UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

COMMISSIONER

March 13, 1997

MEMORANDUM FOR: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner McGaffigan

FROM: Commissioner Diaz

SUBJECT: WHITE PAPER ON DOE OVERSIGHT BY NRC

Enclosed is a white paper on DOE oversight by NRC prepared by my staff as an information item. It contains a summary scope of activities, a description of facilities and suggests that both safety and radiation protection of selected DOE facilities be under NRC oversight.

As we all know, congressional staffers appeared eager to start the DOE-NRC interaction in FY98 with "some pilot program". An alternative is to consider the whole class of "other laboratories" in this paper. There are 7 of them:

Ames Lab
Environmental Measurements Lab
Fermi National Accelerator Lab
Inhalation Toxicology Research Institute
Lawrence Berkely Lab
Laboratory for Energy Related Health Research
Princeton Plasma Physics Lab

These labs are similar in size and scope to existing NRC licensees (NIH, MIT), they have little or no defense function, and we have needed regulations already in place (Parts 20 and 30). On the down side, there are many accelerators in these facilities; these would actually constitute a good training ground for future work with accelerators in other areas.

The staff could make a quick estimate of resources needed to conduct these pilots; the cost should be relatively small (~ $5 million total) compared to other efforts.

Best regards

cc: J. Callan, EDO

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EXTERNAL REGULATION OF DOE FACILITIES

BACKGROUND

On December 16, 1993, GAO released a report entitled "Health and Safety: DOE's Implementation of a Comprehensive Health Surveillance Program is Slow" (GAO/RCED-94-49). On June 7, 1994, GAO released another report entitled "Nuclear Safety: Unresolved Issues Could Impair DOE's Oversight Effectiveness" (GAO/RCED-94-129). On September 22, 1994, Jim Wells, Associate Director, Energy and Science Issues, Resources, Community, and Economic Development Division, GAO testified before the House Subcommittee on Energy, Committee on Science, Space, and Technology about GAO's findings. He testified that

- not all workers are included in safety and health programs;
- no systematic process for evaluating safety issues exists within DOE;
- DOE lacks adequate numbers of qualified staff to perform oversight; and
- oversight of nuclear facilities may be impaired by a lack of independence.

In January of 1995, Secretary O'Leary established the Advisory Committee on External Regulation of Nuclear Safety to consider pending legislation for ending self regulation of DOE facilities. At that time, DOE requested that Congress postpone consideration of external regulation to allow DOE to study the issue and make appropriate recommendations.

In its December 1995 report, the Advisory Committee made the following key recommendations:

- Essentially all aspects of safety at DOE's nuclear facilities should be externally regulated;
- Existing agencies rather than a new one should be responsible for external regulation;
- Worker protection authorities should be transferred to OSHA, if possible;
- EPA should continue to regulate environmental protection;
- States with authorized programs should initiate or continue to have roles in regulation of environmental protection, facility safety, and worker protection; and
- Under any regulatory scheme, DOE must maintain a strong internal safety management system.

In a letter to the Secretary dated January 19, 1996, the co-chairs of the Advisory Committee provided their personal views on how best to implement the Committee's recommendations. They state that NRC is clearly the appropriate choice for external regulation. They reasoned that safety levels similar to those achieved in the private sector can most easily be met by selecting NRC, NRC is more credible and more stable than any other existing entity reasonably under consideration for this task, and NRC is the only agency with adequate numbers of trained people.

On January 19, 1996, the Secretary of Energy, in accepting and endorsing the Advisory Committee's report, created the Working Group on External Regulation (Working Group) to provide her with recommendations on the implementation of the Advisory Committee's report. In December of 1996, the Working Group published its recommendations (DOE/US-0001). In its recommendations, it provided two options. The first would, over a five year period, transfer to NRC regulatory oversight authority for selected defense program (DP) and environmental management (EM) facilities, all nuclear energy facilities (NE) and all energy research facilities (ER). The balance of facilities would be regulated by the Defense Nuclear Facilities Safety Board (DNFSB). The second option would involve two phases. Phase 1 would be similar to option 1 above, and in phase 2, a second five year period, NRC would subsume DNFSB with all its responsibilities. Option 1 is acknowledged by the working group to be an improvement in safety and health as well as fostering public confidence in DOE, but not external regulation of all DOE nuclear facilities. Of the recommended options, only option 2 would accomplish full external regulation.

In January of 1997, Tara O'Toole, Assistant Secretary for Environment, Safety and Health, forwarded to members of Congress and their staffs the National Academy of Public Administration (NAPA) panel report entitled "Ensuring Worker Safety and Health Across the DOE Complex." The cover letter and the report recommend that all worker safety and health regulatory authority be transferred to OSHA. Interestingly, this recommendation includes responsibility for radiation protection for workers. This OSHA

role would mean that NRC's regulatory role would be for nuclear safety only.

On January 30, 1997, Senator Grams (R-MN) introduced S. 236, the DOE Abolishment Act. As one argument for this proposal, Senator Grams states in his remarks that DOE's desire for external regulation is an acknowledgement that the Department has outlived its usefulness. The proposal suggested that energy research functions of the Department be transferred to the National Science Foundation, defense functions to the Department of Defense, and clean up to EPA and the states.

NRC'S ROLE IN EXTERNAL REGULATION

It is far from certain just what NRC's future role in DOE oversight will be. As it stands today, there appear to be four reasonable possibilities. They are:

- continued DOE self regulation;
- abolishment of DOE;
- NRC oversight of nuclear safety only, phased in over a 10 yr period; and
- NRC oversight of nuclear safety and radiation protection, similar to current licensing and inspection of commercial uses of byproduct materials, phased in over a 10 yr period.

For any option other than continued DOE self regulation, congressional action would be required. In the case of abolishment of DOE, the ramifications for NRC are uncertain. The difference between the third and fourth possibilities is the inclusion of radiation protection. DOE currently has regulations in place that are very similar to NRC's 10 CFR Part 20, "Standards for Protection Against Radiation." Therefore, the transition to compliance with NRC standards in this area would not pose a large burden on the Department, and it would be preferable that NRC oversight of DOE facilities include radiation protection. Only the fourth option will be considered in this paper.

MAJOR FACILITIES THAT MIGHT COME UNDER NRC OVERSIGHT

Reactors

DOE's national labs currently operate several test reactors. In addition, over 50 shut down reactors at the labs are in various stages of decommissioning. There are another 15 larger reactors at DOE's defense related facilities, all but one of which are shut down. NRC possesses significant applicable experience for these facilities. Oversight would require additional NRR and regional resources, possibly transferred from the decreasing number of currently licensed commercial reactors.

Accelerators

DOE has dozens of large accelerator facilities. If regulatory oversight of safety and radiation protection for these facilities were to be transferred to NRC, this would be completely new to NRC. It would also require legislation to extend NRC's authority to accelerators. This might open the door for similar extension of NRC's authority to other commercially operated accelerator facilities. In either case, NRC would need to acquire significant expertise in this area.

High-Level Waste, Spent Fuel, Low-Level Waste and Decommissioning

Nearly all of the DOE facilities have some waste storage and management facilities. Many have not only LLW, but mixed waste, transuranic (TRU) waste, and high level liquid wastes. The scope of waste management at DOE facilities probably vastly exceeds the total of all waste management activities at NRC licensed facilities.

Decommissioning and remediation of contaminated tracts and buildings is a major function of the DOE today. DOE has suggested that most if not all of these remediations will be completed by the end of the 10 years. This appears highly unlikely, even if funding levels are not reduced. Thus, NRC would have to increase its staff and contractor resources in the area of decommissioning over the next 10 years so that at the end of the transition period, sufficient expertise would be available to deal

with the remaining programs.

Many of the sites have spent fuel storage. In some sites, there is significant storage of spent fuel in unlined concrete pools that are not designed to withstand earthquakes and do not have leak monitoring capabilities. As such, transfer of fuel to dry casks will likely remain a high priority. Cladding on some of this spent fuel is quite different than that used in commercial fuel. Some is clad in stainless steel or even aluminum. As such, it does not necessarily possess the same capabilities in terms of a primary containments. As a result, the analyses done for the use of existing dry casks may not be applicable to this fuel. Additional analyses will need to be performed. It is possible that this will have been accomplished by the end of the transition period. Decommissioning of these pools may extend beyond the period.

DOE SITES

The National Laboratories

DOE owns eight major DOE national laboratories (Appendix A to this report contains brief descriptions of most DOE facilities). All of the labs are operated by different contractors. The total annual budget for these labs is about $ 6 Billion and they employ about 50,000 people. In addition, as many as 50,000 visiting scientists work at the labs for some part of each year. Two of the labs, Lawrence Livermore National Laboratory

(LLNL) and Oak Ridge National Laboratory (ORNL) are currently on the EPA National Priorities List. Several of the labs have operating and/or shut down reactors. Idaho National Engineering and Environmental Laboratory (INEEL) has as many as 50 shut down reactors. Over half of the labs have multiple fissile materials storage areas. Most have multiple linear accelerator research facilities. All have LLW, mixed waste, and areas where waste has been buried or spilled. Many have spent fuel storage areas. INEEL has significant amounts of spent fuel in many old unlined spent fuel pools. Each of the eight major DOE labs consists of huge tracts of land (1700 acres to 890 square miles) with many separate areas or buildings where radioactive materials are used or stored (50 to 200).

The national labs are probably the first existing facilities that would be considered for external oversight. They are most like a large university research program, though probably a great deal larger and more complex than any NRC currently licenses. With the increased complexity, comes some additional risk as well. In addition, these facilities have been operating under a very different regulatory structure, in that DOE may have been prone to waive an expensive requirement.

Other Research Laboratories

In addition to the national labs, DOE owns or leases seven other research laboratories. Several of these are affiliated with and collocated on university campuses. As such,

they are quite similar to existing NRC licensed broad scope university research programs. Like the national laboratories, they have not always been subject to rigorous oversight. However, DOE probably has not granted exemptions from its requirements to the non-defense facilities as it did for the national labs.

Production and Enrichment Facilities

The Grand Junction Projects office is managing the clean up of 24 inactive uranium mill sites and over 4,000 vicinity properties. NRC currently asserts oversight for these facilities.

Fernald is a shut down conversion plant that produced uranium metal from uranium yellow cake. Rocky Flats is a plutonium processing plant that will be undergoing decommissioning over the next 25 years. Plutonium stored on the site will be sent to other DOE facilities. The site is currently beginning a $ 7 Billion closure project. There are 2 major enrichment facilities on the Oak Ridge Reservation. K-25 is a gaseous diffusion plant that has been permanently shut down and is awaiting decommissioning. Y-12 is an electromagnetic enrichment facility that has been placed on the EPA National Priorities List. Much of the facility is expected to be declared surplus within the next 5 years. These sites may ultimately involve NRC as it is unlikely that remediation will be completed within the 10 year period during which complete transfer of NRC oversight may occur.

Defense Facilities

The DOE defense facilities are proposed to be the last to come under potential NRC oversight. There are three very large sites (Hanford, Savannah River, and Pantex), in addition to several smaller sites. Mound, Kansas City Plant, Rocky Flats, Weldon Springs, and Pinellas Plant have ceased activities and are undergoing remediation that will last well into the next century. In addition to substantial remediation, the Nevada Test Site is one of the primary low level waste disposal sites for DOE.

Hanford continues to operate the Fast Flux Test Reactor (FFTF), several spent fuel storage facilities, TRU, mixed and LLW, fuel fabrication, plutonium finishing, and vitrification facilities. In addition, there are 9 shut down reactors and extensive contaminated lands and buildings to be remediated.

Savannah River continues tritium recycling, Pu-238 production for space probes, and is a candidate site for future plutonium vitrification. In addition, there are 5 shut down reactors and hundreds of areas in need of significant remediation.

The Pantex Plant's current mission is the dismantlement of nuclear weapons and management of pits and other fissile materials. Several areas are in need of remediation, but the mission of the site is likely to continue. It was suggested in a recent briefing for one of the Commissioners that this site is unlikely to ever be

considered for NRC oversight, due to its strictly defense related function.

SUMMARY

There are several areas where NRC would need to increase its technical expertise if DOE oversight were to become a reality. The programs most impacted would be HLW, LLW, and decommissioning. In addition, resources for oversight of about a dozen additional reactor sites would have to be added. Similarly, the resources for oversight of the equivalent of a few dozen very large broad scope licensees would have to be added.

A significant complication with transfer of oversight to NRC is that existing AEA authority only covers a portion of each DOE site. Dual regulation would likely exist at every site unless the AEA were revised to give NRC authority for all sources of ionizing radiation and radioactive materials. If this were to occur, this could have further implications for current licensees possessing accelerators, NORM sources, or NARM. On the other hand, Congress could limit this increased scope of NRC oversight to DOE facilities and future NRC licensees only.

Furthermore, as recommended by the DOE Working Group on External Regulation, the best way to protect public and worker health and safety is for the NRC to be given the oversight responsibility in both nuclear safety and radiation protection for selected DOE

facilities. This would be similar to what we assert over our current licensees. Once the decision is made regarding the scope and method of DOE external regulation, legislative clarification may be desirable or necessary to solidify authority for NRC licensing of DOE facilities and for the NRC's expenditure of funds for such licensing activities.

APPENDIX A
DOE FACILITY DESCRIPTIONS

INTRODUCTION

The following site descriptions were drawn from numerous DOE Internet resources, briefing notes, staff notes, and presentation materials provided by various DOE officials over the past few years. While the descriptions should be fairly accurate, they are drawn from different sources that often do not agree. It is likely that these brief discussions underestimate the complexity of the sites described.

Argonne National Laboratory (ANL) is one of the largest DOE energy research centers. It has an annual operating budget of about $480 M supporting over 200 research projects. ANL was the nation's first national lab and today employs some 4,500 employees. The multi-program laboratory has a 50 year heritage in nuclear reactor research and development dating back to Enrico Fermi and CP-1, which was reassembled in the Argonne forest as CP-2 in 1943. In 1946, the University of Chicago entered into a contract to operate the yet unnamed lab. There are two Argonne sites. The first is in Argonne IL. The second, Argonne-West, is in Idaho Falls, ID. Over the years, ANL has done extensive development work on HWRs, PWRs, BWRs, and LMRs. ANL maintains a comprehensive staff expertise in nuclear reactor technology.

ANL research falls into four broad categories:

- The Advanced Photon Source will soon provide the nation's most brilliant X-ray beams for pioneering research in materials science.
- Energy and environmental science and technology includes research in biology, alternate energy systems, environmental assessments, economic impact assessments, and urban technology development.
- Engineering research focuses on advanced batteries and fuel cells, and advanced fission reactor systems, including electrochemical treatment of spent DOE fuel for disposal, improved safety of Soviet-designed reactors and technology for decontaminating and decommissioning aging reactors.
- Physical research includes materials science, physics, chemistry, high-energy physics, mathematics and computer science, including high-performance computing and massively parallel computers.

There are hundreds of individual laboratories at ANL-E. Major facilities at ANL-E include the Advanced Photon Source, the Intense Pulsed Neutron Source, the Alpha-Gamma Hot Cell facility, the Large Efficiency Photon Particle Experiment, and several accelerators including the ATLAS (the Argonne Tandem Linear Accelerator System) Heavy Ion Accelerator facility. ATLAS is the world's first superconducting accelerator for projectiles heavier than the electron. ATLAS is a series of very large (up to 20 MV) accelerators and boosters. ANL-E has 2 shut down research reactors currently undergoing decommissioning. ANL-W has nearly 50 different labs involved in radiation

work including 4 shutdown reactors and 4 operating reactors, one of which is expected to be shutdown in the next 10 years.

These are large sophisticated research facilities that are used by visiting scientists from around the world. The complexity of the facility vastly exceeds any existing NRC licensee. The lab possesses large quantities of fissionable material and other radioactive materials. Significant quantities of radioactive wastes are stored at the site.

Brookhaven National Laboratory (BNL) is operated by Associated Universities Inc. (AUI), under contract to DOE. BNL is a 5200 acre site on Long Island, directly east of New York City. The site has over 3000 employees and more than 4,000 visiting scientists perform research or attend conferences each year. BNL consists of dozens of research labs including several accelerator facilities and 2 operating research reactors.

In 1946, AUI was founded by nine top universities to act as a non-profit manager for BNL. AUI is governed by a board of 25 trustees from a broad range of scientific fields, with at least one trustee from each of the founding universities. It is headquartered in Washington, DC.

Major facilities at BNL include:

- Relativistic Heavy Ion Collider, an under construction accelerator facility
- Alternating Gradient Synchrotron, a particle accelerator for high-energy physics
- National synchrotron Light Source, an ultraviolet light and X-ray producing accelerator used for research on crystals, molecules, and materials.
- Accelerator Test Facility, where new technologies are tested
- High Flux Beam Reactor, produces neutrons for experiments
- Medical Research Reactor, used for the development of medical isotopes
- Gamma Irradiation Facility
- Controlled Environment Radiation Facility
- Whole Body Neutron Irradiation Facility

BNL has several fissile material storage facilities and vaults, liquid radioactive waste storage, a hazardous waste management facility and other radioactive waste facilities. In addition, there are an unknown number of contaminated pits, trenches, and holes on the site.

Pacific Northwest National Laboratory (PNNL) is a multi program lab operated by Battelle. It was established in 1965 under a special agreement, Battelle and government owned facilities and equipment are combined in a consolidated lab where Battelle conducts work for DOE, other agencies and industry. PNNL has an annual

budget of about $400 million and employs 4000 people. A dozen or more buildings at PNNL are dedicated to research using radiation and radioactive materials. In addition, PNNL has critical mass fissile storage facilities and vaults.

Idaho National Environmental & Engineering Laboratory (INEEL) operated by Lockheed Martin Idaho Technologies Co, covers nearly 890 square miles and employs over 9000 persons. The site was founded in 1949 as the National Reactor Testing Station to provide an isolated area where reactors and support facilities could be built and tested. Fifty two test reactors were constructed at the site over its life, though most are now shut down. Today the sites mission has been expanded to include environmental research. There are nine primary facilities at INEEL, consisting of about 150 different areas and buildings where radioactive materials are used or stored, as well as administrative, scientific support, and non-nuclear research laboratories in Idaho Falls.

Argonne National Laboratory West (ANL-W) conducts nuclear research and development and operates facilities for DOE. Central Facilities Area includes environmental monitoring and calibration laboratories, security, fire protection, medical, communications, warehouses, and other support units.

Experimental Breeder Reactor I (EBR-1) was the first reactor in the world to generate usable amounts of electricity, on December 20, 1951. ERB-I is a Registered National Historic Landmark, open to the public for tours.

Idaho Chemical Processing Plant complex houses one-of-a-kind reprocessing facilities for government-owned defense and research spent fuels. It has bee in operation since 1953. Reprocessing was discontinued in 1992.

Naval Reactor Facility is operated under the direction of the Office of Naval Reactors. Prototype reactors for both surface ships and submarines were developed here. Research on Naval spent fuel and irradiated materials used in Naval reactors continues.

Power Burst Facility served as the testing ground for nuclear fuels for several years. It is now leased to the Idaho Brain Tumor Center for potential use in brain cancer treatments.

Radioactive Waste Management Complex was established in 1952 as a controlled disposal area. The site contains INEEL and defense generated wastes.

Test Area North consists of facilities for handling, storage, examination and research and development of spent nuclear fuel. It contains one of the world's largest hot shops, storage pools, and support facilities. The TMI-2 fuel is stored here. The many spent

fuel pools are largely unlined pools lacking seismic protection or leak detection capability.

Test Reactor Area is the world's most sophisticated materials testing complex, houses extensive facilities for studying the effects of radiation on materials, fuels and equipment for the nuclear Navy. The advanced test reactor is used for isotope production and materials research.

Lawrence Livermore National Laboratory (LLNL) has been operated by the University of California on the site of the former Livermore Naval Air Station since the early 50's. LLNL has an operating budget of about $900 Million and employs about 7000 people. LLNL's mission can be broken down into three categories; defense programs, environmental restoration, and energy research.

Defense Programs -- About 60% of LLNL's activities are DOE defense related programs. LLNL has facilities for designing and testing weapons, fissile materials storage, fission and fusion reactor research programs, as well as health effects research. LLNL has enrichment facilities and tritium production reactors.

Environmental Restoration -- Projects include packaging and transportation research, uranium handling and much of the work on the Yucca Mountain facility. In addition, the lab is working on remediation of some of its early research areas.

Energy Research -- In addition to nuclear energy research undertaken in conjunction with the defense mission, LLNL performs fossil fuel research and efficiency and renewable research.

LLNL consists of about 60 areas and buildings in which radioactive materials are used or stored.

Los Alamos National Laboratory (LANL) was established in 1943 as Project Y of the Manhattan Engineering District to develop the world's first atomic bomb. Today, LANL is a multi disciplinary lab whose central mission still revolves around national security. The lab, managed by the University of California, covers 43 square miles of mesas and canyons in northern New Mexico. The lab employs about 7000 University of California employees plus about 3500 contractor personnel. The annual budget is over $1 billion.

About [illegible] of the labs current activities use nuclear materials. Much of the remaining work is in high performance computing and simulation. Of possible concern to NRC are 4 groups: environmental systems; nuclear and advanced materials; nuclear weapons science and technology; and nuclear science, plasmas, and beams.

Environmental Systems: Some of the projects in this area include environmental restoration; long-range alpha detector systems; nuclear waste management research; and air, soil, radon, liquid and surface contamination detection and quantification.

Nuclear and Advanced Materials: In addition to plutonium storage, LANL has extensive isotope production and distribution programs.

Nuclear Weapons Science and Technology: LANL operates the Defense Nuclear Agency, nuclear materials and stockpile management. This group performs basic research and development of advanced nuclear weapons and components.

Nuclear Science, Plasmas, and Beams: The projects in this area include the accelerator-driven transmutation technology, accelerator production of tritium, inertial confinement fusion, plasma physics, and the development of ultra cold neutrons.

LANL has over 50 buildings and areas in which nuclear materials are used or stored. In addition to fissile material storage, the site has several operating research reactors and accelerators. There are areas for processing and storing high level waste, mixed waste, TRU waste, and low level waste.

Oak Ridge National Laboratory (ORNL) is the largest of DOE's 5 multi program energy laboratories. ORNL was founded in 1942 during the Manhattan Project to develop the atomic bomb. ORNL has an annual budget of more than $550 million and employs 5000 persons. Another 4000 visiting researchers work at the lab each year. ORNL also has 14 "user facilities" that are open to researchers world wide for studies in high-temperature ceramics and alloys, heavy-ion collisions, advanced building materials, large forest ecosystems, and other scientific phenomena. Program areas are Physical Sciences; Environmental Management; Energy Efficiency and Renewable Energy; Biological and Environmental Research; Defense Programs; Fusion; Nuclear Energy; Fossil; and Environment, Safety, and Health.

ORNL has over 200 areas and buildings in which nuclear materials are used or stored. The site has several research reactors and accelerator facilities. Major facilities include:

Atomic Physics EN Tandem Accelerator
Bioprocessing Research and Development Center
Bulk Shielding Reactor
High Flux Isotope Reactor
High Temperature Materials Laboratory

Holifield Heavy Ion Research Facility
Irradiated Fuels Examination Laboratory
OR Electron Linear Accelerator
Tower Shielding Reactor
Transuranic Research Laboratory

Sandia National Laboratory (SNL) was established in 1945 as one of the major national defense R&D labs as part of the Manhattan Project. SNL is managed by Lockheed Martin. It has an annual budget of over $ 1.2 billion and employs about 8,000 people. Sandia has two primary facilities, one in Albuquerque and one in Livermore California. The site has over 60 buildings and areas in which radioactive materials are used or stored.

SNL has several research reactors including CYBL (Cylindrical Boiling Laboratory) which is a full size test reactor for performing meltdown intervention experiments on any given reactor vessel type. The facility also has fissile material storage vaults and facilities, radioactive and mixed waste storage facilities, and accelerators.

Some of the research under way at the facility include:

- Fusion research
- enhanced oil recovery
- in-situ coal gasification
- oil-shale production
- advanced weapon development

Sandia National Laboratory, California Site (SNM-CA) covers 413 acres just outside Livermore California. The site facilities comprise approximately 800,000 square feet of building floor space. Of this, about 31% is office and drafting areas, 48% is light laboratories and shops, and 3% is heavy laboratories (e.g., high-pressure test facilities and explosives chambers). The remaining 18% is miscellaneous, such as computer rooms or library space. The site has 18 buildings and areas in which radioactive materials are used or stored including low level radioactive and mixed waste management and storage facilities.

OTHER LABORATORIES

Ames Laboratory is a DOE owned research laboratory operated under contract by Iowa State University (ISU). The lab has an annual budget of about $35 million and employs 650, about half of whom are scientists. The lab occupies about 10 acres of land on the north edge of the ISU campus and consists of three research laboratory buildings and several other administrative and support buildings. The lab also rents research space in several ISU buildings.

Ames lab was formally established in 1947 by the AEC as a result of the Ames Project's successful development of the most efficient process to produce high-purity uranium metal in large quantities for atomic energy. Today the lab pursues much broader priorities in chemical, materials, engineering, environmental, mathematical, and physical sciences. Ames lab has internationally recognized expertise in the materials sciences and modern analytical chemistry that has been utilized by DOE to support national security programs. They do not conduct any classified R&D work. One area of expertise is in developing materials control and accounting methods for ensuring the safeguards of disassembled bomb components from both the US and the states of the former Soviet Union.

The DOE Office of Safeguards and Security has supported efforts at the lab to apply optical spectroscopy to the on-line measurement of uranium, plutonium, selected isotopes of these elements, other actinide elements, and other materials of interest in various stages of the nuclear fuel cycle. Optical measurements, which can be remotely made, are particularly useful for monitoring the concentrations of actinides in highly radioactive materials. These spectroscopies can also be used to monitor processes associated with vitrification of high level waste and weapons materials.

In another area of the lab, diode lasers are used for high-resolution spectroscopy to evaluate the measurement of actinides in other materials. Ames has demonstrated that diode lasers can be used to detect uranium and thorium atoms as well as actinides in ultra trace concentrations.

Inductively coupled plasma-mass spectrometry (ICS-MS) is capable of detecting long-lived radionuclides at part-per-trillion levels. This research was pioneered at Ames. It was used to assay smuggled plutonium and is widely used in US national labs as well as the UK, Russia, France, India, and Japan. Ames is also working on the ultra-purification of rare earths such as neodymium, gadolinium, erbium and dysprosium. Ames maintains the Rare-earth Information Center (RIC) which maintains and disseminates scientific information worldwide.

The lab possesses fissile and other fissionable radionuclides and probably some irradiated fuels.

Environmental Measurements Laboratory (EML) is a DOE owned and DOE operated laboratory located in New York City. The lab has been in existence since 1946. EML employs 85 people. Primary areas of research are:

- Environmental radiation and radioactivity
- Radiation transport and dosimetry
- Environmental radon, thoron and related aerosols
- A mospheric surface pollutant studies related to global climate change
- Atmospheric Chemistry
- Metrology, consultation, and emergency response
- Environmental management

Onsite facilities include clean rooms, one of only 4 radon calibration chambers worldwide, and spectroscopic radioanalysis laboratories. EML has a field site in rural New Jersey which serves as a regional baseline monitoring station for environmental pollutants and meteorological data collection. In addition, EML has a van based mobile laboratory used for conducting outdoor radiation measurements.

The lab possesses sealed sources and small quantities of radioactive materials used in research in several labs.

Fermi National Accelerator Laboratory (Fermi), as the name implies, is primarily an accelerator facility. They may possess small amounts of byproduct material for instrument calibrations. The focus of the Fermi site is the four mile diameter Tevatron, the world's most powerful particle accelerator. More than 2,200 scientists from 36 states and 20 countries use Fermi facilities for research in particle physics.

Inhalation Toxicology Research Institute (ITRI) is located in central New Mexico on the Kirtland Air Force Base. ITRI was established in 1960 to conduct research on the human health consequences of inhaling airborne radioactive materials. In the mid 70's, the research program was expanded to investigate the potential health effects of airborne chemicals released from energy use and energy production sources. Beginning in the 80's, the program was shifted to more basic research on the e respiratory tract. Past operations have resulted in the contamination of soils and groundwater with radioactive and hazardous materials. Contamination is known to be present in three areas: underground fuel tanks and fuel lines; holding ponds for low-level radioactive waste; and sewage lagoons. Remediation activities are currently under way in these areas.

Lawrence Berkely Lab (LBL) is the oldest of the national laboratories. It was founded by Ernest Orlando Lawrence in 1931. Lawrence invented the cyclotron which led to revolutionary discoveries about the nature of the universe. LBL is currently a multi

program lab where research in advanced materials, biosciences, energy efficiency, detectors and accelerators, focuses on national needs in technology and the environment. LBL is operated for DOE by the University of California at Berkeley and has about 3,400 employees and hosts over 2,000 participating guest scientists.

Currently there are operating accelerator facilities as well as laboratories and waste storage and management facilities. There are over 20 distinct areas in which radioactive materials are used or stored. Five plumes of contaminated ground water and soil contamination have been identified to date.

Laboratory for Energy Related Health research (LEHR), a 15 acre site owned and operated by the University of California, is located on the UC Davis campus and has been leased to DOE and its predecessors since 1958. LEHR consists of a main administration and office building, two animal hospitals, a specimen storage room, a laboratory and support building, waste treatment facilities, and 500 outdoor dog pens. Research originally focused on the health effects of chronic exposure to radionuclides using beagles to simulate radiation effects on humans. Research operations were terminated in 1988. A number of facilities were contaminated in addition to soil and ground water. The lab was placed on the EPA National priorities List in 1994. Once decontaminated, the site will be returned to the University of California.

Princeton Plasma Physics Laboratory is located in western New Jersey, adjacent to the Princeton University campus. Fusion research at the lab began in the early 50's with the construction of small devices to study magnetic confinement of plasma. The lab continues to conduct fusion research and development focusing on a succession of larger and more powerful devices for magnetic confinement. Currently there are two major research devices at the lab, the Tokamak Fusion test reactor and the Princeton B Experiment-Modification. Past practices at the lab have resulted in the contamination of soils and ground water with hazardous materials.

Eleven potential areas of contamination have been identified. Several of these were subsequently found to have contamination below action levels and several others have been combined to facilitate investigation.

PRODUCTION AND ENRICHMENT FACILITIES

Grand Junction Projects Office (GJPO) is located on a 56 acre site adjacent to the Gunnison River in western Colorado. The original mission of the site was uranium procurement. In addition to uranium recovery plants at Uravan and Durango, a refinery at Grand Junction was built to refine the mill product into uranium oxide, or "yellow cake." Starting in the 80's, GJPO successfully managed a number of large property cleanup projects, including projects in support of other agencies. In 1987, Congress passed the Uranium Mill Tailings radiation control Act (UMTRCA), which required DOE to establish a program of assessment and remediation at 24 inactive uranium mill sites and vicinity properties. GJPO is responsible for on-going vicinity property activities, including the cleanup of hazardous wastes commingled with radioactive tailings, and the long term surveillance of completed UMRTA (Title I and Title II sites as defined under UMTRCA) disposal cells, and for remedial action activities at more than 4,000 vicinity properties located in Mesa County, Colorado. GJPO is the first DOE facility whose primary mission is environmental restoration of sites throughout the nation. In addition to the 24 UMTRCA sites and the 4,000 vicinity properties, GJPO has complete laboratory and calibration facilities.

Fernald was constructed in 1951 and the plant was in full production of uranium metal feed materials in 1952. Environmental remediation of the facility was begun in 1986, and in 1989 EPA added the site to the National Priorities List. In 1991 DOE announced its intention to formally end the production mission at Fernald and closure of the facility became effective in June of that year. The remediation effort is being performed under contract to Flour Daniels.

There are 5 remediation units (areas with similar contamination or collocation) on the site comprising about 40 separate contaminated buildings and areas. Significant soil and groundwater contamination are present at the site. During its operating life, liquid wastes were stored in unlined ponds, tanks, and discharged to a nearby stream.

Rocky Flats is located 15 miles upwind of Denver, within a 50 mile radius of 2.2 million people. It is also upstream of the water supply of 400,000. The site has more than 14 tons of plutonium, the largest quantity of unfinished product in the US. About a quarter of that plutonium is in the form of manufacturing residues contained in more than 7,000 drums. About half of this is in the form of highly dispersible ash. There is also about 30,000 liters of plutonium acid solutions. The site has 500 support facilities.

The site is managed by Kaiser-Hill and is beginning a $ 7 billion closure project. This phase of the decommissioning is expected to be completed sometime between 2005 and 2020. At the end of this cleanup effort, the only remaining buildings onsite, other than those for commercial reuse, will be new facilities for plutonium, TRU, and low-level waste. It is anticipated that this smaller site will have a budget of $50 million per year

as opposed to the current $ 700 million budget. Once a final repository is available, these facilities will be demolished at an estimated cost of $1.5 billion.

K-25 is a gaseous diffusion enrichment plant on 1500 acres of the Oak Ridge Reservation, adjacent to the Clinch River. The site was built as part of the Manhattan Project to supply enriched uranium for nuclear weapons production. The site was used primarily for this purpose through 1964, at which time the focus was shifted to production of commercial-grade low-enriched uranium. The site was placed on standby in 1985, and permanently shut down in 1987. Currently the site is involved in environmental restoration, waste management, technology development and demonstration, and technology transfer. The site currently operates the world's only mixed waste incinerator. About 50 acres of waste management areas will remain under DOE control after decommissioning is complete some 50 years from now.

Y-12 was the world's first uranium enrichment plant and is currently managed by Lockheed Martin Energy Systems Inc.. The site occupies about 800 acres on the Oak Ridge Reservation in the Bear Creek Valley. The approximately 250 buildings total over 7 million square feet of laboratory, machining, dismantlement, and R&D areas. Built in 1943 as part of the Manhattan Project, the original purpose of the plant was to use an electromagnetic process to separate uranium isotopes for nuclear weapons. The role of the site has evolved to include support of fabrication of nuclear weapons components. Currently, the focus of site activities has shifted to nuclear weapon component disassembly, enriched uranium material storage and management, weapons process technology and development support, renovation or decontamination and decommissioning of standby or shutdown buildings, technology transfer, and maintenance and support to DOE Office of Non-Proliferation and Arms Control. In 1989, Y-12 was placed on the EPA National Priorities List. A total of 23 facilities have been or are expected to be declared surplus within the next 5 years.

DEFENSE FACILITIES

Hanford was established in secrecy during world war II to produce plutonium. Peak production was in the 60's when 9 production reactors were in operation at the site. All weapons material production was halted in the late 80's and the site is now engaged in the worlds largest environmental cleanup project. Hanford has a workforce of approximately 15,000, 96% of whom are contractors, and an annual budget of $ 2 billion. The site covers 560 square miles and there is nearly 5 million square feet of building space. The primary contractor is Westinghouse Hanford Corporation, with just over 6,000 employees. Four other contractors work on the site. The current mission of the facility is site cleanup.

Major facilities at Hanford included

- Fast Flux Test Reactor (FFTF) is still operational on the site and may be put back into use for tritium production.
- Several spent fuel storage facilities
- A low-level waste compactor
- Dozens of waste management laboratories and facilities
- Transuranic Storage and assay Facility (TRUSAF)
- Fuel fabrication facilities
- HLW vitrification facility
- Plutonium finishing plant
- Hundreds of waste tanks
- 9 shutdown reactors

Savannah River Site (SRS) occupies about 325 square miles south of the City of Aiken, South Carolina. SRS was constructed during the early 50's to produce the basic materials used in the fabrication of nuclear weapons, primarily tritium and plutonium-239. Five reactors were built on the site. Also built were support facilities including two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility and waste management facilities.

All five of the original SRS production reactors are permanently shut down. While production of new tritium will not be necessary for many years, recycling and reloading of tritium to keep the nuclear arsenal ready is a continuing site mission. SRS is the nation's only source for recycling tritium from nuclear weapons reservoirs returned from service. Tritium recycling takes place in the new Replacement tritium Facility, that went into operation in 1994.

HB line, a part of H canyon, is currently operating to produce plutonium-238 for deep space probes. The H Canyon separations facility is in standby to process spent nuclear fuel, pending the outcome of Interim Management of Nuclear Materials EIS currently under development. The EIS will determine the course of action necessary to place spent fuel stored at SRS in a stable form for an interim period.

Weapons material production at SRS has produced unusable byproducts such as intensely radioactive waste. The high-level radioactive waste, about 35 million gallons, is stored in waste tanks on site. The Defense Waste Processing Facility will bond the radioactive elements in borosilicate glass, a stable storage form. In addition to the HLW, other LLW in solid and liquid forms, TRU waste, hazardous waste, and sanitary waste are stored on site.

In addition to 5 reactors shut down and in standby condition on the site, there are now over 400 inactive waste and groundwater units included in the site's remediation program. Waste units range in size from a few feet to tens of acres and include basins,

pits, burial grounds, landfills, tanks, and ground water. To date more than 80 acres have been remediated and certified closed. Nearly 2 billion gallons of groundwater have been treated with more than 300,000 pounds of organic compounds removed. The full remediation of the site will take many decades.

Pantex Plant is a 16,000 acre site in the Texas panhandle, about 17 miles northeast of Amarillo. With an annual budget approaching $250 million, the site employs about 3,500 people.

The plant was built by the Army in 1942 as a conventional bomb plant. In the 50's, the plant was modified to manufacture high explosives used in nuclear weapons and for the final assembly of nuclear weapons. During the 60's the mission was expanded to include maintaining and evaluating nuclear weapons in the stockpile and dismantling nuclear weapons as they were retired from the stockpile. Pantex continues to be the only facility used for the dismantlement and maintenance of the nation's nuclear weapons stockpile. Pantex is owned by DOE and operated under contract to Mason & Hanger, the US Corps of Engineers, and Sandia National laboratory.

Pantex site is divided into 14 functional zones:

1	administration
2	shop and maintenance
3	finished ammunition storage area
4	high explosives storage area for ammonium nitrate
5	high explosives storage area for TNT
6	bomb booster line
7	ammonium nitrate line
8	inert storage and railroad classification yard
9, 10, 11, and 12	bomb load lines
13	sewage treatment
Pantex Village	969 residences in 71 buildings

Remediation in one zone is complete, and two others required no remediation. Significant radioactive materials exist in Zone 12. Facilities in zone 12 include weapons manufacturing, assembly and disassembly; fissile material storage facilities and vaults; and radioactive and mixed waste management facilities.

Mound Site is a 306 acre site located in western Ohio. Since 1947, the plant has been an integrated R&D and production facility for defense and non-defense programs. The plant's past missions included the fabrication and testing of nuclear and non-nuclear components, the production of stable isotopes for general research, the production of small chemical heat sources, the recovery and purification of spacecraft electrical

power sources, and surveillance of weapons components. DOE has discontinued operations at the site and transferred them to other sites. Because past operations were so diverse, facilities, soils, and groundwater are contaminated with a variety of radioactive materials and chemical pollutants.

Kansas City Plant occupies about 141 acres of the 300 acre Bannister Federal Complex, about 12 miles south of Kansas City, Missouri. The plant was established in 1942 to build aircraft engines for the Navy. After World War II, the site was used for storage and in 1949 was selected to manufacture non-nuclear components for nuclear weapons. The site is currently the only DOE facility conducting non-nuclear manufacturing of nuclear weapons. There are 4 buildings on the site in which radioactive materials are used or stored for materials research.

Nevada Test Site (NTS) occupies 1350 square miles of southern Nevada desert. It was established in 1950 as the primary test site for nuclear and conventional explosives. In addition to weapons testing, the site also had an open-air nuclear reactor, nuclear engine, and nuclear furnace test; hazardous materials spill response testing; and experiments involving radioactive and non-radioactive materials. Above ground nuclear tests were performed at the site until 1963. Below ground nuclear weapons test were conducted until 1992. Currently the site is one of the primary low-level waste disposal sites for the DOE. About 2,000 potential areas have been identified as requiring some level of investigation and possible remediation.

Rocky Flats Environmental Technology Site is an 11 square mile site located in northern Colorado. Rocky Flats was built in 1951 for the production of components for nuclear weapons. The final products included components and assemblies manufactured from uranium, plutonium, beryllium, stainless steel, and other metals. In 1989, many of the site's functions involving the production of weapons components were suspended. In 1992, the plant was permanently shut down and the focus was shifted from production to environmental restoration. During its operation, facilities, soils and ground water were contaminated with radioactive and hazardous materials. Nearly 200 contaminated areas have been identified on and off the site.

Weldon Spring Site is a 229 acre site about 30 miles west of St. Louis Missouri. In the 40's the site was part of an Army ordinance works. In the 50's and 60's, the site was used for processing uranium ore. No activities have been carried out at the site until remediation was undertaken, and it was placed on the EPA National Priorities List in 1989.

Remediation activities at the site will involve removal, treatment and disposal of contaminated materials from the quarry and raffinate pits, and the decontamination and demolition of 44 contaminated buildings. Remediation of vicinity properties will involve removal and disposal of contaminated soil, and monitoring of potentially contaminated

surface and ground water. A section of the site will be used as a permanent disposal area for waste.

Pinellas Plant is a 99 acre nuclear weapons complex located in western Florida. The plant opened in 1957 and was used for the development and production of neutron generators, which were used as external initiators in nuclear weapons. The product line was later expanded to include lightning arrester connectors, capacitors, magnetics, optoelectronic devices, and other components. Production ceased in 1994 when the plant mission was changed to safely shut down the facility and prepare the site for use as a community resource for economic development. Solid waste, soil contamination, and ground water contamination are present on the site. Ground water remediation is the main environmental concern.