United States General Accountin Office

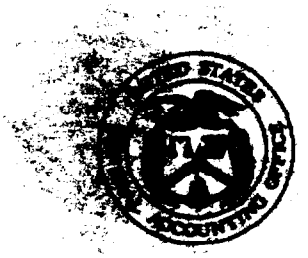
GAO

Briefing Report to the Chairman, Committee on Governmental Affairs, United States Senate

July 1988

NUCLEAR HEALTH AND SAFETY

Dealing With Problems in the Nuclear Defense Complex Expected to Cost Over $100 Billion



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United States
General Accounting Office
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Resources, Community, and
Economic Development Division

B-222195

July 6, 1988

The Honorable John Glenn
Chairman, Committee on
Governmental Affairs
United States Senate

Dear Mr. Chairman:

Pursuant to your request, we have examined the major problem areas facing the Department of Energy's (DOE) nuclear defense complex. This complex produces nuclear material and weapons for defense needs. It consists of about 50 major facilities at various installations around the country. (See sec. 1.) Over the last few years, we have identified a number of specific as well as generic problems associated with the complex. As agreed to with your office, this report discusses the major problem areas facing DOE and provides a perspective on the cost needed to resolve them.

In summary, DOE faces three major problem areas: (1) upgrading existing capability to meet nuclear defense needs and to ensure that they are operated in a safe and environmentally acceptable manner, (2) environmental restoration to clean up existing contamination, and (3) safely disposing of radioactive waste and decontaminating nuclear facilities. While cost estimates are preliminary, our analysis of the most recent DOE cost data indicate that it will cost from about $100 billion to over $130 billion to address these problem areas.[1] These costs do not include expanded capabilities (e.g., new ways of making nuclear material) and the relocation of existing capabilities that DOE is examining as part of a modernization plan it will issue in December 1988. According to DOE information, expanded capabilities and relocation could add another $15 billion to $25 billion to the overall cost.

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[1]To a large degree, this cost information is not budget quality and should be used only to illustrate the magnitude of effort needed to address these problem areas over the next 25 years. The overall cost estimates do not include day-to-day operational costs to produce nuclear material and weapons and maintain compliance with existing standards.

UPGRADING EXISTING CAPABILITY

Much of DOE's nuclear defense complex was built in the 1940s and 1950s and although the facilities have been subject to upgrades, many are approaching the end of their useful life. Some have deteriorated to the point where they now have safety or operational problems. Others are expected to deteriorate rapidly in the near future. In addition to overall aging, many facilities were constructed, in some respects, to less stringent codes and standards than exist today. Finally, some equipment and/or processes used within the complex have become obsolete, making repair work difficult and spare parts virtually impossible to procure. Overall, the current condition of some facilities in the complex makes them susceptible to prolonged shutdowns and thus, threatens the nation's ability to produce nuclear material and components for weapons.

In 1987, DOE assessed all its major facilities in the complex as part of a strategic planning effort. A key part of this effort was to assign a fragility rating to all major aspects of each facility. The rating system used a scale of from one to five, where three meant the condition of the facility was "average for industry," four meant the condition was "marginal" in need of constant attention, and five meant the condition was "serious" with no near-term solution. This rating system allowed the flexibility of rating a facility below "industry average" (between three and four) and less than "marginal" (between four and five). The ratings were done by officials at the facilities and not by an outside, independent group. Finally, the rating system was designed to quickly identify the more severe problem areas and to facilitate any overall assessment of the complex.

In our review, we did not identify any operating facility in the complex that was rated by DOE as "serious." However, many were rated below the "industry average," "marginal," or less than "marginal." The Savannah River Plant (SRP) reactors in South Carolina were rated less than "marginal." The "marginal" facilities included a number of buildings at the Rocky Flats Plant in Colorado, a key operation at the F-area separation facility at SRP, some operations at the Feed Materials Production Center (FMPC) in Ohio, and some operations at the Y-12 Plant in Tennessee. Two other important facilities were rated below the "industry average"--the N-Reactor in Washington and the Idaho Chemical Processing Plant in Idaho.

In general, the condition of these facilities is due to age. Many have been operating for 30 years or more, and the equipment has deteriorated to the point where it requires constant attention. Some facilities have unique safety or operational problems that warrant their marginal condition. For example, concerns about the emergency core cooling system at the SRP reactors have resulted in those reactors having their power levels reduced three different times in the last 18 months. They are now only allowed to operate at about half their designed power levels. Technical and design problems with one of the plutonium operations at Rocky Flats have resulted in the operation being shut down. Finally, safety, health and environmental upgrades are necessary at these facilities to bring them into compliance with today's codes and standards. For example, areas at the SRP reactors and the F-area separation facility do not meet fire protection codes. (See sec. 2 for further details.)

DOE is currently developing cost estimates for modernizing the entire complex. Although these estimates are preliminary and are subject to change when more detailed plans are developed, they do illustrate the magnitude of effort needed to ensure that the nation continues to have the capability of producing nuclear weapons. DOE's data indicate that about $20 billion is necessary to maintain the existing capability and to ensure that this capability is operated in a safe and environmentally acceptable manner. This estimate includes one new production reactor and upgrades to existing facilities. It does not include expanded capabilities[2] or the relocation of capabilities within the complex. According to DOE information, expanded capabilities and restructuring of the complex may cost an additional $15 billion to $25 billion.

ENVIRONMENTAL RESTORATION

Besides upgrading existing capabilities, DOE faces a massive cleanup effort at various locations around the country. For over 30 years, hazardous and radioactive wastes have been disposed at many DOE locations. In many cases it was disposed in a manner that allowed it to enter the environment. As a result, DOE now faces two interrelated

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[2]These expanded capabilities include special isotope separations and a second new production reactor.

problems at virtually all of its installations--groundwater contamination and inactive waste sites.

Groundwater at most DOE installations (see sec. 2) is contaminated to some degree. At many installations including Hanford in Washington, SRP, FMPC, Rocky Flats Plant, Lawrence Livermore Laboratory in California, and the Y-12 Plant, the on-site groundwater contamination levels are hundreds or, in some instances, thousands of times above the drinking water standards. Further, at the Lawrence Livermore Laboratory, FMPC, Hanford, and the Mound Plant in Ohio, groundwater contamination has spread off-site or into rivers.

Interrelated with the groundwater problem are inactive waste sites, one of the principal causes of groundwater contamination. These waste sites are a continuing problem in themselves because large amounts of hazardous and radioactive waste are present and can cause further groundwater contamination or spread into the surrounding soil and move off-site. Some installations such as Hanford, Idaho National Engineering Laboratory (INEL) in Idaho, SRP, and the Rocky Flats Plant appear to have the more serious problems in terms of the number of inactive waste sites and/or quantity of waste buried there. (See sec. 3 for more detail on environmental restoration.)

We also noted in our review that the extent of contamination may not fully be known because of inadequate monitoring or procedural problems in sampling. For example, many inactive waste sites at Hanford do not have adequate groundwater monitoring. Procedural problems, such as an inadequate quality assurance program, have been identified at some DOE installations.

Cleanup costs are very uncertain at this time because the full extent of the problems may not be known and the level of cleanup necessary is uncertain. DOE does have preliminary data which indicate that the cleanup cost could range from $35 billion to $65 billion. DOE officials told us these figures are subject to change depending on the cleanup method chosen and the level of cleanup decided upon by DOE, the Environmental Protection Agency, and state governments. In any event DOE officials acknowledged that some installations may not be totally cleaned up and thus will require long-term institutional care.

DISPOSING OF RADIOACTIVE WASTES AND DECONTAMINATING EXISTING FACILITIES

The last major problem area DOE faces is disposing of radioactive waste and the cleanup of contaminated facilities. DOE has been storing high-level radioactive waste[3] and transuranic[4] waste for eventual disposal in geological repositories. DOE also routinely disposes of low-level radioactive waste.[5] Finally, DOE must eventually decontaminate its nuclear facilities at the end of their useful life.

High-level radioactive waste is currently stored at three installations around the country--Hanford, INEL, and SRP. DOE has detailed plans on solidifying the waste and encapsulating it for disposal in a geological repository. DOE estimates the cost for high-level waste disposal at about $20 billion over the next 25 years.

DOE is also storing transuranic waste and disposing of low-level radioactive waste at various installations around the country. In the case of transuranic waste, DOE plans to use special facilities to prepare and package this waste for final disposal in a geological repository--the Waste Isolation Pilot Plant in New Mexico. For low-level waste, DOE plans to process and dispose of some of this waste using improved confinement techniques. DOE estimates it will cost about $10 billion over the next 25 years to dispose of transuranic and low-level waste.

Finally, DOE has hundreds of facilities that require special cleanup at the end of their useful life to remove

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[3]High-level waste is generated in producing nuclear material. It is characterized by high levels of radiation and heat, and must be handled with special equipment.

[4]Transuranic waste is material contaminated with man-made elements heavier than uranium. This material is generally toxic and long-lived.

[5]Low-level radioactive waste generally decays within a few months or years and usually requires no shielding for handling.

radioactive material that has contaminated the facilities. DOE estimates that decontaminating its nuclear facilities could eventually cost over $15 billion. (See sec. 4 for further details on disposing of radioactive waste and decontaminating facilities.)

OBSERVATIONS

DOE faces a number of costly long-term problem areas which need to be addressed. Current data indicate that it will cost anywhere from about $100 billion to over $130 billion to address these problem areas. Further, expanded production capabilities and relocation of facilities could add $15 billion to $25 billion to the overall cost. The cost data presented in this report are preliminary and are subject to changes as detailed plans to address these problems areas are developed. In the final analysis the total cost may be even higher.

This situation presents a formidable task for the Congress and future administrations in weighing the enormous cost of correcting problem areas in the nuclear defense complex against competing budget priorities in a deficit-conscious era. Further, fundamental questions such as "What should our nuclear capabilities be?"; "How clean is clean?"; and "How safe is safe?" will continually be asked as DOE restructures, rebuilds, and cleans up the nuclear defense complex. The answer to these questions, and the need to set budget priorities in future years, will present difficult choices for the Congress and for current and future administrations.

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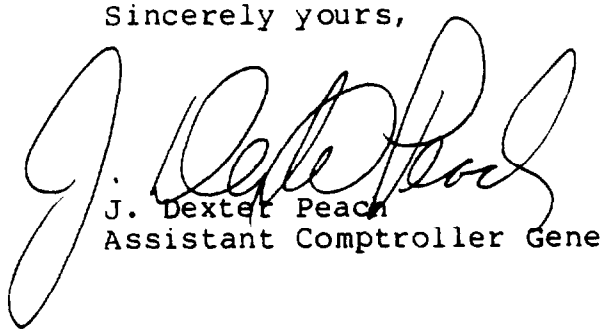
The information contained in this report was based on previous GAO reports and DOE assessments carried out on each of its facilities during 1987. We analyzed and used cost information currently being developed by DOE as part of its ongoing modernization study that is scheduled to be issued in December 1988. We also interviewed responsible DOE officials in headquarters and DOE field offices to gain a better understanding of the problem areas DOE faces and the cost to resolve them. This work was performed between February 1988 and June 1988 in accordance with generally accepted government auditing standards. We discussed the contents of this report with cognizant DOE officials, who generally agreed with the information presented. However,

as you requested, we did not obtain official agency comments on a draft of this report.

Unless you publicly announce its contents earlier, we plan no further distribution of this report for 30 days from the date of this letter. At that time, we will send copies to the appropriate congressional committees; the Secretary of Energy; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

Major contributors to this report are listed in appendix I.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

CONTENTS

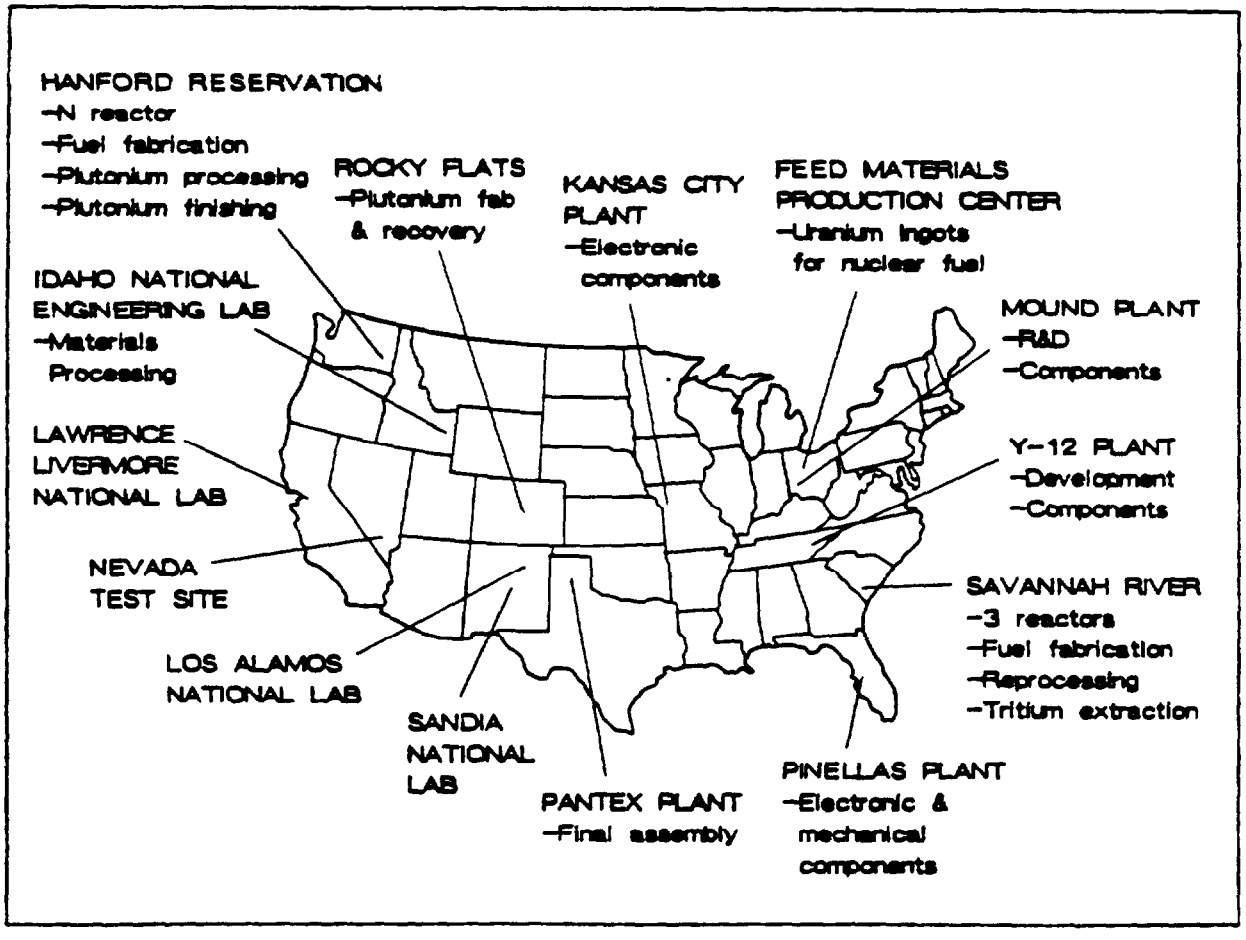
ABBREVIATIONS

D&D	decontamination and decommissioning
DOE	Department of Energy
GAO	General Accounting Office
FMPC	Feed Materials Production Center
INEL	Idaho National Engineering Laboratory
SRP	Savannah River Plant

SECTION 1

MAJOR SITES WITHIN THE NUCLEAR DEFENSE COMPLEX

Figure 1.1: Major Sites Within the Nuclear Defense Complex



SECTION 2

DOE FACILITIES IN NEED OF MAJOR UPGRADE

Much of DOE's defense complex was built in the 1940s and 1950s and many key facilities are approaching the end of their useful life. Others have deteriorated and as a result have safety and/or operational problems. As a result, major upgrades and/or new replacement facilities are needed. DOE data indicate that about $20 billion will be needed to maintain the nation's existing capabilities to make nuclear weapons and to ensure that the complex can be operated in a safe and environmentally acceptable manner. The following are examples of facilities which need major upgrades.

SAVANNAH RIVER PLANT (SRP) PRODUCTION REACTORS

- The SRP production reactors are heavy-water reactors built in the mid-1950s. Three reactors are currently operational. Associated with the reactors are heavy-water facilities and powerhouses to supply back-up power in an emergency. The SRP reactors are rated "less than marginal" by DOE.

- Major safety concerns are associated with SRP reactors.

  -- One reactor has been shut down because of cracks in the reactor vessel. Although no cracks are known to exist in the three operating reactors, cracks could develop. DOE's current inspection practices, which have heavily relied on visual techniques, have not provided the best possible evidence that no cracks exist.

  -- Power levels at all three of the reactors have been reduced because of uncertainties in the emergency cooling system's capabilities to prevent core melting in a severe accident.

  -- Some braces used to support components of the reactors in the event of an earthquake were recently found to be in need of repair.

  -- Fire protection systems do not meet National Fire Protection Association codes and standards. Corroded piping and insufficient water pressure are some examples.

- There is general deterioration due to aging at the reactors and associated facilities.

  -- For example, the powerhouses, which provide on-site electricity, are over 30 years old and prone to increased maintenance and unscheduled shutdowns. At

two of the three powerhouses, the cost to supply power is twice what a commercial company would charge.

- DOE estimates it will cost $785 million to upgrade the reactors. This includes improvements to the existing confinement system and the emergency core-cooling systems.

ROCKY FLATS PLANT

- The mission of the plant is to cast and machine plutonium components for weapons. The plant also is involved in producing other weapons components and plutonium recovery from scrap material and retired weapons. The plant was established in 1953, and many of its existing buildings were built in the 1950s.

- Many aspects of the plant are considered "marginal."

  -- Building 444 is used to manufacture nonnuclear components. This building needs a major rebuilding of its utility and piping system.

  -- Buildings for plutonium assembly and waste management do not meet DOE's structural design criteria for tornados and earthquakes. Old equipment needs constant maintenance and has caused the operation to be shut down--about 20 percent of the time in recent years.

  -- Building 771 is an old chemical plant needing continual repair of tanks, piping, and utilities. Aspects of the facility do not meet current building and safety codes. This building was once planned to be phased out.

- Building 371 needs to be repaired. This building was constructed to replace other older buildings. However, all but one of the operations in the building never operated as intended because of technical and design problems (e.g., poor building design and inappropriate construction material). This has resulted in the continued operation of older facilities that this building was intended to replace.

- The cost to rebuild and upgrade Rocky Flats is estimated to be about $1.5 billion. This includes more than $590 million to rebuild Building 371 and ensure continued plutonium recovery and about $398 million to upgrade plutonium manufacturing and assembly processes.

F-AREA SEPARATION FACILITY AT SRP

- The F-area separation facility constitutes a large chemical plant which chemically processes materials that have been irradiated in production reactors to recover uranium and plutonium. The primary operations include the F-area Canyon where irradiated material is dissolved and separated, the FA line which recovers uranium, and the FB line which recovers and processes plutonium. The facility became operational in the 1950s, and many aspects have been upgraded over the years.

- Aspects of the F-area separation facility are rated below the "average for industry."

  -- FA line needs additional restoration to replace ventilation and filtration systems which have deteriorated in 35 years.

  -- Equipment, instrumentation, wiring, and piping must be replaced periodically in the canyon because of deterioration.

  -- Fire protection systems in many areas of the facility are not in compliance with today's codes.

- The FB line at the facility is rated as "marginal."

  -- Employee radiation exposure on the FB line is about 10 times higher than in other areas at SRP and has doubled since 1983. The FB line requires substantial amounts of hands-on processing.

  -- Fire protection in most of the rooms within the FB line do not meet fire protection guidelines and codes.

  -- Physical constraints (design, space, etc.) prevent the installation of monitoring devices to achieve real-time accountability for measuring the amounts of plutonium in the system.

  -- Administrative controls, such as the reliance by operators on written procedures, are used, to a great extent, to prevent criticality accidents. New equipment would have automated criticality controls built into them and thus reduce reliance on administrative controls.

  -- Ever increasing maintenance is needed to cope with equipment deterioration due to aging and radiation exposure.

- o DOE estimates that about $920 million is needed to upgrade and replace portions of the F-area separation facility. These funds include upgrades throughout the facility and the eventual replacement of the FB line.

FEED MATERIALS PRODUCTION CENTER (FMPC)

FMPC prepares uranium metal forms for the N-reactor and other DOE weapons program activities. Operations at FMPC consist of various chemical and metal processes. According to DOE officials, operations at FMPC have recently been cut back with the shutdown of the N-reactor. Certain operations at FMPC, such as the chemical processes are rated "marginal."

- o Old or obsolete equipment exists throughout the facility. It is difficult to repair or buy replacement parts.
- o Extensive or frequent maintenance is needed on key operations at the facility. The site utility system will need to be upgraded.
- o Chemical operations do not meet environmental regulations and standards. Current capacity is constrained by nitrate emissions.
- o It is not possible to maintain all seals, packing glands, flanges, and piping to meet health standards. Parts of the FMPC operation should be robotized to avoid human contact with material.
- o Upgrades needed for FMPC could range from $450 million to over $600 million depending on FMPC's future role.

Y-12 PLANT

- o The Y-12 Plant is a diverse production facility specializing in highly sophisticated engineering, development, and manufacturing of nuclear weapons components. The plant provides materials for placement in production reactors and is a major producer of components for nuclear weapons from highly enriched and depleted uranium, steel, and lithium material. Some aspects of the plant were built in the 1940s. Many aspects of the plant are rated by DOE as below "industry average" or "marginal."
- o Many aspects of the facility are aging.
  - -- Equipment in some areas is obsolete and is subject to both operating and maintenance problems. For example, aspects of the utility system for the plant are obsolete and subject to high maintenance.

- -- Many of the structures were built in the 1940s and, accordingly, wiring and plumbing do not meet current standards.

- o Some aspects of the facility need health, safety, and environmental upgrades.

  - -- Some equipment, because of its deteriorated condition is a source of continual or potential contamination. In at least one area, respirators need to be worn to prevent possible contamination.

  - -- Upgrading exhaust systems, filters, and scrubber systems are needed to reduce emissions of acid fumes and other hazardous and/or radioactive material.

  - -- A production waste treatment facility for hazardous and radioactive waste is needed to treat hazardous waste and encapsulate radioactive waste.

- o Upgrades needed at the Y-12 Plant may exceed $1 billion.

SECTION 3

ENVIRONMENTAL RESTORATION

DOE faces great challenges in the area of environmental restoration. Current estimates to correct problem areas range from about $35 billion to over $65 billion. We believe three problem areas warrant detailed discussion.

First, groundwater contamination exists at most of the nuclear defense complex locations. At some locations, contamination has migrated to water resources located beyond plant boundaries. Another important problem area is over a thousand inactive hazardous and radioactive waste sites that may need to be cleaned up because they are releasing or can release radioactive or other contaminants into the environment. Finally, there are deficiencies in environmental monitoring at many DOE installations which could lead to undetected contamination.

GROUNDWATER CONTAMINATION

- Groundwater at FMPC, Hanford Reservation, Lawrence Livermore Laboratory, Los Alamos National Laboratory, Mound Plant, the Nevada Test Site, the Pinellas Plant, Rocky Flats Plant, Sandia Laboratory, the Savannah River Plant, and the Y-12 Plant has become contaminated with radioactive material at levels greater than drinking water standards.

- At some sites such as Hanford Reservation, the Nevada Test Site, the Savannah River Plant, and the Y-12 Plant, the levels for radioactive contaminants are hundreds or even thousands of times above drinking water standards.

- Groundwater at FMPC, Hanford Reservation, Idaho National Engineering Laboratory, Kansas City Plant, Lawrence Livermore Laboratory, Nevada Test Site, Rocky Flats Plant, Sandia Laboratory, the Savannah River Plant, and the Y-12 Plant has become contaminated with hazardous material (solvents, mercury, lead, etc.) above drinking water standards.

- At some sites, such as FMPC, Idaho National Engineering Laboratory, the Kansas City Plant, Lawrence Livermore Laboratory, Rocky Flats Plant, the Savannah River Plant, and the Y-12 Plant, the levels for hazardous contaminants are a hundred or even thousands of times above drinking water standards.

CONTAMINATION HAS MIGRATED OFF-SITE AND IN SOME CASES CAN THREATEN DRINKING WATER SUPPLIES

- o Several off-site wells near FMPC have become unsuitable for drinking water use due to uranium contamination.
- o Groundwater contaminated with radioactive material in excess of drinking water standards is migrating from Hanford into the Columbia River at the plant boundary.
- o Groundwater at Lawrence Livermore Laboratory has become contaminated with solvents greatly in excess of drinking water standards. The contamination has migrated off-site and residential wells have been closed.
- o Tritium contamination at the Mound Plant migrated off-site and contaminated a number of private wells in excess of drinking water standards. Remedial action, however, has reduced levels to within the standards for the wells, but at least one off-site surface spring has levels about five times above the drinking water standard.

INACTIVE WASTE SITES

- o Most nuclear defense complex installations have inactive waste sites of one type or another. These include petroleum, chemical, and radioactive waste spills as well as locations used to dispose of the radioactive and non-radioactive wastes into the ground. These sites can lead to environmental problems when, for example, contaminants migrate into surrounding soil, surface or groundwater, or are suspended in the air by wind or industrial activity and are deposited elsewhere.
- o Some installations have significant inactive waste site problems.
  - -- Hanford has by far the largest number of inactive waste sites--about 1,000. Over the years, liquid waste containing hazardous, radioactive, or other waste was frequently discharged directly into the ground, causing groundwater contamination. There is a high potential for continued groundwater contamination from various waste sites, including two high-level radioactive sites.
  - -- INEL has at least 232 inactive waste sites. In the past, low-level radioactive liquid waste and chemicals were discharged into ponds, wells, or directly into the Snake River Plain aquifer, which flows under the site. Further, solid radioactive and chemical wastes have been disposed in burial grounds,

sometimes in direct contact with the soil, thus providing additional potential for the spread of contamination.

-- There are about 100 inactive waste sites at the Rocky Flats Plant. At least 10 of these sites are considered to be existing or possible sources for significant environmental contamination. Groundwater has been contaminated, and plutonium has contaminated surface soils.

-- There are about 70 inactive waste sites at Savannah River. In its 30 years of operation, the plant has generated large quantities of hazardous, radioactive, and other wastes which have been disposed of in various ways, including shallow land burial or discharge into seepage basins. This has resulted in ground and surface water contamination.

o Waste sites can spread contamination beyond plant boundaries.

-- Uranium in soils within FMPC boundaries has migrated off-site. Further contamination may occur.

-- Plutonium was found beyond the Rocky Flats Plant boundaries in the 1960s. Sediment in two nearby reservoirs contains low-levels of plutonium.

-- High levels of cesium contamination have been found in sediments of an off-site swamp near the Savannah River Plant. Radiation dose rates in the swamp area would be above the DOE guidelines for an unrestricted area if the swamp were populated.

-- Mercury has migrated off-site to contaminate sediments in two stream beds near the Y-12 Plant.

DEFICIENCIES IN ENVIRONMENTAL MONITORING

o Deficiencies in environmental monitoring have been identified in DOE's environmental surveys at many installations within the nuclear defense complex. In some instances, potential sources of contamination are not monitored or are inadequately monitored. These include inactive waste sites and underground tanks. There are also shortcomings in sampling procedures, which can lead to inconsistent and inaccurate results.

o Potential sources of environmental contamination are not adequately monitored.

- -- Many known disposal sites at the Hanford Reservation do not have groundwater-monitoring systems.

- -- Several liquid discharge locations at Los Alamos National Laboratory are discharging chemicals that are not monitored and can result in potential contamination of soils and sediments.

- -- Not all inactive waste areas at the Pinellas Plant have been studied for groundwater contamination, which means that such contamination could go undetected.

- -- Leaks in underground petroleum storage tanks at the Savannah River Plant, Rocky Flats Plant, and the Y-12 Plant could go unreported because of a lack of monitoring.

o Procedural problems exists with environmental monitoring.

- -- The Pinellas facility does not test certain sludge residues for contamination, and residues of hazardous substances and/or tritium could be present and disposed of improperly.

- -- The groundwater-sampling program at the Savannah River Plant has had deficiencies, including mislabeled sampling sites and poor sampling methods.

- -- Lack of formal quality assurance practices and procedures at FMPC, and the Y-12 Plant, means that the validity of analytical data at these facilities may be suspect.

- -- Data from 14 ambient air sampling sites at Los Alamos National Laboratory may be questionable because of improper placement of the sites.

SECTION 4

DISPOSAL OF RADIOACTIVE WASTES AND CLEANUP OF CONTAMINATED FACILITIES

Because of the nature of DOE's nuclear defense complex, unique waste and contamination problems must be resolved. These include the disposal of radioactive wastes which have accumulated for many years at DOE defense sites, and the decontamination and decommissioning of nuclear facilities after their useful lives are over. While detailed costs are not available, DOE data indicate the eventual cost could easily exceed $45 billion to safely dispose of radioactive wastes and decontaminate existing facilities.

HIGH-LEVEL RADIOACTIVE WASTE

- High-level radioactive waste is generated when irradiated material from nuclear reactors is reprocessed to recover nuclear material (e.g., plutonium). This waste is highly radioactive, produces heat, and must be stored in special containers and handled with special equipment to protect workers and the public.

- High-level waste is produced and stored at three sites--the Hanford Reservation, Idaho National Engineering Laboratory, and the Savannah River Plant. In total about 370,000 cubic meters is stored as liquid, sludge, slurry, and other forms.

- Special techniques are necessary for disposal of high-level waste because it is highly dangerous and long lived. DOE is building a plant at the Savannah River Plant to convert the stored waste into glass to be placed in canisters for eventual permanent disposal in a geologic repository. DOE has plans to build a similar plant at the Hanford Reservation and has tentative plans to build a plant at Idaho National Engineering Laboratory to process and immobilize high-level waste for geologic disposal.

- The geologic repository is being developed under the civilian radioactive waste management program and is expected to be available to accept defense wastes, for a fee, early next century.

- DOE estimates the cost for high-level waste disposal at about $20 billion over the next 25 years. This includes developing and applying technology needed to end interim storage and achieve permanent disposal of all defense high-level waste. It also includes building waste-processing plants and geologic repository fees. The repository is being developed with money from the commercial nuclear power

industry, and DOE will have to pay to dispose of defense waste.

TRANSURANIC WASTE

- Transuranic waste is material such as discarded tools, rags, machinery, paper, sheet metal, and glass contaminated with man-made radioactive elements having atomic numbers greater than uranium. It contains radioactivity, which can be dangerous if it is inhaled, ingested, or otherwise gets inside the body.

- Since the early 1970s, about 60,000 cubic meters of transuranic waste has been stored in a retrievable manner--much of it is in 55-gallon drums--at six locations: the Hanford Reservation, Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Savannah River Plant, and the Nevada Test Site.

    -- DOE plans to use special facilities to prepare and package this stored waste for transportation to the geological repository--the Waste Isolation Pilot Plant in New Mexico.

    -- DOE estimates the cost for disposal of transuranic waste in retrievable storage and to be generated in the future at $5 billion through the year 2015.

- Prior to the early 1970s, transuranic waste was not retrievably stored but was buried at five locations. DOE estimates there is about 190,000 cubic meters of buried transuranic waste at the five locations and up to 300,000 cubic meters of transuranic contaminated soil. According to a DOE official, the cost estimates for treating and/or disposing of this waste are included under Environmental Restoration.

LOW-LEVEL RADIOACTIVE WASTE

- Although low-level waste contains potentially hazardous quantities of radioactive materials in a wide range of concentrations, most generally decays within a few months or years and usually requires little or no radiation shielding for handling. Although some is generated as liquid, most is in the form of dry solids such as equipment, clothing, etc., and is typically disposed of in shallow land burial.

- DOE facilities produce large quantities of low-level waste which requires disposal. DOE operates six major disposal sites for this purpose--Los Alamos National Laboratory, Oak Ridge National Laboratory, Savannah River Plant, Idaho

National Engineering Laboratory, Hanford Reservation, and the Nevada Test Site.

- o DOE estimates the cost to dispose of low-level waste over the next 25 years at more than $5 billion. This includes processing and burying some of the waste using improved confinement techniques, as well as management and technological support for the program.

DECONTAMINATION AND DECOMMISSIONING

- o Many nuclear defense complex facilities become radioactively contaminated because of the materials they use and generate and require special cleanup at the end of their useful lives to remove or reduce levels of radioactivity.

- o Hundreds of facilities have been deactivated and are now awaiting decontamination and decommissioning (D&D), and many more will be deactivated in coming years as aging facilities reach the end of their useful lives.

- o Facilities available for D&D prior to 1995.

  - -- DOE is developing an inventory of nuclear defense complex facilities which are now awaiting D&D or which will become deactivated and available for D&D by the year 1995.

  - -- This inventory is expected to be completed in the fall of 1988 and includes over 400 facilities.

  - -- This total eventual D&D cost is estimated by DOE to range from $5 billion to $7 billion. (This does not include an estimated $3 billion for enrichment facilities.)

- o Facilities to become available for D&D after 1995.

  - -- Although a complete list of all such facilities is not available, many of today's operating facilities such as separations facilities will be difficult and costly to decontaminate.

  - -- Total cost estimates to D&D facilities which will be deactivated beyond the year 1995 are not available, and will depend on policy decisions such as whether or not to close certain facilities. However, DOE officials told us that preliminary indications are that these additional D&D costs could easily exceed $10 billion.

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