiple times. A variety of job planning, maintenance, and operational activities were also observed to understand how work activities are planned and executed.

The investigation team collected over 30 samples from groundwater wells, surface water sources, sediments, and soil, as well as from materials, equipment, and facilities (see Section 2.1 for more information). Samples were collected both inside and outside the perimeter security fence. These samples were evaluated for the presence of radioactive and non-radioactive contaminants. Most samples were "split" or separated into two samples for purposes of running a parallel test, and samples were maintained under a strict chain of custody.

To supplement the interview, observation, and sampling processes, hundreds of documents — including plans, procedures, and assessments — were reviewed by the investigation team. These reviews provided crucial perspectives on the assignment of roles and responsibilities, conduct of work activities, and the record of assessment findings. This extensive process for gathering information enabled the team to proceed in a structured fashion to: (1) understand conditions as they existed in 1990; (2) fully comprehend the issues being raised regarding past operations, past work practices, and management of legacy materials; (3) evaluate the effectiveness of actions taken by the Plant in the last decade to address ES&H issues, and (4) assess current conditions at the site and their impact on worker safety, public safety, and the protection of the environment. These evaluations are documented in the remainder of this report.

The sampling team collected soil samples at the base of Drum Mountain. Grass areas were surveyed at 8 million disintegrations per minute with visible uranium materials present.

2.0 Assessment of Current Conditions

In keeping with the investigation team's mission of evaluating current conditions at the Plant and their impact on ES&H, the results of these evaluations are organized in three main sections — Public and Environmental Protection (Section 2.1), Radiation Protection and Worker Safety (Section 2.2), and Line Oversight (Section 2.3). The Public and Environmental Protection section examines existing pathways for hazardous materials to be transported to the environment, the types of effluents that are being transported, legacy sources of contamination, the extent of contamination in groundwater and in surface waters, the site's efforts undertaken by the site to control contamination, key results from the sampling and analysis conducted by the investigation team, and the effectiveness of efforts to provide information to the public and other stakeholders. The Radiation Protection and Worker Safety section outlines the nature and extent of risks that workers face at the site from both radiological and non-radiological hazards, the use of engineering and administrative controls to mitigate these hazards, and the effectiveness of systems for planning and managing work at the site. The Line Oversight section examines the effectiveness of DOE and contractor management functions that are necessary to ensure protection of workers, the public, and the environment.

2.1 Public and Environmental Protection

Since the 1950s, past industrial operations at PGDP produced large quantities of legacy materials that have been disposed of in landfills or burial grounds, released into the environment, or placed in long-term storage. Current DOE operations at PGDP focus primarily on the administration of programs to address legacy materials and on infrastructure maintenance.

DOE has the responsibility to characterize and control emissions of contaminants into the environment from DOE operations or past practices. To characterize chemical and radionuclide effluents into the environment from DOE operations at PGDP, the site has established an environmental monitoring program as required by DOE Order 5400.1, *General Environmental Protection Program*. Compliance with the terms of the Commonwealth of Kentucky permit for discharges of liquid effluents is also monitored on a routine basis. In addition to routine environmental monitoring, DOE, with oversight by the EPA and the Commonwealth of Kentucky, is conducting extensive investigations into the nature and magnitude of contamination in the environment as provided for in agreements and permits.

Current Pathways for Contaminant Transport in the Environment from DOE Operations Include:

- *Discharges of process and stormwater runoff from the site into local surface water bodies*
- *Sediment transport through erosion and surface water runoff*
- *Air emissions from diffuse sources, such as wind-blown dispersion of surface contamination and suspension of contaminated dusts by vehicle traffic*
- *Rainwater infiltration, leaching, and transport of contamination into the groundwater from former spills, burial grounds, and landfills*

Investigations conducted in 1990 and 1991 reported that the offsite contaminated groundwater plumes are some of the largest in the DOE complex.

Investigations conducted in 1990 and 1991 reported that the offsite contaminated groundwater plumes are some of the largest in the DOE complex. Additionally, numerous areas of radiological and chemical contamination have been discovered within the site security fence, outside the security fence on surrounding DOE property, and in offsite areas now managed by the State of Kentucky Fish and Wildlife Service.

Sources of contamination include waste burial grounds, old sanitary landfills, scrap yards, waste lagoons, spill sites, and leaks from contaminated buildings. These areas will be examined in more detail in Phase II of this investigation.

Interim steps have been taken since 1990 to protect the environment and public health. Groundwater pumping and treating efforts have helped to impede some of the highest areas of contamination. In a defined area referred to as the water policy area, alternative sources of water have been provided to residents with contaminated wells. These steps have reduced public risk, but contamination sources still exist, and the groundwater plumes have continued to spread from the site at approximately one foot per day.

Cleanup plans and strategies have been developed in accordance with Federal environmental regulations. The site is currently in compliance with the provisions of the Federal Facility Agreement. DOE developed a Site Management Plan that includes program management requirements and a Site Remediation Strategy to coordinate RCRA and CERCLA cleanup requirements. The Site Remediation Strategy defines remediation priorities and provides a framework for establishing site-specific goals that are consistent with the overall cleanup goals and priorities outlined in the OR document, "U.S. DOE Accelerating Cleanup: Paths to Closure," revised May 1999.

Activities to Control Migration of and Exposure to Contaminants at PGDP

- *Supplying public water to residents and businesses with the potential for contaminated drinking water wells*
- *Installing limited groundwater pump and treatment systems on the Northwest and Northeast Plumes*
- *Placing sediment fences around the scrap yard*
- *Diverting the discharge from the North-South Diversion Ditch through the wastewater treatment plant*
- *Installing clay caps on some old landfills*
- *Excavating "hot spot" PCB contamination*
- *Retrieving contaminated material from the Ballard Wildlife Area*

DOE has taken a number of steps to improve the efficiency of site cleanup operations.

DOE has taken a number of steps to improve the efficiency of site cleanup operations. A management and integration contract was established to increase accountability for meeting cleanup milestones. DOE waste areas were organized into a smaller number of operable units to accelerate regulatory review and approval of cleanup methods and strategies. Actions have been taken to control waste management activities at the point of generation and in the facilities regulated by external environmental requirements. These actions include developing and implementing procedures for managing and disposing of waste generated by DOE operations at the site. In part, these procedures were developed to address findings from the 1990 DOE Tiger Team assessment involving waste management, waste characterization, and the scrap yard and landfill operations.

In addition, the site constructed two new waste management facilities, built a new landfill, and adequately maintains existing waste management facilities for regulated waste streams including hazardous waste, asbestos and PCB wastes, and sanitary waste. The site's waste acceptance criteria document, revised in May 1999, provides guidance and requirements for meeting the acceptance criteria for these facilities for most waste streams generated by DOE operations at the site.

Radiological and chemical contamination from past industrial activities at PGDP has been released into the surrounding ground, soil, and air.

Radiological and chemical contamination from past industrial activities at PGDP has been released into the ground, soil, and air around the Plant. Effluents from current DOE operations appear to be in compliance with State discharge limits. Radiological and chemical contamination has spread from the site boundary into the groundwater and surface sediments, particularly into the Big and Little Bayou Creeks, and is documented in investigation reports published by DOE. Contamination continues to propagate in these media, prompting DOE and regulatory organizations to take precautionary steps to protect public health, such as connecting local residents to public water supplies and limiting public use of lakes and sections of local streams and ditches. Contamination continues to migrate from source areas into the environment. However, based on the limited duration of public exposure to contamination and the mitigation measures taken to prevent the consumption of contaminated water and foodstuffs, DOE operations at PGDP do not now present a significant public health risk.

Limited progress has been made in remediating hazardous material source areas.

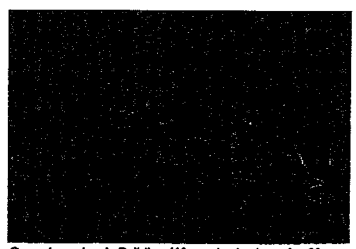
Despite the limited public health risk, significant improvements in protecting the public and the environment are needed. Limited progress has been made in remediating hazardous material source areas such as landfills, burial grounds, and waste and scrap piles. Limited funding has played a significant role. Additionally, weaknesses in characterization of groundwater and surface contamination were identified. Controls to prevent the spread of contamination have not yet been fully implemented. While limited in magnitude, some radiological exposure pathways to the public have not been fully assessed or evaluated. These include airborne fugitive emissions from contaminated areas and the direct radiation from cylinder yards. Although improvements were noted in most waste management practices, the investigation team noted a number of concerns, primarily relating to inappropriate storage of legacy waste materials. Additionally, program management weaknesses were identified within the Paducah Site Office and Bechtel Jacobs regarding their ability to integrate and interpret environmental information. Technical personnel are not assigned or available in sufficient numbers to interpret the vast amounts of data associated with specific environmental disciplines, such as groundwater and environmental radiation protection. Finally, public communication has not been effective in providing information regarding environmental contamination and cleanup initiatives, contributing to the perception among some stakeholders that DOE and the contractor are withholding information.

Issues

1. **There has been limited progress in remediating and characterizing environmental contamination, low-level wastes, and stored hazardous materials that were produced by past industrial activities, and major cleanup milestones under the Federal Facility Agreement are jeopardized by funding constraints.** A key element contributing to the lack of progress is limited available funding. DOE has not provided sufficient funds to significantly reduce sources of contamination, such as buried wastes, soil contaminated by previous spills and releases, exposed contaminated scrap metal and waste materials, and degrading contaminated buildings. The scope of PGDP work funded by DOE has been limited primarily to characterizing contamination, operating and maintaining the site infrastructure, meeting regulatory requirements, and controlling the spread of contamination. While the site is currently in compliance with the 1998 Federal Facility Agreement, near-term milestones are in jeopardy. Progress has been limited in the following areas.

Contamination continues to propagate at one foot per day and now extends for over two miles.

- Most of the sources of contamination identified in 1991 still remain. Contaminated materials from burial grounds, old landfills, inactive waste lagoons, or spill sites have not been removed or treated. Groundwater plumes containing TCE and technetium-99 that have resulted from some of these sources continue to propagate at one foot per day and now extend for over two miles.



One ash receiver in Building 410 remains in place after 22 years, held in place by corroded C-Clamps. Uranium materials were clearly migrating from the receiver.

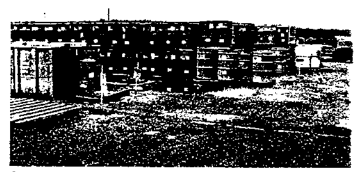
Shutdown buildings have been allowed to deteriorate and are subject to animal infestation, broken windows, and leaking roofs.

- Contaminated process buildings, which were shut down over 20 years ago and for which no future use is expected, have not been adequately maintained or taken down. Residual materials have not been fully analyzed or removed, and surveys indicate that contamination is spreading within the buildings. Large volumes of low-level radioactive wastes remain stored within the buildings. These shutdown buildings have been allowed to deteriorate and are subject to animal infestation, broken windows, and leaking roofs. They are not included in the 2010 cleanup schedule, and they are increasing in risk and cost to decommission.

- A large volume of contaminated waste materials (Drum Mountain) and scrap metal that has accumulated since the 1950s is stored outside in piles and inside the Plant security fence. These areas continue to contribute contamination to the environment through surface water runoff and dispersion. The Federal Facility Agreement requires removal of this material from Drum Mountain and beneath it by 2003. The site estimated and requested funding, but current budget proposals provide only $1.3M (versus $3.6M required) for fiscal year 2000 and $3.2M (versus $13.7M required) for fiscal year 2001 (see Figure 6).

Disposal of low-level waste has received low funding priority because there are no regulatory requirements or identified safety concerns requiring near-term disposition.

- A total of 6,444 cubic meters (equivalent to approximately 31,000, 55-gallon drums) of low-level waste are stored onsite at PGDP. This includes 1,775 m^3 stored outside in over 8,000 containers that were not designed for long-term storage. Many of the containers stored outside are severely degraded, and some have leaked as a result. Much of the site's low-level waste is not fully characterized for shipment, and some may contain transuranic materials. Disposal of this waste has received low funding priority because there are no regulatory requirements or identified safety concerns requiring near-term disposition. As a result, only 157 m^3 have been shipped from the site since 1990. The schedule for completing disposal has subsequently changed from fiscal year 2006 to fiscal year 2012. Additionally, current funding targets assume that no new waste management facilities will be needed to accomplish the site mission. This assumption does not take into account necessary efforts to open, inspect, and characterize the thousands of low-level and mixed waste drums currently stored onsite. Elsewhere in the DOE complex (Rocky Flats Environmental Technology Site and Nevada Test Site), engineered facilities are used to conduct these characterization and segregation efforts. Such facilities would significantly reduce the risk to the workers who open the containers for inspection and characterization.



Outdoor drum storage

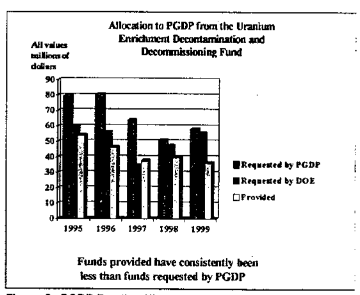
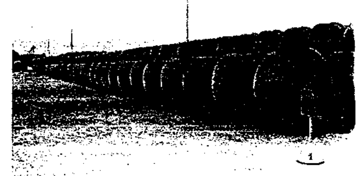


Figure 6. PGDP Funding History
(Budget information provided by Bechtel Jacobs)

DMSAs contain large amounts of uncharacterized material.

- DOE Material Storage Areas (DMSAs) belonging to DOE but located in facilities that have been leased to USEC, contain large amounts of uncharacterized material that includes drums labeled as asbestos waste, drums labeled as containing detectable levels of PCBs, and old electrical equipment. A multiyear project to characterize this material has identified waste regulated under RCRA. DOE is not managing DMSAs pursuant to either RCRA or CERCLA regulatory requirements.

- The nearly 37,000 UF_6 cylinders stored on site in the open at PGDP constitute a radiological exposure hazard and a potential threat to worker and public health in the event of fire and rupture. In 1995, the DNFSB recommended upgrading the condition of the cylinders and converting the UF_6 to a more stable form. Plans to paint 1,400 cylinders (to seal them) were cancelled due to funding constraints, and funds for a UF_6 conversion facility have not yet been appropriated.



Approximately 37,000 cylinders of UF_6, each containing up to 14 tons, remain stored on site pending conversion to more stable forms.

- The published accelerated cleanup schedule for remediation of environmental hazards at PGDP is not realistic. PGDP received a total of $36M for fiscal year 1999. Site estimates indicate that PGDP will require significant increases in funding, up to $160M in fiscal year 2008, to meet the completion goal of fiscal year 2012. The scheduled completion date is based on an assumed increase in funding for PGDP. Nevertheless, appropriations have decreased significantly since 1995, despite requests for increases, and have been significantly below the targets necessary to accomplish the accelerated cleanup. The funding necessary to accomplish the 2012 goal will not be available without a significant change in appropriations. As indicated in Figure 7, current funding levels will extend site cleanup until 2020, well beyond the required 2012 milestone.

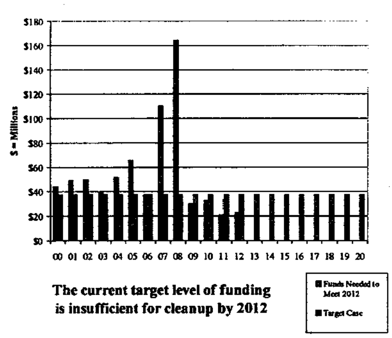


Figure 7. PGDP Funding Requirements vs. Target, Fiscal Years 2000-2020

The Site Remediation Strategy does not reflect the increasing risk and cleanup costs associated with decontamination and decommissioning of shutdown process buildings.

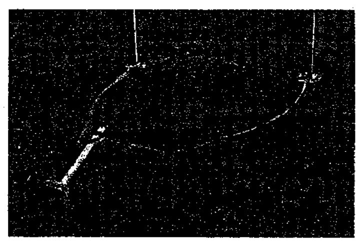
- The Site Remediation Strategy does not reflect the increasing risk and cleanup costs associated with decontamination and decommissioning of shutdown process buildings. The schedule also assumes the success of cost-saving initiatives, such as reduction of overhead expenses by use of an management and integrating contractor, use of a revised documentation strategy to limit the number of remedial investigations and feasibility studies, significant cost savings by recycling scrap left on site, and reduction of long-term site maintenance costs by replacing the current pump-and-treat approach to groundwater remediation with a passive alternative. Achieving the necessary cost savings through these initiatives has not been demonstrated.

DOE has not been successful in conveying needs and obtaining congressional funding for cleanup of PGDP.

- DOE has not been successful in conveying needs and obtaining congressional funding for cleanup of PGDP. PGDP has consistently been allocated less funding than requested for waste management and environmental remediation. These reductions occurred during a period when environmental risks and regulatory commitments for cleanup were increasing. Cleanup activities at PGDP have been funded almost entirely from the Uranium Decontamination and Decommissioning Fund. A 1998 report to Congress by DOE on the use of this fund did not identify the need for additional funds to keep the contamination at PGDP from spreading to the surrounding environment. This OR-prepared report emphasized accomplishments, but did not discuss the challenges faced at the site to reduce and prevent spread of contamination to the environment within a declining budget.

2. **There are continuing weaknesses in the radiation protection management of known environmental contamination areas by both Bechtel Jacobs and DOE.** These include deficiencies in radiological characterization, posting, contamination control, and application of principles to reduce environmental hazards as low as reasonably achievable (ALARA). Such weaknesses are contrary to sound health physics practices and the radiological expectations delineated by DOE in orders, regulations, and standards.

The full extent of radiological contamination both inside and outside the site security fence has still not been characterized through a sitewide survey and sampling program.



This area was recently discovered near the S&T Landfill. Black "ooze" was discovered to be radiologically contaminated. This area has been covered and posted, pending further investigation.

- **The areas of most significant radiological contamination have been identified during past investigations; however, the full extent of radiological contamination both inside and outside the site security fence has still not been characterized through a sitewide survey and sampling program. For example, an area of contamination adjacent to the S Landfill was recently identified. At this location, a tar-like substance reading 43,000 disintegrations per minute was discovered and subsequently covered and posted to control access. There is no documented listing or database of radiologically contaminated areas other than what is included in the SWMU list, which is not maintained by the radiological control organization and does not clearly designate contaminants of concern for each SMWU.**

Areas of contamination that exceed Bechtel Jacobs radiological posting criteria were noted.

- The investigation team noted areas of contamination that exceed Bechtel Jacobs radiological posting criteria in Kentucky Permit Discharge Elimination System Outfall 011, the North-South Diversion Ditch, and along Little Bayou Creek at some distance from the site security boundary. Under the Bechtel Jacobs health physics procedures, these areas would require posting as soil contamination areas and/or contamination areas, and appropriate measures would be needed to prevent inadvertent entry. Some of these areas are currently posted with signage and wording that are the result of CERCLA Records of Decision or interim corrective measures, but these postings are not consistent and, in some cases, do not specify the presence of a radiological hazard. Neither DOE nor Bechtel Jacobs could provide a basis for not controlling such areas in accordance with the Bechtel Jacobs radiation protection program. The relationship among the radiation protection program, DOE orders, 10 CFR 835 (Occupational Radiation Protection), and CERCLA requirements has not been adequately defined. It appears that DOE and Bechtel Jacobs believed that the provisions of 10 CFR 835 were not applicable, because these areas are outside the security fence. However, the scope of 10 CFR 835 includes protecting individuals from ionizing radiation resulting from DOE activities. Since the contamination of these areas is the direct result of DOE activities, 10 CFR 835 would apply.

- Radiological contamination has migrated from known sources at PGDP. These environmental problems may impact areas previously free from radiological contamination. Resuspension of wind-blown, radiologically contaminated soils or the impact of radiologically contaminated surface water runoff represent potential problems, further complicated by the potential tracking of contamination by personnel and vehicle traffic. Only limited and incomplete mitigation measures for these potential sources have been implemented on site, such as at Drum Mountain, the scrap yards, or the three decontamination and decommissioning buildings. Sediment fencing has been installed but does not eliminate sediment runoff.

Drum Mountain contains residual uranium materials that are contributing to contamination of the environment.

Environmental ALARA considerations have not been integrated into all processes.

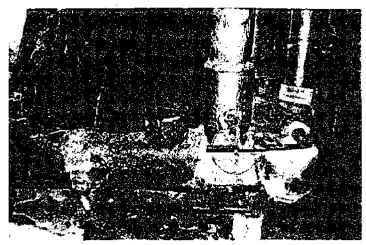
- Environmental ALARA considerations have not been integrated into all processes, and appropriate controls have not always been incorporated into design, construction, and remediation activities. An effort was made to develop an environmental ALARA program in 1995 in anticipation of 10 CFR 834, Radiation Protection of the Public and the Environment, but the process is not fully documented or implemented. Environmental ALARA considerations have not been formally integrated into environmental programs as required by DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. The manner in which liquid and airborne radiological discharges are subjected to the ALARA process is not defined.

- The current waste acceptance criteria for the sanitary landfill do not specifically prohibit disposal of objects that could be classified as low-level radioactive waste based on exceeding DOE Order 5400.5 surface contamination limits. The current landfill waste acceptance criteria fail to specify any limits for surface contamination and rely solely on a uranium limit of 30 pCi per gram as the only radiological criterion to determine the suitability of waste for disposal. The technical basis document that established waste acceptance criteria for the landfill does not address surface contaminated objects, such as roofing material, concrete, rubble, and debris that are disposed of in the landfill. It is unclear whether, or how, such materials are to be sampled volumetrically, or whether waste disposal practices would allow for disposal of materials that exceed DOE Order 5400.5 radiological limits in the sanitary landfill. This technical basis, although approved by the Field Office Manager, contained items that exceeded the Field Office approval criteria. Therefore, pursuant to DOE Order 5400.5, this technical basis document should have been approved by the Office of Environment, Safety and Health.

3. **Radiological exposure pathways for DOE operations have not been fully assessed or documented.** While projected doses are expected to remain low, weaknesses are evident in the assessment and reporting of all possible air emission sources and in the accuracy of public dose calculations.

The magnitude of "fugitive" emissions at PGDP DOE facilities is not known.

- The magnitude of "fugitive" emissions at PGDP DOE facilities is not known, and this pathway has not been fully evaluated or documented. Radionuclide calculations do not include any contribution to dose from fugitive emissions as required under the National Emission Standards for Hazardous Air Pollutants. Fugitive emissions from a number of diffuse sources -- such as contaminated ground resuspension, scrap piles, rooftop dispersion, and vehicular traffic — are inevitable and could contribute significantly to the calculated public dose (estimated to be 1.14 mrem in 1997). In lieu of actual source term data, the concentration of uranium and transuranic contaminants in soils has never been used in estimating a release fraction or fugitive emission source term for input to the dose model. Instead, the site assumes that fugitive emissions are insignificant and reports negligible contributions to dose from this pathway; this assumption is not supported by any documented technical basis. The absence of measurable readings on the ambient air monitors used by USEC and the Commonwealth of Kentucky is not a valid basis for concluding that fugitive emissions from DOE activities are insignificant, since the sensitivity and location of the air monitors are not sufficient to make that determination.



Many locations in shutdown buildings contain degraded lagging probably containing asbestos.

Public dose estimates from ingestion of contaminated sediment are not consistent.

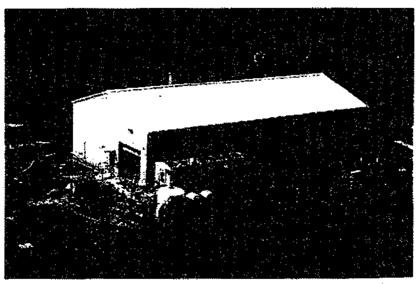
- Estimates of radiation doses to the public from ingestion of contaminated sediment are not consistent. Although no remediation of contamination has occurred, the reported dose changed from 2 mrem per year in 1992 to 0.07 mrem per year in 1995. The main difference is the use of sediment sampling results obtained during the current year for dose calculations. While actual radionuclide concentrations may be decreasing because contamination is spreading downstream, only one or two sediment samples are taken in each location annually. This variation raises questions about the use of such data as accurate, representative, and conservative. In lieu of a complete characterization or remediation of sediments, the highest reported historical values would be more appropriate for use in the public dose calculations. In addition, even though transuranics and thorium were found in some samples, dose calculations are only based on uranium and technetium data.

- The 1998 draft Annual Site Environmental Report provides data on studies of thermoluminescent dosimetry conducted in the vicinity of the UF_6 cylinder storage yards. Before 1998, direct exposure to penetrating radiation from cylinder storage was not considered in the public dose calculations. The 1998 data indicates that up to 1,000 mrem in a year could be accrued just outside the security fence; however, the 1998 draft Annual Site Environmental Report indicates no actual public dose from this pathway. DOE and Bechtel Jacobs justify this assessment by using the nearest resident as the "maximally exposed receptor point" when calculating radiation exposures. This is not the most conservative or realistic receptor point, given that there are members of the public who have access to areas in close enough proximity to potentially receive a dose (e.g., staged truck drivers awaiting offload, joggers, hunters, and hikers) greater than the nearest resident.

4. **Groundwater contamination has not been adequately characterized in some areas.** Extensive efforts have been undertaken to characterize the major sources and the extent of groundwater contamination as a result of the discovery in 1988 of contaminated residential drinking water wells near the site. DOE has generally defined the nature and extent of contamination in the Regional Gravel Aquifer and the McNairy Formation, has established a water policy to ensure that the public is adequately protected, and has taken interim pump-and-treat actions. While these characterization and control efforts were appropriate, some areas have not been fully characterized.

Sufficient data are lacking on the leading edges of both the Northeast and the Northwest Plumes.

- Sufficient data are lacking on the leading edges of both the Northeast and the Northwest Plumes. The density and positioning of monitoring wells are not adequate to assess the furthest movement or the discharge locations, such as streams, of the two northern plumes. The most recent plume map shows that movement has occurred under a portion of the Tennessee Valley Authority (TVA) property (see Figure 8). Groundwater samples taken by the site in the early 1990s indicated low concentrations of technetium-99 on TVA property. Those sampling efforts were discontinued in the early 1990s. The TVA Shawnee Steam Plant borders the Ohio River.



The pump-and-treat facility for the Northeast Plume was installed to slow the spread of TCE.

- The Southwestern Plume was recently discovered. The rate of movement and the direction have not yet been characterized, but the apparent movement is initially toward the southwest. After a short distance it bends toward the north. Because groundwater flow may be influenced by the abundant gravel in river deposits in this area, this plume will require additional characterization. Recent field studies have bounded the plume to the north and the south as it exists in the fenced area.

- Several sources are responsible for the groundwater contamination in the two major plumes. A major contributor to the Northwest Plume is a facility that used large volumes of TCE for degreasing equipment (Building C-400). High concentrations of TCE dissolved in groundwater near C-400 and characterization studies suggest that TCE exists in pure form in the subsurface. Building C-400 is also a major source of technetium-99 contributing to the

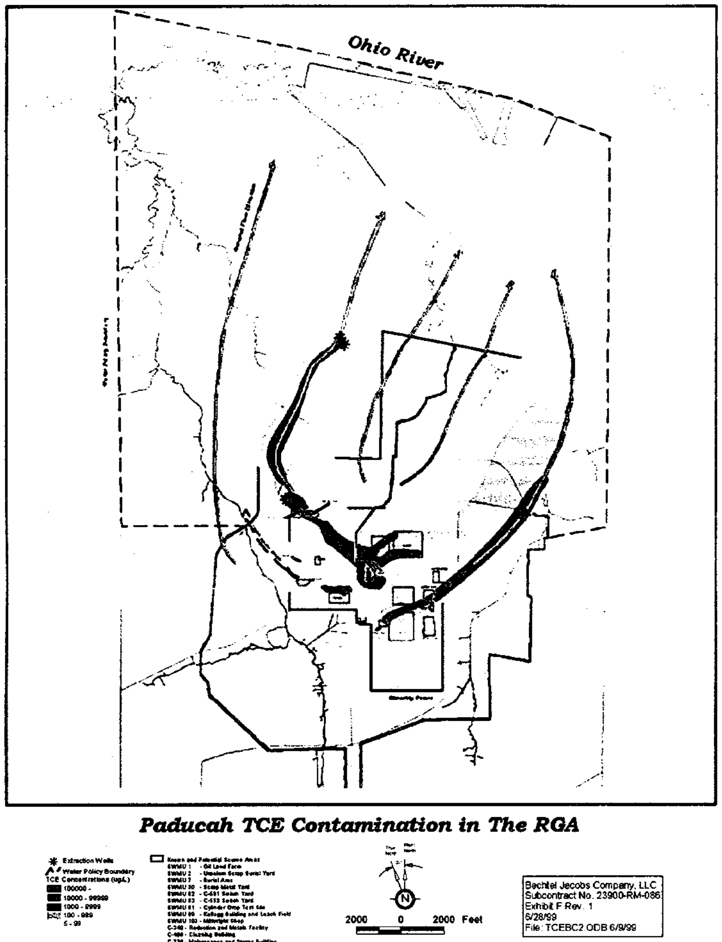


Figure 8. Northeast and Northwest Plumes

Northwest Plume. Building C-400, which contributes to both northern plumes, indicates the complexity of the source areas. Because of this complexity and interaction of plumes and source areas at PGDP, it is necessary to analyze these elements as one interactive system in the subsurface. However, since 1992, plumes and sources have been analyzed individually or in limited groups, resulting in redundant work and limiting the effectiveness of the sitewide analysis. The recently established Groundwater Operable Unit concept is designed to consider all sources and plumes in an integrated fashion.

Removal or treatment of the sources of groundwater contamination has not begun.

- Removal or treatment of the sources of groundwater contamination has not begun, although extensive characterization studies and treatability studies have been conducted. Innovative removal technologies have been reviewed for application, and the Lasagna treatment technology will be initiated on one major source in the near future. The site has also installed two groundwater pump-and-treat systems to contain and reduce concentrations in the Northeast and Northwest Plumes. During the Office of Oversight investigation, the Northeast Treatment System was not operational due to maintenance of the cooling towers. These systems were installed as interim measures to contain contamination existing in the most concentrated portions of the plumes. Limited pumping rates decrease the effectiveness of the plume removal systems, as confirmed by subcontractors' calculations. Small portions of the contaminated groundwater plumes with the highest concentrations are being treated by the systems.

5. **Unclear assignment of responsibilities and weaknesses in the integration and interpretation of environmental information have adversely impacted the understanding of environmental conditions.** DOE and Bechtel Jacobs staff at the site do not have the requisite comprehensive knowledge of the nature of existing contamination in the various environmental media (surface water, sediment, soils, groundwater, and air). In this area, sufficient technical personnel are not assigned or available to interpret the vast amounts of data associated with specific environmental disciplines. The site has not established clear staff responsibilities for environmental radiation protection functions. The site's outsourcing strategy will compound this weakness, at least in the near term, as additional environmental professionals are transitioned to subcontractor positions or find other employment. Specific weaknesses were identified in the following areas.

- Although the TCE and technetium-99 plume maps have been updated regularly, their interpretation has not been reported. Such a report would discuss data used in preparing the map, changes in the plumes from previous interpretations, and recommended actions. A comprehensive sitewide discussion of hydrogeology is available in an investigation released in November 1992. In 1995, two reports were issued regarding further characterization efforts on the Northeast and the Northwest Plumes. However, since 1992 there has been no integrated interpretation of groundwater data; such an interpretation would include water level and plume maps prepared for selected dates to support assessment projection of contaminant transport.

Existing landfills have been capped, monitoring wells have been put in place, and controls have been installed to limit erosion of sediments and spread of contamination.

- **Accountability and protection issues have not been clearly defined.** Neither DOE nor Bechtel Jacobs has defined clear responsibilities or designated specific individuals for managing environmental radiation protection issues including pathway analysis, public dose, environmental ALARA, postings, and contamination control. One subcontracted individual has addressed some of these issues, but his current contract does not include radiological support. Such support is handled on a task-specific basis through contract extensions.

- While the scope of DOE and USEC responsibilities was adequately delineated in lease agreements, the magnitude of continuing DOE environmental responsibilities following the transition may have been underestimated by DOE and site contractors, adversely impacting effective environmental management. For example, in the area of radiological air emissions, the initial assumption was that process air emissions constitute the only emissions from the site. This assumption has led to inaccurate representations in the DOE environmental monitoring plan that there are no airborne radioactive emissions resulting from DOE legacy operations.

The site has not included technical data gathered from remedial investigations in the Annual Site Environmental Report since 1993.

- Another programmatic weakness noted was in the information collected from the environmental monitoring program, which forms the basis of the information reported in Annual Site Environmental Reports. While these reports make generic statements about the types and kinds of remedial investigations, the site has not included technical data gathered from remedial investigations in the Annual Site Environmental Report since 1993. This is contrary to the intent of DOE Order 5400.1, which states that results of sampling conducted as part of the environmental monitoring program or as part of a special study should be summarized in Annual Site Environmental Reports. By omitting this data, site management is not providing a complete description regarding the nature and extent of the presence and transport of environmental contamination at the site. Bechtel Jacobs has indicated that DOE site management concurred with the decision to provide only a generic summary rather than a quantitative report.

6. **Information to the public has sometimes been delayed and is in forms not clearly understood by the general public and other stakeholder groups, contributing to a perception that DOE and the contractor are withholding information from the public.** Public participation and communications are fundamental components in DOE program operations, planning activities, and decision-making. Pursuant to the Department's public participation policy (DOE Policy 1210.1, Public Participation), the public is entitled both to provide input to Departmental decision-making and to fully understand the impacts of the site's activities on their quality of life. Upon discovery of groundwater contamination in 1988, the site prepared a Community Relations Plan in response to CERCLA requirements. Initially, the communication mechanisms used by the site pertaining to groundwater contamination were useful, such as public meetings, information bulletins, press releases, personal contacts, and advisory committees. While some improvements have been initiated, a review of current public participation and community outreach programs and activities identified a number of weaknesses resulting primarily from the lack of clearly defined roles and responsibilities for public communication activities at PGDP. This shortcoming has contributed to deficiencies in the planning, development, implementation, and evaluation of public affairs and community relations efforts. Specific concerns include the following.

- There are limited DOE and Bechtel Jacobs personnel trained to communicate technical information to the public in such areas as risk communication, public involvement, and media relations. This has contributed to instances where information was presented to members of the public in a manner that was difficult to understand.

- The site has not implemented all the elements outlined in its 1997 Community Relations Plan. From 1996 to 1998, the site significantly reduced public communication efforts. For example, the site did not provide significant public information in the forms of information bulletins, public meetings, personal contacts, and speaker bureaus as outlined in the Plan. In addition, public information bulletins were not published for this three-year period. Furthermore, the evaluation conducted for the 1997 update included recommendations for program enhancements, such as providing information in language that the public can easily understand. These recommendations have not been implemented, indicating a lack of attention by DOE and Bechtel Jacobs management.

- Members of the public may have difficulty in understanding ES&H conditions and initiatives from the available technical information. For example, annual environmental reports published by the site did not contain a clear summary of site conditions and public health risks. Other materials prepared by the site have generally not been effective in communicating to the public the presence and hazards of transuranic materials at the site.

Some members of the SSAB are dissatisfied with the quality of information they are receiving.

- The site has developed a public participation process through the Site Specific Advisory Board (SSAB), which was established under the Federal Advisory Committee Act in 1996. However, some members of the SSAB are dissatisfied with the quality (type, amount, completeness, and timeliness) of information they are receiving. Some members also expressed concerns about not being included in the planning process for environmental restoration activities. Additionally, the Paducah Site Office is partially reliant on the SSAB as their vehicle for notifying the public of activities and issues at PDGP. Although the SSAB has a written mission statement, discussions with SSAB members determined that the mission and function of the SSAB are not well understood.

- Members of the public believe that DOE does not adequately disclose information about hazards and risks and does not provide information that meets their needs. Some have stated that they have not received complete information on health data, health risks, or general cleanup activity for the site and often find it difficult to obtain such information from the site. In addition, many stakeholders question the availability of the Environmental Information Center, which is open only during normal business hours and not on nights or weekends.

Independent Investigation Team Sampling Results

Environmental samples were collected and analyzed by the investigation team in an effort to confirm that the current analytical results being reported by the site are accurate and representative of environmental conditions. The types of environmental samples and the locations where they were taken are shown in Figure 9. The total sampling effort consisted of 15 groundwater, 9 surface water, and 8 soil/sediment samples. All samples but one were collected outside the Plant security fenced area, some on DOE property. Site subcontractor personnel collected all the samples in accordance with approved procedures that follow the guidelines established by the EPA. The Oversight investigators witnessed the collection of all samples, and chain-of-custody forms were completed. The Oversight investigators affixed adhesive labels to the containers in the field to ensure sample integrity. The Oversight investigators also observed all samples being placed in locked refrigerators at the end of the sampling day and subsequently accompanied them to the USEC Laboratory, where the samples were held until shipment off site. Additionally, to witness the condition of the samples as they arrived, one of the investigators met the samples upon arrival at the independent analytical laboratory that performed the analysis.

The team used historical sampling results and local topography to map out their sampling locations.

Groundwater, surface water, soil, and stream sediment were sampled and analyzed for several key radionuclides and volatile organic compounds.

In general, the groundwater samples were taken at the extremities of the reported plumes to confirm the extent of contaminant migration. Surface water samples were taken at major site outfalls flowing during the sampling period and

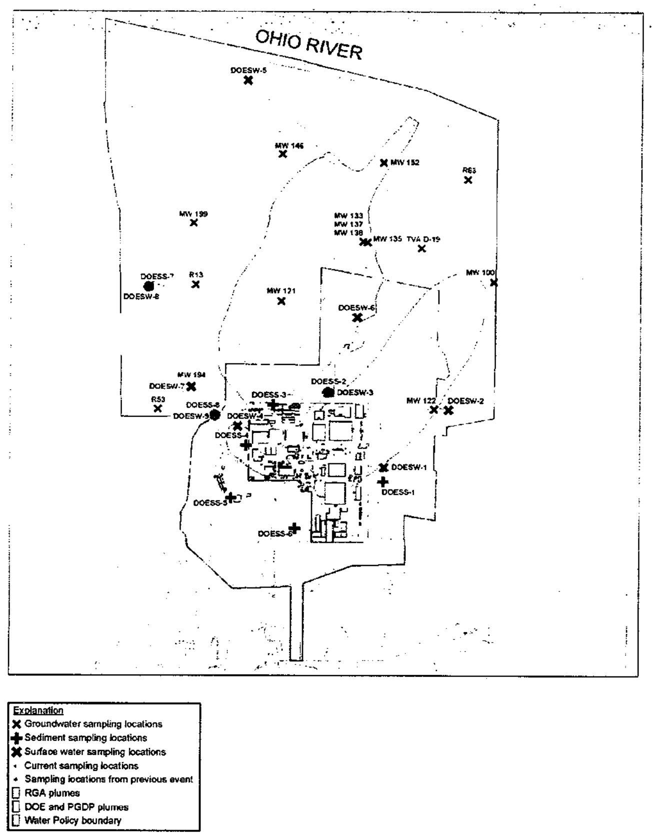


Figure 9. Locations of Samples
(Plume Delineation Performed by Bechtel Jacobs)

Radionuclides	Chemicals
Technetium-99 Plutonium-239/240 Neptunium-237 Uranium-238 Thorium-230 Americium-241 Cesium-137	Volatile organic compounds, including trichloroethene (TCE) Polychlorinated biphenyls (PCBs)

at points associated with surface waterways in the vicinity of the Plant. Soil and sediment were primarily sampled at outfalls and ditches near source areas of contamination. Groundwater, surface water, soil, and stream sediment were sampled and analyzed for several key radionuclides and volatile organic compounds, focusing on the compounds listed in the box above. Some analytical results were not available in time to be considered in this report. Any abnormal results from this remaining analytical work will be incorporated into subsequent reports. Laboratory analytical detection limits were designed to be low enough to ensure that contaminants would be detected at levels well below those that could be significant to public health.

Summary of Sampling Results

The types and levels of contamination detected in samples analyzed independently were generally consistent with the site's past environmental monitoring results.

Radiological and chemical contamination in groundwater, surface water, and soils/sediment was detected in some of the samples taken for this investigation. With a few exceptions, the types and levels of contamination detected in the samples were consistent with the levels identified by past environmental monitoring conducted by the site. At some locations, contamination was not detected, or was detected at insignificant levels or at levels representing background conditions. The analysis of split samples by the site produced results that were in general agreement with results produced by the independent analyses undertaken by the Oversight investigation team. The broad agreement between data produced by the site and the results from this independent investigation provide a level of assurance that the site can produce, and has produced, accurate environmental monitoring results. However, for two media—surface water and sediments—the site performs only very limited sampling annually and does not include all analytes in all sets of samples. Therefore, it is not clear that the site's environmental monitoring and surveillance results are fully representative of actual conditions. In two instances, independent soil/sediment sample analyses identified concentrations of isotopes other than uranium and technetium at levels not previously reported by the site for locations outside the site security fence. These were in Outfall 15 and in the North-South Diversion Ditch, where the independent analyses detected transuranics and cesium-137 at significant environmental concentrations. The site has not routinely taken samples from these locations as part of the environmental surveillance program.

Groundwater

The Oversight investigation team's groundwater sampling strategy involved taking a sample ahead of the plume in the direction of the plume movement in order to confirm the advance of the contamination. In a one-to-one comparison using previous data from the same wells, analytical results agreed with the site database and the chemical analyses of contaminants being reported by the site. The numerical values for key parameters are tabulated in Table 1.

Table 1. Measured Values of Activities and Concentrations of Constituents in Groundwater Samples Taken from Fifteen Wells

Well Identification	Pu-239/240 (pCi/L)	Pu-238 (pCi/L)	Tc-99 (pCi/L)	Am-241 (pCi/L)	Sr-90 (µg/L)	U-238 (µg/L)	TCE[1] (µg/L)
MW-199	0.008	0.007	ND[2]	<0.02	NA	0.79	ND
MW-146	0.009	ND	ND	0.24	NA	0.008	ND
MW-152	ND	ND	148	<0.03	NAV	0.006	0.8
MW-100	ND	ND	ND	<0.03	NA	0.006	ND
TVA D-47, W-1[3]	NA[4]	NA	0.9	NAV[5]	NA	15.4	ND
R83	ND	ND	ND	<0.02	NA	0.004	ND
R53	NA	NA	ND	NAV	NA	1.87	ND
MW-194	0.008	ND	0.6	<0.02	NA	0.004	ND
R-13	ND	ND	ND	NAV	NA	0.02	ND
MW-121	0.014	ND	ND	<0.01	NA	0.04	ND
MW-122	ND	ND	ND	<0.02	NA	0.03	ND
MW-133	0.010	ND	ND	<0.02	NA	0.29	ND
MW-138	NA	NA	20	NAV	NA	6.40	ND
MW-137	0.006	ND	87	<0.03	NAV	0.01	3.0
MW-135	ND	ND	81	<0.03	NAV	0.19	3.5

[1] TCE samples experienced elevated temperatures during shipping.
[2] ND = analyzed value at or below detection limit
[3] Water contained suspended solids.
[4] NA = not analyzed
[5] NAV = not available - analysis in progress

The Northwest and Northeast Plumes are contained within the water policy boundaries.

The technetium-99 results confirm that the Northwest Plume is contained within the water policy boundaries and that it is migrating northward in the vicinity of MW-152 through the TVA property. The concentration of technetium-99 reported in MW-152 was 148 pCi/L. In other sampled well water, technetium-99 was not detected or was found in lower concentrations. These values were consistent with site information obtained from previous monitoring and investigations. Of the wells sampled in this study, none had detectable levels of other radionuclides above background levels.

Trace concentrations of TCE were detected in MW-135, MW-137, and MW-152. The highest concentration detected, 3.5 parts per billion (ppb), is below the drinking water standard of 5 ppb. The presence of TCE is in agreement with the TCE plume location maps prepared by the site. The absence of TCE in MW-100 confirms the eastward extent of the Northeast Plume. This plume is within the eastern boundary of the water policy area. In addition, residential wells sampled by the investigation team that were outside, but near the plume boundaries, were found to be free of contaminants. These results indicate that the offsite groundwater contamination is currently within the water policy area. Elevated uranium values were reported for a subset of the well water samples. These wells are scattered throughout the water policy area and do not occur in any pattern associated with the plumes or the groundwater flow system.

Surface Water

Surface water samples were collected from nine selected locations along the Little and Big Bayou Creeks, as well as at several Plant Outfalls where surface water was present. Since there were drought conditions during this sampling event, surface water samples could not be collected from some of the desired Outfalls, such as K015 and K017, west and southwest of the Plant. A sample was collected from the Lagoon by the S and T Landfill and from a location in the North-South Diversion Ditch where enough standing water was found. Analytical results for key parameters are shown in Table 2.

Table 2. Measured Values of Activities and Concentrations of Six Constituents in Surface Water Samples Taken at PGDP

Sample Number	Pu-239/240 (pCi/L)	Pu-238 (pCi/L)	Am-241 (pCi/L)	Tc-99 (pCi/L)	U-238 (μg/L)	TCE[1] (μg/L)
SW 01	ND[2]	ND	<0.05	0.5	1.73	ND
SW 02	ND	ND	<0.05	0.8	1.68	ND
SW 03	0.352	ND	0.172	26	37.1	ND
SW 04	ND	ND	<0. 2	5.3	1.16	0.4
SW 05	ND	ND	<0.03	5.5	0.79	ND
SW 06	ND	ND	<0.03	ND	0.25	ND
SW 07	ND	ND	<0.04	1.4	0.83	ND
SW 08	ND	ND	<0.03	2.0	0.76	ND
SW 09	ND	ND	0.054	1.9	0.96	ND

[1] TCE samples experienced elevated temperatures during shipping.
[2] ND = analyzed value at or below detection limit

Surface waters showed minimal levels of contaminants.

Sampling for volatile organics at K001 Outfall

Radioactivity analyses for surface waters showed relatively low concentrations for all isotopes, with the North-South Diversion Ditch sample showing the highest levels of uranium and technetium-99 at 37 mg/L (12.5 pCi/L) and 26 pCi/L, respectively. Transuranic and thorium isotopes were either not detected or were present in very low concentrations, consistent with prior sampling results conducted by the site. For comparison purposes, one may note that the surface water results are all well below the Derived Concentration Guidelines (DCGs) established by DOE Order 5400.5. The DCGs can be used to evaluate the risk associated with the presence of radionuclides in surface water. The DCG for water is the concentration of a radionuclide that, under conditions of normal ingestion of water for one year, would result in an effective dose equivalent of 100 mrem. As a condition of DOE Order 5400.5, DOE sites are prohibited from releasing process effluents to surface waters in excess of the DCG guidelines.

With respect to other analytes, surface water samples were also analyzed for volatile organic compounds and PCBs. Only trace amounts of volatile organic compounds were detected, and none of these exceeded the Maximum Contaminant Levels (MCLs), which are considered the maximum acceptable levels for drinking water. For PCBs, only the North-South Diversion Ditch sample showed any positive results. The level detected (0.00035 mg/L) is also below the MCL for PCBs (0.0005 mg/L), although there have been previous PCB results in surface water that exceeded the MCL.

Soil and Sediments

Results for soil and sediment samples varied greatly, and some analyses showed higher concentrations of contaminants than noted in the past.

The results of the soil and sediment sampling are shown in Table 3. A total of eight soil/sediment locations were sampled for radionuclide and PCB contaminants. Seven of the samples were collected from outfalls and ditches

Table 3. Measured Values of Activities and Concentrations of Constituents in Soil and Sediment Samples Taken at PGDP

Sample Number	Pu-239/240 (pCi/g)	Pu-238 (pCi/g)	Np-237 (pCi/g)	Tc-99 (pCi/g)	Cs-137 (pCi/g)	Th-230 (pCi/g)	U-238 (pCi/g)	U (total) (μg/g)	Am-241 (pCi/g)	PCBs (μg/kg)
SS-1	0.009	ND[1]	<0.007	NAV[2]	1.02	NAV	100	232	<0.3	84,121[3]
SS-2	52.3	0.68	7.89	NAV	NAV	808	NAV	NAV	NAV	10,549
SS-3	0.38	ND	<0.3	NAV	NAV	NAV	NAV	NAV	NAV	1,832
SS-4	18.5	0.199	<0.3	NAV	44.6	14	77	160	0.88	790
SS-5	0.004	ND	<0.003	NAV	ND	NAV	<2	0.44	<0.2	19
SS-6	0.013	ND	<0.004	NAV	0.35	NAV	<4	2.14	<0.2	44
SS-7	0.012	ND	<0.003	NAV	0.04	NAV	1.2	2.21	<0.3	11
SS-8	0.022	ND	<0.005	NAV	0.05	NAV	<3	1.43	<0.3	23

[1] ND = analyzed value at or below detection limit
[2] NAV = not available - analysis in progress
[3] Duplicate sample result reported at this location

adjacent to the site, and one was collected inside the site security fence near the Drum Mountain area. The magnitude of the radionuclide results was generally in keeping with historical data reported by the site in the Outfall and Big Bayou locations. Sediments collected at Outfalls 11 and 15 and the North-South Diversion Ditch clearly exhibited radioactivity levels above what would be expected from natural background or radioactive fallout and are of sufficient magnitude to warrant management as soil contamination areas under the DOE/Bechtel Jacobs radiological protection program. In fact, Outfall 15 exhibited relatively high levels of plutonium, thorium, and cesium, at 18.5, 14, and 44.6 pCi/g respectively, which are higher than has been reported for transuranic and fission product isotopes at similar locations in the past. The North-South Diversion Ditch contained plutonium at 52.3 pCi/g and thorium-230 at up to 808 pCi/g. Results for split samples analyzed by the site are consistent with these results. PCB contaminants were also detected in all of the soil/sediment samples at levels similar to past reporting with one exception: Outfall 11 exhibited a PCB concentration of 84,121 mg/kg, which is approximately five times the highest reported level from prior sampling. The possibility of high variability and lack of homogeneity of contaminants in these media highlights the uncertainty associated with the process of limited soil sampling conducted annually by Bechtel Jacobs. This uncertainty also demonstrates the need for conservative decision-making and assumptions, including the use of historical data when drawing conclusions or conducting pathway analyses using data from sample results.

Conclusions

Radiological and chemical contamination from PGDP industrial activities has been released into the ground, soil, and air around PGDP. These conditions have prompted DOE and regulatory organizations to take a number of steps to protect public health. Because of the limited duration of exposure of the public to contamination and the mitigation measures taken, DOE operations at PGDP do not present a significant public health risk at this time. Nevertheless, significant improvements in DOE's protection of the public and the environment are needed. Increased funding and management emphasis on actual remediation activities are needed to address the sources of continuing contamination, to limit the degradation of contaminated buildings, and to control the continued spread of contamination pending cleanup. Exposure pathways need to be better analyzed to fully document the technical basis and the site's conclusion that no significant public exposures to radiation sources, such as fugitive air emissions, are occurring. Site management also needs to improve the characterization of groundwater in several areas, such as the extent of progression of the Northwest Plume towards the Ohio River. Improvements in waste management practices are needed to address storage of materials in DMSAs and the degrading containers of low-level waste. Additionally, DOE and Bechtel Jacobs need to supplement staff assignments and subcontractor support to ensure that site personnel can effectively integrate, interpret, and communicate environmental information.

2.2 Radiation Protection and Worker Safety

2.2.1 Radiation Protection

The Bechtel Jacobs radiation protection program exists to protect individuals from radiological exposures that could occur as a result of DOE activities at the PGDP. These activities have changed during the 1990s with the transition of gaseous diffusion operations to USEC. Currently, DOE's responsibilities include environmental restoration and management of legacy contamination and the large quantity of radioactive wastes present at the site. Despite the mission change, the nature, extent, and magnitude of contaminated facilities and uncharacterized materials at the site present unique challenges and highlights the importance and need for a comprehensive and robust radiological protection program.

During the early 1990s, radiological assessments identified fundamental program weaknesses in the site's ability to control potential exposures to transuranics.

During the early 1990s, radiological assessments, including the 1990 DOE Tiger Team, identified fundamental program weaknesses in the site's ability to control potential exposures to transuranics and to conduct an effective contamination survey program. In response, the site enhanced the quality and sensitivity of radiological survey equipment and increased the number of radiological control technician staffing from just a few to more than 50 to handle the increased survey workload caused by the discovery of transuranics in the workplace. Also the use of personal protective equipment was upgraded, and more emphasis was placed on posting and access control. Finally, the bioassay program was continued. When the radiological control program transitioned to USEC, many of the resources went to USEC, creating a shortage of resources for DOE activities.

To meet current 10 CFR 835 requirements for comprehensive assessment of the radiological control program, Bechtel Jacobs developed checklists of topical questions for 12 functional areas. The checklists are completed by the project health physicist, who describes how the site meets each of the requirements. Audit teams from the site Quality Assurance organization typically do not include health physics expertise. Radiological control audits by the radiological control organization in 1995 and 1997 identified similar weaknesses (e.g., auditors with no audit training, auditors assessing their own work, and audits that did not assess the adequacy of procedures and programs). In general, audit findings were minimal and did not reflect an extensive scope of audit review or an examination of the adequacy of corrective actions, although some recent improvement was noted.

OR conducted regulatory oversight reviews from July 1993 to March 1997. Radiological findings, the second most common deficiency after operations, were tracked to closure. At the termination of the DOE regulatory oversight program in 1997, there were no outstanding or unresolved radiological control issues at PGDP.

The lack of formality and rigor in radiological controls is exacerbated by an absence of DOE or Bechtel Jacobs oversight of radiological work practices.

The transition of gaseous diffusion activities to USEC has essentially created two distinct radiological protection programs at PGDP. Tiger Team issues attributable to the health physics activities associated with gaseous diffusion operations were not reviewed since those activities are now under USEC and regulated by NRC. On the DOE-regulated side, Bechtel Jacobs has a functional radiological control program that workers consider superior to the program as it was in the early 1990s. While the investigation team found deficiencies similar to those raised by the 1990 Tiger Team report, their magnitude (in areas such as postings, procedures, air monitoring, and contamination control) is less. Nevertheless, the number of deficiencies, combined with legacy radiological hazards, widespread contamination, uncharacterized materials and waste, and deteriorating contaminated facilities, is cause for concern. The lack of formality and rigor in radiological controls is exacerbated by an absence of DOE or Bechtel Jacobs oversight of radiological work practices.

At the time of the investigation, worker training on transuranic contamination and health effects had not been incorporated into current training. Other radiation protection training weaknesses include a lack of effective oversight of radiation protection training programs and a lack of assurance that individuals have received training before work is initiated in radiological areas. The current program was also found to be inconsistent with several requirements of Federal regulations on Occupational Radiation Protection (10 CFR 835) and Quality Assurance (10 CFR 830.120). Additional information on radiation protection training weaknesses can be found under Worker Safety and Health (Section 2.2.2).

Issues

7. Incomplete radiological characterization of the workplace adversely affects the ability of the radiological control organization to identify hazards and institute controls as necessary to ensure consistent and appropriate radiological protection for workers.

The North-South Diversion Ditch inside the Controlled Area was not controlled as a transuranic area.

- There is a lack of knowledge as to the isotopic mix of radionuclides present in various work areas. This information has never been obtained through comprehensive characterization, nor is it available in technical basis documentation. Radiological control technicians need this information to analyze the hazards and establish proper radiological controls. Lacking this information, they generally have established radiological control limits based upon the most restrictive radionuclides thought to be present (e.g., Np-237). However, the North-South Diversion Ditch inside the Controlled Area was not controlled as a transuranic area. This area has not been adequately controlled because the radiological control technicians are not aware of isotopic analysis information indicating the transuranic levels in the ditch.

- The procedures for planning and implementing radiological controls in the workplace presume knowledge of radiological control personnel about the isotopic mix in work areas.

8. There is a lack of rigor, formality, and discipline in the development, maintenance, and implementation of the Bechtel Jacobs radiation protection program.

Bechtel Jacobs RWPs lack information required by procedure to control radiological work effectively.

- Bechtel Jacobs radiological work permits (RWPs) lack information required by procedure to control radiological work effectively. They do not provide required survey information or the anticipated radiological conditions to be expected, such as the presence of transuranics. No radiological suspension limits are delineated to stop work if conditions are encountered beyond the scope of the designated radiological controls. Further, training requirements are not specified on RWPs. The investigation team noted specific instances where personnel were unaware that the radiological conditions at the work site were beyond what was appropriate for the scope of the general RWP in use. In these cases, the radiological control supervisors, who were contacted by the team, concurred that the activities should be stopped pending more complete planning and preparation of more specific RWPs.

In many cases, the monitored work activity was already completed before the final air sample activity was determined.

- Air sampler placement is not always consistent or adequate to sample the air in the work area or representative of the air breathed by the worker. In addition, analysis of air samples is not timely. Many air sample analyses are delayed from six to ten days to allow radon progeny to decay. This site does not perform a more timely (e.g., four-hour decay count) screening count of air samples (even though Bechtel Jacobs' procedures address how to screen samples) to evaluate whether appropriate radiological controls are in place. In many cases, the monitored work activity was already completed before the final air sample activity was determined. Also, site procedures do not identify the conditions that require isotopic analysis of air samples.


The Building 410 ash receiver, held in place with corroded C-Clamps.

A survey of the interior of one work area inaccurately showed radiation levels a factor of ten lower than those observed by the investigation team.

- Line management's initial determination that no dosimetry or radiological worker training was needed for construction personnel working at the cylinder yard project was inappropriate. This Bechtel Jacobs decision was initially based on an April 1999 survey that focused on the perimeter of the cylinder yard work area. Another survey, taken June 3, 1999, to confirm the initial determination included only the perimeter area and not the interior of the work area. On June 4, 1999, a survey of the interior of the work area inaccurately showed radiation levels a factor of ten lower than those observed by the investigation team on August 30, 1999. Contrary to Bechtel Jacobs' initial assessment, independent dose rate measurements of the work area by the investigation team (see Figure 10) indicated that, based on an anticipated six-month job duration, worker doses would likely exceed the 100 mrem threshold for such controls, and workers should have been monitored and provided Radiation Worker I training. This finding led to a shutdown of work and implementation of radiation monitoring (thermoluminescent dosimeters) and radiological training for workers. One worker escort who was monitored recorded a dose of 24 mrem in 35 days on the job in May and June. A subsequent Bechtel Jacobs evaluation indicated that worker doses would probably not have exceeded 100 mrem. However, this evaluation assumed an average work area dose rate that was two to three times lower than the dose rate that the investigation team observed in the work area.

- The Bechtel Jacobs program for auditing and assessing the radiation protection program was not effective in identifying programmatic deficiencies such as those observed by the investigation team.

- The project health physicist's expectations for day-to-day operations are not effectively communicated to the radiological control technicians. Radiological control technicians believe that they have the authority to allow work in certain areas (North-South Diversion Ditch) or decide not to take the air samples required by ALARA reviews. These beliefs are contrary to the project health physicist's expectation for control of the work.

Bechtel Jacobs cannot adequately demonstrate that the unconditional release of equipment from the site is consistent with DOE requirements.

- Bechtel Jacobs cannot adequately demonstrate that the unconditional release of equipment from the site, such as the release of fluorine cells, is consistent with DOE requirements. Bechtel Jacobs does not have a technical basis for determining how to meet the DOE requirements for unconditional release of equipment, including appropriate criteria for determining when it is necessary to use more restrictive transuranic limits versus uranium

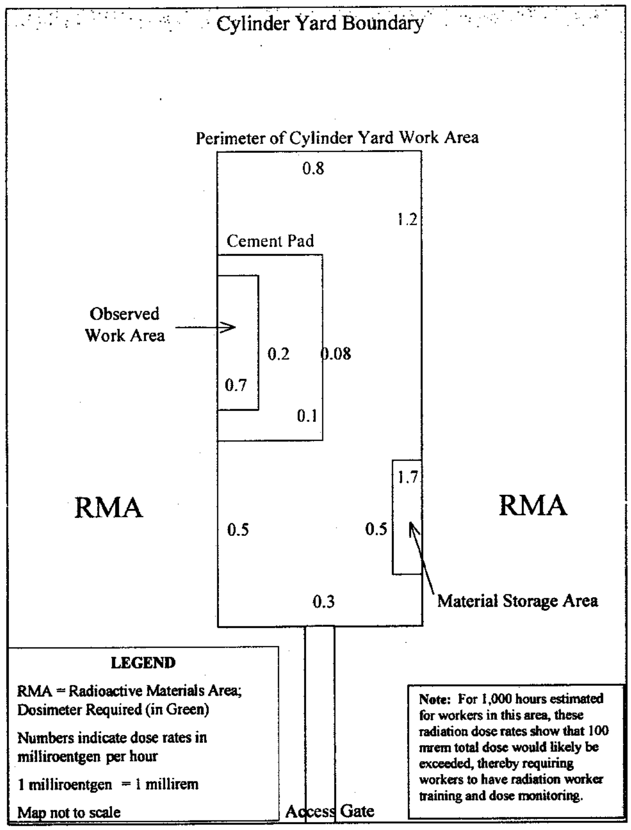


Figure 10. L Cylinder Yard Survey Readings

limits. While Bechtel Jacobs does have a procedure for unrestricted release of equipment, they did not apply it during the process of releasing the fluorine cells

Contamination levels in excess of eight million disintegrations per minute per 100 cm² were measured in outdoor contamination areas.

- Outdoor contamination areas, particularly in the vicinity of Drum Mountain, were not adequately posted and barricaded, even though contamination levels in excess of eight million disintegrations per minute per 100 cm^2 were measured in these areas. Other onsite areas, primarily drainage ditches, were posted as contamination areas in the absence of specific information on the radiological or chemical hazards being present. Removable contamination levels were in excess of 10 CFR 835 Appendix D. Because there is no contamination monitoring of individuals leaving the site, there is the potential for contamination to be taken off site. Items, such as manhole covers, with "fixed" contamination were not labeled to warn individuals of the radiological hazards. Postings for some areas were either missing or not visible to personnel accessing the area, and in other cases were not consistent with the work controls in the area.

- During the 1980s and early 1990s (before Buildings 340, 410, and 420 were controlled as contamination areas), the security force conducted daily patrols, periodic security drills, and joint exercises with the Paducah Police Department, the McCracken County Sheriff's Department, and Kentucky State Police in Building 340. There were no controls in place at that time to prevent exercise participants from potentially becoming contaminated and unknowingly carrying the contamination off the site.

Uranium materials at product handling points in Building 340.

Subcontractor personnel attributed the lack of postings to inadequate funding.

- Bechtel Jacobs subcontractor personnel attributed the lack of postings to inadequate funding for maintenance of the barricades and postings, and the assertion that workers knew the areas where they were allowed to go.

- Bechtel Jacobs procedures do not always contain specific instructions on required radiological control activities, including entry control, posting and labeling, radiation surveys, and radioactive contamination control and monitoring.

- Numerous instances of a failure to follow procedures were noted, including radiation safety training, generating and implementing RWPs, performing contamination surveys, and implementing the pre-job ALARA review requirements.

- Bechtel Jacobs allows individuals who lack the requisite training to work for up to 40 hours in radiological areas and potentially receive occupational exposure. This practice is not consistent with DOE radiation safety training requirements.

- The practice of allowing individuals to work at different company-managed sites using their home site's dosimetry is inconsistent with the DOE exposure reporting requirements. USEC employees performing work for DOE continue to wear USEC-issued dosimeters. USEC dosimetry, which is accredited by the National Voluntary Laboratory Accreditation Program (and accepted by NRC) and is not accredited under the DOE system (DOE

Description of PGDP 1990 Bioassay Issue

Background. The 1990 bioassay results of urine specimens taken from PGDP workers and evaluated by an outside analytical laboratory were subsequently declared invalid by the PGDP contractor (Martin Marietta Energy Systems, or MMES). This declaration continues to be an issue of great concern to the union (Paper, Allied-Industrial, Chemical, and Energy, or PACE), and there is a great deal of misunderstanding about the facts.

Sequence of Events. On March 22, 1990, radioactive waste was spilled in warehouse C-746-Q. Workers involved in the spill were sent to Fernald for whole body/lung counts on June 8-14, 1990. On July 8-10, 1990, a first set of urine samples was sent to an offsite analytical laboratory for evaluation; the results, received on August 7, 1990, indicated that all samples tested positive for the presence of plutonium. On August 13, 1990, additional workers provided urine samples. On August 22, 1990, MMES questioned the analytical laboratory on the validity of the results, and they also met with the analytical laboratory and DOE on September 10, 1990. A second set of samples was taken from workers on September 26, 1990; the samples were "split" and provided to the Oak Ridge National Laboratory (ORNL) and the original analytical laboratory for evaluation. During this period, MMES conducted two audits of the analytical laboratory (September 12, 1990, and October 18, 1990). On January 11, 1991, MMES officially declared the original analytical laboratory results invalid. MMES provided a briefing to workers and to PACE on the urinalysis results on March 6, 1991.

Actions Taken by Oversight Investigation Team. Records associated with the bioassay process were reviewed in the USEC Building 710 vault. Additional records from the Building C-100 vault, which included whole count data, were also examined. The investigation team attempted to interpret the raw data and also reviewed supporting documents.

Results. The investigation team's review of information indicated the following:

1. The results for all 23 original bioassay sample results were reported as positive for the presence of plutonium. The samples included 20 from workers, 2 unexposed control samples, and a blank water sample. Blind samples "spiked" by Martin Marietta Energy Systems with plutonium were reported high by a factor of 2.5.
2. The plutonium blind spike samples sent to the analytical laboratory by MMES were 1,000 times too high due to a misunderstanding between MMES and ORNL of typical spike levels. MMES interpreted the ORNL recommendations as disintegrations per minute/milliliter rather than disintegrations per minute/liter. Since the spiked samples were abnormally radioactive (hot), compared to the samples typically encountered by the analytical laboratory, these samples could have contaminated the laboratory equipment. If this occurred, it would account for the reported results.
3. The initial uranium results were not consistent with what would be expected for actual exposures to uranium contaminated with transuranic elements.
4. MMES audits of the analytical laboratory revealed problems in procedural compliance, quality assurance and quality control, failure to meet contractual requirements for Minimum Detectable Activities, and failure to subtract natural background radiation before reporting results.
5. All results of the whole body/lung counts conducted by Fernald were negative for the presence of uranium-235, uranium-238, plutonium-239, neptunium-237, and americium-241.
6. All results of the resampled urine samples split between the analytical laboratory and ORNL were also negative for the presence of plutonium-238, plutonium-239, and americium-241.

Assessment. Based upon the investigation team's review of the available information, there is no evidence to invalidate the MMES basic conclusions that the original sample results were false and that worker intakes did not occur from the original spill. The sampling and analysis approach used by the contractor, which bases a determination of intake on the predominance of the sample trial results (i.e., if two out of three trials are negative, the results are judged to be negative), is consistent with the Internal Dosimetry Implementation Guide and Internal Dosimetry Technical Standards as issued by DOE Headquarters. A determination of intakes is rarely confirmed based on the results of a single sample. As a general practice, follow-up or confirmatory samples are always prescribed. Also, due to the slow excretion of transuranic elements from the body, samples taken years after the initiating event would detect the presence of transuranic elements if significant intakes were involved.

Laboratory Accreditation Program), is therefore used to monitor exposures from DOE activities. This practice is not approved under the DOE Laboratory Accreditation Program as required.

- Procedural requirements for establishing airborne radioactivity areas are inconsistent and conflicting. One section calls for use of the uranium Derived Air Concentration if the isotopic mixture is unknown. This conflicts with another section that specifies use of the most restrictive Derived Air Concentration for the radionuclides known to be present when the percentage of radionuclides is unknown. In some cases, following the uranium Derived Air Concentration guidance would result in airborne controls that are much less restrictive than those required for the transuranic contaminants present.

Conclusions

Records indicate that the external doses to employees from the types of radiation present at PGDP are very low, and there have been no recent significant intakes of radioactive material. However, the multiple deficiencies that were identified in radiological protection are symptomatic of a site that has had to cope with the same legacy hazards for many years and that is no longer in an operational mode. The site has increasingly relied on the workers' knowledge of and sensitivity to radiological hazards. The site radiation protection program exhibits a level of informality, rather than a disciplined and rigorous application of controls such as detailed radiation work permits, procedures, postings, barriers, and air monitoring. An event in which multiple personnel were contaminated with technetium-99, the presence of contamination with legacy materials in shutdown hazardous facilities, and the site's failure to monitor and train all workers in radiation protection are indications of program weaknesses. While some of these deficiencies are not significant, collectively they are of concern because of the remaining uncharacterized hazards, the unique and challenging risks associated with future hazardous material cleanup, and the move toward almost total reliance on subcontractors ---some of whom lack the historical knowledge of site radiological hazards, including transuranics, and the applicable precautions and controls.

In conclusion, it is important that DOE and Bechtel Jacobs recognize that the cumulative deficiencies, in what could be a viable and effective radiological protection program, represent a weakness that warrants management attention. A level of discipline, rigor, and formality needs to be established in the process to protect worker health and safety during hazardous material characterization and onsite cleanup activities. DOE and Bechtel Jacobs also need to accept increased responsibility for the oversight of subcontractor radiological safety and performance, including holding them accountable for adhering to applicable DOE requirements.

2.2.2 Worker Safety and Health

The 1990 DOE Tiger Team identified significant deficiencies in worker safety programs and practices at PGDP. Corrective actions were taken and performance improved. Since that time, DOE contractors at PGDP and the nature of work performed by these contractors have changed. In 1993, USEC assumed full responsibility for managing enrichment operations. In 1997, regulatory oversight of enrichment operations was transferred from DOE to NRC. The nature of work by DOE contractors since that transition has focused on maintenance of UF_6 cylinders, maintenance and characterization of packaged waste, and assessment of environmental impacts. Completion of the cleanup mission at PGDP will require a significant increase in hazardous activities, such as removing buried waste and inspecting the contents of thousands of drums of radioactive waste. This work presents risks because it involves handling material containing radioactive and chemical carcinogens, much of which has not been fully characterized. There have already been several occurrences of drum pressurization due to improper drum handling practices, one of which resulted in the contamination of workers.

Most occupational physical hazards and worker exposure hazards at PGDP have been adequately identified and characterized.

Most occupational physical hazards (e.g., electrical hazards) and worker exposure hazards (e.g., to chemicals) at PGDP have been adequately identified and characterized. Bechtel Jacobs has developed a comprehensive set of safety and health procedures for identifying, evaluating, and controlling occupational hazards. A review of selected work activities indicated that most physical hazards are adequately identified, and job hazard analyses and/or activity hazard analyses are performed in accordance with procedures. However, some safety and health procedures are not being followed, and some hazards are not sufficiently analyzed, particularly for work performed by subcontractors. The type, quantity, enrichment, and configuration of fissionable materials in DMSAs have not been fully characterized, and the risk of a criticality accident occurring in several of these DMSAs is unknown.

Limited safety and health resources have resulted in overreliance on personal protective equipment in lieu of performing hazard analyses and implementing engineering controls. Assessment of employee exposures relies heavily on screening mechanisms (e.g., chemical detector tubes) and professional judgment. Record keeping for air and noise sampling data is weak. Locating historical sampling data is difficult, and reconstructing personnel exposures is not always possible, particularly for subcontractors. Access to worker exposure and job hazard information by medical personnel is a longstanding weakness that has never been fully resolved.

Workers are generally involved in the work planning process, and the workers and line managers who were interviewed expressed satisfaction with the level of management attention to worker safety. The monthly safety committee meeting is well attended by DOE, Bechtel Jacobs management and workers, and subcontractors. Injury and illness rates at the PGDP are lower than at many DOE sites, and lower than the other two DOE sites managed by Bechtel Jacobs. Notwithstanding these positive attributes, many precursor conditions are developing that, if not addressed, will lead to decreased safety performance and an increased risk to workers.

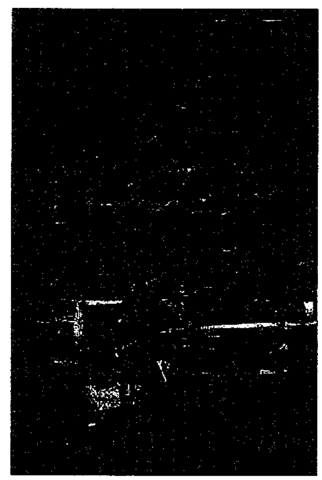
Issues

9. **Criticality safety deficiencies in DMSAs have not been resolved by DOE in a timely manner, posing an unnecessary hazard to workers in surrounding areas.** Lockheed Martin Utility Services documented these deficiencies in an occurrence report to the DOE identifying the issue as a potential unreviewed safety question on January 15, 1997 (ORO-LMES-PGDPENVRES-1997-001). This issue was subsequently upgraded to an unreviewed safety question on July 21, 1998, based on the results of non-destructive analysis performed on an axial compressor in DMSA 31 inside the C-333 process building at PGDP. The analysis indicated that the compressor contains less than 1,737 grams uranium-235 at an assay of 1.157 weight percent. No nuclear criticality safety analysis documentation had been prepared for this compressor as required by DOE orders, Work Smart standards, and American National Standards Institute standards when the mass of uranium exceeds 700 grams. Corrective actions have not been taken in the higher-risk DMSAs, and current compensatory measures are not adequate.

In several of the DMSAs, the risk of a criticality accident is not known.

- In several of the DMSAs, the risk of a criticality accident is not known. However, non-destructive assay data obtained from some, but not all, of the equipment that originated at Portsmouth or Oak Ridge indicate that there is insufficient localized fissile mass in the equipment surveyed to make a criticality accident possible.

- The type, quantity, enrichment, and configuration of fissionable materials in these areas have not been fully characterized.



DOE Material Storage Area

Background. Uncharacterized radiological and chemical equipment, materials, and waste in DMSAs (as shown in the picture) continue to present unnecessary and avoidable risk to workers and the environment. In 1996, DOE accepted responsibility for large amounts of legacy materials (e.g., uncharacterized scrap, equipment, drums, and other wastes) that were stored in the leased facilities so that USEC could obtain a certificate of compliance from the NRC. These materials are currently stored in 148 DMSAs located across the site, including "islands" within in the USEC operating facilities. Eleven DMSAs have been identified as high-priority areas based on nuclear criticality safety concerns. These 11 DMSAs include equipment that could contain large deposits and fissile materials with enrichments as high as 93 percent.

- **Continuing Management Weaknesses**
  - Responsibilities and accountabilities for DMSAs have not been clearly established.
  - Although problems and corrective actions were identified and submitted to the Paducah Site Office in 1997, an acceptable plan and schedule for disposition of the materials have not been developed.
  - DOE has not provided the funds to disposition the materials.
  - Almost no actions to disposition the material have been accomplished.

- **Criticality Concerns**
  - The risk of an inadvertent criticality is not known.
  - The fissionable material content has not been quantified.
  - Acceptable safeguards to preclude reconfiguration of fissionable materials have not been established.
  - Protection from introduction of moderator (e.g., sprinklers, pipe ruptures, fire hose locations, and flooding) has not been established.
  - Double-contingency protection against criticality has not been established.

- **Environmental Concerns**
  - Only limited action has been taken to inventory and characterize the hazardous materials that are known to be present.
  - DMSAs are not managed in accordance with RCRA waste storage requirements.
  - On at least two occasions, USEC has introduced new materials without DOE prior's knowledge or authorization.

- Safeguards are not sufficient to preclude unauthorized movement of material in DMSAs.

- Procedures are not in place nor have workers been trained to properly respond in the event of inadvertent addition of moderator due to activation of sprinkler systems or flooding. There is a remote possibility that such an event could initiate a criticality accident.

- The DMSAs do not comply with DOE Order 420.1, Section 4.3 and American Nuclear Standards Institute/ American Nuclear Society Criticality Safety Standards that require that no single abnormal event can cause a criticality accident. Such an event cannot be precluded since the DMSA material has not been characterized.

- Lockheed Martin Utility Services documented these deficiencies in an occurrence report identifying the issue as a potential unreviewed safety question on January 15, 1997 (ORO-LMES-PGDPENVRES-1997-001); however, corrective actions have not been taken in the higher risk DMSAs and current compensatory measures are not adequate

- Agreements between DOE and USEC to characterize and correct conditions within the DMSAs have not been adhered to, and DOE has not identified or provided alternative funding. The only planned DMSA characterization program was initiated to support seismic upgrades and only addresses a small fraction of the equipment that is suspected of containing fissile material. There is no funding for correcting the deficiencies in all the DMSAs and eliminating the criticality safety hazard.

10. Safety and health procedures are not consistently applied and followed, and in some cases, hazards are not adequately addressed by those procedures.

- Of the occurrence reports submitted to DOE by Bechtel Jacobs since April 1998, a number were attributed to either inadequate procedures or a failure to follow procedures. For example:
  - On July 10, 1998, a subcontractor did not follow a section of an RWP, resulting in a failure to obtain a required baseline bioassay sample.
  - On June 30, 1998, a low-pressure sanitary water line was inadvertently penetrated as a result of an inadequate procedure.
  - On September 3, 1998, two waste containers were found to have been moved in violation of procedures regarding weight limits for a forklift.
  - On December 15, 1998, a pressurized container was discovered during sampling activities. Evaluation of such "neutralized media" had not been included in the Bechtel Jacobs "Scrap Metal Acceptance Criteria and Waste Acceptance Criteria."
  - On May 28, 1999, a small bottle with unknown contents was discovered in a sediment sample. The procedure for this activity was judged to be inadequate and a contributing cause to the occurrence, since the procedure did not address what to do if unexpected items are encountered.
  - On August 25, 1999, a subcontractor violated an Excavation/Penetration Permit by failing to notify the underground utility locator service for the Commonwealth of Kentucky as required by the permit. Consequently, they nearly severed a telecommunications line.

Laboratory personnel did not adhere to the laboratory standard operating procedures or follow guidelines for safe handling of methylene chloride.

- On May 27, 1999, it was determined that laboratory personnel working in a mobile field extraction laboratory had been exposed to methylene chloride above the 15-minute Short-Term Exposure Limit defined by OSHA Regulation 1910.1052. Both root and direct causes of this event were that laboratory personnel did not adhere to the laboratory standard operating procedures or follow guidelines for safe handling of methylene chloride as described in the Material Safety Data Sheet.

- The investigation team observed that some safety and health procedures are not consistently followed. Sections of the sitewide procedure and the subcontractor's Health and Safety Plan for confined space entry were not followed at the L Cylinder Yard. Confined spaces were not evaluated, were not posted in accordance with procedures, and did not have required permits. Sections of Bechtel Jacobs procedures on biological monitoring for industrial chemicals, and workplace air sampling were not followed.

- At the L Cylinder Yard Project, occupational noise is not discussed in the subcontractor's Health and Safety Plan, nor are administrative controls (e.g., hearing protection and hearing conservation program requirements) described in the subcontractor's procedure on noise. Exposure to occupational noise is a safety concern for heavy equipment operators at the L Cylinder Yard. Furthermore, the subcontractor's lack of a documented basis to support the prescribed hearing protection, the absence of sound surveys or noise dosimetry, and the lack of an evaluation to determine whether workers should be enrolled in a hearing conservation program are not in compliance with either OSHA regulations or the Bechtel Jacobs procedure on occupational noise exposure.

- Some subcontractor safety and health procedures have not kept current with changes in OSHA regulations. At the L Cylinder Yard, Bechtel Jacobs approved a subcontractor procedure for confined space entry that differed from the sitewide confined space procedure, resulting in two conflicting procedures being applied. Further, the subcontractor procedure did not reflect current OSHA requirements for confined spaces.

- Bechtel Jacobs does not have a clearly defined or expressed policy on procedure adherence. The Bechtel Jacobs procedure on "Use of Procedures" was deleted and replaced by a procedure on the "Procedure Document Process" that is less stringent in requiring the use of procedures. Bechtel Jacobs' policy statements do not adequately address the importance of following procedures when performing work.

11. Bechtel Jacobs has not assured that subcontracted medical personnel are sufficiently involved in the identification, evaluation, and integration of workplace hazards to ensure effective worker medical programs.

- Several Office of Environment, Safety and Health reviews and assessments of the PGDP occupational medical program performed during the 1990s identified the need for site medical personnel to be more involved in the identification, evaluation, and integration of workplace hazards to ensure effective worker medical surveillance programs. This deficiency has yet to be resolved.

- The Bechtel Jacobs Work Authorization for ES&H services to be provided by USEC is brief and focuses on the frequency and cost of medical services, rather than on the scope and quality of services.

Animal material in Building 340 poses potential health effects to workers.

- The required interfaces between industrial hygiene and safety, health physics, emergency planning, and subcontractor medical programs are not well documented, and they are not feasible for the USEC Medical Director to accomplish.

- The site's Work Smart Standards have not incorporated DOE Order 440.1A and the subsequent DOE requirements for contractor medical programs.

Neither Bechtel Jacobs nor DOE has performed an assessment of subcontractor medical programs.

- Neither Bechtel Jacobs nor DOE has performed an assessment of subcontractor medical programs.

12. Bechtel Jacobs training programs do not ensure that all workers are knowledgeable of hazards and protection requirements, including those associated with transuranic contamination.

- The Bechtel Jacobs radiation safety training program does not include a process to assure that individuals receive the required training before working in controlled or radiological areas. Although required by procedure, mandatory training is not included in RWPs. The site does not maintain training records for individuals working at the site who are based at other Bechtel Jacobs locations. These individuals are escorted but are not given site-specific training.

None of the current Bechtel Jacobs radiation safety training modules adequately address the presence of transuranic contaminants at the site.

- None of the current Bechtel Jacobs radiation safety training modules adequately address the presence of transuranic contaminants at the site. Training on transuranics was provided once in 1992, and although DOE and Bechtel Jacobs personnel believed that such training was being conducted, in fact the 1992 transuranic-based training was not incorporated into the ongoing radiation worker training program.

- Training for Bechtel Jacobs radiological control technicians does not include monitoring for transuranics, the release criteria to be used, or the use of isotopic analysis information to determine the need for controls.

- Bechtel Jacobs personnel and subcontractors trained to the "Site Access Orientation" level are allowed access to radiological and controlled areas for a period of up to 40 hours per year. This level of training does not meet all 10 CFR 835 training requirements.

- Some workers have not completed required ES&H training. Several subcontractor personnel at the L Cylinder Yard had not met training requirements commensurate with the hazards to which they are exposed (e.g., confined spaces, hazard communication, and noise).

- Although Bechtel Jacobs provides a measure of oversight of subcontractor training programs through quality assurance audits, surveillances, and readiness reviews, this oversight is not consistently applied and is performed at the discretion of the Bechtel Jacobs project manager. There is no threshold or guidance for performing surveillances based on risk or previously identified ES&H deficiencies. At the L Cylinder Yard, for example, no surveillances have been performed to date, although there are a number of hazards, and training deficiencies were previously identified in the project readiness review.

Conclusions

Most occupational and worker exposure hazards have been identified and analyzed, and they are adequately controlled, although criticality safety deficiencies pose an unknown degree of risk and hazard to workers. The failure to address potential criticality safety deficiencies that have been apparent for more than 20 months indicates that DOE management has not placed sufficient priority on this important area of worker safety. Procedures address most occupational hazards; however, improvements are needed in establishing, maintaining, and following procedures, particularly on the part of subcontractors. Pre-job mentoring and review of subcontractor programs by Bechtel Jacobs are evident. However, the rigors of future waste remediation work and the increasing numbers of subcontractors will require more demand for oversight of subcontractors. The lack of training for workers and radiation control technicians regarding the presence of transuranics has exacerbated workers' fear of exposure and contributed to the current mistrust between some workers and line management. The need for medical personnel to be more involved in the identification, evaluation, and integration of workplace hazards was previously identified at the site. Ensuring an effective medical surveillance program is especially important at PGDP in view of the health concerns that have been raised. Overall, increased management attention is needed, particularly in criticality safety risk analysis, oversight of worker training, occupational medicine, and procedure adherence.

2.3 Line Oversight

DOE established the Paducah Site Office in 1989 to provide program direction and day-to-day oversight. In the early 1990s, DOE took steps to strengthen the oversight of contractor activities at PGDP. The need for more effective oversight was based on emerging environmental and worker safety issues. Technetium-99 had been discovered in offsite wells in 1988, and numerous sources of contamination at PGDP were being investigated as potential contributors to a plume of contaminated groundwater. A 1990 DOE Tiger Team assessment identified a number of safety problems at the site, problems with contractor activities, and a failure to provide clear direction to the management and operating contractor. A 1997 Type B accident investigation by OR concluded that "DOE does not adequately perform oversight." In addition, a 1992 OR investigation of a former worker's concern about radiological control practices at PGDP found evidence that workers were intimidated and afraid to raise safety concerns.

The Site Safety Representative Program was completed in 1997 and its two staff members were reassigned to other duties.

Following the Tiger Team assessment, the recently established Paducah Site Office staff was increased from five to 12 staff members to provide more effective line oversight of contractor activities. In 1993, OR assigned two Site Safety Representatives to provide DOE oversight of enrichment activities while line oversight responsibility was being transferred to NRC. The two individuals were selected from the Paducah Site Office staff and reported directly to OR for this assignment. The Site Safety Representative Program was completed in 1997 and the two staff members were reassigned to other duties. With the final transition to NRC regulation of the enrichment facilities in 1997, the scope of DOE activities at PGDP decreased significantly to involving only waste management, environmental assessment, and remediation. Paducah Site Office activities have focused primarily on project management. In April 1998, DOE transitioned from a management and operations contract with Lockheed Martin Energy Services to a management and integration contract with Bechtel Jacobs. The work of the current DOE contractors is focused on maintenance of UF_6 cylinders, maintenance and characterization of packaged waste, assessment of environmental impacts, environmental monitoring, containment of the groundwater plume, and control of surface water runoff.

The current level and effectiveness of line management oversight of ES&H and assurance of compliance with DOE requirements are a matter of concern. Programmatic deficiencies identified through the 1990s either continue or have recurred. Written or verbal direction provided by DOE, primarily OR, regarding implementation of the management and integration contract has significantly reduced the level of oversight conducted by both the Paducah Site Office and Bechtel Jacobs. Consequently, line management has not identified and corrected many of the programmatic problems identified elsewhere in this report.

Issues

13. DOE has not conducted effective oversight of ES&H or ensured that Bechtel Jacobs and its subcontractors effectively implement all DOE and regulatory requirements.

- The improvements in oversight of contractor activities during the early 1990s are no longer apparent. There has been no formal oversight program and few oversight activities since the Site Safety Representative Program was completed in 1997.

- OR has provided little written direction to the Paducah Site Office for oversight of the management and integration contractor, Bechtel Jacobs. Written guidance stated that "the DOE role will center on establishing policies, standards, baselines, and objectives and measuring performance rather than focusing on day-to-day oversight and control." Consequently "day-to-day oversight" has received little attention.

- Without an ongoing program of surveillance and oversight, DOE was unable to provide timely information regarding the status of hazards to workers and the public when allegations regarding worker safety and health were raised in the lawsuit against former operating contractors for PGDP.

Neither OR nor the Paducah Site Office has provided sufficient direction to Bechtel Jacobs to assure adequate oversight of subcontractors.

- Neither OR nor the Paducah Site Office has provided sufficient direction to Bechtel Jacobs to assure adequate oversight of subcontractors, even though subcontractors are performing an increasing amount of work. Written guidance for administration of the Bechtel Jacobs contract was provided to all OR employees in a memorandum from the OR Manager, dated January 29, 1998, which stated that "the DOE role will center on establishing policies, standards, baselines, and objectives and measuring performance rather than focusing on day-to-day oversight and control."

- The investigation team observed subcontractor ES&H performance that did not meet DOE requirements.

- Performance deficiencies were particularly evident in radiation protection, an area where the Paducah Site Office lacks sufficient expertise to provide effective oversight. The investigation team observed a number of deficiencies in this area that had not been previously identified by the Site Office.

- The Paducah Site Office does not have a formal program or process, including definition of roles and responsibilities, for assessment of Bechtel Jacobs' performance at the activity level, and has performed little assessment of Bechtel Jacobs' activities or conditions.

- OR has not maintained a DOE Facility Representative at PGDP since the regulation of enrichment was transferred to NRC.

- There is little oversight of training programs by DOE, and there are no mechanisms to ensure that the training that is provided is adequate.

- The Paducah Site Office did not identify the appropriate DOE requirements for unrestricted release of potentially contaminated property before approving the sale of fluorine cells.

14. Bechtel Jacobs has not conducted fully effective oversight of ES&H performance or ensured that its subcontractors effectively implement all DOE and regulatory requirements and are held accountable.

- Numerous weaknesses were identified in procedure adherence, safe work practices, occupational medicine, and worker training. These weaknesses resulted in a stop-work action for one subcontractor during the investigation period.

- Bechtel Jacobs' subcontractors do not consistently follow safety and health procedures.

- Subcontractors are screened by Bechtel Jacobs before starting work, but these screenings are not adequate to ensure that the subcontractors have working programs in place that meet DOE requirements for industrial safety, industrial hygiene, and medical surveillance.

- Some recent subcontractor work activities have resulted in unsafe work practices.

- Although Bechtel Jacobs provides a measure of oversight of subcontractor training programs through quality assurance audits, surveillances, and readiness reviews, the oversight is not consistently applied and is performed only at the discretion of the Bechtel Jacobs project manager.

Building 410 corroded ash receiver

Planned reductions in staff will further reduce Bechtel Jacobs' technical capability to conduct oversight and surveillance of subcontractor activities.

- Planned reductions in staff within Bechtel Jacobs will further reduce Bechtel Jacobs' technical capability to conduct oversight and surveillance of subcontractor activities. Planned staffing changes include a reduction in Safety Advocates from four (one Safety Advocate and three Safety Engineers who perform the Safety Advocate function) to one and elimination of the training coordinator position. In addition, there are significant shortages in key safety disciplines, such as industrial hygiene.

Conclusions

DOE and Bechtel Jacobs line management practices and processes have not assured compliance with ES&H requirements. Previously-identified problems that had been corrected after the Tiger Team assessment have resurfaced. With the shift to a management and integration contract, expanding reliance on subcontractors for the cleanup and waste management activities will require significantly more surveillance and oversight by both Bechtel Jacobs and DOE personnel who are knowledgeable of DOE requirements. In some cases, these requirements may be more stringent than the subcontractors' normally accepted practices. It has been demonstrated throughout the DOE complex that more active oversight and surveillance at the activity level is necessary to raise the threshold of acceptability for safe work practices and environmental conditions. If DOE is successful in obtaining funding to accelerate cleanup activities at PGDP, significantly more effort must be expended on surveillance and oversight to achieve and maintain the requisite standards for protecting the environment, the public, and especially the workers.

APPENDIX A

ISSUES FOR CORRECTIVE ACTION AND FOLLOW-UP

Line management is responsible for correcting deficiencies and addressing weaknesses identified in Office of Oversight reviews. Following each review, line management prepares a corrective action plan. The Office of Oversight follows up on significant issues as part of a multifaceted program that involves follow-up reviews, site profile updates, and tracking of individual issues.

This appendix summarizes the significant issues identified in this report of the Phase I investigation of PGDP. The issues identified in Table A-1 will be formally tracked in accordance with the DOE plan developed in response to DNFSB Recommendation 98-1, which addressed follow-up of independent oversight findings. OR, the Paducah Site Office, and Bechtel Jacobs need to specifically address these issues in the corrective action plan.

During an investigation, the Office of Oversight team may identify isolated weaknesses and/or minor deficiencies in otherwise effective programs. Although the site needs to correct such weaknesses and deficiencies, the Office of Oversight does not include every identified weakness in the formal tracking system. However, all weaknesses and deficiencies are considered as part of the Office of Oversight follow-up program when evaluating performance and planning future Oversight evaluation and follow-up activities.

Table A-1. Issues Identified in the Phase I Investigation at PGDP

IDENTIFIER	ISSUE STATEMENT	REFER TO PAGES
PGDP-INV-99-01	There has been limited progress in remediating and characterizing environmental contamination, low-level wastes, and stored hazardous materials that were produced by past industrial activities, and major cleanup milestones under the Federal Facility Agreement are jeopardized by funding constraints.	18-21
PGDP-INV-99-02	There are continuing weaknesses in the radiation protection management of known environmental contamination areas by both Bechtel Jacobs and DOE.	21-23
PGDP-INV-99-03	Radiological exposure pathways for DOE operations have not been fully assessed or documented.	23-24
PGDP-INV-99-04	Groundwater contamination has not been adequately characterized in some areas.	24-26
PGDP-INV-99-05	Unclear assignment of responsibilities and weaknesses in the integration and interpretation of environmental information have adversely impacted the understanding of environmental conditions.	26-27
PGDP-INV-99-06	Information to the public has sometimes been delayed and is in forms not clearly understood by the general public and other stakeholder groups, contributing to a perception that DOE and the contractor are withholding information from the public.	27-28
PGDP-INV-99-07	Incomplete radiological characterization of the workplace adversely affects the ability of the radiological control organization to identify hazards and institute controls as necessary to ensure consistent and appropriate radiological protection for workers.	35
PGDP-INV-99-08	There is a lack of rigor, formality, and discipline in the development, maintenance, and implementation of the Bechtel Jacobs radiation protection program.	35-40
PGDP-INV-99-09	Criticality safety deficiencies in DMSAs have not been resolved by DOE in a timely manner, posing an unnecessary hazard to workers in surrounding areas.	41-43
PGDP-INV-99-10	Safety and health procedures are not consistently applied and followed, and in some cases, hazards are not adequately addressed by those procedures.	43-44
PGDP-INV-99-11	Bechtel Jacobs has not assured that subcontracted medical personnel are sufficiently involved in the identification, evaluation, and integration of workplace hazards to ensure effective worker medical programs.	44
PGDP-INV-99-12	Bechtel Jacobs training programs do not ensure that all workers are knowledgeable of hazards and protection requirements, including those associated with transuranic contamination.	44-45
PGDP-INV-99-13	DOE has not conducted effective oversight of ES&H or ensured that Bechtel Jacobs and its subcontractors effectively implement all DOE and regulatory requirements.	46-47
PGDP-INV-99-14	Bechtel Jacobs has not conducted fully effective oversight of ES&H performance or ensured that its subcontractors effectively implement all DOE and regulatory requirements and are held accountable.	47-48

APPENDIX B

CHARACTERIZATION OF SELECTED SOLID WASTE MANAGEMENT UNITS

Table B-1 provides a characterization of selected SWMUs at PGDP as they were understood in the early 1990s. Information in the table was obtained from "Results of the Site Investigation, Phase II at the Paducah Gaseous Diffusion Plant," KY/ER-4, Volume 2 of 6, April 1992. SWMUs presented in the table are those units for which quantitative sampling information on either radioactive or hazardous materials was provided in the reference document.

Table B-1. Characterization of Selected PDGP Solid Waste Management Units from 1990[1]

Number & Location	Areal Extent	Period of Operation	Sampling Data	Comments
SWMU 1: C-747C Oil Landfarm	96,300 ft^2	1975-1979	Phase I: TCE – 190 μg/kg Aroclor 1242 and 1254 – 1,400 μg/kg Semivolitale organics – 1,800 μg/kg PCBs – range from 25-10,000 ppm Tc-99 – 2.36J ± 8.7 pCi/g U-234, U-238 – 15.7J ±1.28 pCi/g	At least 5,000 gallons of waste oil were applied to the landfarm. Periodically, lime and fertilizer were applied to the area, and the surface was replowed.
SWMU 2: C-749 Uranium Burial Ground	32,000 ft^2	1951-1977	270 tons of uranium 59,000 gallons of oils 450 gallons of TCE Phase I well data near Burial Ground: Tc-99 – 747J pCi/g U-234 – 1,860J pCi/g U-238 – 3,333J pCi/g	Burial ground included pyrophoric forms of U metal. Only 4 of 15 (30-gallon) drums with TCE were recovered.
SWMU 3: C-404 Low-Level Waste Radioactive Waste Burial Ground	53,200 ft^2	1951-1986	Phase I: Tc-99 – 2,175 pCi/g TCE – 210 μg/L	Most Tc-99 was released from the C-400 facility to the C-404 facility. The upper tier of waste includes 450 drums with Cd, Se, and Pb.
SWMU 5: C-746F Classified Burial Yard	168,000 ft^2	1965 – present	Phase I: Benzene – 980J μg/kg TCE – 9 μg/kg	
SWMU 7: C-747A Burial Ground	7 areas ranging from 1,500 ft^2 to 19,250 ft^2, with an overall total of 53,650 ft^2	1957-1979	Phase I: TCE – 6,100 and 5,300 μg/L Tc-99 – 3,195 and 2,830 pCi/L Phase I Deep Borings: Tc-99 – 72.7 pCi/g Aroclor 1254 – 730 μg/kg Aroclor 1260 – 26 μg/kg	No record of TCE disposal, although Well 66 has the highest concentrations of any onsite or offsite wells. Burial ground contains uranium-contaminated material from C-410 Feed Plant and uranium powder scrap from C-340 facility.
SWMU 9: C-746S Residential Landfill	6 cells occupying 700,000 ft^2	1982 – present	Phase I: TCE – 21 μg/L Tc-99 – 83 pCi/L	Landfill is a potential offsite contamination source.
SWMU 11: C-400 Trichloroethene Leak Site	4,200 ft^2	Storm sewer received TCE from early 1950s to June 1986 from C-400 Cleaning Building	1986 samples from excavation: TCE – 7,000 mg/kg Phase I: TCE – 33 μg/L Tc-99 – 177J pCi/g Phase I Deep Boring: TCE – 220 μg/kg	In 1986, 310 ft^3 of contaminated soil was removed containing 150 pounds of TCE. Some contaminated soil was left in and around C-400 Cleaning Building for structural reasons. Deep boring identified detectable concentrations to the base of the Regional Gravel Aquifer.

[1] Information obtained from "Results of the Site Investigation, Phase II at the Paducah Gaseous Diffusion Plant," KY/ER-4, Volume 2 of 6, April 1992 SWMUs presented in the table are those for which quantitative sampling information on either radioactive or hazardous materials was provided in the reference document. The symbol "J" indicates an estimated, measured value.

Number & Location	Areal Extent	Period of Operation	Sampling Data	Comments
SWMU 17: C-616E Sludge Lagoon	Impoundment of 215,000 ft^2	1979 – present	Phase I: Tc-99 – 4.9 pCi/L Phase I Deep Borings: TCE, chloroform, and chloromethane – 1.0J to 34 μg/L Gross beta, Tc-99, U-238, Pu-239 – 0.05 $\pm$ 0.05 to 16 $\pm$ 1.7 pCi/g	The lagoon is located north of Plant security fence. The lagoon sludge also contains chromium.
SWMU 18: C-616F Full Flow Lagoon	N/A	1977 – present	Phase I: TCE – 22 μg/L Tc-99 – 76 pCi/L Phase I Deep Borings: Toluene, TCE, chloroform, and chloromethane – 1.0J to 34 ug/l Gross beta, Tc-99, U-238, Pu-239 – 0.05 $\pm$ 0.05 to 16 $\pm$ 1.7 pCi/g	The lagoon is located north of the Plant security fence. The lagoon receives much of the Tc-99 discharged from the Plant. The lagoon overflows to Big Bayou Creek through Outfall 001.
SWMU 20: Emergency Holding Pond	Below grade impoundment of 600 ft^2	1950s – present	Phase I samples from sludge: Tc-99 – 56 pCi/g Total Uranium – 381.8 pCi/g Np-237 – 1.2 pCi/g Nickel – 201,600 μg/L, TCLP extract PCBs – 3,000 μg/kg	It is reported that the unit never received TCE, Tc-99, or PCBs.
SWMU 30: C-747A Burn Area	128,000 ft^2	1951-1970	Phase I – from Well 66: TCE – 5,300 μg/L Tc-99 – 2,830 pCi/g Phase I Deep Boring: Aroclors 1254 – 120 μg/kg Aroclors 1260 – 26 μg/kg	Ash and burned material were buried when the incinerator was closed. Much lower concentrations of TCE and Tc-99 were obtained during Phase I sampling from Wells 63, 64, and 65 that are all located west of the unit.
SWMU 33: C-727 Motor Cleaning Facility	N/A	1957 – present	Phase I Shallow Borings: PCBs – 66,000 μg/kg Dioxins/furans – 3.29J μg/kg VOCs (e.g., benzene, ethylbenzene, and xylenes) – 210 μg/kg	Process for cleaning changed in 1975 from dipping in mineral spirits to steam cleaning.
SWMU 40: C-403 Neutralization Tank	N/A	1950s – present	Approximately 3,200 Ci of Tc-99 were discharged at a controlled rate from the Plant to surface waters, primarily from C-400 effluents and, therefore, potentially through C-403.	C-403 receives effluents from C-400 Cleaning Building and discharges to North/South Diversion Ditch, where it is directed to the C-616-F Full Flow Lagoon. C-616 discharges to Big Bayou Creek through Outfall 001.
SWMU 47: C-400 Technetium Storage Tank Area	4,000 gallons	1960s – 1986 when the tank was removed	1986 samples in and around tank: Tc-99 – 0.5 ppm in soil, 0.08 ppm in concrete Chromium – 10.1 ppm in soil, 17.2 ppm in concrete Uranium – 165 ppm in soil, in concrete	No spills of Tc-99 were 28 ppm were documented.
SWMUs 58-69: Effluent Ditches and Little and Big Bayou Creeks	The two creeks follow along the western and eastern sides of the Plant, respectively, and empty into the Ohio River.	N/A	Phase I; Evidence of transuranic, Tc-99, PCB, and organic compound contamination in sediments and surface water. Subsequent assessment indicated risk from exposure to creek sediments.	Reaches with contaminated soils and sediments include: the North/South Diversion Ditch from the Plant to Little Bayou Creek (10,000 ft), Little Bayou Creek from Plant Outfall 011 to the North/South Diversion Ditch (16,000 ft), and Big Bayou Creek from Plant Outfall 009 to New Water Line Road (3,000 ft).

Number & Location	Areal Extent	Period of Operation	Sampling Data	Comments
SWMU 74: PCB Spill Site	N/A	Spills occurred from 1950s to early 1970s	Phase I: Aroclor 1260 – 2,974.8 µg/kg Dioxins – 16 µg/kg Gross beta – 38.5 ± 2.1 pCi/g	Exact release dates are unknown.
SWMU 75: PCB Spill Site	N/A	Spills occurred from 1950s to early 1970s	Phase I: Aroclor 1254 and 1260 - 770 µg/kg Dioxins/furans – 230 µg/kg	Exact release dates are unknown.
SWMU 79: PCB Spill Site	N/A	Spills occurred from 1950s to early 1970s	Phase I: Aroclor 1260 – 12,000 µg/kg Dioxin (OCDD) – 8.69J µg/kg Organics – 80J µg/kg Tc-99 – 1.0J pCi/g Pu-239 – 0.36 ± 0.17 pCi/g	Exact release dates are unknown.
SWMU 80: PCB Spill Site	N/A	Spills occurred from 1950s to early 1970s	Phase I: Aroclor 1260 – 150,000 µg/kg Dioxins – 37.2 µg/kg OCDD – 8.3 ug/kg Tc-99 – 1.9J ± 0.2 pCi/g	Exact release dates are unknown.
SWMU 81: PCB Spill Site	N/A	Spills occurred from 1950s to early 1970s	Phase I: Aroclor 1260 – 17,417 µg/kg Dioxins – 12.63J µg/kg OCDD – 170 µg/kg	Exact release dates are unknown.
SWMU 82: Electrical Switchyard	N/A	1951 – present	Phase I: Aroclor 1260 < 112.9 µg/kg OCDD < 7.51 µg/kg Gross beta – 21.7 ± 1.9 pCi/g	Pre-RCRA, TCE was dumped on the ground when cleaning operations were finished. Several hundred gallons were used annually. PCB contamination also found.
SWMU 83: Electrical Switchyard	N/A	1951 – present	Phase I: Aroclor 1260 < 570 µg/kg	Pre-RCRA, TCE was dumped on the ground when cleaning operations were finished. Several hundred gallons were used annually. PCB contamination was found.
SWMU 84: Electrical Switchyard	N/A	1953 – present	Phase I: Aroclor 1260 < 63 µg/kg	Pre-RCRA, TCE was dumped on the ground when cleaning operations were finished. Several hundred gallons were used annually.
SWMU 85: Electrical Switchyard	N/A	1951 – present	Phase I Chloromethane – 480J µg/kg Total xylenes – 250J µg/kg	Pre-RCRA, TCE was dumped on the ground when cleaning operations were finished. Several hundred gallons were used annually.
SWMU 91: UF_6 Cylinder Drop Test Area	N/A	1979	Phase I Deep Boring: TCE – present to 24 feet bls in concentrations up to 260 µg/kg	TCE was typically left in pit for days prior to pumping.
SWMUs 94 and 95: Old Kentucky Ordnance Works	N/A	1942 – 1946	1988 leach field samples, SWMU 94: PAH – 131 to 1,040 µg/kg	
SWMU 138: C-100 South Side Lawn	N/A	See comments	No samples identified as having been taken for SWMU 138; however, historic analyses of the SWMU 38 sludge (one of two sources of the sludge) reported the presence of PCBs and uranium.	Receives sludge from the C-611 Water Treatment Plant and the C-615 Sewage Disposal Plant (SWMU 38). Sludge applied directly to lawn as fertilizer. C-615 sludge contained PCBs and uranium.

APPENDIX C
TEAM COMPOSITION

To reflect the investigation team's overall mission of assessing the impact of current DOE activities on worker safety, public safety, and environmental protection, the investigation activities of the team are organized into three groups – management and worker safety, environmental management, and radiation protection. Each group is composed of a group leader and individual members with relevant expertise. Each group developed lines of inquiry that guided the evaluation scope of interest for that group. The specific activities of the investigation team are discussed in Section 1.4.

The team composition and areas of responsibility are shown below.

Senior Manager

S. David Stadler, Ph.D.

Team Leader

Patricia Worthington, Ph.D.

Management and Worker Safety Group

Brad Davy - Group Leader
Marvin Mielke, RN
Bob Freeman
Regina Griego
Bill McArthur, Ph.D., CIH
Jerry McKamy, Ph.D.
Al Gibson**
Jim Lockridge, PE, CIH, CSP**
Mark Good**

Environmental Management Group

Bill Eckroade, REM – Group Leader
Vic Crawford, PE, REM
Arlene Weiner, REM**
Thomas Naymik, Ph.D., CPG, RG**
Chris Perry, CPG**
Mario Vigliani, CHP**

Radiation Protection Group

Ed Blackwood – Group Leader
Robert Loesch, RRPT
Bill Cooper, CSP
Pete O'Connell, CHP

** Technical Advisor

Communications and Support

Mary Anne Sirk
Barbara Harshman
Bob McCallum
Marcia Taylor
Kathy Moore

Quality Review Board

S. David Stadler
Raymond Hardwick
Thomas Staker
Tom Davis

RN	Registered Nurse
CIH	Certified Industrial Hygienist
CSP	Certified Safety Professional
REM	Registered Environmental Manager
PE	Professional Engineer
CPG	Certified Professional Geologist
RG	Registered Geologist
CHP	Certified Health Physicist
RRPT	Registered Radiation Protection Technologist

Abbreviations Used in This Report

ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DCG	Derived Concentration Guidelines
DHHS	U.S. Department of Health and Human Services
DMSA	DOE Material Storage Area
DNFSB	Defense Nuclear Facilities Safety Board
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
ES&H	Environment, Safety, and Health
MCL	Maximum Contaminant Level
MMES	Martin Marietta Energy Systems
NRC	Nuclear Regulatory Commission
OR	Oak Ridge Operations Office
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PACE	Paper, Allied-Industrial, Chemical, and Energy (Workers)
PCB	Polychlorinated Biphenyl
PGDP	Paducah Gaseous Diffusion Plant
ppb	Parts Per Billion
RCRA	Resource Conservation and Recovery Act
RWP	Radiological Work Permit
SSAB	Site Specific Advisory Board
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TVA	Tennessee Valley Authority
USEC	United States Enrichment Corporation

Question 2: During its recent independent investigation, DOE sampled media for chemical and radiological analysis. What was the purpose of this sampling effort, and what are your findings?

Answer: Environmental samples were collected and analyzed by the investigation team in an effort to confirm that the current analytical results being reported by the site are accurate and representative of actual environmental conditions. This effort was not intended to characterize the site for remediation purposes. Remedial Investigations studies are conducted by the Department's Environmental Management Program and are reviewed and approved by environmental regulatory agencies.

The results of the independent sampling were generally consistent with historical environmental monitoring results produced and published by the site. There also was general agreement between the independent sample results and the results of the analysis of split samples by the site. Those matches provides, additional confidence that DOE site contractors are producing accurate environmental monitoring results.

In a few cases, sediment sample results identified contaminants at levels not previously identified by the site. These transplant were taken at the North-South Diversion Ditch (between Ogden Landing Road and the site security fence), and outfalls K011 and K015. These discrepancies are likely to be related to the lack of homogeneity of contaminants in the soils.

Question 3: Did DOE plan its independent investigation sampling effort with the Environmental Protection Agency (EPA)? If not, please explain why. Also, prior to the release of the independent investigation report, did EPA request or receive environmental sampling data. If not please explain why.

Answer: DOE did not plan the sampling effort with the EPA. The team was directed to conduct an independent investigation of the site, and operated under strict deadlines established by the Secretary of Energy for the completion of the initial phase of the investigation. In planning the independent environmental sampling effort, the team evaluated the results of past Remedial Investigations that were performed by DOE contractors and overseen and approved by EPA and the Commonwealth of Kentucky. These reports described the nature and extent of environmental contamination from past releases from the Paducah plant. The team utilized these reports, as well as routine environmental monitoring results produced by DOE site management, to plan the most effective and efficient sampling strategy for the independent investigation. Onsite representatives from Kentucky participated in the sampling effort by collecting several split samples of groundwater, surface water and soils/sediments. The EPA Project Manager for Paducah was consulted on the initial conclusions of the investigation team immediately following the completion of field investigations.

The EPA did request sampling results from the investigation team. Upon completion of the analysis of most samples and the assessment of the data by the investigation team, sampling data were provided to EPA Region IV and Commonwealth of Kentucky staff on Friday, October 8, 1999. An EPA project manager was briefed on the final results of the investigation on Thursday, October 14, 1999. The investigation report was formally published on Wednesday, October 20, 1999.

Question 4: At the hearing, DOE indicated that areas onsite had been identified with radiological contamination high enough to require sampling technicians to wear protective clothing. Why have these contamination areas remained uncontrolled for public access? Are there other areas onsite with similar amounts of contamination that are also un-posted?

Answer: The investigation team noted areas of contamination that exceed Bechtel Jacobs radiological posting criteria in outfalls K011, the North South Diversion Ditch, and along little Bayou creek on DOE property but outside the site security fence. The Bechtel Jacobs health physics procedures require that such areas be posted as soil contamination areas and/or contamination areas, and that appropriate measures be taken to prevent inadvertent entry. Some of these areas were posted with signage and wording that were the result of CERCLA Records of Decision or interim corrective measures, but these postings were not consistent and, in some cases, did not specify the presence of a radiological hazard. Neither DOE nor Bechtel Jacobs site representatives was able to provide a sound basis for not controlling such areas in accordance with the Bechtel Jacobs radiation protection program.

The investigation team noted that the most significant areas of contamination have been identified during past investigations, but, the full extent of radiological contamination both inside and outside the security fence has still not been characterized by a sitewide survey and sampling program.

The Department subsequently made changes to improve the sign postings for radioactively contaminated areas on DOE property. Site personnel have, for example, posted signs that clearly identify the presence of radiological contamination on both sides of the North-South Diversion Ditch, and at several outfall ditches and culverts associated with Little Bayou Creek.

QUESTIONS FROM CHAIRMAN UPTON

Assessment of Environmental Media

Question 5: Why has DOE failed to adequately assess sediments, soils, surface water, and other environmental media in areas outside the security fence to ensure public safety in these areas?

Answer 5: The Department has worked with regulators in the U.S. Environmental Protection Agency (EPA) and the Commonwealth of Kentucky to ensure that assessments are done in areas outside the security fence to identify contamination in sediments, soils, surface water, and other environmental media, as described below. In addition, on November 8th and 9th, 1999, representatives from DOE field offices and Headquarters, EPA, and Kentucky met to review strategies and priorities for assessment and remediation to maximize cleanup within available resources.

DOE regularly assesses conditions, both inside and outside the security perimeter, and reports results of environmental monitoring at the Paducah Gaseous Diffusion Plant in the site's Annual Environmental Report. In addition to the environmental monitoring reported annually in this report, the Department has conducted environmental assessments and investigations since the discovery of off-site groundwater contamination in 1988 to assess conditions outside the security perimeter, or contamination inside the security perimeter which could migrate beyond the fence boundaries. I would like to provide for the record a listing of investigation activities the Department has carried out from 1989 to the current time.

The information follows.

Environmental Assessments Conducted at Paducah Gaseous Diffusion Plant (PGDP)

Date	Assessment/Investigation	Report Title/Number
1989-1991	Phase I Site Investigation	Phase I Site Investigation Work Plan DOE/OR/07-1203. Volumes 1, 2, and 3
		Results of Site Investigation Phase I at the PGDP KY/F-R-4
1991	Public Health and Ecological Assessment.	Results of Public Health and Ecological Assessment KY/SUB/13B-97777CP-03/1991/1
1990-1992	Phase II Site Investigation	Phase II Site Investigation Work Plan KY/ER-3
		Results of the Site Investigation, Phase II at PGDP KY/SUB/13B-97777 P03/1991/1
1993	Northwest Plume Investigation	Characterization of the Northwest Plume Utilizing a Driven Discrete-Depth Sampling System KY/ER-22
1994	Northeast Plume Investigation	Field Sampling Plan for the Northeast Plume DOE/OR/07-1222&D2
1993-1995	Waste Area Groups (WAG) 1&7	Remedial Facility Investigation Work Plan for WAGs 1&7 and Kentucky Ordnance Works SWMUs 94, 95, and 157 DOE/OR/07-1147
		Remedial Investigation Report for WAGs 1&7 at PGDP, Paducah, KY DOE/OR/07-1404
		Remedial Investigation Report for SWMUs 94, 95, and 157 DOE/OR/07-1405
1994-1996	WAG 17	RCRA Facility Investigation Work Plan for WAG 17 at PGDP, Paducah, KY DOE/OR/07-1202&D2
		Remedial Investigation Report for WAG 17 at PGDP, Paducah, KY DOE/OR/07-1404
1995-1999	WAG 6	Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Group 6 at the PGDP DOE/OR/07-1243&D4
		Remedial Investigation Report for WAG 6 at the PGDP, Paducah, KY DOE/OR/07-1727 Volumes 1, 2, 3, and 4
1996-1999	WAG 27	Integrated Remedial Investigation/Feasibility Study Work Plan for Waste Area Group 27 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky DOE/OR/07-1518&D3
		Remedial Investigation Report for WAG 27 at the PGDP, Paducah, KY DOE/OR/07-1777 Volumes 1, 2, 3, and 4
1997-Current	WAG 28	Work Plan for Waste Area Group 28 Remedial Investigation/Feasibility Study and Waste Area Group 8 Preliminary Assessment/Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky DOE/OR/07-1592&D2 Primary
1998-Current	Data Gaps	Sampling and Analysis Plan to Support a Site Wide Current Remedial Strategy for DNAPL DOE/OR-07-1719

Environmental Assessments Conducted at Paducah Gaseous Diffusion Plant (PGDP)—Continued

Date	Assessment/Investigation	Report Title/Number
1998-Current	WAG 8	Work Plan for Waste Area Group 28 Remedial Investigation/Feasibility Study and Waste Area Group 8 Preliminary Assessment/Site Investigation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky DOE/OR/07-1592&D2 Primary

As a result of these data collection and assessment activities, a number of actions have been taken to protect the public's health and safety outside the plant security fence. I would like to provide for the record a summary of the actions taken.

The information follows.

Actions Taken at Paducah Gaseous Diffusion Plant to Protect the Public Health & Safety

Project/Event	Action Taken
Off-site Groundwater Contamination Controls (1988-89).	Identified and sampled local wells Provided interim bottle water to anyone who wanted it Initiated routine residential sampling Provided water tanks to any residents with contaminated wells Initiated health surveys of residents with contaminated wells Identified radiological contamination in Little Bayou Creek, North/South Diversion Ditch, and KPDES Outfall 011. Posted ''No Trespassing'' signs.
Contaminated Rubble Pile at Ballard County Wildlife Area and Related Controls.	Removed rubble pile Performed systematic search for other rubble piles which resulted in identification of several additional rubble piles which were grouped into WAG 17 Performed expedited health physics surveys of piles
Subsidence Control at the Sewage Treatment Plant.	Fenced sewage treatment plant to protect recreational users of the area from physical hazards (i.e., subsidence)
Elevated levels of PCBs in fish	Commonwealth of Kentucky issued a fish advisory for the Little Bayou Creek and KPDPS Outfall 011
C-750-A and B Underground Storage Tanks.	Removed tanks in 1991 with partial soil excavation Excavated additional soils and closed in 1998
C-746-K Sanitary Landfill Interim Corrective Measures (Initiated in 1992).	Installed a low permeability cap to repair subsidence and restore a 5% slope to the top of the landfill to assist in precipitation runoff Implemented a surface water monitoring program Maintenance of a previously installed leachate containment dam and filter trap
Tricliloroethylene (TCE) Use at PGDP ..	Use of TCE was discontinued at PGDP on June 30, 1993 Sludges/sediments from large degreaser were containerized and placed in waste storage
RCRA Closures (1993-present)	Closed the following units in accordance with RCRA: C-400-B&C Nickel Stripper, C-409 RCRA Pilot Plant, C-720 Large Degreaser, and C-746-R RCRA Storage Pad Closed C-404 Uranium Burial Ground in 1987
Institutional Control of Off-Site Contamination in Surface Water Interim Corrective Measures (Initiated in 1993).	Installed fencing at 13 sites outside the PGDP security perimeter along the KPDES outfalls 001 and 011, C-616 lagoons, the NSDD, Big Bayou Creek, and Little Bayou Creek to restrict casual public access Posted warning signs at C-616 Posted warning signs at the Outfalls and NSDD Posted a Fish Consumption Advisory for Little Bayou Creek
Containment of Scrap Yard Sediment Runoff Interim Corrective Measures (Initiated in 1993).	Installed sill fences around the scrap yards to filter the contaminated silt which could be mobilized during rainfall events Installed gabion type silt traps with nonwoven geotextile material in two ditches draining the scrap yards to contain contaminated sediments
Water Policy Engineering Evaluation/ Cost Analysis (Initiated in 1993).	Provided municipal mater supply to residents with in the area that could potentially be affected by migration of groundwater contamination Established agreements with residents which restricted use of their wells Established agreements with residents which allowed access for sampling or testing Ongoing payment of associated water bills Locked and capped affected residential wells
North/South Diversion Ditch (NSDD) Record of Decision (Initiated in 1994).	Installed ion exchange system in C-400 to reduce radionuclide concentrations in effluents prior to discharge into the NSDD Established the target treatment level as the Maximum Contaminant Levels (MCLs) Installed (by USEC) settling lagoons at the C-600 facility to remove fly ash from effluents prior to discharge to the NSDD

Actions Taken at Paducah Gaseous Diffusion Plant to Protect the Public Health & Safety—Continued

Project/Event	Action Taken
	Installed two lift stations in the NSDD which discharged to a pipeline to transport permitted effluent discharges and storm water runoff from the southern end. This system bypassed approximately 50% of the NSDD inside the security perimeter, thereby reducing the potential for mobilizing contaminated sediments in the vicinity of NSDD
	Installed a gabion type rock structure with nonwoven geotextile material secured to the upstream side near the ditch 001 lift station to mitigate the potential for contaminant transport from the bypassed portion of the NSDD to offsite area
	Installed warning signs on both sides of the NSDD to give notice that elevated levels of radionuclides, metals, and PCBs are present in the area
Interim Remedial Action for the Northwest Plume (Initiated in 1993).	Installed a total of four extraction wells at two locations (two at each location) and associated piping to extract contaminated groundwater from the highest concentration area of the Northwest plume and pump this water to a treatment system
	Installed a treatment system consisting of air strippers, ion exchange, and activated carbon to treat the contaminated (TCE and Tc-99) groundwater to a target treatment limit of 5 ppb for tricliloroethene (TCE) and 900 pCi/g for Tc-99 prior to discharge to Outfall 001
Outfall 011 (1995)	Lined ditch with bentonite and installed rip-rap to reduce transport of PCB-contaminated sediments
Interim Remedial Action for the Northeast Plume (Initiated in 1995).	Installed a total of two extraction wells at one location to extract contaminated groundwater from the highest concentration area of the Northeast plume
	Installed a collection and piping system to collect and pump contaminated groundwater to an existing cooling tower for volatilization of TCE and 1,1-dicholoroethene
WAG 22 Solid Waste Management Units (SWMU) 2 and 3 Record of Decision (Initiated in 1995).	Implemented a groundwater monitoring program in the uppermost aquifer, the Regional Gravel Aquifer, to detect any release of contaminants from SWMU 2
	Implemented institutional controls (signs and deed restriction) at SWW 2
C-746-S&T Landfill Closures	Closure was initiated in accordance with Kentucky Solid Waste Regulations in 1995
WAG 17 Removal Action (1996)	Removed contaminated soils 124 under DOE removal action authority
	Properly packaged and stored material as waste
WAG 17 Record of Decision (1997)	Established that no further remedial action was necessary to protect human health and the environment
WAG 23 Removal Action (1997)	Excavated approximately 115 cubic meters from SWMUs 1, 56, 57, 80, and 81 to reduce PCB levels to below 25 ppm and dioxin levels to less than 1.3 ppb
WAGs 1 and 7 Record of Decision (Initiated in 1998).	Deferred investigation and action on SWMU 38, C-615 Sewage Treatment Plant, until unit ceases operation
	Upgraded groundwater monitoring system around the C-746-K landfill
	Installed institutional controls (signs and fences) around C-746-K
	Implemented deed restrictions on C-746-K
	Transferred responsibility for SWMUs 94, 95, and 157 (all located in former KOW area) to the Corp of Engineers
	Established that no further remedial action was necessary to protect human health and the environment for the following SWMUs: 130, 131, 132, 133, 134 and 136
SWMU 91 Record of Decision (Lasagna ™) (Initiated in 1999).	Completed design of Lasagna ™ treatment system
	Abandoned three wells located within the SWMU
	Removed a cold bath pit used in testing UF6 cylinders
	Construction scheduled for treatment system September 1999
Radiological Postings (Ongoing)	Post areas of radiological contamination which exceed limits defined in 10 CFR 835.

In addition to the activities identified in the two proceeding listings, three major remedial investigations remain to be completed in accordance with the Federal Facility Agreement. These include investigation of the surface water in FY 2000-2001, investigation of surface soils in FY 2001-2002, and investigation of burial grounds in FY 2004-2005.

Radiological Contamination

Question 6: What is DOE doing to identify radiological contamination at other offsite areas accessible to the public?

Answer 6: The Department has conducted a number of investigations to identify possible radiological contamination at offsite areas around the Paducah, Kentucky site. Where we have identified contamination, we have taken steps to mitigate risks to public health and safety.

Actions taken to identify and address offsite radiological and chemical contamination have included routine sampling of residential water supplies; provision of alternative water supplies when contamination was found in residential wells; removal of deteriorating tanks and excavation of contaminated soils; improved treatment of waste streams to decrease possible offsite releases; installation of additional fencing to restrict access to possible contaminated areas; posting of warning signs to prevent use of contaminated water, including fishing and recreational use; installation of extraction wells to remove contaminated groundwater from various areas around the site-, and implementation of a groundwater monitoring program to ensure that any releases are detected. A detailed listing of the assessments conducted at the Paducah site, and actions taken to protect health and safety, was provided for the record in response to the preceding question. These listings show, by year, the various Departmental actions taken to mitigate the spread of contamination offsite and to prevent public access to unsafe areas.

Paducah Gaseous Diffusion Plant

Question 7: What was the assessed value of natural uranium DOE transferred to the United States Enrichment Corporation (USEC) in 1998 for the purposes of completing nuclear safety upgrades at Paducah?

Answer: In 1998, the Department transferred 3,803,610 kgU of natural uranium and 44.276 Metric Tons of low-enriched uranium to the United States Enrichment Corporation for settlement of nuclear safety liabilities at the gaseous diffusion plants and other liabilities. The value of these transfers was assessed at $220 million.

Question 8: What portion of the assessed value of the natural uranium transferred to USEC was intended to pay for the completion of seismic upgrades at Paducah?

Answer: The Department transferred natural uranium and low-enriched uranium valued at $220 million under the Department-negotiated agreement with the United States Enrichment Corporation related to nuclear safety upgrades costs at the gaseous diffusion plants. That agreement settled a number of Departmental liabilities, including completion of seismic upgrades at Paducah, which the Department estimated would total $34.6 million.

Question 9: Please explain why DOE material storage areas at Paducah have not been characterized, analyzed or resolved even though they were identified more than two years ago.

Answer: There are 148 DOE Material Storage Areas (DMSAs) at the Paducah Site. Based on inspections and records review, enough is known about the materials and equipment in 70 of these DMSAs to conclude that they do not present a criticality hazard. However, there are 78 DMSAs in which additional information is needed. Of the 78 DMSAs, 13 present the highest priority for near-term characterization and disposition because fissile material could be present in quantities that could present a hazard under certain conditions.

Over the last year, the Department had been developing nuclear-grade procedures and controls for the characterization and disposition of DMSAs with a potential for accumulation of fissile materials. Because of the nuclear safety aspects of this work, it proceeded at a slower pace. For example, we have taken the time that was needed to develop procedures to govern this work, to conduct the necessary criticality safety evaluations and safety assessments, and to perform a readiness assessment—all of which provide the basis for DOE's approval to proceed with characterization and disposition actions for the DMSAs.

Until recently, the priority for DMSA characterization and disposition was focused on portions of 24 DMSAs that contain materials and equipment that must be moved in order for United States Enrichment Corporation's (USEC) seismic upgrade to proceed. However, a recent investigation completed by DOE's Office of Environment, Safety and Health identified 11 DMSAs that possibly contain fissile materials, presenting a criticality hazard—consequently, these areas must also be characterized and dispositioned on a priority basis. Subsequent review by the DOE contractor identified an additional 2 areas of potential concern. About half of these 13 DMSAs that are of concern to DOE are the same DMSAs that are a priority with USEC—but some of them are not. This has caused the Department to re-examine the priority and schedule for characterization and disposition of the DMSAs that are a priority for DOE and those that are a priority for USEC. In the interim, until a final plan is complete, we have proceeded to characterize and disposition/move materials in one DMSA that does not present a criticality concern. By doing so, this allows work required by USEC to proceed while providing an opportunity for workers to gain more experience before handling a DMSA that presents a potential criticality hazard.

We are currently working with the USEC and the Nuclear Regulatory Commission to develop a consolidated plan for accelerating the characterization and removal or disposition of the DMSAs in a manner that meets the needs of both USEC and the Department. It is essential that DOE and USEC work closely together on this as the work depends on a limited number of properly trained and security-cleared USEC Inc employees at the site. Once issued, the final plan will be provided to the House Commerce Subcommittee on Oversight and Investigations.

Question 10: Please explain what schedule or cost impacts may occur with USEC's efforts to complete seismic upgrades at Paducah due to DOE's failure to characterize, analyze, and resolve DOE material storage areas.

Answer: The Department is presently working with the United States Enrichment Corporation (USEC) and the Nuclear Regulatory Commission (NRC) to determine the schedule and cost impacts associated with plans to remove materials and equipment located in DOE Material Storage Areas (DMSAs) to support USEC's seismic upgrade project. However, a recent investigation by the Department of Energy (October 1999) identified several other DMSAs not related to the seismic upgrade project that also require expeditious removal. At present, plans are being developed that would allow for timely removal and disposition of all materials and equipment in the DMSAs that are adjacent to areas in which seismic upgrades are planned, as well as for timely characterization and disposition of the additional DMSAs that were identified as potential areas of criticality concern in the recent DOE investigation.

We are working together to develop a comprehensive plan that meets the objectives of USEC, which are to complete the seismic upgrades, and the objectives of DOE, which are to address DMSAs that may have criticality safety concerns on an expedited basis. Once the plan is finalized we will be able to provide you the impact on cost and schedule.

Question 11: Is USEC responsible for funding the characterization and movement of DOE material storage areas? If so, what is the estimated cost of this effort, and how will USEC provide the necessary funds to complete the characterization in a timely manner?

Answer: Generally, the United States Enrichment Corporation (USEC) is not responsible for funding the characterization of materials and equipment contained in the DOE Material Storage Areas (DMSAs). However, since 1997, USEC has been funding and conducting non-characterization work associated with the DMSAs in accordance with the agreements signed on June 23, 1996, and December 31, 1996. Both of these agreements have been previously submitted to the Subcommittee. In addition, to support their seismic upgrade project, USEC has also agreed to fund and provide manpower for equipment and materials that must be removed from DMSAs in order for USEC to complete seismic upgrades.

The total estimated costs of completing the DMSA removal actions for the seismic upgrade project and for the remaining DMSAs where potential criticality concerns exist are currently under development by the Department and USEC.

Plutonium Contamination

Question 12: Please explain why plutonium contamination in offsite sediments was not identified in the Executive Summary of the DOE report "Phase I Results of the Site Investigation, March 22, 1991."

Answer l2: The Executive Summary discusses chemical and radiological contamination off site, but does not specifically identify plutonium contamination, although other radiological contaminants were identified in the summary. However, the body of the Phase I Site Investigation Report, March 22, 1991, does discuss plutonium contamination. The full report received DOE, Environmental Protection Agency (EPA), public, contractor, and State review. It is unclear why the plutonium contamination was not mentioned in the Executive Summary.

Prior to the Phase I report, plutonium contamination had been identified and reported. For example, the 1980 Annual Site Environmental Report contained a table showing that transuranic elements (plutonium and neptunium) had been detected in fish, apples, milk, and deer. The 1980 report was submitted to various State agencies, the U.S. EPA Regional Office, and local news media.

The Department also identified the presence of plutonium contamination and elevated radiation exposure readings in documents reporting the results of a Phase I investigation survey, including a September 18, 1990, Occurrence Report and a DOE media advisory issued on October 1, 1990. The local newspaper, the *Paducah Sun,* carried a story in its October 2, 1990, edition that discussed the presence of uranium and "transuranic elements such as plutonium, neptunium and technetium."

The regulatory agencies in the Commonwealth of Kentucky and U.S. EPA were also informed of these findings through the monthly reports.

Question 13: Please explain whether soil sample SS-2—measured as part of DOE's independent investigation—is consistent with data obtained in the March 22, 1991 Phase I report.

Answer: The independent investigation team collected a sample in the North South Diversion Ditch between Ogden Landing Road and the site security fence (sample SS-2). This sample was determined to contain elevated plutonium 239/240, neptunium 23.7, and thorium 230 levels. The 1991 Phase I report and supporting data dated January 4, 1991, contains survey and sampling results for soils and sediments in the North South Diversion Ditch. The results of these samples in the vicinity of the location of SS-2 also showed elevated levels of plutonium, cesium and thorium. While the reported levels of plutonium and cesium from the 1991 samples are consistent with the results of the independent investigation team associated SS-2, the level of thorium-230 reported in 1991 is significantly lower than the level recently identified by the investigation team at that location.

Institutional Controls

Question 14: Based on current institutional controls that inform the public and restrict access to offsite contaminated areas, are visitors, workers, and residents surrounding the Paducah site adequately protected from radiological and chemical releases from the Paducah site?

Answer]4: The Department has installed institutional controls that restrict access to offsite contaminated areas on DOE property surrounding the operating facilities at the Paducah site. The Department installed postings, fences, and signs agreed to by the Commonwealth of Kentucky and the U.S. Environmental Protection Agency as measures that would protect the public and workers. In addition, in response to the observations of the investigation team led by the Department's Office of Environment, Safety and Health, the Department has completed additional postings on DOE property outside the security fence that identify radiologically contaminated areas.

Contaminated Water

Question 15: When contaminated wells were discovered in 1988, EPA ordered DOE to provide safe drinking water to private residences and the extension of municipal water lines to the homes in the area of contamination. In addition, a comprehensive water monitoring program was put into effect. The current "sump & pump" method for dealing with the contaminated water does not appear to be addressing the problem at the source. Please explain what efforts are currently underway to control "hot spots" that are contributing to this groundwater contamination. Specifically, please include a description of your efforts to remove TCE stored in the C-400 building. Please also identify any proven technologies that may address the problem more effectively.

Answer 15: The Department's programmatic strategy for site remediation, which was developed in conjunction with, and approved by, both EPA and the Commonwealth of Kentucky, utilizes a risk-based approach consisting of four phases. The Department will first address imminent threats, including both on and off-site conditions; then reduce further migration of off-site contamination; then address sources of off-site contamination; and lastly address remaining areas of on-site contamination.

Providing municipal water to affected residents and installing groundwater pump-and-treat systems were intended to address imminent threats and reduce the further mitigation of the high concentration portion of the off-site contamination plumes. However, these two steps are only intended to serve as interim measures until a more comprehensive solution can be developed. DOE recognizes the limitations of the existing pump and treat system and acknowledges that any comprehensive solution for groundwater must include actions at the source areas (i.e., the "hot spots" in the vicinity of the C-400 Building) to be effective.

The "hot spots" in the vicinity of the C-400 Building (Waste Area Groups, WAGS, 3, 6, 27, and 28) are the sources of the contaminated groundwater migrating from the site. These source areas are contamination from past activities; there are no trichloroethylene (TCE) materials currently stored in the C-400 Building. DOE recently completed remedial investigations for several of the major TCE source areas (WAGs 6 and 27) and expects to complete characterization of the southwest plume and remaining TCE sources (WAGs 3 and 28) in early FY 2000. Upon collection of this additional data, the Department will have sufficient information to complete a site-wide feasibility study that will lead to the selection of a final remedial action for the groundwater contamination. The draft feasibility study is scheduled to be issued in June 2000.

To support source remediation, DOE recently completed a successful demonstration of the "LASAGNA" Technology, which removes TCE from soils, and is in the process of full-scale deployment at the TCE test pit area. DOE is also conducting a pilot field demonstration of another promising new technology in FY 2000. This new in-situ reactive barrier technology, when used in conjunction with other source treatment technologies, may prove to be significantly more effective than the traditional pump and treat systems. In addition, DOE is working to identify technologies at Paducah through the Innovative Treatment Remediation Demonstration Program (ITRD), which provides outside technical expertise to help find solutions to complex remediation problems at DOE sites and works with stakeholders to gain acceptance of promising technologies. At Paducah, the ITRD is working to identify proven technologies to address ground water and soil contamination problems.

Question 16: DOE has proposed a plan to compensate workers at Paducah that have demonstrated adverse health effects due to radiological exposure. Please explain how causation will be established between exposure to radioactive contaminants at Paducah facilities and adverse health effects pursuant to the proposed compensation plan.

Answer: The Department considered a number of options for compensating workers at Paducah who have illnesses that may be associated with radiological exposure. Because of the lack of exposure monitoring data for these workers, it is not possible to accurately determine the doses they received. Therefore, in consultation with the National Economic Council, the Department elected to adopt the Radiation Exposure Compensation Act (RECA) model in developing Title III of the legislation. RECA has a compensation program for workers who were on site during atmospheric nuclear weapons testing. To be eligible for compensation, workers must establish that they were (1) onsite at the time of weapons testing and (2) have one of the cancers listed in the statute.

In the Administration's proposal for Paducah workers, criteria are that (1) workers must have worked on site for one year during the time period winch recycled reactor tailings were processed, (2) worked in a position where they were badged for radiation exposure (or should have been badged), and (3) have primary cancer of the bone or the lung or one of the radiogenic cancers listed in RECA.

Question 17. Was radiation exposure to workers monitored and documented prior to 1989? How could anyone actually prove causation if no records were kept?

Answer: DOE has radiation protection standards and requirements in place that include monitoring thresholds, documentation, and reporting requirements. At Paducah, DOE has found a lack of exposure monitoring data and is currently investigating the adequacy of worker exposure records at all three gaseous diffusion plants, including Paducah. While it may be difficult to prove causation from these records, causation is not the only criteria used in compensation systems. In the program established by the Radiation Exposure Compensation Act, workers are eligible for compensation is they establish that they were (1) onsite at the time of weapons testing and (2) have one of the cancers listed in the statute. This was the model used in the Administration's proposal for Paducah workers.

Paducah Gaseous Diffusion Plant

Question 18: Was DOE aware of illegal dumping activities reported in Spring 1991 by Kentucky police investigator Mr. D.W. Senf, and referenced in Dr. Tom Cochran's written testimony? If so, what did DOE do with this information?

Answer: Based upon our review, it does not appear that DOE was aware of a report of illegal dumping made in 1991 by Mr. Senf. In recent discussions with the Kentucky Cabinet for Health Services, we have been told, in response to that allegation, the cabinet had the area in question surveyed and no elevated levels of contamination were found.

Question 19: During Secretary Richardson's most recent visit to Paducah, he said DOE would take whatever legal action is necessary to "make all former operators at the plant responsible for their roles in keeping workers in the dark about plutonium." He later commented that those actions could impact not just the most recent contractors, but Union Carbide as well. Please explain what actions DOE is taking to hold former contractors at Paducah responsible for nuclear safety deficiencies.

Answer: The Department's actions include: the investigation of the current (since 1990) and prior (before 1990) environment, safety and health procedures and practices; evaluation of concerns related to operations prior to 1990; examination of relevant site records; evaluation of potential liability for civil penalties (applicable to activities after January 1996); and assessment of current and prior contractual responsibilities and liabilities.