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Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives

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NUCLEAR HEALTH AND SAFETY

Environmental, Health, and Safety Practices at Naval Reactors Facilities

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Resources, Community, and
Economic Development Division

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August 1, 1991

The Honorable Mike Synar
Chairman, Environment, Energy,
and Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

This report responds to your request that we review the environmental, health, and safety practices at the Department of Energy's Naval Reactors Program facilities. The report discusses the programs and procedures implemented by Naval Reactors to protect the environment and ensure the health and safety of workers and the public.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time we will send copies of this report to 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.

If you have any questions about this report, please contact me at (202) 275-1441. Major contributors to this report are listed in appendix I.

Sincerely yours,

Victor S. Rezendes
Director, Energy Issues

Executive Summary

Purpose

The Department of Energy's (DOE) Naval Reactors Program has been the subject of several allegations concerning poor environmental, health, and safety practices. Naval Reactors presently operates two laboratories and seven small land-based reactors. The allegations involved employees' overexposure to radiation, unsafe reactor design, asbestos problems, and improper radioactive and hazardous waste disposal.

Concerns about the allegations and the program's historically limited external oversight prompted the Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, to ask GAO to perform a comprehensive review of environmental, safety, and health issues at Naval Reactors laboratories and prototype sites. The Chairman specifically asked that GAO assess (1) workers' exposure to radiation and other hazardous materials, including asbestos; (2) reactor safety; (3) the adequacy of oversight; and (4) the classification of information, insofar as this could prevent the disclosure of problems.

Background

Naval Reactors is a joint program of DOE and the Navy. The program is responsible for designing, constructing, operating, and eventually decommissioning nuclear-powered vessels. Naval Reactors contractor-operated laboratories carry out research and development directed toward improving reactor performance and safety. In addition, the laboratories operate prototype reactor training programs that supply the Navy with qualified personnel to operate its vessels.

Results in Brief

GAO's review of specific environmental and safety programs at Naval Reactors facilities shows no basis for allegations that unsafe conditions exist there or that the environment is being adversely affected by activities conducted there. The programs and procedures implemented by Naval Reactors and its contractors at the laboratories and prototype training sites are adequate to protect workers and the environment from exposures to radioactive and hazardous materials, including asbestos.

The prototype reactor design provides safety measures that are consistent with commercial nuclear power requirements. However, minor environmental and safety incidents have occurred, and as with other nuclear facilities, past activities have left environmental problems that require continuous monitoring and vigilance.

While Naval Reactors has historically been exempt from most oversight, some federal and state environmental oversight agencies have recently been permitted access to Naval Reactors facilities for oversight functions. Naval Reactors also voluntarily interacts with the Nuclear Regulatory Commission (NRC) in activities involving reactor modifications, safety improvements, and component reliability. In addition, Naval Reactors and its contractors have established an extensive internal oversight program that is geared toward reporting the slightest deviations from requirements or procedures.

Given Naval Reactors classification policies and requirements, it does not appear that Naval Reactors routinely overclassifies information to prevent its release to the public to avoid embarrassment. However, GAO did note some instances in which documents were improperly classified.

Principal Findings

Workers' Protection Against Exposures

Naval Reactors and its contractors have developed and implemented procedures that are adequate to protect workers from exposure to radiation and other hazardous materials. To control radiation releases and prevent exposures, activities are carried out in shielded cells, glove boxes, and other engineered radiation containment devices. In addition, areas containing radioactive materials and radiological activities are plainly marked or tagged. All radiological workers undergo extensive training on the handling of radioactive materials and on actions to avoid releases. This training is documented and each worker is periodically retrained.

Naval Reactors facilities and workers are constantly monitored to detect releases of radiation. In areas where radiological work is conducted, air is monitored, personnel wear devices to detect radiation, and workers are monitored by radiation-detection instruments when they depart the areas. In addition, radiation-detection devices are placed in rooms, outside of buildings, and around site perimeters. These devices are periodically collected and analyzed. Each laboratory and site conducts routine radiological surveys of facilities either daily, weekly, monthly, or annually depending on the activities conducted.

Radiation-detection devices worn by workers are periodically analyzed and the results recorded in individual personnel exposure records. GAO's

review of these records, incident reports, and historic exposure information dating back to 1967 disclosed no evidence that anyone in the Naval Reactors program has exceeded the federal limit of 5 rem per year, and no one has exceeded the Naval Reactors administrative limit of 2 rem per year since 1984. The system is accurately maintained and reported on annually. In addition, certain workers are required to have periodic urinalysis and lung scans to detect internal radiation exposures. According to health physicists at NRC, the routine bioassaying programs at Naval Reactor laboratories and sites are more extensive than those at most licensed commercial nuclear facilities. For example, most commercial facilities do not perform routine urinalysis while Naval Reactors laboratories do require these on a periodic basis.

Naval Reactors laboratories and sites have implemented procedures to control radioactive and chemical waste. These materials are collected, identified, and stored in designated areas. All of the materials are properly disposed of off-site, and the entire process is documented.

Asbestos Controls

Procedures and requirements adopted by Naval Reactors either meet or exceed federal standards for asbestos controls. During the review, GAO physically inspected all laboratories and sites, except one small site, and took 57 independent air samples at locations that have a potential for asbestos contamination. While none of the air samples were positive, GAO noted exposed asbestos on piping and two other instances of exposed asbestos. While these were not significant in number and posed no immediate hazard, such instances do require vigilance to reduce the potential for asbestos exposure. Naval Reactors has initiated a 10-year program to remove all asbestos from its facilities. However, until the program is completed, close vigilance must be maintained through periodic inspections to detect potential asbestos hazards.

Reactor Safety

Naval Reactors prototype reactors are designed and operated in a safe manner. GAO reviewed reactor design information and relevant NRC design analyses and found that the prototype reactors employ engineered safeguard systems designed to improve safety. In addition, any unusual event or deviation from normal reactor operations initiates an "incident report," which describes the event in detail, recommends corrective action, if necessary, and remains open until corrective action is completed by the contractor. GAO's review of over 1,700 incident reports on the prototype reactors disclosed that no significant accident—one resulting in fuel degradation—has ever occurred.

Oversight at Naval Reactors Laboratories and Sites

Oversight of Naval Reactors laboratories and sites is provided both internally and externally. Naval Reactors headquarters, its field offices, and contractors perform literally hundreds of audits and inspections annually. For example, from January 1988 to December 1990 Naval Reactors field offices performed 919 audits of environmental, health, and safety activities. GAO verified on a selective basis that deficiencies resulting from the audits are tracked until corrections are implemented.

The Environmental Protection Agency and state environmental agencies are also active in performing audits and inspections of Naval Reactors laboratories and sites. Deficiencies reported to Naval Reactors by these agencies are corrected to their satisfaction. In addition, Naval Reactors frequently has requested NRC to review various reactor designs and design modifications and has acted in response to certain comments.

Classification Practices at Naval Reactors

Naval Reactors classification practices are not directed toward classifying information to prevent disclosures of problems at laboratories or sites. While some information has been improperly classified, GAO found no evidence of a trend toward improper classification of only information concerning problems. Information that was improperly classified was no more significant in this regard than was unclassified information. Due to the nature of Naval Reactors' activities, a large amount of information concerning its program is classified and not releasable to the public. GAO believes the inability to make certain information available has contributed to public mistrust and suspicion concerning activities at Naval Reactors facilities.

Recommendations

This report makes no recommendations.

Agency Comments

As requested, GAO did not obtain official agency comments on a draft of this report. However, Naval Reactors officials did review the section on reactor safety to ensure classified information has not been disclosed, and GAO discussed the facts contained in this report with them during the course of its audit.

Contents

Abbreviations

CFR	Code of Federal Regulations
DEC	Department of Environmental Conservation
DER	Department of Environmental Resources
DOE	Department of Energy
GAO	General Accounting Office
EPA	Environmental Protection Agency
NRC	Nuclear Regulatory Commission
OSHA	Occupational Health and Safety Administration
TLD	thermoluminescent dosimeter

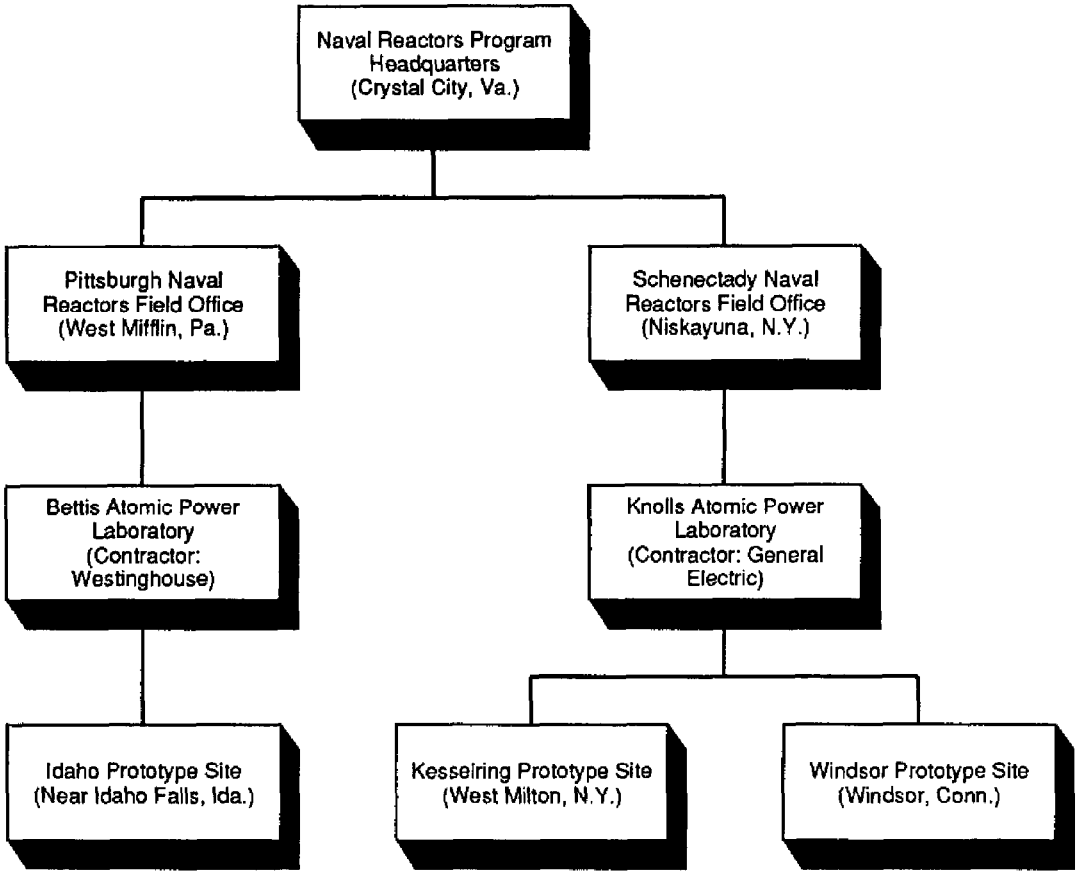
Background

The Naval Reactors Program is a joint program of the Department of Energy (DOE) and the Navy. Naval Reactors is headed by a DOE Deputy Assistant Secretary who is also an Admiral in the Navy. Naval Reactors is responsible for operating nuclear propulsion plants for vessels at sea, as well as the following functions:

- researching, designing, and developing advanced naval reactor propulsion plants;
- conducting procurement, quality assurance, and logistic support for new and operating plants;
- constructing, testing, and certifying shipboard and land-based reactor plants and training facilities;
- operating, overhauling, and maintaining existing plants;
- selecting, training, and qualifying operators; and
- ensuring continued safe and reliable operation of reactor plants.

Naval Reactors operates two laboratories that perform research and development in the design and operation of nuclear propulsion plants used in Navy vessels. Both laboratories also conduct training of naval personnel in reactor plant operations. The laboratories are contractor-operated, and Naval Reactors has established field offices at both laboratories to oversee the operations. The two laboratories operate three prototype training reactor sites that have a total of nine reactors, of which seven are in operation. Figure 1.1 shows Naval Reactors' basic organizational entities and their locations.

Figure 1.1: Naval Reactors' Organizational Elements and Locations



Source: Naval Reactors Program, DOE.

Naval Reactors Field Offices

The Schenectady and Pittsburgh Naval Reactors field offices provide the on-site presence for Naval Reactors headquarters. The role of these field organizations is to administer the prime contract between the government and its contractors. The role includes conducting audits and reviews of contractors' activities to protect the environment and the safety and health of the public.

Each prototype site also has representatives from either the Schenectady or Pittsburgh field offices on-site. Individuals from these offices monitor the prototype reactor operations and general activities at the site.

Knolls and Bettis Atomic Power Laboratories

In addition to managing and operating the prototype nuclear reactors, the Knolls Atomic Power Laboratory (Knolls) and the Bettis Atomic Power Laboratory (Bettis) conduct various activities to support Naval Reactors programs, mostly related to research and development into the nuclear propulsion plants. Both Knolls and Bettis are equipped similarly, with various chemistry and physics laboratories, machine shops, treatment facilities for both radioactive and other hazardous waste, facilities for maintaining nuclear materials, and administrative offices.

Research and development activities at Bettis are similar to those conducted at Knolls, except that each laboratory is responsible for the various reactors it has designed. Thus, each laboratory conducts research on reactor fuel, steam generators, etc., for the operating reactors it has designed.

Prototype nuclear reactor facilities are primarily responsible for training and qualifying naval personnel for shipboard reactor operations. The sites are generally operated 24 hours a day and resemble as nearly as possible actual operations at sea. To support the reactor operations, each site houses laboratories, craft shops, and other facilities.

Knolls and Its Prototypes

Knolls is located near Schenectady, New York, and is situated on 170 acres adjacent to the Mohawk River. Knolls is operated by the General Electric Company and employs about 2,400 personnel. Knolls manages two prototype reactor sites—the Kesselring site at West Milton, New York, and the Windsor site at Windsor, Connecticut.

The Kesselring site consists of about 3,900 acres and under normal operations has about 4,000 General Electric, U.S. Navy, and subcontractor personnel. Kesselring operates four prototype training reactors and support facilities for naval personnel. The Windsor site consists of about 50 acres and under normal operations has about 750 General Electric, naval, and subcontractor personnel. When reactors are refueled, or when other major maintenance or construction activities take place, the work force increases with the additional subcontractor personnel. Windsor has only one prototype training reactor for naval personnel.

Bettis and Its Prototypes

Bettis is located in West Mifflin, Pennsylvania, near Pittsburgh and is situated on 201 acres. Bettis is operated by Westinghouse Corporation and employs about 2,400 personnel.

Bettis operates one prototype reactor site located at DOE's Idaho National Engineering Laboratory, about 70 miles west of Idaho Falls, Idaho. The Idaho site occupies about 4,400 acres and employs 1,600 Navy and contractor personnel. The Idaho site has four prototype training reactors; however, only two are currently operating. One is permanently shut down awaiting decommissioning, and the other is in standby status.

Bettis also operates the expended core facility, located in Idaho, where all used naval reactor fuel is returned and prepared for reprocessing to separate out the unused nuclear material for reuse. The used fuel is reprocessed at a nearby facility at Idaho National Engineering Laboratory that is operated by DOE.

Objectives, Scope, and Methodology

On August 24, 1989, the Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked us to study environmental, safety, and health issues at Naval Reactors laboratories. The request was prompted by allegations concerning safety, environmental, and health conditions at the Knolls laboratory.

The Chairman requested that we review (1) workers' radiation exposures and exposures to toxins and carcinogens; (2) the distribution and quantity of radiation and hazardous waste contamination at the sites; (3) the history of reactor safety and current conditions at the sites; (4) the adequacy of the oversight and accountability mechanisms within Naval Reactors, including whether the operation is subject to outside and/or independent oversight and review; (5) the status of the Naval Reactors asbestos program at the laboratories and sites; and (6) the classification of documents, specifically whether or not any documents describing problems were classified in order to merely prevent public access to information, which could cause embarrassment to DOE and Naval Reactors.

During our review, we interviewed individuals and reviewed information at Naval Reactors headquarters, Crystal City, Virginia; the Knolls laboratory, Niskayuna, New York; Kesselring prototype site in West Milton, New York; and the Windsor prototype site in Windsor, Connecticut; the Bettis laboratory in West Mifflin, Pennsylvania; and its prototype site in Idaho Falls, Idaho; the Nuclear Regulatory Commission

(NRC), Rockville, Maryland; the Department of Energy; and the Environmental Protection Agency. In addition, we interviewed New York, Connecticut, Pennsylvania, and Idaho state environmental program officials that have oversight responsibility for Naval Reactors laboratories and sites. We also reviewed documents of the oversight agencies.

Information was provided by and discussions were held with the Government Accountability Project and the Natural Resources Defense Council, Washington, D.C. Discussions were held with the Executive Director of the Advisory Committee on Reactor Safeguards and a former Chairman of the Nuclear Regulatory Commission.

We distributed a memorandum to over 4,000 Knolls and its subcontractor employees, requesting that anyone with information about environmental, safety, or health problems contact us at our Albany, New York, suboffice, on weekends or after working hours to provide such information. Additionally, we contacted individuals whose names were provided by others as potentially having information. When allegations were made concerning environmental, safety, or health problems, we reviewed the specifics of the allegations to determine if the allegations were true and whether or not the situation was studied or resolved by the contractor or Naval Reactors.

To evaluate radiological controls at Naval Reactors laboratories and sites, we reviewed their programs for controlling access to radioactive materials and contamination, the systems of monitors and alarms, incidents involving employees' exposure and the exposure records of those employees, and employee records for routine monitoring programs for both external and internal exposures. We also reviewed audits of the various radiological controls programs conducted by Naval Reactors headquarters, Naval Reactors field offices, and the contractors. We interviewed outside experts in the area of radiological health and discussed Naval Reactors radiological controls program with NRC health physicists. We also reviewed Naval Reactors' compliance with applicable standards established by the National Council on Radiological Protection. Finally, where a specific allegation was made concerning an individual's possible overexposure or hazardous radiological conditions, we reviewed those circumstances in detail, including our own radiological survey of areas that were alleged to have radiological contamination.

To evaluate the safety of reactor operations at the prototype sites—both historical and current conditions of the prototypes—we relied on our nuclear engineer to review the reactor designs in detail, the Safety

Analysis Reports and Safety Evaluation Reports, correspondence between Naval Reactors and the Atomic Energy Commission (the predecessor agency of DOE), the Advisory Committee on Reactor Safeguards, and NRC, and certain reactor incident reports from the inception of the program. We reviewed all incident reports concerning specific safety systems, reports of incidents with potential environmental risks, and all reports generated since January 1, 1988. Additionally, we reviewed specific allegations made to us concerning reactor problems. We discussed prototype reactor safety with a former Chairman of NRC, the NRC Deputy Director for Reactor Regulation, and the Executive Director of the Advisory Committee on Reactor Safeguards. We observed safety drills at one prototype reactor, discussed reactor safety issues with prototype operators and managers, and reviewed the reactor operator and shift supervisor training program.

To determine workers' exposure to hazardous waste, including radioactive and chemical waste, we reviewed Naval Reactors laboratories' procedures that basically adhere to EPA and DOE orders for handling, storing, and shipping the waste. We verified implementation of the procedures by inspecting waste operations and tracking accountability of waste from its generation to disposal.

To determine the adequacy and the extent of any problems associated with the Naval Reactors asbestos program, we compared Naval Reactors asbestos controls and procedures to the Occupational Safety and Health Administration standards. We also verified implementation of controls and procedures through documentation reviews, analysis of asbestos incident reports, and discussions with responsible officials. In addition, we obtained the assistance of our office's Manager for Health and Safety, who has extensive experience with asbestos control, and who toured all Naval Reactors laboratories and sites, except the Windsor site, and took air samples, which we had independently analyzed.

To determine the adequacy of the oversight and accountability mechanisms within Naval Reactors, including whether the operation is subject to outside and/or independent oversight and review, we reviewed the types of internal and external controls placed over Naval Reactors, and the Executive orders, laws, or regulations that exempt the program from external oversight. Additionally, we discussed the need for oversight with a former NRC official and the Executive Director of the Advisory Committee on Reactor Safeguards.

To determine whether or not documents describing problems at Naval Reactors were classified in order to merely prevent their public access and release, which could cause embarrassment to DOE and Naval Reactors, we did not select a sample of classified documents for review. Rather, during the course of conducting our review of Naval Reactors programs and activities, we reviewed thousands of classified documents, and it was these documents we reviewed for improper classification. We reviewed each document to determine if it appeared to be classified in accordance with Naval Reactors classification requirements. Additionally, we reviewed Naval Reactors classification guidelines and interpretive bulletins.

We discussed the facts presented in this report with officials at Naval Reactors headquarters. They agreed with the facts as presented. As requested, we did not ask Naval Reactors or DOE to review and comment on the report. We conducted our work between January 1990 and February 1991 in accordance with generally accepted government auditing standards.

Environmental, Health, and Safety Programs and Procedures Are Being Adequately Implemented

The programs and procedures implemented by Naval Reactors at its laboratories and sites are adequate to protect employees and the environment from exposures to radioactive and hazardous materials. This part of our review concentrated on the areas of radiological controls, prototype reactor safety, and asbestos controls. These are areas that have a great potential to adversely affect the environment, health, and safety. The following sections discuss the programs and procedures in each of the areas and how Naval Reactors ensures proper implementation.

Naval Reactors Program for Radiological Controls

The radiological controls being implemented at Naval Reactors laboratories and sites are adequate to protect workers' health and safety and minimize radiation exposures. In addition, according to documentation we reviewed, the laboratories are in full compliance with federal and/or state standards regarding radiation releases to the environment. Our review of Naval Reactors radiological procedures and requirements, visits to radiological areas at the laboratories and sites, and evaluations of personnel dosimetry procedures, disclosed no evidence that unsafe radiological operations or conditions were present at the Naval Reactors laboratories and sites reviewed.

The essence of a radiological control program is (1) controlling radiological activities to prevent releases, (2) ensuring radiation is detected if a release occurs, and (3) measuring personnel's exposures. This last element, measuring personnel's exposures, determines the effectiveness of the first two elements. Thus, an accurate and reliable program to measure personnel's exposure to radiation must be in place to ensure the adequacy of the overall program.

Controlling Radioactivity to Prevent Releases

Research and development activities at the laboratories include handling and manipulating such raw materials as highly enriched uranium used in reactor fuel and exposed fuel elements, which contain radioactive fission products. When radioactive dust particles are likely to be present, the operation is housed in shielded cells, glove boxes, or other engineered containment.[1] If it is not possible to prevent airborne radioactivity from coming in contact with the workers, breathing respirators or air-supplying suits are used.

[1]These are devices commonly used in nuclear facilities and allow workers to handle nuclear materials without coming in direct contact with the material. For example, shielded cells employ robotic handling, while glove boxes are sealed glass boxes that allow workers to insert their hands into sealed gloves that provide access into the box.

During our review, we noted that areas where these activities were conducted were plainly marked and isolated by visible barriers identifying the presence of radioactive materials. Every person employed by or visiting the laboratories receives a radiological indoctrination that includes information on how to recognize a radiation area and the precautions to take. In addition, radiological workers undergo training on the handling of radioactive materials and actions to avoid releases.

Naval Reactors laboratories operate several prototype reactors for training, and the trainees all work in close proximity to the reactors. However, the reactor compartment is heavily shielded, and while the reactor is operating, no one is allowed to enter the compartment. The only area outside the compartment that has a potential for radiation release under normal operating conditions is a water-sampling station. Access to the station is controlled, and only trained personnel are allowed to take and analyze samples.

During maintenance periods, the reactor is shut down and personnel enter the reactor compartment. At this time, there is a potential for radiation exposure to personnel performing the maintenance work. Specific work procedures are developed for the various tasks to be performed, and these often require shielding, anticontamination clothing, and catch bags when radioactive liquids are expected.[2] In addition, radioactive spots or areas within the compartment are identified and labeled as to the extent of the radiation. If it becomes necessary for personnel to work in a radiation area and to receive an exposure, the estimated exposure is calculated. Generally, the extent of the radiation is known and the exposure is limited by the amount of time personnel remain in the area.

Detecting Radiation Releases

Naval Reactors laboratories and sites use several methods to detect radiation releases. In areas where there is a potential for airborne or particle releases, the air is constantly monitored, and if radiation is detected, an alarm sounds automatically. Monitoring systems include fixed filter, air-sampling systems that run continuously in every facility where work with radioactive materials takes place, and portable air-sample monitors located near the worker. Fixed dosimeters[3] are located in numerous

[2]Anticontamination clothing is designed to cover the body completely. Boots, gloves, and hoods are employed which gives a space-suitlike appearance. Catch bags are plastic bags set up under pipes, etc., to catch leaking liquids.

[3]Dosimeters are small devices that absorb radiation and can be analyzed to determine exposure.

places inside and outside of buildings and around the site perimeter to detect any unusual amounts of radioactivity. In addition, laboratories require that during reactor maintenance and other radiological work, trained personnel monitor the area of work with radiation-detection devices. Each radiological worker is required to have a whole body survey using radiation-detection devices when he or she exits the radiological work area to determine whether exposure has occurred.

The laboratories also have an extensive program for surveying the buildings and grounds at the various sites. The laboratories and sites routinely perform daily, weekly, monthly, semiannual, and annual radiological surveys of designated buildings and areas to determine the presence of any radioactive materials. The frequency that areas are surveyed depends on their relative potential for radioactive contamination. For example, daily surveys are performed in all areas where activities involving radioactive material are routinely conducted, such as reactor fuel research buildings. Annual surveys are performed in areas where no radioactive materials are handled or processed, such as administrative offices. During our review, we took a judgmental sample of surveys, in which we verified that (1) surveys were performed at the stated frequency, (2) areas and locations were varied to provide adequate coverage, and (3) survey readings were below the reportable level.

In addition to performing these surveys, Naval Reactors laboratories and sites perform special surveys of areas that have been identified by individuals or historical documents noting activities that have a potential for radioactive contamination. These surveys are performed by surveying surface areas with radiation-detection equipment and analyzing soil samples on the surface and at various depths by core sampling.

During our review at Knolls, we received information from an employee at Knolls that a specific area was contaminated to the extent that it should be posted as a radiation area. We surveyed the area using radiation-detection devices provided by Knolls and found that some contamination did exist. However, the radiation levels met federal and state requirements and were far below the limits necessary for posting warnings. Upon further investigation, we found that higher levels had previously existed, but Knolls had taken action to remediate or decontaminate the area to acceptable levels.

In a similar situation at Bettis, we found a contaminated spot on the floor of a building that had previously been decontaminated. The spot was smaller than a dime and while it did not exceed federal standards, it

did exceed Bettis' "clean limit," which is any reading above background. Bettis took immediate action to decontaminate and remove the spot.

Detecting and Measuring Exposures

There are basically two types of radiation exposures that personnel can receive—internal and external. Internal exposures occur when very small radioactive particles are either breathed into the lungs or swallowed into the digestive system. External exposures occur from sources discharging penetrating rays that can pass through skin and enter body organs. Naval Reactors laboratories have programs to detect internal exposures and measure external exposures.

To detect and measure internal exposures, Naval Reactors laboratories operate a routine bioassaying program consisting of lung scanning and urinalysis. According to the National Council on Radiation Protection and Measurements, routine bioassaying is generally considered to be a final quality control check to ensure adequate protection of workers against internal radiation exposure. It is also used to evaluate general exposure conditions at the laboratories to ensure the worker is adequately protected.

Health physicists at NRC agree that routine bioassaying is a quality control check and is not designed to be an indicator of dose. However, in the event there is an accidental release that provides a potential for internal exposure, bioassaying can be used immediately after the accident to obtain an indication of the extent of the dose received. According to these health physicists, the routine bioassaying programs at the Naval Reactors laboratories are more extensive than those at most licensed commercial nuclear facilities. For example, most commercial facilities do not perform routine urinalysis while Naval Reactors laboratories do require this on a periodic basis. In addition, lung scans are required on a periodic basis for all radiological workers at the laboratories and sites, and there is no such periodic requirement for commercial nuclear facilities.

We found that the laboratories were conducting routine bioassaying (periodically scheduled) as required by their procedures. In addition, we reviewed 16 incidents that occurred between January 1988 and September 1990 at Bettis that involved potential internal exposures to individuals. To determine if internal exposures had occurred, each individual involved was given a lung scan and/or urinalysis within 24 hours as required by laboratory procedures. None of the incidents resulted in internal exposures.

The detection and measuring of external exposures is accomplished by requiring that all radiological workers wear thermoluminescent dosimeters (TLD). TLDs are small devices—usually worn on the waist, chest, or neck—that measure accumulative radiation exposure to the torso area of the body. In some cases, multiple TLDs are worn when there is a potential for exposure to the hands, arms, legs, etc. All radiological workers and anyone entering radiological areas are required to wear TLDs. The TLDs are collected and analyzed every month unless an individual works in a high-radiation area or is involved in an incident, in which case the TLD is immediately read to determine any exposure.

In addition, if an individual enters a radiation area that has been surveyed and the extent of radiation is known, the individual wears a self-reading pocket dosimeter. This device is a pencil-sized tube that records radiation exposure as it occurs and can be read anytime by reading a scale inside the tube. Thus, if radiation in excess of that expected is encountered, it would be detected by the individual by periodically looking through the device and reading the scale. If the radiation reaches unacceptable levels, the individual could immediately leave the area.

Individual exposure records are kept for all permanently assigned individuals at the laboratories and sites. The records contain the monthly TLD readings, periodic lung scans and/or urinalysis results, and the results of any testing done in response to incidents. The results are periodically reported to each individual. During our review, we verified the recording of the periodic results of both the internal and external monitoring programs for a judgmental sample of 153 permanently assigned radiological workers. We found no incidents requiring a change to those records.

As stated previously, we reviewed 16 incidents involving the potential for internal exposures. While none was found to result in any internal exposure, Naval Reactors' review of five of the incidents showed that the external exposure levels assigned to the individuals may have been higher than the incident report indicated. The exposures were reconstructed and increased for the individuals involved. Since all individuals involved were subcontractor personnel and their permanent records were not maintained at the site, we did not review their records. However, we did verify that the individual's employer and DOE's central records system were notified of the required increases.

Effectiveness of Radiological Controls

On the basis of our review, we believe Naval Reactors laboratories are accurately measuring, recording, and reporting radiation exposures. Naval Reactors' reported exposures show that exposures have been minimal and overall are lower than commercial nuclear facilities' and other DOE facilities'. For example, on the basis of information dating back to 1967, we conclude no one has exceeded the federal limit of 5 rem per year, and no one has exceeded the Naval Reactors administrative limit of 2 rem per year since 1984.

Safety at Naval Reactors Prototype Reactors

Naval Reactors currently operates seven land-based prototype reactors for training purposes at three locations. Compared with commercial nuclear power reactors, the prototype training reactors are relatively small. For example, the power rating of seven operating prototype reactors combined would not equal the power rating of a typical commercial reactor.

In evaluating reactor safety, two elements must be considered—reactor design and reactor operations. During our review, we evaluated the design and the operational aspects of each operating prototype reactor. Based on our evaluation, Naval Reactors laboratories have provided safety measures that are consistent with commercial nuclear reactor requirements. In fact, the prototype reactors may exceed some of the safety requirements because of their rugged design and construction for combat stress and their relatively small size. Our review of the operational history of the prototypes disclosed that no significant nuclear accidents—those resulting in fuel degradation—or related injuries have occurred during prototype operations.

Prototype Design and Safety Modifications

Naval Reactors started operating reactor prototype sites in the early 1950s, and although external safety oversight was not required, each prototype reactor design was reviewed by outside agencies at Naval Reactors' request. For instance, the early reactor designs were reviewed by either the Advisory Committee on Reactor Safeguards or the regulatory part of the Atomic Energy Commission. NRC has been active in reviewing design and design modifications in more recent years. Safety concerns identified during these reviews have led to modifications directed toward providing additional safety. For example, NRC expressed concern about one Naval Reactors prototype reactor that did not meet certain criteria for radiation releases under accident conditions. As a result, Naval Reactors directed that the necessary modifications be completed to resolve NRC's concern. In addition, Naval Reactors employs

about 300 engineers at its headquarters and field offices to review reactor design and modifications. According to Naval Reactors officials, the main emphasis of their review is on safety.

The early prototype reactors were designed to incorporate the engineered safety systems known at the time. For example, one prototype at Knolls' Kesselring site has a massive sphere around it to contain radioactive material if an accident occurs.

However, additional or modified engineered safety systems have been developed over the years. Consequently, in 1979, Naval Reactors decided to enhance safety at the prototypes by upgrading or adding safety systems. By mid-1991, all prototypes will have these enhanced systems in place. While the identification and description of many of these systems is classified, our nuclear engineer's review of the reactor designs and systems concluded that the prototypes will meet the intent of NRC safety criteria for normal operations and accident conditions.

These major modifications generally require changes in the reactors' Safety Analysis Reports, which are reviewed by NRC at the request of Naval Reactors.[4] For example, at the time of our review NRC was preparing to review modifications related to the reactor core in one of the prototypes at the Kesselring site.

During our review, we found that one prototype at Bettis' Idaho site did not directly meet the reactor-siting criteria established under 10 C.F.R. part 100.[5] In other words, the hypothetical accident referred to in 10 C.F.R. part 100—a release of 15 percent of all fission products--would result in radiation exposures at the site boundary in excess of the limits established. Upon further investigation, we obtained and reviewed NRC documents that recognized the problem and concluded that the intent of the criteria was met because the off-site area is virtually uninhabited and emergency plans are sufficient to prevent any problems.

In addition to having NRC review major modifications, Naval Reactors laboratories receive NRC bulletins and publications that evaluate certain commercial reactor components such as pumps, electrical breakers, etc., for design problems and reliability. The laboratories have established a

[4]A safety Analysis Report describes the design and operation of various reactor components or systems and their related safety functions.

[5]Part 100 of title 10 of the Code of Federal Regulations sets forth the criteria for siting nuclear reactors.

system to identify prototype components that NRC has determined to have problems or that are unreliable. If a prototype is identified that employs the particular component, action is taken to correct the problem or replace the component. From January 1988 to August 1990, Bettis reviewed 360 such documents for applicability to reactor operations. Thirty of these were found to be pertinent to Bettis reactors.

During our review, we contacted NRC officials to determine their interaction with Naval Reactors, and according to NRC's Deputy Director for Reactor Regulation, Naval Reactors has maintained an active dialogue with NRC and its Advisory Committee on Reactor Safeguards concerning safety issues. The deputy director also said that although Naval Reactors is exempt from day-to-day external operational review, Naval Reactors has historically exerted an aggressive monitoring program to improve safety.

Operational Safety of Prototype Reactors

Our review of selected incident reports and discussions with personnel at Naval Reactors laboratories and sites disclosed that no nuclear accident or incident that could endanger health, safety, or the environment has happened at any of the prototype reactors. All together, the nine prototype reactors have accumulated a total of 247 reactor years of safe operation.

According to the Director of Naval Reactors, a major strength of the program comes from critical self-evaluation of problems when they are identified. The laboratories incident-reporting system is thorough, requiring the slightest deviation from normal operating conditions to be reported, including any deviation from expected performance of systems, equipment, or personnel. Even administrative or training problems result in an incident report and provide learning opportunities for those in the program. Each incident, regardless of its significance, is reported in detail, reviewed by contractor and Naval Reactors officials, and the necessary action to prevent recurrence is agreed to by both parties. This tool has contributed to a program philosophy that underscores the insignificant problems in an effort to prevent significant ones.

We reviewed over 1,700 incident reports out of a total of over 12,000 generated from the beginning of the operations of the nine prototype reactors to July 1990. Included in this review were all incident reports since 1983 that Naval Reactors categorized as being slightly more significant than others. The incidents were typically insignificant, thoroughly

reviewed, and critiqued. For example, several reports noted blown electrical fuses, personnel's errors, and loose wire connections. Several reports consisted of personnel's procedural mistakes that occurred during training activities.

The following are typical of the reports we reviewed:

- During a routine maintenance period, a worker entered the reactor space to perform required work without his self-reading pocket dosimeter, as required. Even though he was wearing his required primary dosimeter, which did not indicate exposure, an incident report was issued due to the violation of procedures.
- During normal operations, a student shifted electrical power to an incorrect source, prior to a trainer's stopping him. The momentary loss of power led to an automatic shutdown, or "scram," of the reactor. Additional training resulted for the student. There were no safety-related consequences, in that the reactor is designed to accommodate such transients, and the scrams are an anticipated part of the training program.
- During normal operations, a student electrician shifted a power circuit "out of phase," but this did not result in a scram, because there was adequate power going to the necessary systems. The plant continued normal operations, and additional training was prescribed for the electrician.
- During normal operations, a student was required to clean and inspect fuses. The student removed the wrong fuses, resulting in a momentary loss of power and an automatic scram. There were no safety-related consequences, and additional operator training ensued.

One factor contributing to operational safety is that the prototypes are seldom operated at full power during training activities. Naval Reactors has established requirements that limit the power level, and if the limit is exceeded, this is regarded as an incident. This requirement enhances safety because if a problem should occur, it can generally be resolved more easily at low power than at full power. In addition, there would be less of a heat buildup to dissipate at low power.

Another factor that is extremely important to safe reactor operations is the qualifications and training of the personnel that manage and operate the reactors. Contractor personnel are responsible for managing, operating, and maintaining the protoytpe reactors, as well as assisting the Navy in the training program. Contractor prototype managers, supervisors, and operators are subject to the same training program as Navy

officers and crew members. For example, the senior contractor representative stationed at the prototype reactor on a full-time basis is the shift supervisor. The prospective shift supervisor is recruited out of college with a bachelor's degree in a technical field, such as mechanical, electrical, chemical, nuclear, or marine engineering. The training process to become shift supervisor takes 5 or more years as follows:

- Six months of classroom training at Naval Reactors Nuclear Power School in Orlando, Florida, includes topics such as reactor dynamics, core characteristics, and plant operations.
- Six months of training at an operating reactor and classroom training with both oral and written certification examinations follow.
- Fifteen weeks of training to achieve nuclear plant engineering qualifications includes topics such as plant safety and security and personnel safety.
- Over 3-1/2 years are spent obtaining shift supervisor qualifications for the individual's specific reactor plant. This period could be longer if the specific prototype plant is not operating due to maintenance or refueling. Prior to being designated a shift supervisor, the person must pass numerous oral and written examinations concerning plant systems and management. The certifications include all aspects of both normal operations and potential emergency preparedness and response.

In contrast, NRC requires that shift supervisors at commercial nuclear power plants have a high school diploma and 4 years' experience and training at a nuclear power plant. According to an NRC official, the training received is equivalent to a 2-year associate's degree in nuclear technology.

Asbestos Controls and Procedures at Naval Reactors Laboratories

Asbestos exposures are a serious health hazard and federal standards have been established to control them. The asbestos controls and procedures implemented at Naval Reactors laboratories meet federal standards and in some cases exceed the standards. However, asbestos incidents have been reported, and at the Knolls laboratory a major lapse in asbestos control was experienced in 1986. Also, in anticipation of more stringent federal requirements, Naval Reactors is planning a comprehensive asbestos removal program.

Naval Reactors Has Implemented Federal Standards

Before 1971, little federal guidance existed to protect personnel from asbestos exposures. Since then, federal guidance has been extensive. In 1971, the Occupational Health and Safety Administration (OSHA) announced pending asbestos standards. The Navy reacted to this pending legislation by implementing the OSHA standards in a February 1971 instruction dealing with the control of asbestos exposure hazards. One month later, although exempt from OSHA, Naval Reactors implemented the Navy instruction initially at the prototype sites, then programwide. The instruction described the minimum health and safety precautions necessary when fabricating, installing, and removing insulation containing asbestos.

Another Navy instruction replaced the 1971 instruction in October 1975. The new instruction established policies on the elimination of asbestos and actions to further reduce asbestos exposures. By the end of 1975, Naval Reactors implemented the 1975 instruction and another Navy instruction that incorporated OSHA safety and health standards and EPA emission standards. This latter instruction also changed in 1979 and again in 1986 in response to changes in OSHA and EPA standards.

We found that the Naval Reactors laboratories and sites meet or exceed the federal standards for asbestos control programs. While the asbestos controls at Bettis and its site were in compliance with OSHA standards, Knolls and its sites exceed OSHA standards in several areas. The Knolls program has reduced the OSHA action level from .1 to .01 fiber per cubic centimeter calculated as an 8-hour time-weighted average. Further, because of the potential danger of asbestos dust, Knolls requires authorization from its industrial hygiene group before removing ceiling panels although this is not required by federal standards. Finally, OSHA and EPA allow the use of half-face respirators in certain situations while the Knolls program only permits the use of full-face respiratory equipment.

Asbestos Exposures at Knolls in 1986 Exceeded Federal Standards

During our review, we found one serious incident, over the past 20 years, involving asbestos that resulted in exposures exceeding federal limits at Naval Reactors-operated facilities. As a result, Naval Reactors took positive actions to provide programwide improvements in all aspects of asbestos control.

The incident occurred during a 3-month period in 1986, in which Navy personnel were assigned to remove asbestos at Knolls' Kesselring site.

The work was done under the direction of Knolls. During the work, airborne asbestos was discovered that exceeded federal exposure standards. Naval Reactors has established an asbestos monitoring program for personnel who may have been overexposed to asbestos. However, there is no method to measure asbestos inhalation, and most health effects from asbestos exposure would be latent.

A board of five representatives from Naval Reactors was convened to investigate the incident and recommend corrective actions. The board concluded that the incident was caused by fundamental weaknesses in Knolls' methods for planning, performing, and controlling asbestos work. The board made numerous recommendations to correct the weaknesses, including

- establishing an asbestos work control program at Knolls laboratory and its sites based on engineering controls as the primary means to control asbestos exposures;
- revising training programs for asbestos workers as necessary to demonstrate that they are fully qualified; and
- developing a documented system for asbestos work planning, performance, and closeout.

Responding to the recommendations, Knolls laboratory developed asbestos control programs at each of its sites. These programs consisted of procedures, instructions, and training that parallel, to the extent possible, Naval Reactors radiological controls. A Knolls laboratory assessment performed 6 months after the board's report found that its asbestos control programs met OSHA standards and were being effectively administered.

While the board's final report was in process, Naval Reactors field office at Pittsburgh reviewed the asbestos control problems with its contractor at Bettis. Consideration was given to requiring a review of asbestos controls at Bettis and its Idaho site; however, this was not deemed necessary. The Pittsburgh field office determined that in 1986—the year of the board's review—asbestos controls at Bettis and a newly revised program at Idaho had already been reviewed. Both actions addressed the issues found during the Knolls review, and no changes in the asbestos control programs were required.

Naval Reactors Has Asbestos Removal Program

In anticipation of new, more comprehensive OSHA standards, Naval Reactors has adopted a policy of systematic asbestos removal and replacement. Both laboratories have submitted proposals for asbestos removal to Naval Reactors. Naval Reactors has reviewed and approved both proposals.

The Knolls laboratory plan, estimated to cost $30 million over 10 years, has three objectives. The objectives are to (1) catalogue all asbestos-containing building materials, (2) provide maintenance and surveillance of existing asbestos materials, and (3) remove or stabilize accessible asbestos materials.

Knolls contracted with an asbestos removal vendor, and the cataloging of asbestos-containing materials is underway at two of Knolls' three sites, Kesselring and Knolls. Cataloging is to be completed at all sites by September 1991. Knolls awarded an abatement contract for work at the Knolls Laboratory site in May 1991.

The approved plans at Bettis and its Idaho site were estimated at $10 million over 6 years and $28 million over 10 years, respectively. Both estimates are for planning purposes only and will be updated based on the asbestos catalogue programs in operation at both locations.

Status of Asbestos Controls at Naval Reactors Facilities

During our review, we physically inspected all laboratories and sites, except the Windsor site, and took 57 air samples to determine the status of asbestos controls at the facilities. This part of the work was performed by our Manager for Health and Safety because of his extensive experience in GAO's ongoing asbestos control and removal programs.

The air samples were taken at various locations that were deemed to potentially have asbestos. These samples (filters) were sent to a commercial laboratory for analysis. None of the 57 samples showed any statistically significant amount of asbestos. All of the samples that did contain traces of asbestos fibers were far below the federal limits for detectable asbestos.

The physical inspections of the facilities noted torn asbestos wrapping on pipes and other instances of exposed asbestos. According to our Manager for Health and Safety, these instances are typical for facilities of the size inspected and appeared to be the result of normal operations. Unless the asbestos is disturbed inadvertently or during operation or maintenance activities, it poses no hazard to employees. However, close

vigilance will help to identify and eliminate these potential hazards until the asbestos removal program is completed at the facilities.

Current Practices for Hazardous Waste Are Acceptable but Past Activities Posed Problems

Naval Reactors facilities generate two types of hazardous wastes—radioactive and chemical. Currently, these wastes are stored in designated areas until they are shipped off-site for proper disposal. Naval Reactors has implemented procedures to ensure the wastes are handled, stored, and disposed of in a safe manner.

Current handling, storage, and disposal of chemical wastes at Naval Reactors laboratories and sites is inspected by EPA and/or state agencies. In addition, the laboratories and sites are in the process of complying with EPA requirements concerning landfills and disposal areas. EPA and other oversight at Naval Reactors facilities is discussed in chapter 4.

From the early 1950s to about 1970, hazardous waste was disposed of in landfills and other areas at Naval Reactors facilities. These past practices have left problems that must be dealt with under new and more stringent environmental requirements. Consequently, each laboratory and some of their sites have remaining problems that require some sort of continuous action to prevent health hazards.

Current Waste Handling and Disposal Procedures at Naval Reactors Laboratories

The Naval Reactors laboratories have implemented procedures to protect employees and the public against exposures to radioactive and hazardous waste materials. While Knolls and Bettis laboratories' programs have minor differences, both follow applicable federal, state, and local laws and regulations. In addition, both must follow restrictions set forth by the disposal sites they use. There are basically two types of waste that require special handling and disposal practices—radioactive and chemical waste materials.

Radioactive Waste Handling and Disposal

Radioactive waste generated at Naval Reactors laboratories and sites includes contaminated equipment, tools, filters, anticontamination clothing, liquids, and other items. The total radioactive waste generated at Naval Reactors laboratories and sites averages over 2,000 cubic meters a year. The quantity of the waste is reduced by decontamination, compacting, and solidifying liquids. No radioactive waste is presently disposed of on-site by the laboratories or sites.

At the point of generation, radioactive waste is collected and temporarily stored in containers that are labeled as to their contents. The waste is then taken to an on-site storage facility, where it is processed

and packaged for disposal. When enough material is collected, arrangements are made to ship the waste to an approved disposal site. To determine if procedures were being followed, we traced the documentation of 17 shipments made by the laboratories and sites. We found that the procedures were followed and at no time in the process—from generation to disposal—was accountability of the radioactive waste lost.

Chemical Waste Handling and Disposal

The Naval Reactors laboratories procedures for chemical waste handling and disposal are similar to the ones for radioactive waste. However, as chemicals come into the laboratory, information is obtained from the manufacturer concerning the chemical properties and handling and health warnings. As the chemicals are used and declared waste, they are placed in proper containers and the amounts and description of the contents maintained in a log by the generators. The chemicals are then moved to a central storage area and placed in containers for shipment. Each shipping container is weighed, packing slips and a manifest are prepared, and permits (shipper, disposal site) are checked. The shipper and disposal site are then notified, and departure and arrival dates coordinated. During our review, we traced the documentation of 61 waste shipments at the laboratories and sites from generation to removal. The accountability of the waste was maintained throughout the entire process.

In addition, during our review, we physically inspected both areas that generate radioactive and chemical waste and areas for temporary storage, central storage, and processing. We checked records and logs attached to storage containers to verify the implementation of procedures. We found no deviations at the laboratories.

Status of Past Problems at Knolls Laboratory and Sites

Knolls laboratory has several problems created by past activities. These include

- a plutonium separation research facility used by the Atomic Energy Commission, prior to Naval Reactors involvement with the site, and
- landfills that contain hazardous chemical wastes at Knolls and its Kesselring site.

Knolls determined through interviewing personnel and past records that its Windsor site does not have any environmental problems associated with past activities.

Early Research Facility Created Major Problem

From 1950 to 1954, the Atomic Energy Commission conducted plutonium separation research work in two buildings located at Knolls laboratory. As a result, the two buildings were contaminated with radioactive material along with several underground tanks used to store radioactive sludge. In addition, an area close to the two buildings and another area at a landfill were used for storing drums filled with radioactive sludge awaiting shipment to a disposal site. These areas were contaminated by leaking drums.

Some areas in the buildings have been decontaminated and are presently used as office space. Other areas are used for storing radioactive material, and some areas have been sealed. The buildings are routinely monitored for radioactivity, and when any maintenance is required, special procedures are implemented to protect workers from radioactive materials.

The underground tanks are encased in concrete, and inspections performed by the Knolls contractor show that the tanks are sound. In addition, a gravel pit has been installed around one of the buildings to collect groundwater, which is treated to remove radioactive material. While the radioactivity in the water collected is below federal and state limits, it is still treated before it is released. The two buildings and the tanks are scheduled for removal sometime in the late 1990s.

The radioactive sludge that leaked from the drums contaminated soil and some small buildings where they were stored. However, 1,074 cubic yards of radioactive contaminated soil was removed from the landfill storage area and several truckloads from the area near the two large buildings. The material was disposed of at an approved disposal site. In addition, one of the small storage buildings has been sealed, and the other one determined to be free of radioactive contamination.

Landfills Require Monitoring

From the beginning of operations until 1978, Knolls and its Kesselring site disposed of chemical waste in several landfill areas. After inspecting the areas and examining old disposal records, Knolls estimated that about 90 cubic feet of chemical waste was buried per year at a landfill near the laboratory and that Kesselring had buried about 170 cubic feet per year, all prior to 1978. These wastes included acids, chemical reagents, cooling system and lubricating oils, battery acid, paint, solvents, and photographic developing chemicals.

Knolls has 18 groundwater monitoring wells around the laboratory site to detect the presence of the chemical wastes. Samples taken from these wells indicate elevated levels of lead, chromium, vinyl chloride, iron, manganese, and chloride ions. The iron and manganese levels are higher than New York State drinking water standards. According to Knolls' 1988 Environmental Summary Report, the groundwater in the area is not used for drinking water, and in addition, there are no elevated levels of toxic chemicals such as solvents or laboratory chemicals.

The Kesselring site has 53 groundwater monitoring wells to detect chemical wastes. No significant concentration of toxic chemicals has been detected at the site. Pollutants that have been detected are within drinking water standards.

Status of Problems at Bettis Laboratory and Idaho Site

The Bettis laboratory and its prototype site in Idaho also have environmental problems associated with past activities. Both are currently conducting activities to evaluate historic disposal areas and establish priorities for remedial action in order to comply with EPA requirements.

The Bettis laboratory has identified seven areas or sites that may have been used to dispose of chemicals. Four of the areas are inactive, and three have been remediated for closure. The four inactive sites consist of a waste site used from the late 1950s to about 1964 for the disposal of rubbish and selected chemicals, a shop area used for removing grease from equipment, soil surrounding tanks that leaked but have since been removed, and a landfill area used from 1960 to 1987.

The major problem associated with all of these sites is the presence of a chemical called tetrachloroethylene. At present, there are no federal or state standards for soil or groundwater contamination by tetrachloroethylene. However, drinking water standards do exist, and the levels measured at Bettis exceed these standards. According to Bettis laboratory officials, this poses no immediate health hazard because no groundwater in the area is used for drinking water. EPA will eventually decide whether remedial action is necessary and the extent of the action.

The three sites being closed consist of a target range contaminated with lead bullets, a chemical waste storage pad, and an acid storage tank. All of these have been remediated, and closure plans have been submitted to EPA for its approval.

In addition, Bettis has identified six areas contaminated with radioactive material and has taken actions to address all of them. Soil has been excavated from all of the areas and disposed of at licensed radioactive waste disposal facilities. At this time, Bettis has plans for additional remedial decontamination at only one of the identified areas.

The past contamination on-site at two of the areas has resulted in off-site radiation releases. The waste site, which is contaminated with chemical waste, also contains some radioactivity that moves off-site through precipitation. However, the highest levels identified at the off-site area were less than 2 percent of the federal limits for unrestricted use. In addition to the waste site, liquid releases from the Bettis site have caused some radioactive contamination in an adjacent small stream. However, readings conducted off-site were only slightly above natural background readings.

Bettis' Idaho site has identified 68 potentially hazardous sites or areas. Twelve of these sites are suspected of having both chemical and radioactive waste, and may require some remedial action; 18 sites are suspected of having only chemical waste and are being analyzed to determine if remedial action is necessary; and the remaining 38 sites will not require any action.

Of the 12 sites suspected of having both types of waste, 11 will be sampled during 1991 to determine the type and extent of contamination. However, before remedial action is initiated, an investigation of each site and a feasibility study will be prepared. Naval Reactors officials estimate a final decision on the method for remediation will be made in the late 1990s.

External and Internal Oversight Is Being Provided at Naval Reactors Laboratories

Despite numerous exemptions,[1] existing oversight of Naval Reactors is extensive. Certain federal and state oversight bodies are authorized access to the laboratories and sites as necessary, while others maintain frequent communications as requested by Naval Reactors. Naval Reactors and its two major contractors have established an extensive internal oversight program at the Naval Reactors laboratories and sites consisting of frequent audits and inspections and close personal attention by its technical staff.

External Oversight of Naval Reactors Laboratories Provided by Federal and State Agencies

External oversight of Naval Reactors laboratories and sites is basically provided by EPA and state agencies in the respective locations. These inspections are conducted to ensure compliance with a variety of current environmental programs and address compliance with regulations governing past problems arising from land disposal of chemical waste. For example, EPA conducts inspections of the Knolls and Bettis laboratories, including their prototype sites. However, EPA has delegated much of its regulatory authority to the states. Consequently, either the state conducts the inspections, or EPA and the state conduct joint inspections.

Oversight at Knolls and Its Sites

From January 1988 to June 1990, EPA conducted seven inspections at Knolls and the Kesselring site, either by itself or jointly with New York. Two deficiencies were reported as a result of the inspections.

Knolls' other prototype site in Windsor, Connecticut, was inspected two times by EPA from January 1988 to June 1990. One violation was found. However, since there are no landfills on the Windsor site, the inspections were only for air and water requirements.

New York State provides oversight of Knolls and its Kesselring site through the State Department of Environmental Conservation (DEC) and the Department of Health. These agencies monitor activities and conduct inspections to ensure that environmental and health laws are followed.

The DEC issues permits for water and air emissions, and Knolls routinely submits emission reports to DEC. In addition, DEC conducts surprise site

[1]Presidential Executive Order 12344 of Feb. 1, 1982, which was codified by P.L. 98-525-Oct. 19, 1984 (42 U.S.C. 7158), enables Naval Reactors to assume numerous DOE and Navy functions, including ensuring safe reactor operations by prescribing and enforcing standards and regulations related to the environment and the safety and health of workers, operators, and the general public. Naval Reactors is also exempt from review by independent organizations such as NRC and the Defense Nuclear Facilities Safety Board.

inspections, testing the water coming from the sites and inspecting the air emission points. From January 1988 to June 1990, DEC inspected the Knolls and Kesselring sites 24 times and did not find any reportable items.

DEC also inspects the landfills at the Knolls and Kesselring sites. New York has a program under way to close all of the old landfills in the state, including those at the Knolls and Kesselring sites. Thus, the state did not renew the landfill permits; however, the landfills are operated under the requirement of the expired permit. Knolls laboratory has submitted closure plans for its landfills and is awaiting state action on the plans. In addition to having DEC inspections, Knolls laboratory submits quarterly reports to DEC on the materials that are dumped at the sites and annually on the results of tests from the monitoring wells surrounding the landfills. DEC officials said that neither Knolls nor its Kesselring site has had any serious problems.

The New York State Department of Health does not issue permits, nor does it inspect the Knolls or Kessselring sites. However, it monitors air near the sites for radiation releases and has assisted DEC in testing the nearby Mohawk River for radioactivity.

Oversight at Bettis and Its Idaho Site

The Bettis laboratory and its prototype site in Idaho have been inspected a total of eight times by the cognizant EPA regional offices and state agencies between January 1988 and August 1990. The Bettis laboratory has been inspected three times by EPA Region III (Philadelphia) and twice by the Pennsylvania Department of Environmental Resources (DER). DER issued a notice of violation in July 1990.

The notice of violation concerned the release of hazardous constituents causing pollution of the groundwater. The notice of violation did not address the current environmental controls at the Bettis site. Rather, of concern was the extent of health risk and/or environmental degradation due to historical disposal practices.

The Idaho site has been inspected three times by regulatory personnel between January 1988 and August 1990. EPA Region X (Seattle) inspected the Idaho National Engineering Laboratory in 1988, 1989, and 1990. In 1990, the inspection was conducted jointly with the state of Idaho Department of Health and Welfare. Bettis' Idaho site was inspected as part of the Idaho National Engineering Laboratory. No

enforcement actions cited by the regulatory bodies were applicable to the Idaho site.

In addition to on-site inspections, the cognizant regulatory bodies are provided environmental monitoring information on a periodic basis. For example, Bettis prepares and distributes annual effluent and environmental monitoring reports to EPA and DER. The Idaho site provides among its reports monthly drinking water sampling results to the state of Idaho.

Extensive Internal Oversight Is Present at Naval Reactors Laboratories

Audits and inspections conducted by Naval Reactors contractors and field and headquarters personnel have created an extensive oversight of program activities at Naval Reactors laboratories. During our review, we noted that Naval Reactors contractors continuously conduct audits and inspections at almost every level in the organization. In addition, Naval Reactors field office personnel located at the laboratories and sites conduct numerous audits and inspections on a routine basis. Naval Reactors headquarters also conducts biannual inspections of safety, environmental, and radiological conditions.

We reviewed all formal audit reports relating to safety, environment, health, and asbestos from January 1988 to July 1990. Deficiencies were noted in each of the reports, but virtually all of them were of a minor nature, and according to the documentation we reviewed, all were corrected soon after they were brought to the attention of the responsible management unit.

Contractor Audits and Inspections

The contractors responsible for operations at Bettis and Knolls conduct audits and inspections of all aspects of laboratory activities related to safety, the environment, and health. The audits or inspections are directed toward ensuring compliance with written regulations and procedures used to carry out the activities. The audits and inspections are conducted at all levels of the organization and performed by individuals at different levels. For example, the Bettis laboratory has an organizational unit responsible for safety, the environment, and health. This unit conducts audits and inspections of activities in each area. The organizational subunit responsible for safety, audits all activities related to safety, such as radiological controls. In turn, the radiological controls unit audits its activities pertaining to radiation surveying, etc.

During our review at Bettis' Idaho site, we had a computer listing prepared of all radiological findings for a 1-month period in 1989. There were a total of 199 observed radiological deficiencies, and according to the computer listing, all had been corrected. While this number might indicate major problems, virtually all of them were minor and generally did not require major corrective actions. However, the deficiencies reflect the thoroughness of the audits and emphasize compliance with and awareness of regulations and procedures that are often overlooked. Contractor officials at Knolls and Bettis explained that this oversight approach is deliberate and that emphasis is placed on minor deficiencies in an effort to avoid major ones.

Naval Reactors Field Offices Audits and Inspections

The Naval Reactors field offices at Bettis and Knolls basically function as audit and inspection groups. For example, from January 1988 to December 1990, Naval Reactors field offices performed 919 formal audits. These audits looked at general and specific operational matters pertaining to activities related to safety, the environment, and health. The findings or deficiencies noted in these audits require a response from the contractor as to the corrective action planned. The action planned must meet the approval of the Naval Reactors field office, which follows up to ensure each action is implemented.

In addition to conducting formal audits and inspections, Naval Reactors field personnel of Knolls conduct daily inspections of activities and require contractors to correct any deficiencies they find. When they record a deficiency, a report is filled out and the manager of the activity has 1 week to respond and identify the actions to correct the deficiency.

Naval Reactors field personnel also perform surveillance of contractors' activities. For example, at Knolls two prototype reactors are visited each week and observed for a 3-hour period. Some of the visits are unannounced and may occur on any of the three daily shifts. Other visits that require a document review are conducted after a one-half day's notice to allow time to assemble the documents. In addition, once each quarter, the prototypes are monitored for 36 continuous hours for either operations, training, chemical/radiological controls, or maintenance.

Naval Reactors Headquarters Audits and Inspections

Naval Reactors headquarters conducts broad audits of activities associated with safety, the environment, and health. Generally, 4 to 20 headquarters senior level personnel participate in each audit. From January 1988 to November 1990, Naval Reactors headquarters conducted 28 formal audits at Knolls and Bettis. These audits included the following.

- Nine operational reactor safeguards examinations of prototype reactors: Each prototype reactor undergoes this examination every 2 years. Four to six senior individuals conduct the audit, which addresses the areas of safe and reliable prototype operations. For example, they review areas such as operators' knowledge of the plant, conduct drills in areas such as casualty response and radiological controls, and conduct detailed inspections of operating equipment.
- Four prototype reactor site performance evaluations: Nine to 20 individuals conduct these biannual evaluations, which include all activities of the site in support of prototype operations. For example, the evaluations include reviewing training activities, quality assurance programs, environmental protection, emergency preparedness, and physical security.
- Eight radiological controls inspections: Four Naval Reactors representatives conduct a 1-week review of the site radiological control program. The inspections include exposure control and dosimetry, training, radioactive material control, environmental radiological monitoring, and radioactive waste processing and shipment.
- Five criticality and fuel handling audits: Five Naval Reactors inspectors evaluate the adequacy of criticality and fuel handling at the laboratories. The objectives of these audits include evaluating the performance in fuel accountability, criticality alarms, and emergency procedures.

Each review conducted by Naval Reactors was discussed with contractor personnel and actions were planned to address deficiencies. Most actions planned included additional training for individuals and tighter control procedures to ensure safe program operations.

Conservative Classification Practices at Naval Reactors Result in Overclassification of Some Information

During our work at Naval Reactors, we reviewed thousands of documents that were classified. On the basis of our review of Naval Reactors classification policies and requirements, we found no evidence that Naval Reactors routinely overclassifies information to prevent its release to the public. However, we did note instances in which documents were improperly classified.

Naval Reactors Classification Policy

Naval Reactors generally uses two designations for classified materials originating from its program. They are "confidential restricted data" and "NOFORN." Information designated as confidential restricted data requires documented accountability and may be released only to individuals with security clearances who need to have access to the information. The information must also be maintained and stored in secured containers or areas. Information designated NOFORN, which means no distribution can be made to foreign governments without Naval Reactors' approval, does not require documented accountability, may be released to individuals approved by Naval Reactors, and can be stored in ordinary locking cabinets. Therefore, both designations prevent release to the general public.

Since the 1950s, the United States has maintained a policy opposed to the transfer of nuclear propulsion technology to foreign nations, due to the military value and concerns over nuclear proliferation. The Congress and the executive branch have reinforced that policy. In 1981, the Congress amended the Atomic Energy Act to provide protection for unclassified nuclear information under DOE's control (41 U.S.C. 2168). Subsequent amendments provided additional protection for unclassified technical information related to nuclear propulsion.

Naval nuclear propulsion information is defined as that information, classified or unclassified, concerning the design arrangement, development, testing, operation, administration, training, maintenance, and repair of the propulsion plants of naval nuclear-powered ships and prototypes, including the associated nuclear support facilities. Where an association with naval nuclear propulsion can be directly identified, the information must be designated as naval nuclear propulsion information. Public release of this information is a violation of several statutes, including the Atomic Energy Act, and agency regulations such as the U.S. Department of Commerce Export Control Regulations and the U.S. Department of State International Traffic in Arms Regulations.

Naval Reactors Classification Criteria

The Director of Naval Reactors is responsible for establishing classification rules, practices, and procedures to address the security concerns of each agency, so that different DOE and Navy facilities will be held accountable for one set of classification rules. One set of central classification guidelines was developed to ensure uniformity. All facilities that conduct Naval Reactors work, including laboratories and prototype reactor sites, follow these guidelines. No local exceptions are allowed.

According to the Deputy Director of Naval Reactors, this classification program is necessary to protect the information for at least the following reasons.

- Protecting the technological advantage: Nuclear-powered vessels comprise about 40 percent of the Navy's major vessels, including the entire sea-based strategic nuclear deterrent. Protecting the technology is of vital national security interest. Additionally, the transfer of any information that might assist a potential adversary by revealing nuclear-powered warships' capabilities could jeopardize defense capabilities in time of conflict.
- Freedom to operate in foreign waters: Nuclear-powered warships operate in foreign waters and ports of over 50 nations and U.S. dependencies. The acceptance of these vessels into foreign ports is based on the assurance that the same safe procedures and practices followed in U.S. ports will be followed elsewhere.
- Limit proliferation of nuclear-powered ships and nuclear technology: The transfer of any technology that would assist a potential adversary would raise serious national defense concerns.

Improper Classification of Documents

During our review of Naval Reactors programs and activities, we reviewed thousands of classified documents. While we did not select a random sample, we did review each document for classification. As a result of this process, we identified 11 classified documents that we believed did not require classification. We asked the qualified Naval Reactors classifiers to review the documents. As a result, 6 of the 11 documents were determined not to be classified information, and 2 of the 5 remaining were downgraded from confidential to NOFORN. We noted that the information contained in the documents did not contain adverse environmental, health, or safety information. For example, a classified incident report described an incident in which a large crane mounted on tracks moved 10 feet during high winds at the Idaho site because it had not been properly secured. Another example, which occurred at the Kesselring site, involved an employee's receiving a mild

electrical shock from a vending machine. Again, this information was contained in a classified incident report.

In addition, we found several unclassified documents that contained information concerning adverse environmental effects. For example, unclassified documents contained findings on asbestos problems, chemical spills, and radioactive contamination. We believe that if Naval Reactors was classifying information to hide such problems, many of the above documents would have been classified.

In our opinion, Naval Reactors and its contractors, due to their extreme concern about the potential for disclosure of nuclear technological information to foreign interests that could be detrimental to the United States, err on the conservative side in classifying information. Due to the nature of Naval Reactors' activities, a large amount of information concerning them is classified and not releasable to the public. We believe the inability to make certain information available and discuss activities at the laboratories and sites has contributed to public mistrust and suspicions concerning activities at Naval Reactors facilities, and especially at Knolls Laboratory. During our review, we were provided full access to all information concerning Naval Reactors programs and activities.

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