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Supplement to *Containing the Cold War Mess*
IEER's Response to the Department of Energy's Review

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Introduction

In October 1997, IEER published *Containing the Cold War Mess: Restructuring the Environmental Management of the U.S. Nuclear Weapons Complex*, a detailed report on the environmental management program of the Department of Energy. When it was released on October 23, 1997, Al Alm, then-Assistant Secretary for Environmental Management at the Department of Energy (DOE), ordered a thorough review of the analysis, findings, and recommendations of the report to be completed within 30 days. DOE provided an initial, partial draft response within this time.

DOE has made a very substantial effort to review *Containing the Cold War Mess*. We appreciate the seriousness and commitment with which the DOE has approached the promised review. We understand that about twenty-five people were involved in reviewing our report, and that copies of the report were made and distributed to about one hundred Environmental Management staff.

Three meetings were held between IEER and DOE staff to discuss the substance of the three case studies. The whole review process took almost five months. We would like to thank then-Assistant Secretary Al Alm and Acting Assistant Secretary Jim Owendoff for the seriousness and cooperative spirit with which they and their staff in Environmental Management approached this review process. We would also like to thank Jim Werner and Matt Zenkowich in the Office of Strategic Planning and Analysis for their extraordinary efforts in coordinating the Department's response.

The very fact that DOE has completed a serious review of our report represents a positive break from its past pattern of all too frequently ignoring inconvenient advice. We also appreciate the fact that DOE's final response is better than the initial draft response, making the time spent on meetings worthwhile. Further, three very important substantive efforts are being undertaken, wholly or partly in response to IEER's report.

- First, DOE is going to review aspects of its management of buried transuranic wastes.
- Second, it is making a greater and more serious effort to create a plant for vadose zone remediation at Hanford. On a number of other Hanford issues, discussed below, DOE and IEER remain far apart on the appropriate course of action.
- Third, DOE is taking steps to put in place independent review of all major projects.

These are all substantial management improvements provided they are pursued vigorously and thoroughly. However, we regret to note that despite almost five months of effort, DOE failed to address many serious issues raised in *Containing the Cold War Mess*. Finally, many differences remain between DOE's plans and IEER's recommendations.

DOE has expressed a desire to continue to work with IEER to help it improve its Environmental Management program. IEER will continue to provide DOE with its views as part of this process.

Summary of DOE Responses to Case Studies and Discussion

Transuranic Waste Management

Our main finding in the area of transuranic waste management was that the vast majority of resources spent in this area are being devoted to the development of the Waste Isolation Pilot Plant (WIPP) site in New Mexico, a proposed repository in salt deposits 2150 feet deep. However, the waste authorized to go to WIPP -- referred to as "retrievably-stored" transuranic waste -- poses the least near- and medium-term risks to health and the environment. In contrast, "buried" transuranic wastes, which have contaminated soil and groundwater at several sites and which pose the most urgent risks, have been mainly neglected, mostly due to political deals and faulty technical arguments. The political deals were struck between DOE and the states during the Cold War in order to allow DOE to continue focusing on weapons production. Specifically, promises were made to the states of Colorado and Idaho to remove transuranic waste from their states. The original promise to Idaho was to remove transuranic waste from the Idaho Lab by 1980. This deadline has obviously passed, but a 1995 Settlement Agreement between DOE, the Navy, and the state of Idaho requires the first shipment of retrievably-stored transuranic waste to begin in April 1999.[1]

The faulty technical arguments date back to 1983, when DOE issued *The Defense Waste Management Plan.*[2] The plan is based on three premises:

1) that the radioactivity of "buried" transuranic waste was much less than "retrievable" transuranic waste and transuranic waste that DOE intended to generate over the next 30 years,
2) that transuranic radionuclides in shallow-land burial sites would remain relatively immobile and thus not threaten the environment, and
3) that, should it be necessary to take action to protect the environment, technologies would be available to reduce the risk of buried transuranic waste.

Our detailed review of five major sites with buried transuranic waste showed that these assumptions have been invalidated by real-world experience and by the limited investigation that has taken place. The only comprehensive analysis of historical records relating to buried transuranic that we found was performed for the Idaho Laboratory and

[1] INEEL Environmental Management Program, "The facts on The Settlement Agreement," February 1998.
[2] The essence of DOE's transuranic waste program has not changed since the 1983 plan was issued. In the 1987 *Defense Waste Management Plan* and the 1988 DOE Order 5820.2A *Radioactive Waste Management*, DOE reaffirmed the 1983 Plan.

completed in 1995.[3] This study estimated that there was roughly 9 to 12 times the transuranic radioactivity previously assumed -- making the radioactivity in buried transuranic waste at just one site comparable to the estimates of radioactivity in stored transuranic waste (estimated at the time to be about 1,100,000 curies[4]) at the time of the 1983. Another key assumption, that of immobility in the environment, has also been overturned by studies such as at Oak Ridge, where researchers found "significant and rapid transport" of curium-244.[5] Finally, the failure of the Pit 9 project at the Idaho Laboratory speaks to the lack of available technologies.[6]

Department of Energy Announces Review

DOE's response agrees with our analysis that the premises of the 1983 Plan no longer reflect the best available information. In response to our analysis, DOE has announced that it will undertake a review of key aspects of the transuranic waste program. The first step will involve a review of data quality issues relating to buried transuranic waste and transuranic-contaminated soil. IEER pointed out numerous problems with data in *Containing the Cold War Mess*. We urge the DOE to thoroughly investigate all these issues in its review. Our analysis of quality of data led us to conclude that "DOE's process for generating 'estimates' of buried TRU waste is more akin to throwing darts than to any scientific estimating process."[7] Indeed, in response to a Freedom of Information Act request filed by IEER, DOE did not provide any evidence that there were technical guidelines for site managers to provide reliable quantitative information on transuranic waste. We are pleased that DOE has agreed to a review of data quality issues and that DOE has stated its intent to ensure that information is provided "using consistent and documented assumptions."[8]

In the interim, the DOE should issue a draft guidance to its field office and contractors on how they might make estimates that have a technical foundation that can be documented. If these estimates are educated guesses based on partial data, the assumptions that go into the estimates should be well-documented. Even during the review process, DOE was unable to provide us with any technical guidance document that would enable anyone to establish the basis for the data that are published.

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[3] Lockheed Martin Idaho Technologies Company, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952-1983*, INEL-95/0310, Rev. 1, Idaho Falls, ID: Idaho National Engineering Laboratory, August 1995.

[4] IEER, *Containing the Cold War Mess*, October 1997, page 84.

[5] IEER, *Containing the Cold War Mess*, October 1997, pages 121-124.

[6] IEER, *Containing the Cold War Mess*, October 1997, pages 131-147.

[7] IEER, *Containing the Cold War Mess*, October 1997, page 61.

[8] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, Section 1.0.

IEER Recommendation:
In view of the large increase in transuranic radioactivity estimates as a result of the review that was done at the Idaho Lab, we recommend that for budget planning and projections the DOE should immediately discard its assumption that buried transuranic waste constitutes only a small fraction of the total transuranic waste radioactivity.

Approach to Management of Buried Transuranic Waste

Also as part of the review it will undertake, DOE will prepare a summary and status of remediation activities at various sites for buried transuranic waste. Currently, remediation activities for buried transuranic waste largely fall under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. DOE notes that separate programs have been developed for buried and stored transuranic waste -- buried waste is managed by the Office of Environmental Restoration, stored waste by the Office of Waste Management. This reflects the fact that the two types of waste fall under different regulatory structures -- buried waste must comply with CERCLA, stored waste with the Resource Conservation and Recovery Act (RCRA). DOE notes that any approach to buried transuranic waste must comply with the CERCLA process, which emphasizes the need for site-specific decision-making.

The argument that DOE needs to respect the CERCLA site-specific process is used as a general argument for its approach to remediation by DOE. According to the Waste Management Programmatic EIS, "the fundamental reasoning behind its decision" to abandon the environmental restoration component of the Waste Management and Environmental Restoration Programmatic EIS was that DOE needed to operate "with the regulatory framework of CERCLA and the Resource Recovery and Conservation Act."[9] In dropping the environmental restoration component, DOE argues that "the site-specific nature of cleanup is inconsistent with programmatic initiatives that would be implemented nationwide."[10]

DOE has used its claim of adhering to CERCLA and RCRA as a means of getting around transuranic waste management regulations. There is no reason for the DOE to have failed to include adherence in the plans to 40 CFR 191, the transuranic waste disposal regulations. They are not incompatible with CERCLA or RCRA. The transuranic waste

[9] U.S. Department of Energy, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-200-F, Washington, D.C.: Office of Environmental Management, June 1997, page A-3. In 1990, DOE agreed to the Waste Management and Environmental Restoration Programmatic EIS as part of a settlement of a lawsuit by national and community-based environmental groups. DOE's decision to drop the "Environmental Restoration" component of this EIS is under litigation by many of the same co-plaintiffs.
[10] U.S. Department of Energy, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-200-F, Washington, D.C.: Office of Environmental Management, June 1997, page A-3.

disposal regulations require no timetable for disposal of transuranic waste in a repository, but they do require proper planning for repository capacity. Hence IEER does not agree with DOE that its plan to conform to CERCLA and RCRA relieves it of the obligation to plan for repository disposal of buried transuranic waste and transuranic contaminated soil. Further, DOE's argument is disingenuous because the Los Alamos National Laboratory, with an estimated 14,000 cubic meters of buried transuranic waste, is not a CERCLA site.

There are clear repository-related programmatic issues raised by the fact that the amount of buried transuranic waste, transuranic-contaminated soil, and decontamination and decommissioning waste cannot all be accommodated in the WIPP repository.

Although DOE has agreed to perform a review because the premises of the plan for buried transuranic waste have been shown incorrect, DOE maintains that it is pursuing the appropriate "mix of priorities." DOE's response to *Containing the Cold War Mess* states that "neither stored nor buried transuranic waste pose a near-term risk to human health and the environment." DOE's mix of priorities involves proceeding with plans to send "retrievably stored" waste to WIPP and dealing with buried transuranic waste on a site-by-site basis according to the CERCLA process. Under DOE's transuranic waste program, buried transuranic waste is not authorized for disposal at WIPP.[11] DOE simply states that the future of buried transuranic waste is still undecided.

The appropriate "mix of priorities" remains an issue of disagreement between IEER and DOE, as shown below. At four of the five major sites with buried transuranic waste, DOE intends to begin shipment of retrievably-stored waste to WIPP before it has even completed the CERCLA process.

Site	Proposed First Shipment of TRU Waste to WIPP	Schedule for Final Decision on Buried TRU Waste
Hanford	1999	2008
Idaho Lab	1998	2002
Los Alamos	1998	2008
Oak Ridge	2002	2000
Savannah River Site	1999	2001

Sources: *Department of Energy Response to 1997 IEER Environmental Management Report*, Section 1.1, March 1997 and U.S. Department of Energy, *The National TRU Waste Management Plan*, DOE/NTP-96-1204, December 1997, page 17.

[11] U.S. Department of Energy, *Transuranic Waste Baseline Inventory Report*, Revision 2, DOE/CAO-95-1121, December 1995, Section 5.2.

IEER's Suggestions for New Transuranic Waste Priorities

IEER's conclusion that WIPP is an inappropriate priority is based on three premises.

1) DOE has not addressed the implications of the fact that total amount of transuranic waste is more than double the capacity of WIPP. Further, the WIPP program is part of a larger, fundamentally-flawed repository program

The estimated volumes of transuranic waste are shown in the table below, along with the capacity of WIPP. The total volume of transuranic waste includes buried waste, stored waste, waste to be generated from future nuclear weapons activity, and waste to be generated during decontamination and decommissioning, as well as a large volume of transuranic-contaminated soil, a significant amount of which is above the 100 nanocuries per gram that defines transuranic waste.

Transuranic Waste Category	Volume (cubic meters)
WIPP Capacity[1]	175,600
Current waste authorized for WIPP[2]	68,700
Future waste authorized for WIPP[2]	64,000
Buried [3]	141,000
"Environmental Restoration Transferred"[4]	70,300
TRU-contaminated soil[5]	77,000 at Hanford alone

References:

[1] The allowed capacity of WIPP, under the terms of the 1992 *Waste Isolation Pilot Plant Land Withdrawal Act* (Public Law 102-579), is approximately 175,600 cubic meters (U.S. Department of Energy, *Transuranic Waste Baseline Inventory Report*, Revision 2, DOE/CAO-95-1121, December 1995, Section 5.2.)

[2] U.S. Department of Energy, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-200-F, Office of Environmental Management, June 1997, page 8-4.

[3] U.S. Department of Energy, *Linking Legacies: Connecting the Cold War Nuclear Weapons Production Processes to Their Environmental Consequences*, DOE/EM-0319, January 1997, page 40.

[4] IEER, *Containing the Cold War Mess*, October 1997,, page 37, based on Environmental Restoration Core Database (U.S. Department of Energy, *Integrated Data Base Report--1995: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics*, DOE/RW-0006, Rev. 12, December 1996, page 164). The largest portion of this waste is an estimated 65,000 cubic meters of transuranic waste to come from decontamination and decommissioning of the reprocessing canyons at the Savannah River Site. The 70,300 cubic meters is only the transuranic waste that the Office of Environmental Restoration plans to "transfer" to the Office of Waste Management. There is an additional 11,600 cubic meters of transuranic waste that DOE plans to leave in-place or whose future disposition is undecided. The Environmental Restoration Core Database includes the estimated final waste volume of buried transuranic waste from the Idaho Lab in the "Environmental Restoration Transferred" waste, but for consistency and to avoid double-counting, we have listed the Idaho Lab buried transuranic waste in the 141,000 cubic meters of Buried transuranic waste in this table.

[5] IEER, *Containing the Cold War Mess*, October 1997, pages 74-75.

This table reveals a major weakness with proceeding with the WIPP repository and indicates that DOE is presenting a distorted picture by only considering a limited subset of transuranic waste -- the 132,700 cubic meters currently authorized for WIPP. For example, at the Hanford site, it is estimated that there is 12 times as much buried waste and transuranic-contaminated soil as there is retrievably-stored waste. The buried transuranic waste and transuranic-contaminated soil at Hanford are currently estimated to contain 540 kilograms of plutonium and represent 80 percent of the capacity of WIPP.[12] Ignoring for a moment the relative environmental threats of buried versus stored transuranic waste at Hanford (discussed below), we note that DOE is putting its resources into preparing shipments of retrievably-stored transuranic waste in May 1999, while decisions on Hanford buried transuranic waste will not be made until 2008. DOE's insistence that stored wastes are the priority despite the fact that they are one-twelfth the volume of buried is inappropriate in light of these facts. If DOE actually does a sound review, we expect that it will result in a higher priority for buried transuranic waste. We continue to believe that there is enough evidence for DOE to make such a finding now, at least on a preliminary basis.

2) Buried transuranic waste poses much greater near-and medium-term risks to the environment than retrievably stored waste

DOE's response states that it continues to believe that "neither stored nor buried TRU waste pose a near-term risk to human health and the environment."[13] We partly agree with the Department that retrievably-stored transuranic waste does not pose near-term risks to human health and the environment. However, we note that

- at the Savannah River Site, generation of hydrogen, a flammable gas, in stored transuranic waste has resulted in concentrations of the gas in waste drums that are above the lower flammability limit,[14] and
- not all waste generated since the 1970 requirement that transuranic waste be "retrievably stored" is in RCRA-compliant storage.

DOE needs to make its statement less sweeping in light of these facts and to state the risks clearly.

We maintain, however, that buried transuranic waste poses much greater near- and medium-term risks than the stored waste. Buried transuranic waste has already contaminated large volumes of soil as well as groundwater. No one is now using the contaminated groundwater, but continued failure to address the issue allows the problem to worsen and in all likelihood cause irreversible environmental damage. As DOE acknowledges in its response, past assumptions have understated the mobility of

[12] IEER, *Containing the Cold War Mess*, October 1997, pages 67-75.
[13] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, Section 1.0.
[14] OE Weekly Summary 97-47, Section 1, November 14-20, 1997.

transuranic radionuclides in the environment and subsequent investigations have identified new contaminant transport mechanisms, both of which may greatly change the nature of the risks from buried waste. Measurement of americium-241, a transuranic radionuclide, in two groundwater samples at the Idaho Lab taken in October 1997 may be an indication of serious problems.[15] The Idaho Lab has increased its sampling frequency and is expediting its analysis of more recent samples in order to verify the findings. The Idaho Lab lies 580 feet above Idaho's largest aquifer, the Snake River Plain Aquifer, which supplies water for agricultural products consumed throughout the country.

3) Serious concerns remain about the suitability of the WIPP.

The geology and hydrology of the WIPP site raises serious concerns about its suitability as a repository for transuranic waste. Water leakage, cracks in the ceilings and floors of waste storage rooms caused by brittle rock that could also serve as a pathways for waste movement, the presence of natural gas and oil reserves below the site (which invites future intrusion), and active mining and drilling immediately surrounding the site that may result in fluid injection into the waste rooms are all factors that argue against WIPP.

Additionally, the Environmental Protection Agency standards for waste disposal at WIPP are not stringent enough since they do not limit maximum doses for the duration of the threat from the waste, but rather for an arbitrary period of 10,000 years, which is far shorter than the half-lives of important constituents of transuranic waste such as plutonium-239 and neptunium-237.

Even though it has published Records of Decision for the Waste Isolation Pilot Plant and for transuranic waste, DOE has not studied the proper alternatives. The choice should not be between indefinite storage for thousands of years versus repository disposal, but whether (i) risks in the near and medium term will be reduced or increased by various actions(ii) the repository program will be able to accommodate all transuranic wastes and (iii) the WIPP repository is appropriate or another repository program is needed. Our analysis of DOE's decision to proceed with WIPP leads to the conclusion that not only is DOE increasing risk in the short- and medium-term, but that its repository programs are flawed. Throwing good money after bad in these programs is not appropriate.

Summary

DOE is right to acknowledge that there needs to be better "communication and information exchange between the programs and sites responsible for management of stored and buried TRU" so that "decisions regarding TRU management will be based on

[15] Snake River Alliance, "Americium-241 in Aquifer Heightens Concern / Plutonium Found Beyond Dump's Fence / Alliance Calls for Public Explanation," Press Release, March 12, 1998 and Department of Energy, Idaho Operations Office, "Fact Sheet on INEEL Environmental Monitoring Results," March 13, 1998.

a comprehensive data set and common assumptions."[16] We believe that this can form the basis for a revised transuranic waste management program.

> ***IEER Recommendation***
> ***DOE should appoint a coordinator who is not in either the buried transuranic waste or the WIPP program who will be responsible for insuring that there is proper coordination of all transuranic waste management at a national level. DOE should also announce how it will involve the public in the review and should set a deadline for its review. We suggest that DOE issue technical guidance for compiling transuranic waste data in 30 days and complete its review in 12 months.***

IEER appreciates DOE's announcement of its intention to review some of the key aspects of its transuranic waste program and looks forward to a continued dialogue on these issues.

High-Level Waste Tank Farms at Hanford Reservation

The Hanford high-level radioactive waste tanks are the most complicated and expensive single element in DOE's Environmental Management program. The most significant progress we found was the tank waste characterization program, which has put into place a sound approach for identifying how issues such as safe interim storage, retrieval, and treatment of the waste can be resolved through sampling, modeling, and laboratory experiments. There has also been progress in resolving some safety issues, such as the flammability risk from hydrogen gas generation in Tank SY-101.

However, our evaluation of the Hanford tanks program raised serious questions about DOE's plans which call for proceeding with very large-scale efforts before the technical issues are adequately defined and resolved on a smaller scale. DOE plans to "privatize" much of the important work, a risky and unproved contracting arrangement for such an important project. Additionally, we found that DOE's plans for disposing of a large volume of tank waste on-site lacked a thorough technical and economic analysis. Finally, plans for ongoing and future activities (such as waste retrieval and tank closure) were not well-integrated with the goal of protecting groundwater and the Columbia River.

The most important change in DOE's plans since the publication of *Containing the Cold War Mess* has been to initiate a more urgent and comprehensive approach to addressing vadose zone issues (see below). DOE's response agreed with several concerns raised in *Containing the Cold War Mess*, including the importance of emptying liquids from single shell tanks into double shell tanks in order to reduce the chances for future leaks to the vadose zone beneath the tanks and the need for aggressive technology development for retrieval of hardened waste in the tanks so that large volumes of water are not required.

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[16] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, Section 1.0.

DOE had already been doing some of these things before our report was written.

However, there continue to be disagreements on priorities and approach to Hanford tank remediation between IEER and DOE, as discussed below. There are three crucial areas where DOE's failure to reconsider its plans put it on a risky course:

- Privatization of the Hanford tank waste treatment
- A refusal to consider calcination as an interim step and proceeding with vitrification without more careful small-scale testing
- The plan to dispose of a large amount of cesium-137 waste in vitrified form into shallow land burial on site.

We refer the reader to our report for a discussion of these issues.

Vadose Zone and Groundwater Contamination

In *Containing the Cold War Mess*, IEER highlighted studies of the SX tank farm that had conclusively determined that tank waste had reached the groundwater beneath that tank farm. IEER also highlighted significant underestimates of the volume of waste that has leaked from the tanks. IEER's report concluded that because of the new evidence that waste from the tanks had reached the groundwater, a serious revision of key programs and Environmental Impact Statements was necessary, including the *Tank Waste Remediation System Environmental Impact Statement*, which forms the basis for decisions on remediation of the 177 high-level waste tanks at Hanford, as well as the *Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan*, which analyzes the impact of decisions relating to future land use. These documents relied on a faulty 1995 Groundwater Management Plan that assumed no groundwater contamination originated from single shell tanks.

IEER called for a new conceptual model for contaminant migration from the tanks through the vadose zone and the aquifer beneath the site, which empties into the Columbia River. A more accurate model may change the predicted impacts from the preferred alternative selected in the *Tank Waste Remediation System EIS*, such as sluicing of tanks, leaving up to 1% of the waste in the tanks, and disposal of "low activity waste" on-site. (IEER's report said that DOE planned to leave one percent of the waste in the tanks. The Tri-Party Agreement allows DOE to leave *up to* one percent of the waste.[17] We appreciate the DOE pointing out this error in our report.)

In November 1997, DOE publicly announced the release of draft reports that confirmed the finding that waste leaking from the tanks had contaminated the groundwater.[18]

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[17] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, Section 2.1.

[18] DOE Richland Operations Office, "Draft Reports Confirm Hanford Tank Farm Leaks Contributing to Source of Groundwater Contamination," Press Release, November 25, 1997.

DOE's response to IEER's report notes that Undersecretary Moniz has been directly involved with improving efforts to address vadose zone and groundwater issues. In March 1998, DOE also convened an expert panel on vadose zone issues at Hanford. Our recommendations for the Hanford tanks were based on the premise that it is essential to protect groundwater and the Columbia River. The DOE is now making a serious and substantial effort to address these issues. Continued work along these lines will improve the prospects for meaningful remediation of the tank farm areas. Further, investing in remediating the vadose zone contamination at Hanford is not only important as a regional issue, but also for other DOE sites that have extensive contamination of soil and groundwater.

Flexibility in Treatment of Tank Waste

DOE and IEER both agreed on the need for flexibility in proceeding with treatment of the tank waste. However, we could not agree on what flexibility means in practice. DOE's response states that many years of research and development have been completed internationally, throughout the DOE complex, and on specific studies of Hanford waste. It further states that the Hanford Site has carefully considered the lessons learned at other sites and that they will be incorporated into plans for treatment of Hanford waste. DOE feels that the technical uncertainties have been reduced to manageable levels.

DOE is nearing the end of a 20-month contracting period, in which two teams of contractors are each preparing bids for treatment of tank waste under a "privatization" contract. The 20-month period began in September 1996 and is referred to as "Part A of Phase I" of the Tank Waste Remediation System. Based on the results, zero, one, or both teams may be awarded contracts for Part B of Phase I of the tank waste plan, where up to 13% of the high-level waste may be treated. This part, called a "commercial demonstration" would last 10 to 14 years. The final phase would treat the remainder of the waste by 2028.

In its response and in discussions with IEER, DOE noted several aspects of its tank remediation plan that allow for flexibility. After the initial 20-month contracts are completed in May 1998, there will be extensive DOE review, stakeholder involvement, and a 30-day Congressional review. By awarding two contracts for Part A and possibly two for Part B, DOE hopes to avoid reliance on a single technology and contractor. In personal communications, DOE officials stated that efforts by former Undersecretary Grumbly had resulted in incorporating periodic reviews into DOE projects. Finally, DOE notes that it is taking steps to incorporate independent project reviews of all major projects, as recommended in *Containing the Cold War Mess* and also in a later (1998) National Research Council report.[19]

[19] IEER, *Containing the Cold War Mess*, pages 259-261, and National Research Council, *Assessing the Need for Independent Project Reviews in the Department of Energy*, 1998.

IEER agrees that all of these aspects of the tank remediation plan represent positive steps for DOE's planning process. However, DOE's plan does not properly reflect the complexity of wastes at Hanford and the lack of sufficient experimentation with different pretreatment processes and waste forms using Hanford tank waste. DOE has not considered our recommendation that it consider calcining as an interim step. DOE's evaluation in the *Tank Waste Remediation System Environmental Impact Statement* of calcining as a final waste form is irrelevant to our recommendation. We reiterate our recommendation that DOE consider calcining as an interim step because we continue to believe that DOE is on a very risky course.

Additionally, IEER still believes that Part B of Phase I does not adequately take into account the experience at other sites. *Containing the Cold War Mess* notes that the "demonstration phase" plants, if built, would be the largest radioactive waste vitrification plants in the world. IEER believes that the DOE is not learning the lessons of its large failure of high-level waste pretreatment at Savannah River Site (see below) where the composition of waste is far less complex. For that reason, we provide here a brief review of this very important project and crucial failure.

The importance of Defense Waste Processing Facility and In-Tank Precipitation

The startup of Defense Waste Processing Facility (DWPF) in 1996 was one of the most important developments for the Environmental Management program. With its startup, the Savannah River Site began turning some of the 34 million gallons of high-level waste into a far safer and immobile glass form. Vitrification reduces the risk of leaks from the tanks, as well as fires and explosions that could have disastrous consequences.

However, startup of the plant did not come without its failures along the way. The DWPF was delayed by five years and the initial costs were $3 billion over the initial cost estimate. These delays and cost overruns were not a surprise at least to some analysts. DOE had proceeded to build a full scale vitrification plant without ever casting a full size glass log with real radioactive waste from Savannah River Site tanks.

The program has had even more serious problems since start up. In January 1998, DOE and its contractor, Westinghouse, announced that the In-Tank Precipitation (ITP) pretreatment technology had failed. ITP was to concentrate cesium-137 so as to reduce the number of high-level waste glass canisters destined for a high-level waste repository. The cesium-137 constitutes about one-fourth of the total radioactivity in the Savannah River Site tanks and about one-seventh of the total radioactivity in the DOE weapons complex. With the failure of ITP, there is no technology ready to treat 90 percent of the high-level tank waste at the Savannah River Site.

The ITP failure came after sixteen years of development and $550 million in expenditures

on a project that was supposed to be completed in 1988 for a cost of $32 million.[20] The failure of ITP is not just a failure in technology development, however. It is also a failure in management, one that reflects other similar failures that we have found in DOE.

ITP has been discontinued because dangerous levels of benzene are generated as a result of adding tetraphenylborate to the tanks. In the first large-scale test since 1983, site officials found that benzene generation was unexpectedly rapid and did not correspond to predictions.[21] A report issued by the Defense Nuclear Facilities Safety Board in August 1996 (shortly after the large-scale test), recommended canceling additional planned tests until there was greater understanding of the mechanisms of benzene generation.[22] The Safety Board voiced a concern that "an enormous amount of benzene could be generated, and the rate of release could be rapid enough to overwhelm the removal capability of the purging system." Benzene is a volatile and flammable gas, and must be kept at a low enough concentration so that it does not react with oxygen in the tanks.

The failure of ITP comes after years of warnings from its own staff and outside experts. For sixteen years, DOE relied on a risky and dangerous technology that was previously untested without a backup technology. A 1988 letter from H.L. Brandt, General Engineer in the DWPF Project Office, warned "at its worst, [ITP] could become inoperable."[23] Brandt further cautioned that the ITP process

> will be burdened with problems with dependence on so many difficult-to-control variables... Almost any combination of these variables could be setting the stage, if not for inoperability, then for excessive process upsets; for DOE/SR embarrassment; and for a serious setback to the high-level waste (HLW) management program.

In 1990, G.H. Beyer, a chemistry professor at Virginia Polytechnic Institute, sent a letter to then-DOE Secretary James D. Watkins in which he said "I question the wisdom of using tetraphenyl borate in high-radiation fields." He also stated

> I believe it is highly advisable to develop an alternative processing scheme which avoids introducing benzene and its derivatives. Benzene is widely known as a dangerous carcinogen, benzene forms explosive mixtures with air, and benzene must be very carefully incinerated after use. A more benign flowsheet would be highly desirable, since many years will be required to immobilize our huge inventory of waste...
>
> [F]urther research [into alternatives] is unlikely to occur without... persistent and active support because of the time and money already invested in the current process.[24]

Despite such repeated warnings over the years, DOE neither cut funding of the In-Tank

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[20] Karin Schill, "Waste system troubles SRS," Augusta Chronicle, March 1, 1998.
[21] Defense Nuclear Facilities Safety Board, Recommendation 96-1, August 1996.
[22] Defense Nuclear Facilities Safety Board, Recommendation 96-1, August 1996.
[23] H.L. Brandt, General Engineer, letter to D.L. Fulmer, Deputy Project Manager, Defense Waste Processing Facility Project Office, "Ion Exchange (IX) vs. In-Tank Precipitation (ITP) in the Defense Waste Processing Facility (DWPF)," December 12, 1988.
[24] G.H. Beyer, Professor of Chemical Engineering, letter to James D. Watkins, Secretary of Energy, dated October 14, 1990.

Precipitation process nor developed an alternative, though an alternative, ion exchange, was suggested. Even a scathing report in 1992 by the General Accounting Office was not enough to cause DOE to change its course.[25]

DOE's response to *Containing the Cold War Mess* notes that an independent review team is being formed to evaluate the ITP situation at the Savannah River Site. This is an appropriate action.

But DOE must go farther and incorporate the lessons of this failure with its Hanford program. We are skeptical of DOE's plans to potentially have two privatization contracting teams at Hanford start down a similar path of initiating large-scale projects without adequate preparatory work. We recommend that DOE change course now, or it will risk mounting bills to pay for more incomplete or failed projects.

In *Containing the Cold War Mess*, IEER recommended that DOE examine an alternative approach including immediate expansion of laboratory work and initiation of small-scale pilot plant projects to thoroughly test all technologies and waste forms. We argued that DOE should initiate two parallel programs for solidification of high-level waste. One program should develop methods for calcining the high-level waste coupled with research into ceramic immobilization forms for calcined waste. This program should be implemented along with a program of vitrification research and development for calcined wastes. The second should pursue the development of pretreatment and specific glass-making and ceramic technologies that would not require calcining.

DOE often claims, with some justification, that it is facing pressure from Congress and the States to "show progress" in its Environmental Management program. This is used as an argument to rush ahead with projects that have some "final" disposal as part of the plan. However, given the complexity of the problems DOE faces, such projects have often resulted in cost overruns, premature construction of plants that are too large, and outright failure. This type of approach is a poor way to show "progress" or "results." DOE needs to be more frank with Congress and the States about the difficulties of the Environmental Management program and take steps to ensure that what it does is actually successful and sound.

Separation of high-level tank waste into high-level and low-activity waste

An additional issue discussed by IEER and DOE relating to Hanford tanks is the separation of high-level tank waste into two waste streams, one destined for a repository and a second to be disposed of on-site. DOE's response clarified that the waste to be disposed of on-site (called "low activity waste") is required to be kept in a retrievable state, thereby allowing DOE the option to dispose of it in an alternative manner (e.g., a

[25] Karin Schill, "Waste system troubles SRS," Augusta Chronicle, March 1, 1998.

geologic repository).[26] DOE's response notes that the Nuclear Regulatory Commission (NRC) has supported disposal of low activity waste on-site, quoting the NRC conclusion that "the vitrified waste form is expected to meet the limit for Class C or less." IEER has argued the inadequacy of the NRC waste classification system in our 1992 report, *High-Level Dollars, Low-Level Sense*. In *Containing the Cold War Mess*, IEER points out that other countries, such as Britain, France, and Sweden, have more stringent regulations that require wastes with far lower concentrations of radioactivity than expected for Hanford's "low activity waste" to be put in a deep geologic repository.

With respect to separation of high-level tank waste -- at Hanford and the Savannah River Site -- IEER recommends that DOE reconsider disposal of large quantities of "low activity waste" in shallow land burial. IEER does not believe that the NRC guidelines for Class C waste are sufficiently protective of human health and the environment. Further, IEER proposed that DOE re-evaluate its assumptions for the density at which high-level waste could be placed within a repository. DOE's high-level waste will have a much lower radioactivity and heat load than commercial spent nuclear fuel, and could therefore be disposed of more densely in a repository. In *Containing the Cold War Mess*, IEER suggested that DOE examine repository scenarios where all Hanford high-level waste is disposed of at densities similar to those examined for transuranic waste, about 1,600 cubic meters per acre. IEER's calculations indicate that disposal costs would be much less than DOE has estimated. DOE failed to address any of these issues substantively in its response, despite almost five months of review time. With the failure of ITP at Savannah River Site, IEER recommends DOE re-examine disposal of all high-level waste the nuclear weapons complex in a repository on the technical and economic grounds discussed.

Finally, we reiterate that DOE should also abandon plans for "privatization" of the Hanford tank waste.

Radium- and Thorium-Waste at Fernald

Our review of found that contractor incompetence (both technical and managerial) as well as a lack of adequate DOE oversight had seriously compromised the program to vitrify approximately 11,000 cubic meters of waste contaminated with a large amount of radium and thorium contained in three large silos at Fernald. Dramatic cost increases and schedule delays occurred during a failed pilot plant effort, resulting in the overall remediation plan being reduced to a shambles. The program, clearly lacking a sound financial and technical footing, became the subject of a General Accounting Office investigation. Additionally, DOE and its site contractor initiated a series of independent reviews of the project. A significantly different approach is now being pursued, requiring an Explanation of Significant Differences as well as a formal Amendment to the Record of Decision. As discussed in *Containing the Cold War Mess*, IEER concurs with DOE on

[26] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, Section 2.2.

the advisability of pursuing remediation of Silo 3 waste separately from Silos 1 and 2 waste.

DOE's response notes that it is addressing many of the concerns raised by IEER and other reviewers. Steps are being taken to address radon emanation from the tanks, characterization of the waste, retrieval of the waste, issues associated with the bentonite clay layer, and pilot scale testing of waste treatment technologies. In addition, DOE's response notes that "continuous technical and cost review of all aspects of the project (design, construction, operations, safety and management) will be performed by independent technical experts."[27] Independent project review was one of IEER's main programmatic recommendations for DOE's Office of Environmental Management. We are encouraged by DOE's announcement that it is taking steps to incorporate independent review of all major projects. An ongoing, rigorous, independent review of the Silos project is an important step and will increase the chances of success.

DOE has taken significant steps to reform the Silos project and the proposed plans address many of the important issues that have been raised. However, although IEER has not reviewed the new proposals in detail, we have several important concerns and reservations on the substance of the steps that DOE is actually taking.

Potential for off-site treatment of waste

The Draft Explanation of Significant Differences opens up the possibility of off-site treatment of Silo 3 waste.[28] The Explanation of Significant Differences states that the Request for Proposal for remediation of Silo 3 waste will allow bidders to propose treatment of waste off-site. The Explanation of Significant Differences notes that the waste must be pretreated on-site to reduce dispersability and to put the waste in a form suitable for transportation; the risk of transportation must be reduced to less than one in one million.

Although no proposals may be made to treat the waste off-site, IEER generally recommends that waste be treated on-site to the extent practical. The capabilities exist at the Fernald site to treat the waste there, and since it must be treated in any case, it should be done on-site. Transporting the waste for treatment elsewhere will involve needless risks to workers and residents near the Fernald plant to risk due to packaging of the wastes. They will also subject communities along the transportation routes.

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[27] U.S. Department of Energy, *DOE Response to 1997 IEER Environmental Management Report*, Office of Environmental Management, section 3.1.

[28] U.S. Department of Energy, *Draft Explanation of Significant Differences for Operable Unit 4 Silo 3 Remedial Action at the Fernald Environmental Management Project, Fernald, Ohio*, FEMP-OU4-ESD-0 Draft, September 9, 1997, pages 28-29.

New Management Approach

DOE has planned four "Proof-of-Principle" tests to obtain more information on treatment technologies for the waste in Silos 1 and 2. The results are to be used in the revised Feasibility Study / Proposed Plan, which will form the basis for the Amendment to the Record of Decision. The new management approach also aims to place greater financial accountability on the contractor through a fixed-price, or "privatized," contract.

A main finding of *Containing the Cold War Mess* was that one of DOE's largest institutional problems was that of "monumentalism" -- jumping into big projects without adequate attention to preparatory scientific and engineering work. The Proof-of-Principle studies, if properly carried out, should provide useful information to the remediation of the silos at Fernald and improve results.

However, recent experience in the DOE complex shows that completion of smaller scale work and testing is still no guarantee of success. At the Pit 9 project in Idaho, the fixed-price contract included a "proof-of-process" test that was carried out by two contractors. The tests were designed to demonstrate key aspects of each team's technology. The team awarded the final contract, Lockheed Martin Advanced Environmental Systems, successfully completed the "proof-of-process" test. However, after being awarded a $200 million contract for full-scale remediation, LMAES began a series of major changes to its remediation technology that successfully completed the "proof-of-process" test. Because of the fixed-price nature of the contract, DOE was powerless to stop the changes until it was too late. Further, Lockheed has claimed $257 million for its work through June 30, 1997 without even having demonstrated that its new system would be workable, never mind completing the project for the "fixed price."

IEER agrees that contractors need to be held more accountable for bad technical and managerial decisions. But we are skeptical that DOE will do so at Fernald or elsewhere on major projects or that privatization can accomplish this in unique projects.

Accelerated retrieval

An important part of the new technical approach involves accelerated retrieval of waste from Silos 1 and 2 into new, temporary storage tanks. According to DOE, moving the wastes to new tanks will reduce threats arising from the poor condition of the silos. DOE will develop treatment technologies while the transfer to safe storage is occurring. There is some merit to this concept because it addresses an immediate risk -- that of silo roof failure and large radon releases -- with an interim step, while the long-term treatment technology is developed.

IEER has not examined the accelerated proposal in detail. However, a preliminary look raises concerns that the proposed project for new tanks is too large and involves waste transfer that has proved difficult in the past at Fernald. A different approach should be

examined. During meetings with DOE officials, IEER reiterated its proposal of constructing tornado-resistant roofs, which would address the main short-term danger from the silos, emission of radon. In combination with this, IEER suggested that one new tank could be constructed to demonstrate retrieval technology, allow for sampling, and provide a homogeneous waste feed. This would avoid construction of additional tanks and handling of waste. A decision by DOE to proceed with building new holding tanks for all the wastes without the back-up of a tornado-resistant roof to contain radon emissions appears to follow the past pattern of large projects that are too risky.