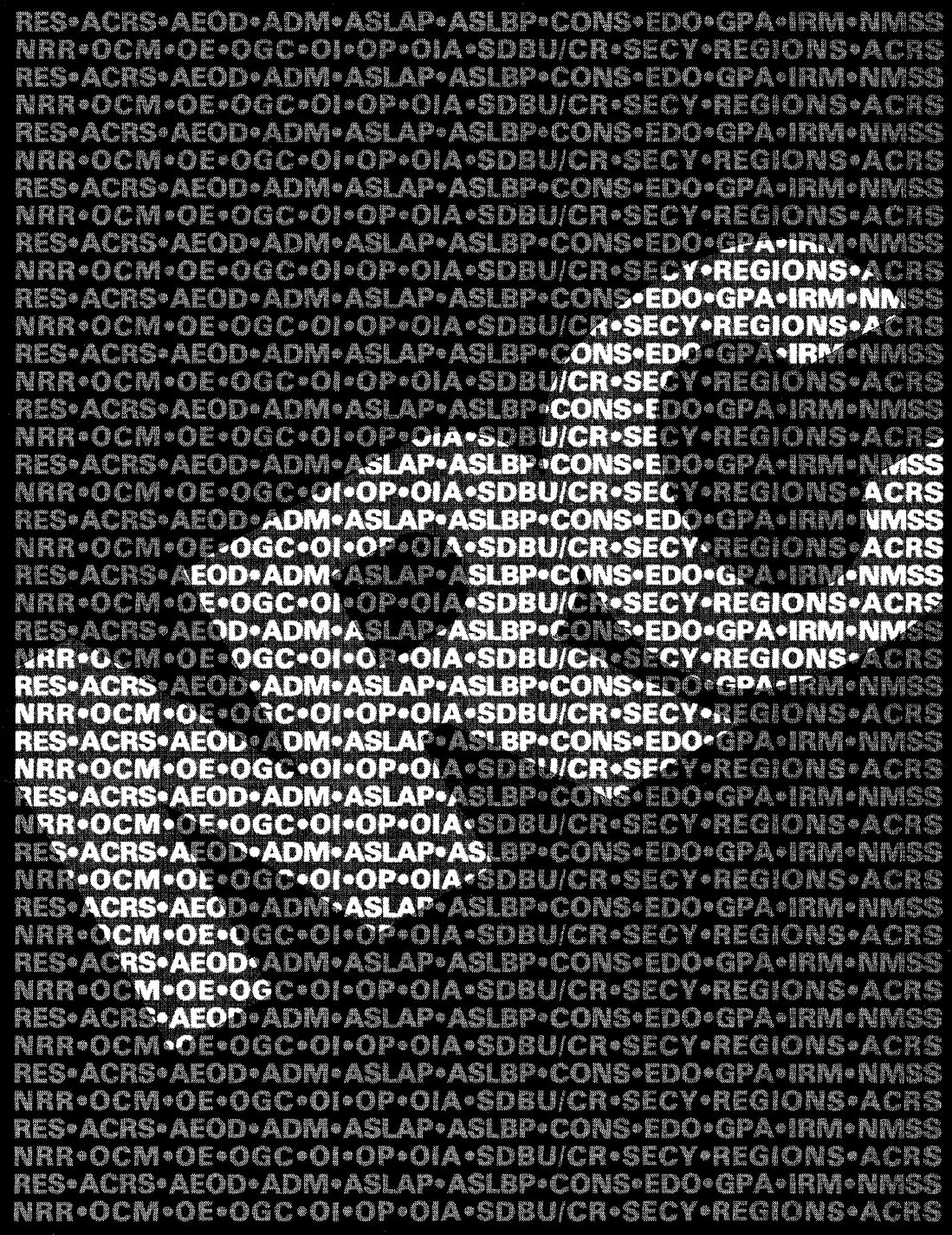
ANNUAL REPORT 1988

United States Nuclear Regulatory Commission



June 12, 1989

The President
The White House
Washington, DC 20500

Dear Mr. President:

This Annual Report for 1988 of the United States Nuclear Regulatory Commission is forwarded for your transmittal to the Congress, as required by Section 307(c) of the Energy Reorganization Act of 1974.

The report is devoted mainly to coverage of events and activities occuring in fiscal year 1988, with additional treatment of events after that period where circumstances warranted.

Respectfully,

Lando W. Zech Jr.

Lando W. Zech, Jr.
Chairman

ANNUAL REPORT 1988

United States Nuclear Regulatory Commission

PREVIOUS REPORTS IN THIS SERIES

1975 NRC Annual Report, published April 1976
1976 NRC Annual Report, published April 1977
NUREG-0400, *1977 NRC Annual Report,* published April 1978
NUREG-0516, *1978 NRC Annual Report,* published February 1979
NUREG-0690, *1979 NRC Annual Report,* published March 1980
NUREG-0774, *1980 NRC Annual Report,* published June 1981
NUREG-0920, *1981 NRC Annual Report,* published June 1982
NUREG-0998, *1982 NRC Annual Report,* published June 1983
NUREG-1090, *1983 NRC Annual Report,* published June 1984
NUREG-1145, Vol. 1, *1984 NRC Annual Report,* published June 1985
NUREG-1145, Vol. 2, *1985 NRC Annual Report,* published June 1986
NUREG-1145, Vol. 3, *1986 NRC Annual Report,* published June 1987
NUREG-1145, Vol. 4, *1987 NRC Annual Report,* published July 1988

The *1988 NRC Annual Report,* NUREG-1145, Vol. 5, is available from
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ENERGY REORGANIZATION ACT OF 1974, AS AMENDED

Section 307(c) directs the Commission to include in its Annual Report statements and descriptions concerning:

"...the short-range and long-range goals, priorities, and plans of the Commission as they are related to the benefits, costs, and risks of nuclear power." (See Chapters 1, 2, 4, 5, 7, 9 and 11.)

"...the Commission's activities and findings in the following areas—

"(1) insuring the safe design of nuclear power plants and other licensed facilities...." (For reactor design, see Chapters 2 and 9; for materials facilities, devices, and transportation packaging, see Chapters 5 and 9; for waste disposal facilities, see Chapters 7 and 9.)

"(2) investigating abnormal occurrences and defects in nuclear power plants and other licensed facilities...." (See Chapters 2, 3 and 4.)

"(3) safeguarding special nuclear materials at all stages of the nuclear fuel cycle...." (See Chapters 6, 8 and 9.)
"(4) investigating suspected, attempted, or actual thefts of special nuclear materials in the licensed sector and developing contingency plans for dealing with such incidents...." (See Chapters 6 and 9.)

"(5) insuring the safe, permanent disposal of high-level radioactive wastes through the licensing of nuclear activities and facilities...." (See Chapter 7 and 9.)

"(6) protecting the public against the hazards of low-level radioactive emissions from licensed nuclear activities and facilities...." (See Chapters 2, 5 and 7.)

Section 205 requires development of "a long term plan for projects for the development of new or improved safety systems for nuclear power plants" and an annual updating of the plan. (See Chapter 9.)

Section 209 requires the Commission to include in each Annual Report a chapter describing the status of the NRC's domestic safeguards program. (See Chapter 6.)

Section 210 requires the Commission to submit "a plan providing for the specification and analysis of unresolved safety issues relating to nuclear reactors," and to include progress reports in the Annual Report thereafter concerning corrective actions. (See Chapter 9.)

NUCLEAR NONPROLIFERATION ACT OF 1978

Section 602 requires annual reports by the Commission and the Department of Energy to "include views and recommendations regarding the policies and actions of the United States to prevent proliferation which are the statutory responsibilities of those agencies...." (See Chapter 8.)

ATOMIC ENERGY ACT OF 1954, AS AMENDED

Section 170(i) directs the Commission to report annually on indemnity action implementing the Price-Anderson Act which provides a system to pay public liability claims in the event of a nuclear accident. (See Chapter 2.)

PUBLIC LAW 96-295

Section 303 directs the Commission to report annually a statement of—

"(1) the direct and indirect costs to the Commission for the issuance of any license or permit and for the inspection of any facility; and (2) the fees paid to the Commission for the issuance of any license or permit and for the inspection of any facility." (See Chapter 11.)

PUBLIC LAW 97-415

Section 10(c) requires that the "Commission include as a separate chapter a description of the collaborative efforts...by the Commission and the Department of Energy with respect to the decontamination, repair or rehabilitation of facilities at Three Mile Island Unit 2...." (See Chapter 3.)

1988 Highlights/Special Reports

Chapter 1

This is the 14th annual report of the U.S. Nuclear Regulatory Commission (NRC), covering events and activities occurring in fiscal year 1988 (the year ending September 30, 1988), with some treatment of events, where warranted, from the last quarter of the calendar year.

The NRC came into being under the Energy Reorganization Act of 1974 as an independent agency of the Federal government. The five NRC Commissioners are nominated by the President and confirmed by the U.S. Senate. The Chairman of the Commission is appointed by the President from among the Commissioners confirmed.

The mission of the NRC is to assure that civilian uses of nuclear materials in the United States—as in the operation of nuclear power plants or in medical, industrial or research applications—are carried out with proper regard and provision for the protection of public health and safety, of the environment, and of the national security. The NRC accomplishes its purposes through the licensing of nuclear reactor operations and other activities involving possession and use of nuclear materials, including the transport and disposal of nuclear materials and wastes; through the safeguarding of nuclear materials and facilities from theft and sabotage; and through inspection and enforcement actions.

This report covers the major activities, events, decisions, and planning that took place during fiscal year 1988 (October 1987 through September 1988) within the NRC or involving the NRC. The report is issued in compliance with Section 307(c) of the Energy Reorganization Act of 1974, which requires that an annual report be submitted to the President for transmittal to the Congress.

This chapter deals with highlight events and actions of the report period. It also includes reports of the Office of Special Projects, the Office of Investigations and the Office of Enforcement.

Changes Within Commission and Senior Staff

Two changes took place on the Commission during fiscal year 1988. In June, Commissioner Frederick M. Bernthal completed his five-year term, and in October, Commissioner James R. Curtiss was appointed to fill the vacancy.

New office directors appointed during the report period were:

- Michael L. Springer, Director, Office of Consolidation, in April 1988.
- James G. Partlow, Director, Office of Special Projects, in July 1988.
- Christine N. Kohl, Chairman, Atomic Safety and Licensing Appeal Panel, in September 1988.

Power Reactor Licensing In Fiscal Year 1988

During the fiscal year, the NRC issued one low-power license and three full-power licenses (one of them to the recipient of the low-power license). There were no fuel-loading licenses issued during the report period. The addition of three full-power licenses brings the number of reactors licensed to operate at full power in the United States to 108, plus two facilities with operating licenses for less than full power operation—Seabrook (N.H.), licensed for fuel-loading only, and Shoreham (N.Y.), licensed for low-power operation only (see discussion in Chapters 2 and 10), as of September 30, 1988. At that time, there were 14 other plants for which construction permits had been issued, but most of these are projects which have been halted and/or deferred.

Fuel Cycle and Byproduct Licensing

More than 100 licensing activities dealing with fuel cycle plants—such as fuel fabrication and fuel storage facilities—were completed during fiscal year 1988. Over 5,000 licensing actions were taken on applications for new byproduct materials licenses and amendments or renewals of existing licenses. (Approximately 100 fuel facility inspections were carried out during the fiscal year, and 2,800 material licensee inspections, resulting in the identification of almost 1,900 violations. Seven team assessments at major material licensee facilities were completed during the report period.)

Nuclear Performance Improving

Commercial nuclear power continues to be an important element in the nation's energy supply, for both environmental and economic reasons. Nuclear power reactors that are properly designed, built, and managed, provide a safe, clean way to generate electricity. Nuclear power helps to enhance the nation's economy by providing a stable and secure source of electrical energy.

In 1988, nuclear power produced approximately 20 percent of the nation's electricity. For nuclear power to remain one of the country's energy options, it is essential that it remain safe and reliable. The NRC is seeing evidence of overall improvement both in terms of safety and reliability in the industry's performance. Over the past four years, there has been a clear and significant improvement in the key operational safety indicators that the NRC monitors. In particular, there have been fewer significant operating events, unplanned automatic shutdowns, and safety system actuations per operating reactor (see Chapter 4). The average radiation exposure of plant personnel has been reduced (see Chapter 9), and there has been a reduction in the volume of radioactive wastes generated. There has also been an increase in average annual capacity factors (a measure of actual electrical power output from a given reactor as a percentage of maximum possible output from that reactor,over a given period of time) for U.S. nuclear reactors, from about 58 percent in 1984 to about 65 percent in 1988. NRC programs have played a significant role in improving the industry's safety performance. Despite this encouraging record, there is, of course, room for continued improvement.

With the appointment of James R. Curtiss in October 1988, replacing Commissioner Frederick M. Bernthal, whose term expired in June, the Nuclear Regulatory Commission was again at full strength. Chairman Lando W. Zech, Jr. (seated at center), is flanked by Commissioner Thomas M. Roberts (left) and Commissioner Kenneth C. Rogers. Standing are Commissioner Kenneth M. Carr (left) and Commissioner Curtiss.

Consolidation of NRC Headquarters Nears Completion

The process of consolidating the NRC's Headquarters offices—once widely dispersed in 11 different locations in the Washington, D.C., metropolitan area—reached a major milestone during fiscal year 1988 when full occupancy of the One White Flint North building was attained. The newly constructed building, which is located at 11555 Rockville Pike in Rockville, Md., now houses 62 percent of the NRC Headquarters total staff of 2,250. With the staff of the Office of Nuclear Regulatory Research situated in offices nearby, a full 73 percent of Headquarters staff has now been brought together in Rockville, Md. Total consolidation is scheduled for 1991, with completion of a second building at the White Flint site.

OFFICE OF SPECIAL PROJECTS

By 1985, the NRC had become concerned with the deteriorating performance of the Tennessee Valley Authority (TVA) in the management and operations of its five licensed reactor plants at two sites, and also with its record of compliance with regulatory requirements at four other units under construction at two other sites. This concern, and results of self-assessment by TVA, led to the shutdown of TVA's entire nuclear power program. The Texas Utilities Electric Company (TU Electric) was faced with a similar situation at the two-unit Comanche Peak (Tex.) facility under construction. After initial efforts by NRC to oversee activities at TVA and Comanche Peak through coordinating groups within the Office of Nuclear Reactor Regulation (NRR), the Office of Special Projects (OSP) was established to more efficiently identify and resolve the problems which brought about the shutdowns and to ensure compliance with requirements during recovery efforts at these facilities.

Significant progress has been realized at the affected units during fiscal year 1988. While the need for an increased level of scrutiny remained at the end of the report period, it had been modified by the resolution of technical issues, the implementation of corrective action plans, and changes in managerial attitudes and practices. With continued good performance at these nuclear projects, the OSP mission was subsumed again into NRR operations in 1989.

TVA Projects

In 1985, the NRC staff issued a letter to the Chairman of the TVA Board of Directors indicating that there were significant and continuing weaknesses in TVA performance and that management of the TVA nuclear program was ineffective. By that time, TVA had taken the Browns Ferry (Ala.) and Sequoyah (Tenn.) facilities into a cold shutdown status on its own accord and had made commitments to the NRC that the plants would not be restarted without NRC concurrence. A Senior Management Team (SMT) was created in the NRC to devote particular attention to the TVA operations, to deal with pressing issues in the short term, and to prevent recurrence of the problems in the long term. The multitude and complexity of the issues were not limited to operating reactors, since questionable construction practices had surfaced at the TVA's Watts Bar (Tenn.) project. In 1987, the OSP was created and the SMT disbanded.

Sequoyah Unit 2. During fiscal year 1988, the NRC staff continued its review of TVA's program to resolve the remaining technical issues required for the restart of Sequoyah Unit 2. The staff issued its conclusions in its "Safety Evaluation Report (SER) on Tennessee Valley Authority: Sequoyah Nuclear Performance Plan" (NUREG-1232, Volume 2), issued in May 1988.

In March 1988, after a six-week non-nuclear heatup to normal testing temperature—permitting the TVA to conduct necessary equipment tests, demonstrate plant operability, and give Sequoyah operators experience in nearly normal plant operations—TVA requested the NRC's approval for plant restart. On March 22, 1988, the Commission authorized the staff to permit TVA to restart Unit 2. Subsequently, on March 30, when all outstanding safety concerns were closed, the NRC staff authorized the restart. The staff had monitored the non-nuclear heatup and the startup of Unit 2 with an augmented inspection team that provided 24-hour coverage of plant operations.

The Sequoyah Unit 2 startup was interrupted on April 6, 1988, when the TVA discovered indications of steam generator tube leakage. Unit 2 was cooled down and helium leakage and eddy current testing identified cracks in the tube bends of the innermost row of tubes (caused by residual stress remaining after the cold-forming of the U-bends with tight radius). After all Row 1 tubes in each of the four steam generators had been plugged and correction of leakage problems associated with the primary safety valves had been completed, startup of the reactor was resumed on May 6. On May 13, with NRC's approval, Unit 2 achieved criticality for the first time in 30 months. On May 19, the reactor underwent the first of a series of five scrams (automatic shutdown) in rapid succession (May 19 and 23, June 6, 8 and 9). Although a number of scrams during power ascension is not unusual, the brief intervals between the last three scrams, and other factors, caused heightened concern. TVA was required to perform a post-trip review and root-cause analysis and to discuss its findings with the NRC prior to any restart after the June 9 scram. This was done and the reactor was restarted on June 19, operating without event through the report period.

The entire nuclear power program of the Tennessee Valley Authority had been closed down since 1985, until, in June 1988, the TVA's Sequoyah Unit 2 (Tenn.) was restarted. Members of the NRC Office of Special Projects staff closely monitored the TVA's efforts to bring its reactors back on line. The photo shows the Director of OSP and members of his staff in the Sequoyah Unit 2 control room, in May 1988.

Sequoyah Unit 1. Even though TVA's corrective action programs addressed both units at Sequoyah, the NRC staff did not authorize a restart of Unit 1 as it had for Unit 2, because a number of corrective actions had not yet been completed at Unit 1. On September 26, 1988, with those actions completed, the NRC authorized TVA to begin non-nuclear heatup of Sequoyah Unit 1. which commenced on September 27. An NRC augmented inspection team that included control room shift coverage had been on the scene to oversee heatup and to assess readiness for the unit to reach criticality and go through power ascension. Unit 1 was scheduled to go critical in November 1988.

Browns Ferry. All three units at Browns Ferry remained shut down and defueled throughout the fiscal year. Units 1 and 3 had been shut down since March 1985, and Unit 2 since September 1984. The staff continued review of the Browns Ferry Nuclear Performance Plan. The TVA projected restart for Unit 2 by the first quarter of 1989 but has not established a schedule for restart of Unit 1 and 3, which will require completion of a number of tasks, such as the installation of the Safety Parameter Display System, a permanent post-accident sampling facility, and other long overdue action items.

Watts Bar. TVA had announced that the priorities for the startup of its facilities would be in this order—Sequoyah, Browns Ferry, and Watts Bar. Consequently, following restart of Sequoyah Unit 2, the engineering support staff from Watts Bar was relocated to Sequoyah Unit 1 and Browns Ferry Unit 2. TVA had established a December 1990 date for fuel loading at Watts Bar Unit 1; no completion schedule had yet been adopted for Unit 2. TVA's stated intention was to provide a plan for the licensing of Watts Bar in the Nuclear Performance Plan (NPP) for the site. TVA informed the NRC that an independent Watts Bar Program Team (WBPT), made up of TVA personnel assisted by nationally recognized nuclear power experts, had been formed to define the actions necessary to demonstrate the licensability of the Watts Bar units. The NRC approved this program plan, subject to review of comments, and TVA began implementing portions of the plan. Submission of the NPP, to be developed by the WBPT, was projected for early 1989.

Bellefonte. The TVA had announced that, in order to become more competitive and businesslike in its operations, it would implement numerous cost-saving measures and reduce the TVA-wide workforce by 7,500 employees. In addition, it was announced that construction of the Bellefonte nuclear power plant would be deferred, with only certain inspection activities planned.

TU Electric's Comanche Peak Project

During the report period, TU Electric continued implementing a comprehensive corrective action program addressing deficiencies discovered in the Comanche Peak Response Team (CRPT) program. The program included reanalysis, revision, or updating of existing design calculations, physical reinspection of as-built

hardware, and actual physical hardware changes and reconstruction. The NRC staff approved, with several conditions, the TU Electric CRPT and corrective action program plans, and issued an evaluation of the program as it pertained to large and small bore piping and pipe supports, and as it pertained to conduit supports, cable trays, and cable tray hangers. The staff expected to complete evaluations of the remaining program elements—electrical, equipment qualification, mechanical, instrumentation and controls, civil/structural, heating, ventilation, air conditioning—before the end of calendar year 1988.

At the end of fiscal year 1988, the staff was continuing its efforts with other scheduled activities necessary for Comanche Peak licensing. According to the utility's schedule at that time, Unit 1 was to be ready to load fuel by June 1989. The Unit 2 date was not being projected because work on the unit had been suspended in March 1988 for about one year, pending completion of work at Unit 1.

On July 1, 1988, the utility, the intervenor (Citizens Association for Sound Energy [CASE]), and the NRC filed a Joint Motion for Dismissal of Proceedings before the Atomic Safety and Licensing Board, based on a Joint Stipulation developed in late June. CASE had been supported throughout the hearing process by counsel from the Government Accountability Project (GAP). Among other things, the Joint Stipulation had provided that the President of CASE would serve on the Comanche Peak Steam Electric Station's Operations Review Committee (ORC). The Licensing Board held a pre-hearing conference shortly thereafter to discuss the agreement and consider termination of the proceedings. Following the conference, the board terminated the operating license and construction permit proceedings.

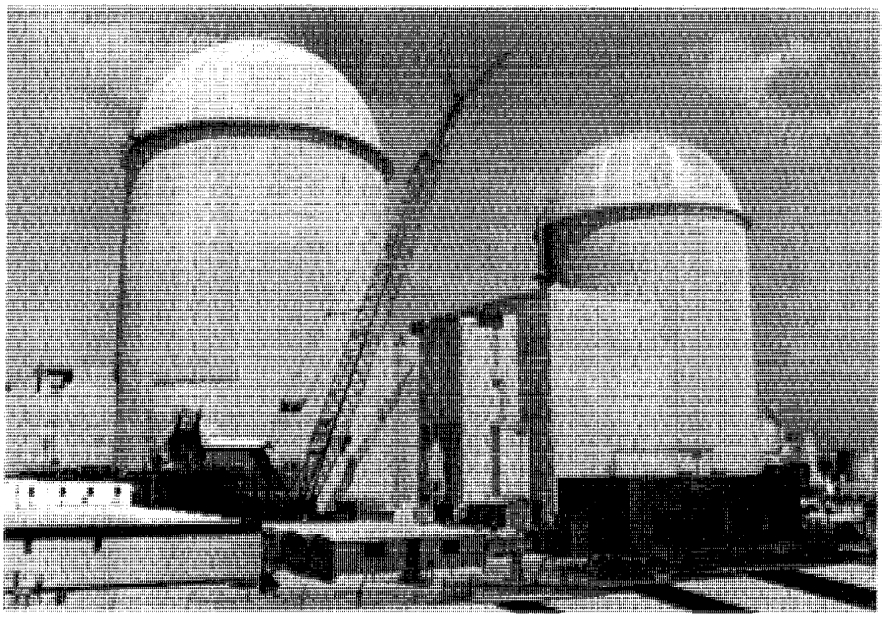
On August 11, 1988, the Citizens for Fair Utility Regulation (CFUR) filed a request for a hearing and a petition for leave to intervene in the Comanche Peak operating license and construction permit amendment hearing proceedings. Both the utility and NRC staff responded before the Commission in filings in opposition to the petition. Both recommended that the Commission deny the petition on the grounds that the petitioner had failed to show that the "late intervention factors" set out in 10 CFR 2.714(a) weighed in the petitioner's favor. In December 1988, the Commission denied the CFUR petition.

OFFICE OF INVESTIGATIONS

The Office of Investigations (OI) continues to perform investigations of alleged wrongdoing by individuals or organizations other than Nuclear Regulatory Commission (NRC) employees or NRC contractors—such as licensees, applicants and vendors, or their contractors—as described in previous NRC annual reports.

In fiscal year 1988, OI opened 91 new cases and closed 107 cases. Thirty-three of the closed cases were closed for administrative purposes; 28 closed cases were referred to the Department of Justice for consideration and possible prosecution.

During fiscal year 1988, OI focused much of its attention on allegations that counterfeit and defective parts—such as fasteners, flanges, valves, piping and



The Texas Utilities Electric Company continued major corrective activities at its Comanche Peak nuclear power plant near Fort Worth, Tex., and the NRC staff was nearing completion of its evaluation of the corrective program at the close of the report period.

circuit-breakers—were being sold to nuclear power plants. Some of these investigations centered on companies located in the southern California area that had been selling used and reconditioned molded case circuit-breakers as new, and affixing counterfeit manufacturers' trademarks and underwriter laboratories' quality certifications to them. The investigations, which entailed 10 criminal search and seizure warrants issued by the U.S. Magistrate in Los Angeles, Cal., resulted in the collection of hundreds of counterfeit labels and thousands of business records showing sales to nuclear utilities, the National Aeronautics and Space Administration, the Department of Defense, and other government agencies. Based on its findings, the NRC alerted the Office of Management and Budget of the widespread nature of the illegal activities and issued notices to the nuclear utilities alerting them to the nature and extent of the problems. The investigations were continuing at the close of the report period.

Convictions/Guilty Pleas

On March 15 and 16, 1988, two employees of Radiation Technology, Inc. (RTI), pled guilty to charges of conspiracy to defraud the government and were sentenced to three years probation each, and $10,000 and $2,500 fines. The company, RTI, was fined $100,000. The former president of the company was indicted on seven counts, ranging from conspiracy to defraud the government to providing false statements. On July 13, 1988, he was convicted on six of seven counts and sentenced, on September 26, 1988, to two years in prison with three years probation, and a $100,000 fine.

On July 14, 1988, the former Section Chief of Clinical Nuclear Medicine at the Edward Hines, Jr., Veterans Administration Hospital, located in a suburb of Chicago, Ill., pled guilty in U.S. Federal District Court to charges that he willfully failed to report to the NRC two instances of diagnostic misadministrations, and further that he lied to the NRC about their occurrence in order to avoid discovery. He was sentenced to three years probation, fined $10,000, and required to conduct 300 hours of community service work.

On October 21, 1988, a former Radiation Safety Officer at the Wright-Patterson Air Force Base in Dayton, Ohio, pled guilty in U.S. Federal District Court in Dayton, Ohio, to illegal possession of radioactive material. His guilty plea came as a result of the OI investigation into the spill of americium-241 at the air base that occurred in September 1986. (See the 1987 *NRC Annual Report*, p. 70.) Sentencing was pending at the close of the report period.

The President of Power Inspection Inc., pled guilty to providing false statements to the government in connection with eddy current testing. The company pled guilty to the same charge; sentencing was pending at the close of the report period.

On November 10, 1988, two senior managers at Pressure Piping Components, Inc. (formerly Tube-Line Corp.,), Long Island City, N.Y., pled guilty to Federal charges of mail fraud and conspiracy resulting from a 1983 OI:Region IV investigation. These individuals and the corporation were found to have sold falsely certified inferior flanges and fittings to the nuclear industry. The two senior managers were sentenced to three months in a community treatment center, with three years probation, and ordered to pay an $11,000 fine and serve 100 hours of community service. The corporation was ordered to pay a fine of $109,000. One other corporate official was awaiting sentencing after pleading guilty to the same offenses as the other two senior managers.

Enforcement Actions/Civil Penalties

On August 11, 1988, the NRC, acting in part on an OI:Region I investigation, imposed a fine against the Philadelphia Electric Company (PECO) for $1,250,000 for failing to detect, report, and deal with inattentive NRC-licensed operators at the Peach Bottom (Pa.) facility, and supervisors who condoned the inattentiveness. Additionally, 33 of 36 present and former operators were fined in amounts ranging from $500 to $1,000 each. The fine levied on the utility is the largest fine ever imposed by the NRC.

On June 6, 1988, the NRC, in partial reliance on an OI investigation, imposed a fine of $27,599 on Milford Memorial Hospital for violations of NRC requirements, namely, falsification of records and deliberate material false statements to the NRC. The violations related to the falsification of recorded checks of Milford Hospital's isotope dose calibrator, from May 6, 1986, to December 17, 1986; the initial deliberate denial of the falsifications; and the falsification of the Radiation Safety Committee Meeting minutes.

During 1988, Log-Tech Corporation, Wrangler Labs, Inc., and A-1 Inspections had their NRC licenses revoked for making false statements to the NRC (Log-Tech and Wrangler Labs) and for violation of license conditions (A-1 Inspections). These cases came to light as a result of OI investigations.

On October 11, 1988, OI concluded a 22-month long investigation into the possible submittal of material false statements by the Tennessee Valley Authority (TVA) to the NRC. The investigation concluded that the manager of the Office of Nuclear Power for TVA forwarded to the NRC two submittals that contained material false statements. In addition, the investigation concluded that the manager of the Office of Nuclear Power made false statements to OI investigators during his testimony to OI. The investigation was

referred to the Department of Justice for prosecutorial review.

During the report period, the NRC imposed a civil penalty of $200,000 on the Georgia Power Company. The fine resulted from the determination by OI that certain security violations had occurred at the Vogtle nuclear power plant.

OFFICE OF ENFORCEMENT

The NRC's enforcement program has as its objective the protection of public health and safety by ensuring that NRC licensees comply with regulatory requirements. The program is currently carried out under a revised enforcement policy (10 CFR Part 2, Appendix C, 53 FR 40019 [1988]) which calls for strong enforcement measures which will encourage full compliance and which will not permit operations by any licensees who fail to achieve adequate levels of protection.

The severity of NRC enforcement actions varies with the seriousness of the matter and the licensee's previous compliance record. Several levels of NRC actions are available:

- Written Notices of Violation are dispatched in all instances of noncompliance with NRC requirements.
- Civil penalties are considered for licensees who evidence significant or repetitive instances of noncompliance, particularly when a Notice of Violation has not been effective in achieving the expected level of corrective action. Civil penalties may also be imposed for particularly significant first-of-a-kind violations.
- Orders to "cease and desist" operations, or for modification, suspension, or revocation of licenses are used to deal with licensees who do not respond to civil penalties or to deal with violations that constitute a significant threat to public health and safety or to the common defense and security. In the latter case, the order may be made effective immediately.

The Regional Administrators have the authority to issue Notices of Violation not involving civil penalties, and Notices of Violation proposing civil penalties, with the concurrence of the Director of Enforcement and the Deputy Executive Director for Regional Operations (DEDRO). The DEDRO is responsible for all enforcement decisions and issues all Orders, including those imposing civil penalties. The Director of the Office of Enforcement acts on behalf of the DEDRO in his absence or as otherwise directed.

Appendix 6 provides a listing and brief summary of the 103 civil penaltyactions taken during fiscal year 1988, and also a brief description of the 16 enforcement Orders issued during fiscal year 1988.

Nuclear Reactor Regulation

Chapter 2

The Office of Nuclear Reactor Regulation (NRR) has responsibility for the licensing and regulatory oversight of nuclear reactors in the civilian sector. These include both the nuclear power reactors operated by electric utilities and non-power research reactors, such as those operated by various universities. Not included are the reactors operated by the Department of Energy for the purpose of furnishing fissionable materials used in nuclear weapons.

The licensing activities of NRR begin with the extensive review given to applications for construction permits and operating licenses for new reactors, and the complex procedures—including inspections from the outset of plant construction throughout a facility's eventual operating lifetime—leading to issuance of permits or licenses, and licensing actions taken thereafter. (See "The Licensing Process," below.)

In recent years, the steady increase in the number of licensed operating nuclear plants and the corresponding decrease in the number of plants still under construction has brought about a substantial shift in overall NRC activity. Staff energies are currently directed mainly to the safety regulation of the 110 nuclear power plants now licensed for operation in the United States.

Regulatory activities related to nuclear power plants during fiscal year 1988 are treated in this chapter under the following headings:

- Status of Licensing
- Improving the Licensing Process
- Inspection Programs
- Performance Evaluation
- Quality Assurance
- Operator Licensing
- Emergency Preparedness
- Safety Reviews
- Antitrust Activities
- Indemnity, Financial Protection and Property Insurance
- The Advisory Committee on Reactor Safeguards
- The Advisory Committee on Nuclear Waste

STATUS OF LICENSING

License Applications and Issuances

During fiscal year 1988, the NRC issued one low-power operating license (for Braidwood Unit 2 (Ill.) and three full-power licenses—one for the same Braidwood Unit 2 facility, and two others (South Texas Unit 1 and Palo Verde Unit 3 [Ariz.]) which had received low-power licenses in fiscal year 1987. No fuel loading licenses were issued during the report period. The addition of the three units authorized to operate at low or full power brings the total of licensed power reactors in the United States to 110, as of September 30, 1988. (See Appendix 7 for complete listing of plants in operation or under construction, with location, reactor-type, and other data.) There were no new applications for operating licenses or construction permits, and no construction permits or manufacturing licenses issued during the fiscal year. At the close of fiscal year 1988, there were 14 nuclear power plants still technically under construction in the United States, although some of them are delayed indefinitely.

Table 1 is a numerical summary of NRR activity in power reactor licensing during fiscal year 1988, and Table 2 identifies the licensee and facilities licensed, with additional information.

Licensing Actions for Operating Power Reactors

As noted, there were 110 power reactors licensed to operate at the end of fiscal year 1988. After operations begin, both routine activities and unexpected events at these facilities can result in a need for "licensing actions" on the part of the NRC. Routine post-licensing activities affecting the reactor operations include license amendment requests and any related public hearings, requests for exemption from regulations, new regulations requiring backfit modifications to operating reactors, orders for modification of a license, new generic activities, petitions for action under 10 CFR 2.206 by members of the public, or review of information supplied by a licensee for the resolution of technical issues. In recent years, it has also included plant-specific actions needed to deal with allegations of violations or other post-licensing concerns. These

THE LICENSING PROCESS

Obtaining an NRC construction permit is the first objective of a utility or other company seeking to operate a nuclear power reactor or other nuclear facility under NRC licensing authority. The process begins with the filing and acceptance of an application, generally comprising many volumes of data, covering both safety and environmental considerations, in accord with NRC requirements and guidance. The second phase encompasses the various safety, environmental, safeguards (from theft or sabotage), and antitrust reviews undertaken by the NRC staff. Third, a safety review is conducted by the independent Advisory Committee on law. Fourth, a mandatory public hearing is carried out by a three-member Atomic Safety and Licensing Board (ASLB), which then makes an initial decision as to whether a construction permit should be granted. This decision is subject to appeal to an Atomic Safety and Licensing Appeal Board (ASLAB), and could ultimately go to the Commissioners for a final NRC decision. Appeal beyond the NRC decision is available by recourse to the Federal courts.

As soon as an initial application is accepted (or "docketed") by the NRC staff, a notice of the fact is published in the *Federal Register*, and copies of the application are furnished to the appropriate State and local authorities and to a local public document room (LPDR), established in the vicinity of the proposed site, as well as to the NRC public document room in Washington, D.C. At the same time, a notice of a public hearing is published in the *Federal Register* and in local newspapers, giving 30 days for members of the public to petition to intervene in the proceeding. Such petitions are entertained and adjudicated by the ASLB appointed to the case, with rights of appeal by the petitioner to an ASLAB.

The NRC staff's safety, environmental, safeguards, and antitrust reviews proceed in parallel. With the guidance of the Standard Format (Regulatory Guide 1.70), the applicant for a construction permit lays out the proposed nuclear plant design in Preliminary Safety Analysis Report (PSAR). If and when this report has been made sufficiently complete to warrant review, the application is docketed and NRC staff evaluations begin. Even before submission of the safety report, NRC staff conducts a substantive review and inspection of the applicant's quality assurance program with respect to design and procurement. The safety review is performed by NRC staff in accordance with the Standard Review Plan for Light-Water-Cooled Reactors, initially published in 1975 and updated periodically. The plan sets forth the acceptance criteria used in evaluating the various systems, components, and structures related to safety and in appraising the suitability of the proposed site; it also describes the procedures to be used in performing the safety review.

The NRC staff examines the applicant's PSAR to determine whether the plant design is safe and consistent with NRC rules and regulations; whether valid methods of calculation were employed and accurately performed; whether the applicant has conducted its analysis and evaluation in sufficient depth and breadth to support staff approval as to assured adequate levels of safety. When the NRC staff is satisfied that the acceptance criteria of the Standard Review Plan have been met by the applicant's preliminary report, a Safety Evaluation Report is prepared by the staff which summarizes the results of its review concerning the anticipated effect of the building and operating of the proposed facility on public health and safety.

Following publication of the Safety Evaluation Report, the ACRS completes its review and meets with the staff and applicant. The ACRS then prepares a report in the form of a letter to the Chairman of the NRC, presenting the results of its independent evaluation and its recommendation as to whether or not a construction permit should be issued. At this stage, the staff issues a supplement to the Safety Evaluation Report which incorporates any changes or actions adopted as a result of ACRS recommendations. A public hearing can then be held, generally in a community near the proposed facility site, on the safety aspects of the licensing decision.

In appropriate cases, the NRC may decide to grant a Limited Work Authorization to an applicant in advance of a final decision on the construction permit, in order to allow certain work to begin at the site; such a step can result in an overall saving of up to seven months' construction Reactor Safeguards (ACRS), as required by time. However, the authorization will not be given until the NRC staff has completed environmental impact and site suitability reviews and the ASLB for the case has conducted a hearing on environmental impact and site suitability and reached a favorable finding. To realize the desired saving of construction time, the applicant must submit the environmental portion of the application early.

The environmental review begins with an assessment of the acceptability of the applicant's Environmental Report (ER). If the ER is judged sufficiently complete to warrant review, it is docketed, and an analysis of the consequences to the environment of the construction and operation of the proposed facility at the proposed site is begun. Upon completion of this analysis, a Draft Environmental Statement is published and distributed, with specific requests for review and comment by Federal, State and local agencies, other interested parties, and members of the public. All of these comments are then taken into account in the preparation of a Final Environmental Statement. Both the draft and final statements are made available to the public at the time of respective publication. During this same period, the NRC is conducting analysis and preparing a report on the site suitability aspects of the proposed licensing action. Upon completion of these activities, a public hearing, presided over by the appointed ASLB, may be held on environmental and site suitability issues related to the proposed licensing action. (When indicated, a single hearing on both safety and environmental matters may be held.)

The antitrust reviews of license applications are carried out by the NRC and the Attorney General in advance of, or concurrent with, other licensing reviews. If an antitrust hearing is required, it is held separately from those on safety and the environment.

U.S. COMMERCIAL NUCLEAR POWER REACTOR SITES

activities, and the growth in the number of operating reactors, have resulted in a relatively large number of new actions and pending actions in the inventory. During fiscal year 1988, NRR and the Office of Special Projects completed about 2,200 licensing actions. About 80 percent of these actions were plant-specific and predominantly licensee-initiated. The balance were multi-plant actions that result from NRC-imposed requirements. The total licensing action inventory has remained relatively constant at approximately 3,600 licensing actions under review.

Licensing Actions for Non-power Reactors

As of September 30, 1988, 51 non-power reactors licensed for operation by the NRC were in use for research, training, and testing. There was also one non-power reactor construction permit in effect, and five non-power reactors were under dismantling orders. Table 3 summarizes licensing actions for non-power reactors in fiscal year 1988.

Two orders were issued in fiscal year 1988 to non-power reactor licensees to convert from high-enriched uranium (HEU) fuel to low-enriched uranium (LEU) fuel. The orders were for Worcester Polytechnic Institute (Mass.) and Ohio State University. The total number of such orders issued by the end of fiscal year 1988 was three (Rensselaer Polytechnic Institute (N.Y.) was ordered to switch to LEU in fiscal year 1987 and had completed its conversion by the close of the report period). The conversion is in response to the HEU/LEU rule published in February 1986, whose purpose is to promote the common defense and security by reducing the risk of theft or diversion of HEU used in non-power reactors. The Department of Energy has provided funding for conversion to eight other licensees.

Two NUREG reports (NUREGS 1281 and 1282) dealing with the evaluation and qualification of low-enriched fuels were issued last fiscal year. This fiscal year, an "Evaluation of Low-Enriched Uranium Silicide-Aluminide Dispersion Fuel for Use in Non-Power Reactors" (NUREG-1313) was issued. The evaluation concludes that plate-type fuels fabricated from U_3Si_2-Al dispersion compacts with uranium densities up to 4.8 b/cm ("b" for "barn," a unit of nuclear cross section) are acceptable for use in non-power reactors.

Table 1. Power Reactor Licensing by Category—FY 1988

Fuel-load and Pre-critical Test Operating Licenses issued	0
Low-Power Operating Licenses issued	1
Full-Power Operating Licenses issued	3
Operating License applications under review	14

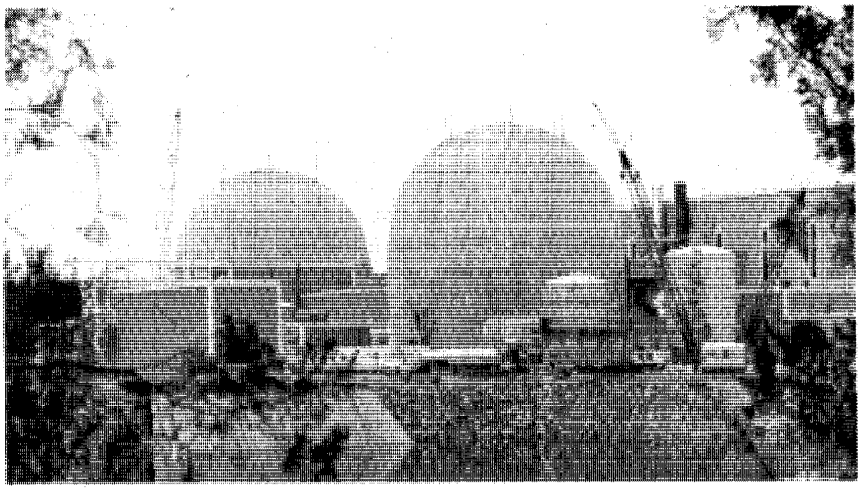
Special Cases

Peach Bottom 2 and 3. In March of 1987, the Peach Bottom (Pa.) nuclear power plant, Units 2 and 3, were ordered shut down by the NRC because of reactor operators found sleeping on duty, and other evidence of inattention while on duty, which raised obvious and serious concerns. (See the *1987 NRC Annual Report*, p. 13.) During fiscal year 1988, the licensee continued corrective actions agreed to following the NRC's shutdown order. The licensee's efforts included a revision of its response to the NRC order; the revision was submitted in the licensee's report, "Plan for Restart of Peach Bottom Atomic Power Station, Sections I and II, Revisions 1," dated April 8, 1988. This submittal revised and updated the licensee's discussion of the root causes for the problems cited in the NRC order and identified areas where changes were being made which addressed the NRC concerns. These areas included changes in plant management, in attitudinal reassessment and training, in the acquisition of additional operators and resources, in plant procedures, in quality assurance, and in management involvement and communication. The NRC staff issued a Safety Evaluation Report on the revised plan in October 1988, concluding that the licensee had in fact identified the root causes to the problems which led to the shutdown order and had identified measures in its plan for restart which appropriately addressed those root causes. The NRC also took enforcement action against the licensee and those licensed individuals who comprised the shift operations staff at the time of the shutdown order.

As of the end of the report period, the NRC staff was awaiting completion of those licensee actions which are prerequisite to the licensee's asserted readiness to resume operations. Before authorizing restart, the NRC will conduct an independent assessment of the licensee's readiness.

Rancho Seco Restart. The Rancho Seco nuclear power plant was restarted on March 30, 1988, following a 27-month, NRC-imposed shutdown. (See *1987 NRC Annual Report*,.pp. 15 and 17.) The restart and a subsequent six-month power ascension program progressed with relatively few problems, although certain unanticipated maintenance requirements delayed the start of full power operations until November 1988.

Rancho Seco was shut down following a reactor trip and overcooling transient on December 26, 1985, at-



The NRC staff continued in 1988 to review corrective actions taken by the Virginia Electric and Power Company following a 1987 generator tube rupture at its North Anna Unit 1 plant at Mineral, Va. An NRC bulletin issued after the event specified a number of remedial actions and ordered inspections to determine if other Westinghouse-designed reactors could be susceptible to similar problems.

tributed to equipment failure. An NRC Incident Investigation Team (IIT) was formed to investigate the event. The IIT identified significant deficiencies in plant hardware, procedures, and management. The utility developed a comprehensive restart plan which, in addition to addressing the IIT-identified issues, prescribed a diagnostic program to identify weaknesses in plant operations and hardware. The restart plan included a testing phase to test hardware components, systems, and integrated systems.

The NRC staff evaluation of the restart plan and its execution is documented in the restart safety evaluation, NUREG-1286, Supplement 1. Based on this evaluation, the staff recommended that the Commission permit Rancho Seco to restart; the Commission voted on March 22, 1988 to allow the restart of the Rancho Seco facility.

North Anna Steam Generator Tube Rupture. On July 15, 1987, a steam generator tube in Unit 1 of the North Anna (Va.) nuclear power plant experienced a double-ended break at the top of the uppermost cold leg tube support plate. (See the 1987 NRC Annual Report, p. 20.) The operators at the plant were able to shut down the reactor without further damage or any significant radiation release to the environment. An NRR Augmented Inspection Team on-site monitored the licensee's recovery efforts.

In addition to performing a comprehensive eddy current examination of all tubes in all steam generators (approximately 10,000 tubes), the licensee was able to remove part of the failed tube for laboratory examination. Examination of the tube by various metallurgical techniques, including electron microscopy, indicated that the failure was caused by a rapidly propagating fatigue crack. Hydrodynamic model testing confirmed that the rupture was due to a flow-induced vibration. A computer model was developed that could be used to predict whether similar failures could occur in other plants.

Corrective measures taken at North Anna Unit 1 included: (1) stabilization of the remaining portion of the failed tube, (2) installation of a steam generator flow resistance plate, (3) preventative plugging of those tubes calculated to be potentially susceptible to similar failure, and (4) enhanced leak rate monitoring to give early warning of impending failure.

Following the North Anna Unit 1 Steam generator tube rupture, NRC Bulletin 88-02 was issued requesting inspections and calculations to determine if Westinghouse designed steam generators in other plants might be susceptible to similar tube rupture. In addition, augmented leakage surveillance programs were required to be implemented in all potentially susceptible plants until certain corrective mitigating measures were taken. The staff was reviewing all programs instituted pursuant to requirements of the bulletin at the close of the report period.

Special Safety Assessment for the Commercial Operation of South Texas Unit 1. South Texas Unit 1 achieved commercial operation on August 24, 1988, following an exceptional power ascension period covering five months. During ascension to 100 percent power, the plant experienced only three reactor trips or shutdowns, which is approximately one-fifth the average number of trips for new reactors during power ascension. That unusual performance, in the utility's first nuclear power project, followed a long and difficult period for the undertaking and gives evidence of a full commitment on the part of the licensee, the Houston Lighting and Power Company.

Commercial operation of the plant represents the culmination of a complicated construction period which lasted 13 years and which included a mid-stream change of engineer-builder. That change, which occurred between 1980 and 1982, was responsible for a significant delay in plant construction. Subsequent to the change, the plant was further delayed by the necessity for extensive reworking of structures and components built or installed by the original contractor.

The successful power ascension served to confirm the findings of the NRC's Safety Significance Assessment Team (SSAT) regarding quality at South Texas. The SSAT was organized specifically to investigate approximately 460 technically oriented safety concerns raised immediately prior to the expected licensing of the plant. The SSAT followed an extensive inspection effort which failed to substantiate any of the safety concerns raised. The NRC team concluded that quality at South Texas Unit 1 was adequate to ensure safe plant operation. This conclusion was supported by still other NRC inspections, conducted by Headquarters and Region IV staff. The SSAT findings were reported in NUREG-1306, published March 1988.

IMPROVING THE LICENSING PROCESS

Standardization

The Commission strongly endorses regulatory policies which encourage the industry to pursue standardization of power reactor design. It is expected that standard designs will benefit public health and safety in a number of ways: concentrating industry resources on common approaches to design problems that have wide application, stimulating adoption of sound construction practices and quality assurance, fostering constantly improving maintenance and operating

Table 2. Licenses Issued for Operation of Nuclear Power Plants—FY 1988

Applicant		*Low-Power*	*Full-Power*	*Location*
Commonwealth Edison	Braidwood 2	12/18/87	5/20/88	24 miles SSW Joilet, Ill.
Houston Lighting and Power	South Texas 1	8/21/87	3/22/88	12 miles SSW of Bay City, Tex.
Arizona Public Service	Palo Verde 3	3/25/87	11/25/87	36 miles west of Phoenix, Ariz.

procedures, and permitting a more efficient and effective licensing and inspection process. In this regard, on September 15, 1987, the Commission issued a Statement of Policy on Nuclear Power Plant Standardization. The policy reflects the experience the agency has acquired in its review of standard designs, the applicable provisions of the Commission's Severe Accident Policy Statement and of the proposed standardization legislation, and the current views of the Commission and industry. The focus of the policy is Design Certification, a regulatory instrument that would enable licensing concerns to be resolved prior to costly investment by utilities. To implement the policy, a rule (10 CFR 52) has been proposed. The proposed rule, which would provide a regulatory framework for certification of standard designs, addresses the following subjects: relationship of the new regulatory framework to the existing provisions of Appendices M, N and O of Part 50; filing requirements; content of applications; design certification review fees and renewal fees; design certification rulemaking requirements; referral of applications to the Advisory Committee on Reactor Safeguards (ACRS); duration and renewal of design certifications; changes to certified designs; and provisions for plant-specific variances.

EPRI Advanced Light Water Reactor Program. The NRC continues to work with the Electric Power Research Institute (EPRI) on an advanced "evolutionary" LWR standard plant program. To date, EPRI has submitted for NRC review the first five chapters of a 13-chapter "Utility Requirements Document" defining licensing basis requirements, investment protection requirements, and risk performance requirements by which advanced LWRs are to be designed and constructed using proven technology. The Requirements Document will identify acceptable resolutions of all applicable Unresolved Safety Issues and Generic Safety Issues and will describe acceptable means for compliance with the Commission's Severe Accident and Safety Goal Policy Statements.

During fiscal year 1988, the NRC issued draft safety evaluation reports for the first four chapters of the Requirements Document covering (1) Overall Requirements, (2) Power Generation Systems, (3) Reactor Coolant System & Reactor Auxiliary Systems, and (4) Reactor Systems. EPRI plans to begin submitting parallel chapters applicable to a "passive plant," i.e., one designed to minimize or eliminate the need for active intervention to correct off-normal conditions, in 1989. The program is scheduled to be completed in 1991.

GE Advanced BWR. General Electric (GE), in cooperation with its international technical associates, is developing an Advanced Boiling Water Reactor (ABWR). The ABWR will incorporate such innovative features as internal recirculation pumps and control rod drives which incorporate diverse means of controlling rod motion. The ABWR is expected to be the first standard design to comply with the EPRI Requirements Document (see above).

To date, the NRC has received and initiated reviews of Chapters 4-15, 17, and 20 of the ABWR Safety Analysis Report. Design Certification is expected to be complete in 1991.

Westinghouse RESAR SP/90. The NRC continues to review the Westinghouse Electric Corporation's application for Preliminary Design Approval (PDA) of its Reference Safety Analysis Report (RESAR) SP/90 standard Nuclear Power Block. Westinghouse intends to pursue Final Design Approval and Design Certification of the RESAR SP/90 following PDA. The SP/90 design is being developed independently of the EPRI Requirements Document.

CESSAR-DC, SYSTEM 80+. In March 1987, Combustion Engineering (CE) initiated discussions with the

Table 3. Licensing Actions for Non-power Reactors—FY 1988

(OL=operating license)

Non-power reactor operating licenses issued	1
Non-power reactor possession only licenses issued	1
OL renewals issued for operation	1
OL renewals issued for possession only	2
Orders issued to decommission/dismantle	2
High-enriched uranium to low-enriched uranium conversion orders issued	2
Licenses terminated	3
Facilities planning decommissioning/dismantlement	3
OL renewals under review	1
Other license amendments issued	20

NRC in preparation for submittal of the System 80+ Nuclear Steam Supply System standard design. Initial submittals were made in late 1987 and continued in 1988. Submittal of additional information in support of design certification began in 1987. Final Design Approval (FDA) is anticipated in early 1991.

CESSAR-F SYSTEM 80. During fiscal year 1988, the NRC continued to review CE's application to amend the previously approved CESSAR-F System 80 standard design. The CESSAR-F System 80 FDA, issued December 21, 1983, applied only to plants whose construction permit (CP) applications referenced the CESSAR PDA in the CP application. CE plans to make the amended CESSAR-F design available for referencing in future Construction Permit and Operating License applications. The NRC review continued throughout fiscal year 1988. A decision is anticipated by the middle of fiscal year 1989.

Severe Accident Program

Until the accident at the Three Mile Island Unit 2 (TMI-2) reactor in Pennsylvania, in March 1979, severe accidents involving substantial fuel cladding and core structure damage were not generally addressed in NRC regulations. For licensing purposes, staff reviews confirmed that plant designs were capable of successfully coping with a number of design-basis accident sequences and thereby averting severe core damage. In addition, plants were being analyzed under assumptions which included a conservatively postulated fission product release within the reactor vessel and a simultaneous design-basis earthquake, in order to verify that systems, components, and structures required for safe shutdown were adequate to perform that function. These analyses also verified that a demonstrable containment leak rate under such circumstances would limit potential off-site radiological exposure, as set forth in 10 CFR 100.11 and 10 CFR 100, Appendix A.

Subsequent to TMI-2, a number of regulatory changes were undertaken separately to adjust licensing requirements. The changes were intended to enhance both prevention and mitigation of those unlikely events in which substantial damage is sustained by the reactor core, independent of concerns about off-site consequences. On August 8, 1985, the Commission issued its "Policy Statement on Severe Reactor Accidents Regarding Future Designs and Existing Plants" (50 FR 32138). This statement described the policy the Commission intended to follow in resolving safety issues related to reactor accidents of greater severity than the regulatory design-basis accidents.

The policy statement addressed both current and future plants. During fiscal year 1988, the NRC staff

The 1979 accident at Three Mile Island Unit 2 (Pa.), shown here, evoked regulatory and research activity that continued throughout the subsequent decade. The many changes brought about as a result of this activity have profoundly affected nuclear power operations nationwide and overseas.

completed and the Commission approved plans for implementing the directives of the statement.

The plans affecting operating reactors are generally described in the "Integration Plan for Closure of Severe Accident Issues" (SECY 88-147), issued on May 25, 1988. The program phases leading to resolution of severe accident issues include individual plant examinations, containment performance improvements, improved plant operations, and continuing severe accident research. The overall integration plan is designed to help assure a coordinated effort and effective allocation of resources among the discrete program elements over the several years necessary to complete the program.

Individual plant examinations are systematic analyses of each plant by the utility owners to identify and remedy any potentially significant plant-specific risks not previously brought to light. The NRC has made available several analytical options, and expects a utility to promptly correct any significant vulnerability as it is uncovered. The NRC will review each plant owner's submitted plan, which will include both external and internal accident initiators. The licensee will also be expected to initiate an accident management program explicitly designed to assure appropriate procedures, equipment, and training are provided for the plant staff, so they will be well prepared to prevent severe accidents, or mitigate the course of their likely consequences.

Containment performance improvements will be evaluated by the NRC as part of an effort to identify and evaluate severe accident containment vulnerabilities. All LWR containment types are under study, with current emphasis on the Mark I.

Improved plant operation is an effort deriving from the known sensitivity of nuclear power plant (NPP) risk to human errors. The work within this general area includes the following specific efforts:

(1) Continued improvement of the Systematic Assessment of Licensee Performance (SALP) process.

(2) Regular reviews by senior NRC managers to identify and evaluate those plants that may not be meeting NRC and industry standards of operational performance.

(3) Diagnostic team inspections to probe further the performance of those plants identified in item 2.

(4) Regulatory actions to improve operational performance where it has fallen below expected standards.

(5) Improved technical specifications.

(6) Continued improvement of operating procedures.

(7) Expanding emergency operating procedures to include guidance on severe accident management strategies.

(8) Industry programs to reduce transients and other challenges to engineered safety features.

(9) Feedback from the Individual Plant Examination program on realizable improvements in operational areas, such as maintenance and training.

(10) Continued research to evaluate the sensitivity of risk to human errors, the contribution of management to the level of human errors, and

the effectiveness of operational reliability methods to help identify potential problems early and prevent their occurrence.

Severe accident research was begun immediately after the TMI-2 accident in March 1979, in order to provide the Commission and NRC staff with the data and methods needed to address severe accident issues. (See discussion in Chapter 9.)

At this time, considerable knowledge has been gathered and assimilated into program elements such as those described above. Some examples of severe accident phenomena and of the technical areas that the severe accident research program has examined include:

(1) Natural circulation in the reactor coolant system.

(2) Core melt progression and hydrogen generation.

(3) Steam explosions as a potential failure mode for both reactor vessel and containment.

(4) The potential for early failure of containment by high pressure melt ejection (Direct Containment Heating).

(5) Core-concrete interactions, fission product behavior, and heat transfer.

(6) Hydrogen ignition and burning in containment.

(7) Fission product behavior and chemical form in the reactor coolant system.

(8) Revaporization of previously deposited fission products.

A substantial body of knowledge and insight on severe accidents has been assembled by the NRC over the past several years. The information has improved the understanding of both the NRC and industry regarding accident sequences which, if unchecked, could lead to severe core damage and the potential for significant off-site releases. Confirmatory research continues to reduce the uncertainties associated with these postulated events. Meanwhile, the available information base is judged solid and broad enough for a range of regulatory decisions regarding severe accidents to be made now.

For future reactor plants, the severe accident policy of August 1985 stated that new designs could be shown to be acceptable for severe accident concerns if the design met certain criteria and procedural requirements. The policy also stated that the Commission fully expects that vendors engaged in designing new standard (or custom) plants will satisfy a higher standard of severe accident prevention and mitigation than their prior designs.

The implementation plan for severe accident issues for future light water reactor (LWR) designs was described in a staff paper to the Commission which recommended that the Commission endorse a staff plan to develop a new rule or rules, with supporting regulatory guidance, applicable to LWR designs. Such rules and guidance would implement the requirements set forth in the Commission's Severe Accident Policy Statement, and would include a general severe accident performance requirement in a modification of 10 CFR 50.34(f).

Implementation plans for addressing the Severe Accident Policy Statement for future non-LWR reactors of advanced design are less complete, but a staff paper to the Commission dated July 15, 1988, "Key Licensing Issues Associated with DOE Sponsored Advanced Reactor Designs" (SECY 88-203), addressed these issues. In the paper, the staff proposed a general approach and the criteria for the review of advanced, non-LWR designs, with specific criteria to address the key licensing issues. These key issues may be expressed as questions, as follows:

(1) What range of accidents must be considered for design, siting, and emergency planning?

(2) How should siting source terms be calculated and used for designs significantly different than current generation LWRs?

(3) How should the adequacy of or the need for a containment building be evaluated?

(4) How should the adequacy of or need for off-site emergency evacuation, sheltering, and drills be evaluated?

The proposed criteria would be based on engineering analyses, complemented by "probabilistic risk assessment" (PRA), to define the spectrum of potential or hypothetical accidents, including severe accidents, that have to be considered in advanced reactor designs.

Technical Specification Improvements

On February 10, 1987, the Commission issued an interim policy statement on Technical Specification improvements for nuclear power plants. The policy established a set of objective criteria for determining which regulatory requirements and operating restrictions should be included in the Technical Specifications that are issued as part of every power reactor operating license. The application of the criteria will permit the relocation of some Technical Specification requirements to licensee-controlled documents and programs. This will permit subsequent changes to those commitments without prior NRC approval, when appro-

priate technical evaluations are performed under approved administrative controls. Those requirements that have a more significant impact on safety will remain in the Technical Specifications, and both the requirements and their bases will be upgraded to provide greater emphasis on human factors and clarity.

The NSSS vendor owners groups have since been developing proposals for new Standard Technical Specifications (STS) based on the policy statement criteria. The new STS are to be used by licensees to improve Technical Specifications for individual plants. An important milestone in this effort was reached on May 9, 1988, when the NRC specified for each of the vendor owners groups which current Technical Specifications should be retained in their respective STS proposals. The owners groups are now completing the new STS and are scheduled to submit them for NRC review in mid-1989.

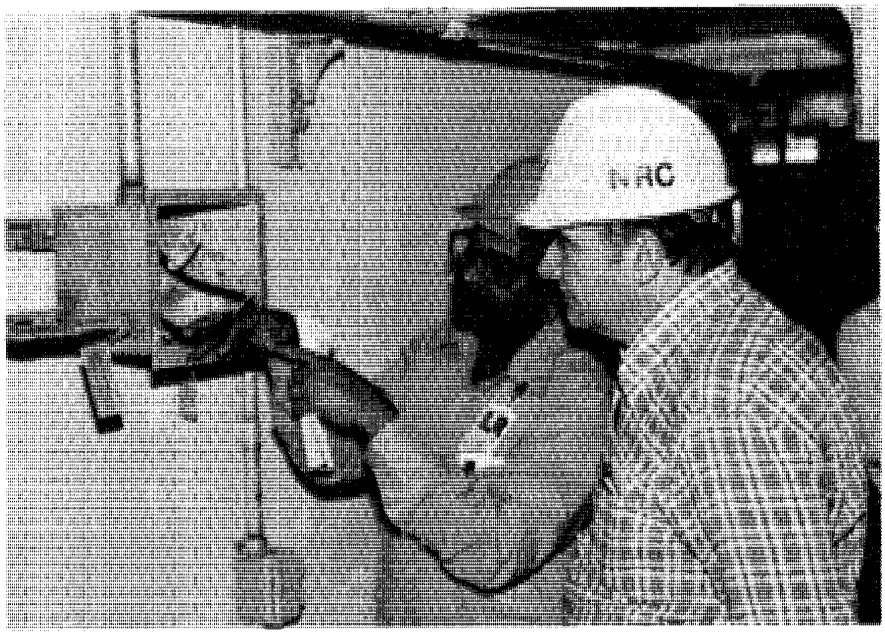
The NRC is continuing with its program of specific line-item improvements to both the scope and substance of existing Technical Specifications, in parallel with the complete redrafting of the STS, mentioned above. During fiscal year 1988, Generic Letters were issued on the following line-item improvements to Technical Specifications: relocation of fire protection requirements to a program required by a standard license condition, removal of the organization charts, and removal of the specific values of cycle-specific variables. Also, several generic changes in the surveillance test intervals and allowed outage times—for reactor protection and for engineered safety features system instrumentation—were approved on the basis of probabilistic risk analyses.

Two new STS initiatives were begun in fiscal year 1988. First, NRC began planning for a pilot program to develop and test risk-based Technical Specifications. NRC believes that such Technical Specifications can be an important element in an overall risk management system for nuclear power plants. Second, the NRC has begun to examine ways to reduce surveillance testing while the reactor is at power. Some of the challenges to the safety systems of nuclear power plants have occurred inadvertently under these conditions, and the staff believes those challenges can be reduced.

INSPECTION PROGRAMS

The Office of Nuclear Reactor Regulation (NRR) is responsible for administering the reactor inspection program. The responsibility for developing, maintaining, and assessing the effectiveness of the reactor inspection program is shared among NRR staff, consistent with their assigned technical responsibilities. Improvements have been made in a number of inspection programs, and measures have been taken to restructure the reactor inspection program so as to focus headquarters and regional inspection effort on those plant operations which contribute most to ensuring reactor safety. NRC plans for restructuring the reactor inspection program, and providing for the integration of the inspection and licensing programs, were implemented in fiscal year 1988.

In fiscal year 1988, the inspection emphasis continued to be on plants with problems calling for special attention. NRC Headquarters and Regional Office inspection personnel were cooperatively involved in the ongoing effort to investigate and resolve various significant plant design, installation, equipment, and performance problems at plants in both construction and



NRC's Office of Nuclear Reactor Regulation continued to intensify the reactor inspection program in 1988 through closer coordination between headquarters and regional inspection functions and broader use of specialized team inspections. Shown here are two members of a special inspection team as they check electrical splices in the containment structure at Houston Lighting and Power Company's South Texas Unit 1, near Bay City, Tex.

operational phases. Alternative approaches within the reactor inspection program were exercised to redirect inspection resources from plants with a high level of performance to plants with marginal performance.

Special team inspection programs, such as the Safety System Functional Inspection and the Safety System Outage Inspection—as well as implementation by the Regional Offices of the routine and reactive inspection programs—continued to be employed as proven and effective tools in assessing the operational readiness for key plant safety systems.

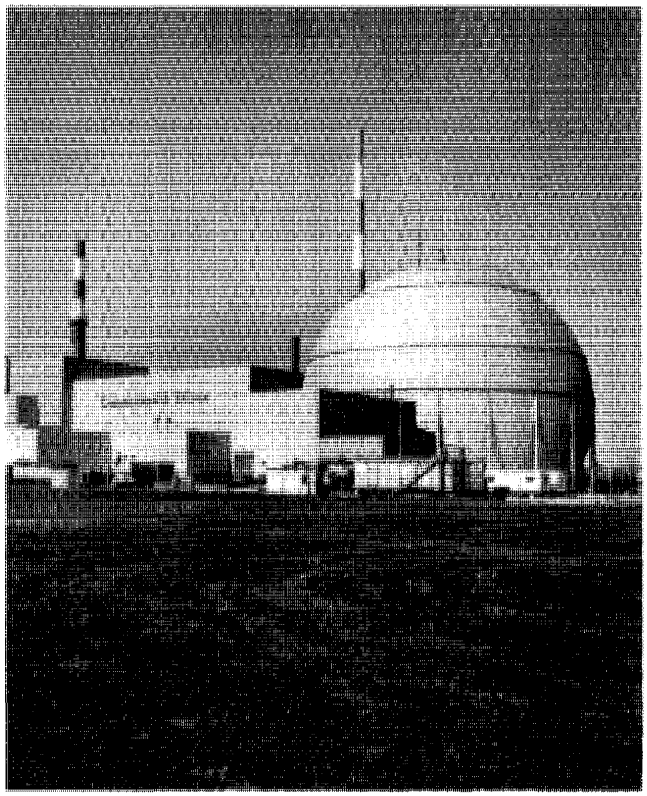
A basic element in NRC reactor regulation is the inspection of licensed reactor facilities to determine the state of reactor safety, to confirm that the operations are in compliance with the provisions of the license, and to ascertain whether other conditions exist which have safety implications serious enough to warrant corrective action. The inspection programs of the NRC are mainly carried out by the five NRC Regional Offices, with only a limited number of inspections conducted directly out of NRC Headquarters. NRR is responsible for developing inspection policies and procedures, and for monitoring and assessing the effectiveness and uniformity of the programs carried out by the NRC Regional Offices; the actual operations of the Regional Offices are under the supervision of the NRC Deputy Executive Director for Regional Operations.

In addition to the routine or planned program of inspections for reactor, fuel cycle facility, and materials licensees, the NRC conducts an aggressive program to deal with unsafe or potentially unsafe events or conditions which occur at individual plant sites or other facilities involving licensed operations (''reactive'' inspections). In conducting these reactive inspections, the NRC seeks to determine the root cause of the event or condition; evaluates the licensee management's response to it, including action to prevent recurrence; and decides whether the problem is one that could occur at other facilities. The staff then takes appropriate action on these judgments.

Reactor Inspection Programs

The operating reactor inspection program is conducted by both region-based and resident inspectors. In general, region-based inspectors are specialists, while resident inspectors are generalists. Resident inspectors provide the major on-site NRC presence for direct observation and verification of licensee activities. The work comprises in-depth inspections of control room activities; maintenance and surveillance testing carried out by the licensee; periodic walk-down inspections to verify the correctness of system lineups for nuclear systems important to safe operation; and frequent plant tours to generally assess housekeeping, radiation control, security, equipment condition, and the like. The resident also acts as the primary on-site evaluator for the NRC inspection efforts related to licensee event reports (LERs), events, and incidents. Residents also serve as the NRC contact with local officials, the press, and the public. Region-based inspectors, on the other hand, perform technically detailed inspections in such areas as system modifications, in-service inspection, fire protection, non-core-physics testing, radiation protection, security/safeguards, and licensee management systems.

Development and utilization of an innovative inspection approach to appraise the functionality of safety systems at operating plants continued in fiscal year 1988. The new methodology, termed a Safety Systems Functional Inspection (SSFI), was included in the reactor inspection program for implementation by the Regions in fiscal year 1986. It continues to prove its usefulness in regional inspections by identifying significant safety issues that require licensee corrective actions. Another approach, the Safety System Outage Modification Inspection, helps identify a need for licensees to maintain more effective controls over activities associated with the evaluation, design, procurement, installation, and testing of plant modifications. Because of its demonstrated success, this method will



Follow-up inspections by Safety System Outage Modification Inspection (SSOMI) teams were conducted at a number of plants in 1988, including the Dresden Unit 3 nuclear power plant, near Morris, Ill. shown here. The SSOMI is performed to see how earlier modifications to plant systems have affected designed safety functions.

also be included in the reactor inspection program for implementation by the Regions in fiscal year 1989.

The pilot program for the application of probabilistic risk assessment (PRA) insights to the inspection process—begun in fiscal year 1986 on a trial basis, and continued in terms of methodology development through fiscal year 1987—has progressed and been expanded in fiscal year 1988. The two principal aspects of the pilot effort are PRA-based team inspections and PRA-based guidance for resident inspectors. PRA insights were applied, for the first time, to team inspections, such as Safety System Functional Inspections, Maintenance Team Inspections, Operational Assessment Readiness Inspections, and Emergency Operating Procedure Inspections. In fiscal year 1988, PRA-based guidance has been provided for 19 team inspections, of which 17 were completed during the report period. Experience with these types of inspections has been positive, with the desired allocation of available inspection resources going to items of high risk significance. An effort has also been initiated to develop generic guidance for use in the further development of PRA-based team inspections. With respect to resident inspectors, PRA-based guidance, in the form of Risk-based Inspection Guidance (RIG) documents has been completed for 17 plants with plant-specific PRAs. Moreover, a method has been developed to generate such guidance for plants without PRAs. Resident inspector acceptance of the RIGs, and the prospect of achieving better utilization of the resident inspector resource in the future, have also been positive. PRA-based guidance efforts for specialized team inspections and the resident inspectors will continue into fiscal year 1989.

A new operating reactor inspection program was developed in fiscal year 1988 for implementation in fiscal year 1989 and thereafter. The new program was developed with the assistance of NRC Regional Offices and under the direction of the Office of Nuclear Reactor Regulation. The objectives of the program are (1) to ensure that a minimum level of inspection takes place at every plant, (2) to integrate Headquarters and Regional Office programs, (3) to provide more flexibility for Regional Administrators to allocate resources based on plant performance, and (4) to explicitly allocate resources in response to safety issues and regulatory concerns. The purpose of the new inspection program is to obtain sufficient information through direct observation and verification of licensee activities to ascertain whether the facility is being operated safely, whether the licensee's management control program is effective, and whether regulatory requirements are being satisfied; the program also seeks to gather information in support of the Systematic Assessment of Licensee Performance (SALP) program evaluations (see "Performance Evaluation," later in this chapter).

The new inspection program comprises the following elements:

Fundamental Inspection Program. This inspection will be conducted at every plant, and consists of the following two parts:

- *The Core Inspection Program* provides a balanced look at a cross section of plant activities considered important to maintaining safety.
- *The Mandatory Team* Inspection Program is a team inspection that addresses one or more specific subject areas, selected by identification of either an emerging safety concern, or of an area requiring increased emphasis because of long-standing or recurring problems. For fiscal year 1989, the area of special emphasis for the Mandatory Team Inspections will be maintenance.

Regional Initiatives and Reactive Inspections. This phase of the new program provides inspection effort beyond that provided by the Fundamental Inspection Program and is based on plant performance in various functional areas. The Regional Administrator identifies the specific inspection activities to be carried out and the plants at which those inspections apply. Reactive inspections are generally unplanned inspections conducted in reaction or response to events or issues as they arise and as deemed necessary or desirable by the Regional Administrator.

Special Team Inspection Programs. Special team inspections provide an independent, in-depth, and balanced assessment of licensee performance. Special team inspections are conducted by both Headquarters and Regional Offices and are particularly useful for making in-depth assessments of the adequacy of specific functional technical disciplines among licensee personnel.

Safety Issues Program. This program provides the special inspection effort prescribed in a Temporary Instruction (TI). A TI may be issued for inspection follow-up on safety issues addressed in a Bulletin, Generic Letter, or any other specific safety issue that requires follow-up inspection on a one-time basis.

The Office of Nuclear Reactor Regulation will monitor the implementation of the new inspection program in all its phases during fiscal year 1989, to judge its effectiveness and make changes as necessary.

Special Inspections

The NRC Headquarters special inspection staff develops and carries out various types of team inspec-

tions in response to specific concerns of NRC management. The special team inspections generally involve a team of eight to 10 inspectors of various technical specialties, and including engineers from NRC contractor organizations. During the report period, the NRC performed 27 special team inspections, under the leadership of the Headquarters Division of Reactor Inspection and Safeguards.

Once a certain kind of special team inspection has proved useful and Headquarters has gained experience with it, that activity may be assigned in part to the Regional Offices. Examples of such assignments are the Safety System Functional Inspection (SSFI) and the Safety System Outage Modification Inspection (SSOMI). The *1987 NRC Annual Report* (pp. 23, 24, 26) contains descriptions of these two types of multi-skill team inspections, and also of the Operational Safety Team Inspection (OSTI). During fiscal year 1988, NRC Regional Offices performed SSFIs at the Palo Verde (Ariz.) and Surry (Va.) facilities, and an SSOMI at the Zion (Ill.) nuclear power plant.

In general terms, the SSFI is an in-depth inspection of a particular safety system, covering every aspect—from design through testing and installation of support systems—as a representative sample of the functionality of all safety systems in a given plant. The SSOMI is an in-depth inspection of modifications performed during a major plant outage to determine whether the modifications have affected the ability of plant systems to perform their designed safety functions. An OSTI examines various aspects of plant operation in detail and may include a period of around-the-clock inspections to sample activities on night shifts. During fiscal year 1988, the NRC performed an SSFI at Indian Point Unit 2 (N.Y.); SSOMIs at Fort Calhoun (Neb.) and Wolf Creek (Kans); follow-up inspections to earlier SSOMIs at Dresden Unit 3 (Ill.) and Fort Calhoun; and OSTIs at Davis-Besse (Ohio), Fort St. Vrain (Colo.), and Perry (Ohio).

Design studies of both SSFIs and SSOMIs have uncovered significant problems both in the adequacy of the documentation which describes the plant design bases and in the way certain of the licensees' engineering personnel understand the design bases. The significance of these findings lies in the fact that some configurations may prevent the systems from performing adequately under certain conditions. The problem is manifested in several ways, including: (1) missing or inappropriate assumptions for calculations; (2) missing or inaccurate calculations in support of a design value, such as a setpoint or a component performance limit; and (3) system configurations that do not meet single-failure criteria. One recurring SSOMI finding is that changes to installation and test procedures are often made in the field without the appropriate supervisory or engineering review and approval.

A detailed discussion of lessons learned from SSFI and SSOMI inspections was published in "Fundamental Attributes of a Practical Configuration Management Program for Nuclear Plant Design Control" (NUREG/CR-5147, June 1988).

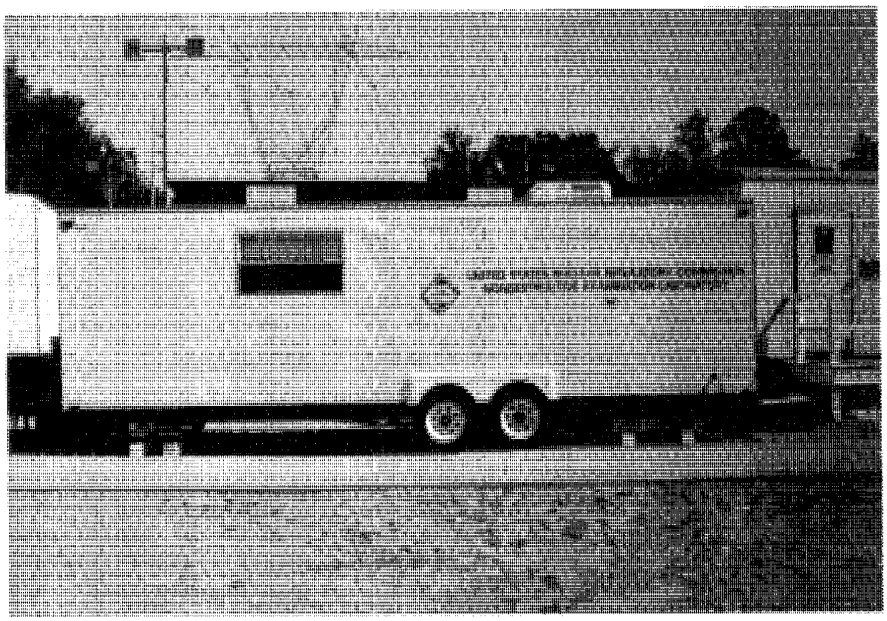
Two independent design and construction inspections were made at Limerick Unit 2 (Pa.), a plant that is in the late stages of construction. Three special team inspections were made at Rancho Seco (Cal.) to determine the effectiveness of the licensee's program for getting the plant ready for restart. And two inspections focused on design were also conducted prior to the restart of TVA's Sequoyah (Tenn.) plant.

Emergency Operating Procedures Inspections

The NRC continues to implement a long-term program of upgrading in the area of emergency operating procedures (EOPs). The program was initiated shortly after the Three Mile Island accident in 1979. The objectives of this early program were both to improve the technical content of EOPs and also see to the incorporation of human factors principles in the procedures. Owners Groups, representing the four nuclear power plant vendors, have satisfactorily reanalyzed relevant transients and accidents and have developed generic technical guidelines for improving their EOPs. The industry has been revising the EOPs to reflect both the engineering guidance contained in the generic technical guidelines and the human factors principles contained in "Guidelines for the Preparation of Emergency Operating Procedures" (NUREG-0899, August 1982).

In order to gain a better understanding of the types and severity of problems that licensees may be having with the EOP's, NRC staff began in fiscal year 1988 an accelerated inspection of the EOPs, with the objective of determining whether the EOPs were technically correct; whether they could be performed by plant operators during an emergency, taking account of locale, accessibility, and other physical factors; and whether the plant staff possessed the requisite knowledge and ability to correctly perform the EOPs in an emergency. Among other methods, the plant reactor simulator was employed, when available, in conducting the assessment.

At its inception, the inspection program was divided into two phases. Phase 1 involved a 16-plant set which included each of the four types of Nuclear Steam Supply Systems (reactors and steam generating systems), in order to assure an industry-wide sample. Phase 2 was more narrowly focused, specifically dealing with Mark I BWR power plants. Both phases employed six-member teams made up of reactor inspectors, human factors specialists, license ex-



The NRC Mobile Non-destructive Examination Laboratory, shown here during an on-site inspection, has been in operation at scores of reactor plant sites since 1981, throughout the United States. The laboratory is based at the Region I office in King of Prussia, Pa.

aminers, and systems engineers. Phase 1 was carried out by region-based teams, while Phase 2 was headquarters-based.

In general, the inspections verified the technical accuracy and validity of the EOPs, though specific concerns emerged at each plant. Examples of findings included problems with the logic or clarity of the procedures; unclear or missing labels on components that would be involved in emergency response; inadequate pre-staging of equipment, tools, and materials that would be needed in emergency procedures; and inadequate training of some operators in the proper conduct of the procedures.

Upon completion of Phases 1 and 2 of the EOP inspections, the staff will analyze the results, prepare summary reports, and, in the context of previous audits and inspections, decide on appropriate follow-up actions.

Non-destructive Examination Laboratory

Since July 1981, over 65 inspections have been conducted at reactor sites throughout the country using the NRC's mobile non-destructive examination (NDE) laboratory. Over the past few years, the scope of the NDE team's inspections has expanded to include activities at operating facilities, as well as the construction sites where NDE has customarily been employed. Routine mobile NDE inspections at operating plants include independent examinations to verify the quality of piping and component replacements, system modifications, and licensees' inservice inspection activities. Examples of special modifications at operating facilities include inspection of the Waterford Unit 3 (La.) modification program, Peach Bottom Unit 3 (Pa.) piping replacement, and steam generator replacement at the D. C. Cook (Mich.) plant. The mobile lab has also been used to provide independent assessments related to NRC investigations of various allegations.

The laboratory consists of a specially equipped trailer, designed for both transport and storage of equipment, a darkroom for manually developing radiographic film, and an area to collect and review results. The assigned personnel and contractors perform radiography, ultrasonic, liquid penetrant, and magnetic particle examinations. Visual examinations of piping, pipe support, and structural welding are also performed, along with testing of concrete and electrical cabling. The laboratory now features a state-of-the-art ultrasonic testing system, further enhancing the team's ability to independently appraise service-induced defects such as stress corrosion cracking.

The NDE program is a joint effort of NRC Headquarters and the Regional Offices. It is operated out of the Region 1 Office near Philadelphia. During the fiscal year, the NDE van was replaced with a new trailer specially designed for NDE purposes. Experience indicates that the new trailer is a dependable and cost-effective replacement, whose design and special features effectively redress certain deficiencies in the older vehicle. A complementary non-destructive examination facility is located at the Region 1 Office, where such appraisals as hardness testing, alloy analysis, ferrite measurements, and non-destructive examination of unirradiated materials can be carried out.

The NDE program continues to provide the NRC with the qualified staff and appropriate equipment to make independent assessments of the quality of licensee construction, modifications, and inservice inspections.

Vendor Inspection Program

In fiscal year 1988, NRC vendor inspections focused on vendor activities associated with nuclear plant operation, maintenance, procurements, and modifications. Inspection emphasis was on the quality of the vendor products, the licensee/vendor interfaces, environmental qualification of equipment, equipment problems found during operation, and corrective actions in response to identified problems. Inspections of vendors and contractors were based on information from a variety of sources including licensee construction deficiency and operating reactor event reports (10 CFR 50.55e, 50.72, and 50.73), vendor reports of product defects (10 CFR 21), reports of events from the NRC Regional Offices, allegations from members of the public pertaining to vendor activities, and vendor issues identified by the NRC through its inspection programs.

During the year, the vendor inspection staff conducted a major investigation to determine the nature and extent of possible misrepresentations by certain vendors that their products were qualified for nuclear service or that they met other quality standards important for components to be installed in a nuclear power reactor. The vendor inspection staff also gave technical support to the NRC's Office of Investigations, which was investigating these vendors to ascertain whether there was wrongdoing and/or possible violation of Federal law in the vendors' sales and services to the nuclear industry. Examples of potentially misrepresented products reviewed during the report period included fasteners, flanges, pipe fittings, valves, and electric circuit-breakers. The vendor staff also conducted inspections to determine the safety significance of other reported component failures and problems, to define and assess the way commercial-grade components were being qualified for use in nuclear safety systems, and to evaluate the adequacy of licensee controls over procurement of components for plant safety-related systems. In all, the NRC's vendor inspection staff performed 92 separate inspections in fiscal year 1988.

The NRC also continued to review inspections of licensee procurement of fasteners (bolts and nuts) begun in fiscal year 1987. The effort was initiated in response to a concern by the Industrial Fastener Institute about the possible use of inferior fasteners in military and industrial applications. Simultaneously, the House Energy and Commerce Committee had under way a long term investigation of fraudulently qualified fasteners in use throughout the Government. A bulletin was issued by the NRC requesting that each licensee test a certain number of fasteners. Results indicated that only a very small fraction of fasteners were substantially substandard, but that about one in 10 fasteners was slightly out of conformance with specifications. The NRC conveyed full particulars on the extent of the problem within the nuclear industry to the House Committee.

Other undertakings in the Vender Inspection Program during the year included major on-site team inspections performed at Maine Yankee and Rancho Seco (Cal.), as part of a continuing examination of licensee procurement practices, and of their interactions with contractors and vendors. Also, equipment qualification inspections were completed at all operating plants, by May 1988. This round of inspections started in 1986 with the objective of determining whether each licensee had completed tests of electrical equipment, in compliance with the environmental qualification requirements of 10 CFR 50.49. The tests determine whether, in the event of a design-basis event, electrical equipment would retain its capacity to help ensure the integrity of the reactor coolant boundary, shut down the reactor safely and keep it in safe shutdown condition, and also prevent or mitigate the consequences from a design-basis event.

PERFORMANCE EVALUATION

The performance evaluation process is intended to improve the NRC's ability to evaluate the effectiveness of nuclear power plant licensee performance. The effort involves the integration of information from various of the NRC's continuing activities—such as the Systematic Assessment of Licensee Performance (SALP), enforcement actions, performance indicator tracking, trend analysis, event evaluation, operator examinations, and inspections generally. The fruition of the process comes with a semiannual meeting of NRC senior management to discuss and assay operating plant performance. On this occasion, the plants of greatest concern to the agency are identified and a coordinated course of action drawn up, including recommendations for special inspections and intensified management attention.

As noted, a principal and regular source of data by which licensee performance is judged is the SALP program. Under the program, the performance of each licensee with a nuclear power facility under construction or in operation in the United States is evaluated through the periodic, comprehensive examination of all available data relevant to each facility.

The SALP is an integrated assessment as to how well a given licensee management is directing, guiding, and providing resources needed for the requisite assurance of safety. The purpose of the SALP review is to direct both NRC and licensee attention and resources toward exactly those areas which can most closely affect nuclear safety and which need improvement.

Part of the SALP assessment involves a review of the past year's Licensee Event Reports, inspection reports, enforcement history, and licensing issues. Also important are evaluations by resident and region-based inspectors, licensing project managers, and senior managers, all of whom are to some degree familiar with the facility's performance. New data are not necessarily generated in the conduct of a SALP assessment, which essentially comprises performance evaluations in certain specific functional areas, such as plant operations, maintenance and surveillance, emergency preparedness, and so forth. The process was recently modified to redefine some of the functional areas to be scrutinized, with emphasis on the detection of changes or noticeable trends in licensee performance and underlying reasons therefor.

The systematic assessment program supplements normal regulatory processes and is intended to be sufficiently diagnostic to give meaningful guidance to utility management regarding NRC concerns about quality and safety in plant construction or plant operation. Results of the assessment make up part of a data base for periodic reporting in the historical data summary published semiannually, most recently in "Historical Data Summary of the Systematic Assessment of Licensee Performance" (NUREG-1214, Revision 4, October 1988).

Policy Statements

The staff has completed a proposed, updated policy statement on working hours for nuclear power plant staff. In addition, the Commission directed the staff to develop a policy statement on the professional conduct of nuclear power plant operators. The staff completed its work on this during the report period and submitted a proposed policy statement for Commission consideration.

Management and Organization

The NRC continues to focus attention on licensees whose management performance appears to be weak. In addition to evaluating leadership and management practices, and their impact on nuclear operational performance, the NRC is also evaluating the overall "organizational environment/operator culture," to determine what effects it is having on plant performance. While leadership and management practices deal with effective management principles and skills, organizational environment/operator culture focuses on attitudes, norms, practices, and history, and their role in creating an atmosphere that may affect nuclear operational performance. During the report period, NRR performed such evaluations at the Peach Bottom (Pa.) nuclear power plant and gave support in a similar diagnostic inspection at the Fermi (Mich.) plant and in an evaluation of a third-party assessment of the Turkey Point (Fla.) plant.

Man-Machine Interface

Staff reviews of the man-machine interface continued during the report period in the two major efforts in this area: "Detailed Control Room Design Reviews" (DCRDR) and "Safety Parameter Display Systems" (SPDS). By the end of fiscal year 1988, the DCRDR process was completed at all but 20 units. However, only 17 units have completed implementation of prescribed control room changes. An SPDS has been installed at all but 10 units, but the NRC has not yet reviewed a majority of them. In 1986, an Information Notice (86-10) was issued to the industry describing some weaknesses found in SPDSs, identified during conduct of a pilot audit program. The NRC plans to accelerate reviews of Control Room Designs and SPDSs throughout fiscal years 1989 and 1990.

The NRC staff's continuing reviews of industry training and accreditation programs for reactor operators confirmed that considerable progress has been made in this area, though certain deficiencies remain. NRC observers are often present when utility training programs are undergoing accreditation evaluation.

Training

During fiscal year 1988, the staff continued to evaluate the results of the Institute of Nuclear Power Operations (INPO) accreditation program to determine whether the industry's voluntary efforts will suffice to ensure that the training is appropriately performance-based. As part of the evaluation, NRC staff personnel are present as observers when utilities' training programs are under scrutiny by an INPO accreditation team. The staff has also conducted post-accreditation reviews during the report period.

The staff has concluded that the industry is making progress in bringing about improvements in training and in implementing the Commission's Policy Statement. While training improvements have been observed, training deficiencies continue to be found in both accredited and non-accredited training programs. The staff has recommended, therefore, that the Commission (1) continue to endorse the industry accreditation program and defer rulemaking in this area, (2) allow the staff to continue to evaluate industry implementation of the training and qualification of nuclear power plant personnel, and (3) direct the staff to propose an amended policy statement on training and qualification of nuclear power plant personnel incorporating the findings from the two-year trial period and the results of discussions with INPO. The staff has recommended that the Commission endorse an amended policy statement reflecting these recommendations.

QUALITY ASSURANCE

Quality Assurance Plan

NRC activities in the area of Quality Assurance (QA) continue to follow the plan designed in accordance with the recommendations of the QA Report to Congress, entitled "Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants" (NUREG-1055, May 1984). The central focus of staff emphasis lies in four areas: the inspection program, software QA, procurement of commercial grade items, and QA training. Activity and accomplishment in these areas are described below. In addition, the QA staff is providing QA guidance to industry and to other program offices of the NRC on such issues as decommissioning, independent spent fuel storage installations, QA standards development, and configuration management.

Inspection Programs for Quality Assurance

Readiness Reviews. A Readiness Review is a formal assessment of a licensee's readiness to construct or operate a nuclear power plant. It is a comprehensive evaluation of the licensee's plans for the design, construction, and pre-operational activity associated with a nuclear facility, so that issues and problems can be identified at a stage when they can best be resolved. Readiness Reviews for the Georgia Power Company's Vogtle Units 1 and 2 were successfully undertaken in 1987.

Quality Verification Functional Inspections. Quality Verification Functional Inspections (QVFIs) are conducted to assess the effectiveness of licensees' quality verification organizations in identifying and obtaining corrective action for the prompt resolution of problems and deficiencies. Seven NRC headquarters-led QVFIs have been conducted in four of the five NRC Regions. The inspections were led by the QA staff, with multi-regional participation and support. These inspections have identified safety-significant technical problems and deficiencies and have successfully alerted licensees to the importance of having their quality verification organizations involved in the daily activities of operations. In this regard, Inspection Procedure 35702, "Inspection of Quality Verification Function," was issued in August 1988 as a regional initiative.

QA Inspection Procedures. The staff is reorienting the NRC QA inspection program for operating reactors in order to assure proper emphasis on QA program performance and effectiveness. The first such measure is described above, under "Quality Verification Functional Inspections." Inspection Procedure 35502, "Evaluation of Licensee Quality Assurance Program Implementation," was issued in August 1988 as a Core Inspection Program.

Procurement Quality Assurance

An inspection procedure was issued during the report period on determining the suitability of applications for commercial grade items to be used in safety-related functions—Inspection Procedure 38703, "Commercial Grade Procurement Inspection" (June 1988). The procedure gives guidance to inspectors in evaluating licensees' commercial grade procurement activities. It focuses on the engineering effort required to identify an item's critical characteristics and the acceptance phase required to verify those characteristics. Trial inspections have been performed at the Ginna (N.Y.) plant, Donald C. Cook (Mich.), Peach Bottom (Pa.), H. B. Robinson (S.C.), and Fermi Unit 2 (Mich.),

to confirm that the guidance appropriately addresses procurement requirements and licensee practices.

In this connection, an issuance of the Electric Power Research Institute (EPRI) entitled, "Guidelines for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications" (NCIG-07, EPRI NP-5652, March 1988), has been submitted to the NRC for review.

As a result of procurement inspections and also of the discovery of fraudulently qualified material and equipment at nuclear facilities (see "Vendor Inspection Program," above), the QA staff is developing guidance by which licensees can improve and strengthen their existing procurement programs and increase their ability to detect fraudulent materials. It will emphasize fraudulent procurement problems, licensee procurement responsibilities, and existing NRC regulations and guidance.

Computer Software Quality

Continuing advancements in computer technology and the ever-increasing use of computers in the nuclear industry require that the NRC become more involved in the assurance of software quality. With the publication of the "Handbook of Software Quality Assurance Techniques Applicable to the Nuclear Industry" (NUREG/CR-4640, August 1987), NRC staff has taken steps to provide the needed guidance to industry. The staff is also involved in the development of a consensus national standard for software quality assurance. A Temporary Instruction is being prepared, so that NRC inspectors can assess the effectiveness of industry's QA programs in the development and use of computer software in nuclear applications.

NRC Inspection Training

A training course, "Inspecting for Performance," has been developed by the NRC to help the agency shift QA inspection emphasis from programmatic QA inspections toward performance-oriented, technical-based inspections. The course has been presented 13 times and is now required for certification of regional inspectors. The basic elements of the course are summarized and discussed in "Performance-Based Inspections" (NUREG/CR-5151, June 1988).

A second course, "Effective Communications with Licensees," has been developed and presented nine times to NRC inspection personnel. This course is designed to facilitate NRC inspectors' communications with licensee personnel during inspections and the inspection-related entrance and exit meetings.

Maintenance

The staff continued activities related to the evaluation of maintenance effectiveness in the nuclear power industry, initiated as part of a Maintenance and Surveillance Program Plan adopted during the report period. On March 23, 1988, the Commission published in the Federal Register (53 FR 9430) a final policy statement on maintenance in nuclear power plants. The statement provides interim guidance to the industry on NRC expectations regarding activities and functions which form the basis of an effective maintenance program, while NRC rulemaking on the subject proceeds. The staff developed a notice of proposed rulemaking on licensee maintenance programs, and a public workshop was held in July 1988 to solicit and receive public comment on the thrust of this rulemaking.

OPERATOR LICENSING

With the decline in new facility license issuances, initial (i.e., for new plants) operator examinations have decreased significantly. Only 35 such examinations were administered in fiscal year 1988. Replacement examinations for power and non-power reactor operators continued to be administered by the five Regional Offices. Following these, the NRC issued 322 new operator licenses and 391 new senior reactor operator licenses. Also, 818 reactor operator and 1,527 senior reactor operator renewal licenses were issued. The NRC-administered requalification examinations were suspended in September 1987, because of concerns as to their impact on plant operations personnel. A completely revamped prototype program was developed to make the requalification examination at each facility less theoretical and more operations-oriented and plant-specific. A pilot test of the prototype examination was conducted at a facility in each of the five Regions and completed in June 1988. The test results indicated that the new requalification program was effective in meeting NRC requirements while causing minimal impact on plant operations personnel. The new program is scheduled to be reinstituted in fiscal year 1989, after final incorporation of comments resulting from the pilot tests.

Oversight of Regional Office performance in administrating the operator licensing program continued to be exercised by means of annual office reviews of the examination process. In addition, quality control audits of NRC and contractor examiner performance during the conduct of examinations on-site were performed periodically by the Headquarters Office. The document "Operating Licensing Examiner Standards" (NUREG-1021, Rev. 4, May 1987) was restructured and

formatted into Revision 5, to be published early in fiscal year 1989. Major changes included the following:

(1) Revision of the written examination process to conform to the "Examiners' Handbook for Developing Operator Licensing Examinations" (NUREG/BR 0122, January 1988).

(2) Administration of the new requalification examination program Examiner Standard-601 (ES-601).

(3) Administrative review procedures to evaluate examination results that lead to a denial of license and appeal for hearing.

(4) Operating test grading practices.

(5) Training and certification of new examiners to conduct NRC-administered examinations.

In response to certification requirements for simulation facilities contained in the revised 10 CFR Part 55, five utilities have submitted certifications. An NRC inspection team conducted the first inspection of a certified simulation facility in August 1988, in order to verify simulator fidelity and the replication of actual plant operating characteristics.

As part of a long range examination development program, the NRC has developed a pilot BWR Fundamentals examination, which was administered to 209 volunteers in September 1988. The examination was designed to test applicants' knowledge of fundamental reactor theory, thermodynamics, and plant components. The questions were generic to all boiling-water reactors and the examination was administered simultaneously at various locations in the Regions. Results of the pilot test are being evaluated and will be incorporated in future pilot tests. A pilot PWR Fundamentals test, on the pressurized-water reactor, was planned for February/March 1989.

EMERGENCY PREPAREDNESS

During the report period, the staff continued to evaluate the adequacy of applicant on-site plans to be included in the Safety Evaluation Report for each plant in near-term operating licensing status (designated NTOLs). NTOLs appraised during fiscal year 1988 included Shoreham (N.Y.), Seabrook (N.H.), and Braidwood Unit 2 (Ill.). Headquarters staff also participated in many of the 70 emergency preparedness exercise inspections conducted by the Regions and provided guidance to the Regions on the implementation of the emergency preparedness inspection program.

A major activity during the report period was the development and implementation of the Commission's new "realism rule" (52 FR 42078). Heretofore, off-site emergency plans were primarily prepared by State and local governments. The new rule permits the evaluation by the NRC of off-site emergency plans that are prepared by a utility, in cases where State and/or local governments decline to participate in emergency planning. The "realism rule" derives from a stated premise in the rule that, in making its determination on the adequacy of a utility plan, the NRC will recognize the reality that in an actual emergency, State and local government officials will exercise their best efforts to protect the health and safety of the public. With the "realism rule," while agreeing that State and local participation in emergency planning is essential to the maximum effectiveness of a plan, the Commission provided that, in the event that State and local governments decline to participate in the planning process, a license can still be issued—even if the emergency plan falls short of the ideal—if the plan is still adequate to protect the public health and safety.

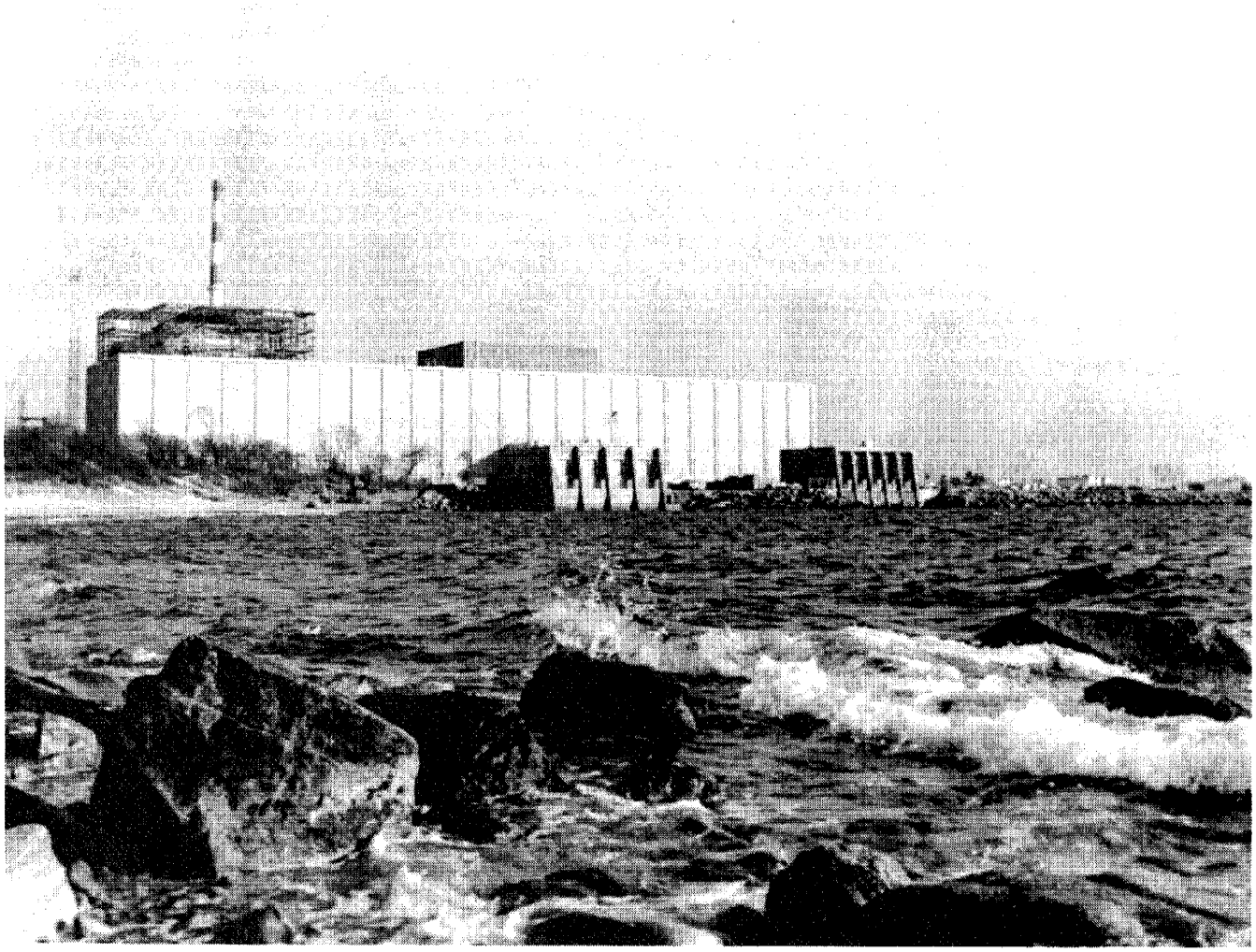
NRC staff, along with the Federal Emergency Management Agency (FEMA), gave guidance for the development, review, and evaluation of these utility off-site radiological emergency response plans. The central features of the guidance are the development of a utility off-site response organization and provision by the utility of liaison personnel to advise and assist State and local officials in an emergency. FEMA has applied these criteria to the review of the Shoreham and Seabrook off-site plans and exercises. Both the Shoreham and Seabrook exercises were found by FEMA to be adequate to protect the public health and safety.

SAFETY REVIEWS

Integrated Safety Assessment Program

In a policy statement published in the Federal Register on November 15, 1984, the Commission proposed a trial program to evaluate all pending licensing issues related to a given operating reactor—in conjunction with relevant operating experience, probabilistic analyses, and licensee plant improvements—so as to establish effective and realistic implementation schedules for any necessary plant modifications. The program, called the Integrated Safety Assessment Program (ISAP), was introduced in early 1985 at two plants in Connecticut, Millstone Unit 1 and Haddam Neck. The licensees for these plants volunteered to implement ISAP.

In 1985 and 1986, Northeast Utilities (agent and service organization for both plants) completed the plant-specific probabilistic safety studies (PSS) for both plants, together with safety assessments for the licensing issues pertaining to the facilities. The NRC staff



Northeast Utilities Company's Millstone nuclear power plant at Waterford, Conn., shown above, was one of two plants volunteered by the utility for participation in a trail program, the Integrated Safety Assessment Program (ISAP), proposed by the NRC in 1984. By mid-1987, the staff had completed draft safety assessment reports on the two facilities and in 1988 began review of comments on those reports. Final Safety Evaluation Reports will be issued in 1989.

completed detailed reviews of the PSS for both plants during 1986. Then, in July 1986 and December 1986, Northeast Utilities submitted the ISAP reports for Millstone Unit 1 and Haddam Neck. These reports specified actions that could be taken to resolve safety issues and rated their relative safety significance.

The staff issued the draft Integrated Safety Assessment Report (ISAR) for Millstone Unit 1 in April 1987 and the draft ISAR for Haddam Neck in July 1987, seeking comments by the public, the licensee, a peer review group, and the ACRS. Comments on the draft reports will be incorporated into final Safety Evaluation Reports (SERs), together with integrated implementation schedules for all issues identified. The final SERs for Millstone Unit 1 and Haddam Neck are to be issued in fiscal year 1989.

The staff detailed the progress made in ISAP and made recommendations for future applications of the program in SECY-87-219, dated August 31, 1987, and also at a November 4, 1987 meeting with the Commission. At the Commission's request, the staff has developed ISAP II, a proposed follow-on program to ISAP, and in Generic Letter 88-02, dated January 20, 1988, solicited industry's reaction to the second program. The phases and components of ISAP II, as well as the results of the industry survey, were set forth in SECY-88-159, dated June 6, 1988. Thereafter, the Commission directed the staff to make resources available in support of licensees who voluntarily chose to use the ISAP approach, in conjunction with the Individual Plant Examinations to be conducted as part of the implementation of the Commission's Severe Accident Policy Statement.

Applications of Probabilistic Risk Assessment

The applications of probabilistic risk assessment (PRA) in regulatory activities continued to expand in fiscal year 1988. Traditional uses of PRA—as in setting priorities for the resolution of generic issues, in policy development, and in plant-specific licensing issues—continued to prove useful and important to the safety of nuclear power plants. NRC staff review of plant-specific PRA studies also continued, with new PRA reviews initiated for Crystal River (Fla.), Brunswick (N.C.), and Three Mile Island Unit 1 (Pa.). Significant progress has been made in the review of PRAs for standard plant designs, including the Westinghouse SP-90. (See "Standardization," under "Improving the Licensing Process," earlier in this chapter.)

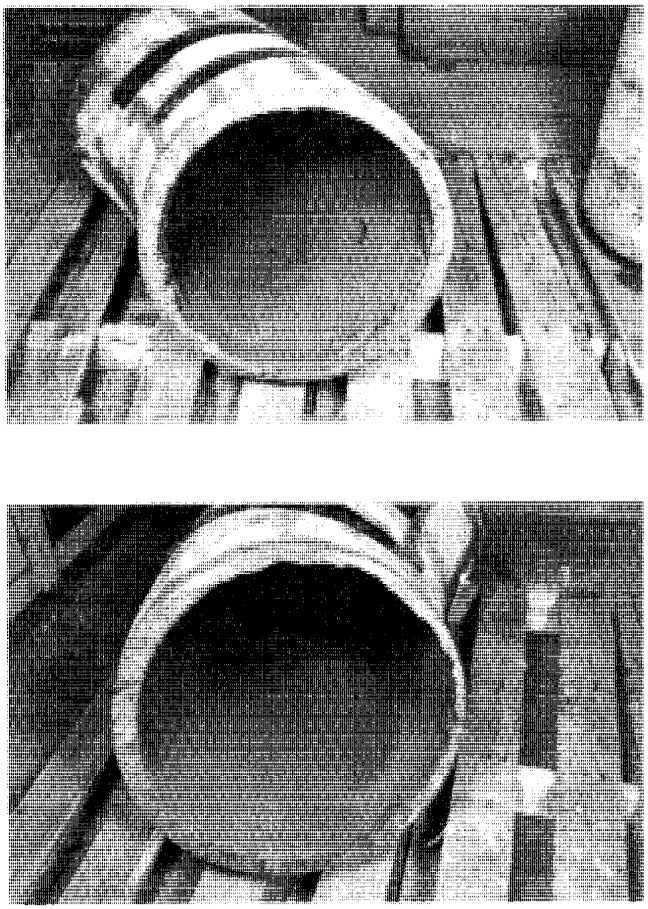
Major progress has been made in the application of PRA results and insights to licensing and inspection activities. PRA-based team inspections were conducted during fiscal year 1988 at the Grand Gulf (Miss.), Brunswick (N.C.), Hatch (Ga.), LaSalle (Ill.), Beaver Valley (Pa.), and Fitzpatrick (N.Y.) facilities. For the first time, PRA insights were applied in the planning of specialized inspections, such as Safety System Functional Inspections, Maintenance Team Inspections, and Emergency Operating Procedure Inspections. PRA-based guidance for resident inspectors has been completed for 17 plants with plant-specific PRA's, and a method has been developed for generating such guidance for plants without PRA's.

Significant improvements in Standard Technical Specifications (STS) have also been made with the use of PRA, through review and approval of Owners-Group-sponsored topical reports and through risk-based evaluation of proposed "relocations" of technical specification under the Technical Specification Improvement Program.

The methods and results of PRA also have a major role in applications of the Severe Accident Policy. The Generic Letter on Individual Plant Examination (IPE), near completion at the end of the report period, gives guidance for all utilities in the use of probabilistic methods to identify and eliminate significant plant-specific risk contributors. Similarly, the two other major aspects of Severe Accident Policy implementation—Accident Management and Containment Performance—will also draw heavily on the results of existing PRA studies. Finally, PRA is used on a regular basis in assessing the significance of operating events, and increasingly in the assessment of plant performance.

Erosion/Corrosion in LWRs

On December 9, 1986, Surry Unit 2 (Va.) experienced a catastrophic failure of a main feedwater pipe. Since that event, the industry, in conjunction with the NRC, has taken steps to develop monitoring programs to anticipate and prevent the rupture of high-energy piping because of single-phase erosion/corrosion.



The failure of a main feedwater pipe at Surry Unit 2 (Va.) in 1986 led to deepened concern about unexpected pipe wall thinning and the need for extensive erosion-corrosion monitoring of feedwater lines at U.S. reactor plants. Above are shown corroded feedwater pump discharge elbow outlet (top) and inlet ends. Industry surveys completed in 1988 disclosed that the problem was widespread. Monitoring programs were in place at the end of the report period, and the NRC is working with the American Society of Mechanic Engineers (ASME) Code Committee to address the issue on a long term basis.

In March 1987, INPO issued a report which recommended adoption at all U.S. nuclear power plants of a continuing program which would include analyses designed to predict wear rates and also prescribe regular inspections. In June 1987, the Nuclear Utilities Management and Resource Council (NUMARC) issued guidelines for erosion/corrosion monitoring in single-phase lines. At the same time, the Electric Power Research Institute (EPRI) issued a computer code to assist licensees in identifying the piping locations most susceptible to erosion/corrosion.

Because of the immediate concern about high-energy, carbon steel systems and the absence of regu-

latory requirements for pipe wall thickness inspections, the staff issued a Bulletin (87-01) on July 9, 1987, to garner data from which to assess the generic implications of the Surry incident. In addition, NRC Information Notice 87-36 was issued on August 4, 1987, alerting licensees to the significance of unexpected pipe wall thinning in the safety-related portion of feedwater lines at the Trojan (Ore.) plant. All licensees responded to the Bulletin, and the staff completed its review in late December 1987. In June 1988, NUMARC also completed its survey on erosion/corrosion among U.S. light-water reactors (LWRs). Results of the staff review and the NUMARC survey indicated that erosion/corrosion is widespread, especially among the PWRs. Wall thinning has been discovered in both safety-related and non-safety-related portions of the feedwater lines.

As part of the overall effort to address the pipe wall thinning issue, the NRC staff and its consultants completed inspection of 10 plants toward the end of the report period, assessing the licensees' erosion/corrosion monitoring program. Results of these inspections were being evaluated at the end of the fiscal year. As of that time, the staff had found that all licensees had in place erosion/corrosion monitoring programs which meet the intent of NUMARC guidelines. With a few exceptions, most licensees had no written procedures or administrative controls implementing the pipe wall thinning monitoring programs. The NRC staff is working with the American Society of Mechanical Engineers (ASME) Code Committee to address the pipe wall thinning issue. Decisions from the ASME Section XI Committee regarding pipe wall thickness inspection, and the staff evaluation of industry's effectiveness in implementing the monitoring programs, will form the basis for staff recommendation regarding the need for additional regulatory requirements concerning erosion/corrosion inspection.

Loss of Decay Heat Removal Function

Since the event at Diablo Canyon Unit 2 (Cal.) on April 10, 1987, involving a loss of the decay heat removal capability (see discussion in the *1987 NRC Annual Report*, p. 49), the staff has evaluated the generic consequences of the loss of this function at PWRs with partially drained reactor coolant systems. The evaluation included the review of: (1) licensee operations during this mode of operation; (2) the ability of licensees to mitigate a loss of decay heat removal event; and (3) the risk significance of such operation.

The staff has concluded that the risk from this kind of event during non-power operation, especially when operating with a partially drained reactor coolant system, may be comparable to that during power operation. Additionally, review of licensee operations indicate that deficiencies exist in procedures, hardware, and training with respect to: (1) prevention of accident initiation; (2) mitigation of accidents before they potentially progress to core damage; and (3) control of radioactive material if a core damage accident should occur. The staff has transmitted to all PWR licensees recommendations for expeditious remedial action and long term improvements. These actions include enhancements in plant instrumentation and procedures which will significantly reduce the risk associated with plant operation with a partially drained reactor coolant system inventory.

Station Blackout Rule

As it applies to commercial nuclear power plants, the term "station blackout" means the loss of off-site alternating current (a.c.) power to the safety and non-safety electrical buses concurrent with turbine trip and the unavailability of the emergency diesel generators (as may be the case with units out of service for maintenance or repair, or failure of the generators to start on demand, or their failure to continue to run after start). If a station blackout persists for a time beyond the capability of the a.c.-independent systems to remove decay heat, core melt and containment failure could result.

Concern about station blackout grew out of accumulated experience involving the reliability of a.c. power supplies. Many operating plants have experienced a total loss of off-site electric power, and more such occurrences are expected in the future. In a few cases, there has been a complete loss of a.c. power, though the a.c. power was restored in a short time without any serious consequences. And the Reactor Safety Study (WASH 1400-75) disclosed that, for some plants, a station-blackout event could be an important contributor to the total risk from nuclear power plant accidents. Although the total risk was found to be small, the relative importance of station blackout was established. To address this concern, the NRC amended its regulations, adding a new requirement (§50.63) that all nuclear power plants be capable of dealing with station blackout for some specified duration of time, as determined by plant-specific design and site-specific considerations.

Following a number of studies, the NRC staff has developed Regulatory Guide 1.155, entitled "Station Blackout," giving guidance as to (1) maintaining a high level of reliability for emergency diesel generators; (2) developing procedures and training to restore off-site and on-site emergency a.c. power, should either one or both become unavailable; and (3) defining an acceptable plant-specific station blackout duration, one

which the plant would be capable of surviving without core damage. Application of the methods set out in the guide permit the selection of an acceptable station blackout duration. Licensees may use an alternate a.c. power source to deal with station blackout if that source meets specific criteria for independence and capacity, and can be available within one hour. A coping analysis is not required for those plants that choose this approach, if the a.c. source can be available to power the reactor shutdown buses within 10 minutes.

Concurrent with the development of Regulatory Guide 1.155, the Nuclear Management and Resource Council (NUMARC) has developed guidelines and procedures for assessing station-blackout coping capability and the allowable duration for light water reactors (NUMARC-8700). The NRC staff has concluded that NUMARC-8700 provides acceptable guidance for meeting the requirements of §50.63 of 10 CFR Part 50.

NRC staff expects licensees' submittals consistent with the format of NUMARC-8700 guidelines to begin arriving in early 1989, 270 days after the effective date of the Rule. The staff has revised the Standard Review Plan (NUREG-0800) and developed a Temporary Instruction to be issued to the Regions on the conduct of inspections on station-blackout rule implementation.

Reassessment of B&W Reactors

The NRC's Executive Director for Operations informed the Chairman of the Babcock & Wilcox Owners Group (BWOG), by letter dated January 24, 1986, that events at B&W-designed reactors had led the NRC staff to conclude that there was a need to re-examine basic design requirements for B&W reactors. In its response, on February 13, 1986, the BWOG agreed to take the lead in a concerted effort to define the factors in B&W plants causing the frequency of reactor trips or shutdowns and the complexity of post-trip response. The BWOG worked up a reassessment plan which NRC staff reviewed, proposing certain changes which were incorporated by the BWOG. A final report by the BWOG, "B&W Owners Group Safety and Performance Improvement Program (SPIP)," Revision 5 (BAW-1919),was issued in July 1987. This effort generated approximately 235 specific recommendations for improving B&W plant safety and performance.

The NRC staff reviewed BAW-1919 and presented its evaluation in "Safety Evaluation Report related to Babcock & Wilcox Owners Group, Plant Reassessment Program" (NUREG-1231, November 1987) and in Supplement No. 1 to NUREG-1231, published in March 1988. Overall, the staff's evaluation was favorable. The staff concluded that the proper implementation of the BWOG/SPIP recommendations by B&W utilities should effect a reduction both in reactor trip frequency and in transient complexity, and should also result in an increase in the level of safety at B&W plants. The staff also concluded that B&W plants do not carry a core damage risk greater than plants with pressurized water reactors (PWRs) designed by Westinghouse or Combustion Engineering. (Seventy-two of the 110 nuclear power plants with operating licenses as of the end of fiscal year 1988 are PWRs, and eight of these are of B&W design; all the other licensed PWRs are either of Westinghouse or Combustion Engineering design.)

To ensure that each utility's program would actually implement the SPIP recommendations, the staff began a program of plant-specific audits in October 1988. The audits addressed (1) each utility's program to evaluate the BWOG/SPIP recommendations, (2) each utility's implementation of selected key recommendations, and (3) each utility's response to Inspection and Enforcement (IE) Bulletin 79-27, "Loss of Non-Class 1E Instrumentation and Control Power System Bus During Operation." This third series of audits was instituted because the staff believed that the B&W utility responses to the concerns of IE Bulletin 79-27—which are not specifically addressed by the SPIP program—need further verification. This audit program will continue into 1989.

Occupational Exposure Data And Dose Reduction Studies For Operating Plants

The staff has been collating the annual occupational doses at light water reactors (LWRs) since 1969. Although the annual dose averages for both pressurized water reactors (PWRs) and boiling water reactors (BWRs) have fluctuated over the years, the overall trend between the early 1970s and 1980 was one of increasing annual dose averages. Annual dose averages peaked in the early 1980s, mainly due to the implementation of TMI-mandated plant upgrades imposed on all LWRs shortly after the 1979 accident. Since 1983, the annual average doses for both PWRs and BWRs have been steadily declining. In 1987, the average dose unit for LWRs was 420 person-rems. This is 14 percent lower than the LWR average for 1986. In 1987, the average doses per unit for PWRs and BWRs were 371 and 513 person-rems, respectively, both down from the 1986 averages of 392 and 635 person-rems. Maintenance jobs which were large contributors to BWR doses in 1987 included replacement of, or work on, recirculation system piping, induction heating stress improvement and inservice inspection of welds, inspection for intergranular stress corrosion cracking, and Appendix R (fire protection) modifications. Steam generator maintenance and repair (including tube

sleeving, plugging, and eddy current testing) was a major source of occupational exposure at PWRs.

The 1987 dose compilation includes data from 64 PWRs and 33 BWRs. This total reflects the addition of five new PWRs—Catawba Unit 2 (S.C.), Diablo Canyon Unit 2 (Cal.), Millstone Unit 3 (Conn.), and Palo Verde Units 2 and 3 (Ariz.)—and three new BWRs—Hope Creek Unit 1 (N.J.), Limerick Unit 1 (Pa.), and River Bend Unit 1 (La.). Plants not licensed to operate for the full year are not included. Dresden Unit 1 (Ill.), Humbolt Bay (Cal.), and Indian Point Unit 1 (N.Y.) are no longer included because there are no plans to operate these plants in the future.

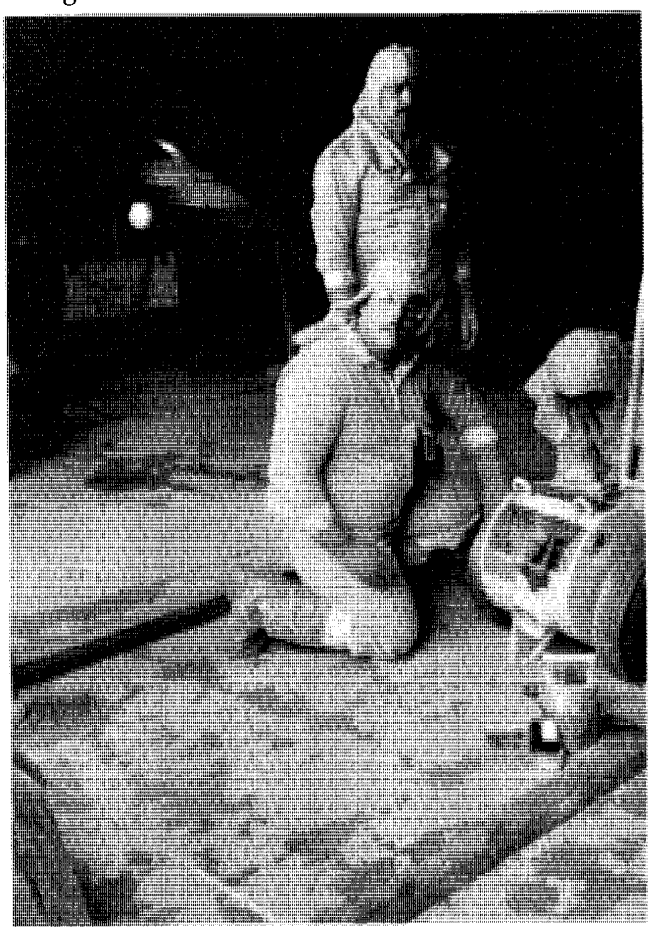
The NRC has ongoing contracts with Brookhaven National Laboratory in the area of occupational dose reduction at LWRs. The objective of one of the NRC-sponsored studies is to estimate the dose and cost savings resulting from the control of contamination at nuclear power plants. Another study involves the compilation of a research data base on dose reduction projects at nuclear power plants.

Radiation Protection At Nuclear Reactors

The integration of radiation protection activities within the NRC into one unit within NRR continues to provide a useful focus for interactions with the Regions and the licensees. Daily monitoring of licensee and Region reports to the NRC Operations Center alerts staff to potential problems developing in radiation safety, ranging from major repair problems involving highly radioactive components to contamination from the cleanup of small leaks of liquid and gaseous materials. These initial alerts are followed up by telecon discussions with regional representatives and eventual follow through on any health physics problems in regional inspections. Further involvement of Headquarters staff in regional and licensee problems is occasioned by the former's participation in routine environmental and radiological inspections, as well as in special team inspections investigating major licensee problems.

During the report period, NRC staff has provided radiation protection support in licensing activities at most of the operating nuclear power reactors. Such support included evaluating requests to expand spent fuel pool capacity and arrangement at Byron (Ill.), South Texas, and Vogtle (Ga.), and extensive discussions regarding control room habitability problems (involving ammonia and chlorine) for such plants as La Salle (Ill.), Indian Point Unit 2 (N.Y.), and Zion (Ill.). Evaluations of radiation doses and risks to members of the public from small amounts of contamination found in shellfish and sediments at several nuclear facilities were also conducted. Licensing action support during the period also included appraisals of candidates for the position of Radiation Protection Manager at the Monticello (Minn.), Comanche Peak (Tex.), and Vogtle (Ga.) plants; a review of the radiation protection history at Millstone Unit 2 (Conn.) in support of an operating license extension to 40 years was also conducted.

An important staff function has been to provide radiation protection evaluation and perspective on the decommissioning activity at the Dresden Unit 1 (Ill.), Indian Point Unit 1 (N.Y.), and LaCrosse (Wis.) power reactors, as well as the UCLA and U. of C.-Berkeley research reactors. In addition, the staff has evaluated proposals for the disposal of wastes contaminated with very low levels of radioactivity—such as sewage and sewage sludge, soil, concrete slabs, and waste oil—for a number of plants, including Vermont Yankee, Point Beach (Wis.), D. C. Cook (Mich.), and Palisades (Mich.). Another important staff function falls in the area of generic communications on radiation protection matters: during the report period, Information Notices were prepared and issued on such subjects as the radioactivity in sewage sludge at nuclear power plants, radiological hazards associated with the withdrawal of incore radiation detectors, and the misuse of high radiation area access controls.



An NRC-contractor team is shown making preparations to perform a radiographic examination in connection with a special inspection for radiation protection in a nuclear power plant.

Inspection support was provided during the year for radiation protection inspections at D. C. Cook (Mich.) and Ft. Calhoun (Neb.), a maintenance program team inspection at Oconee (S.C.), and a special team inspection covering the ALARA ("as low as reasonably achievable") radiation exposure reduction program at North Anna (Va.) and Surry (Va.).

Atmospheric Diffusion of Radionuclides

It is important that nuclear power plant control room personnel be protected in such a manner that they remain capable of ensuring safe reactor operation at all times. This concern includes, among other variables, the quality of the air in the control room which, under normal operating conditions, is vented in from the outside. In the event the outside air becomes contaminated by radiological effluents or toxic chemicals used on or near the site, procedures are in place to ensure that the contamination will not adversely impact the control room operators and render them incapable of operating the reactor in a safe manner. The NRC evaluated and confirmed control room habitability for various possible accident scenarios.

In May 1988, a study of atmospheric diffusion ("Atmospheric Diffusion for Control Room Habitability Assessments," NUREG/CR-5055) was published, reporting and assessing data derived from experiments conducted in the actual atmospheric wakes of reactor buildings. The evaluation of building-wake diffusion data and consequent recommendations with respect to the building-wake diffusion model provide a basis for the review of applications for operating licenses, as well as for a new estimate of some licensing actions for operating reactors. The study also furnishes insights that may be useful in the identification of optimal locations for control room air intakes.

Environmental Radioactivity Around Nuclear Power Plants

All licensed U.S. nuclear power plants are required by Federal regulations to periodically measure samples from the environment outside the boundaries of the plant site, for indications of radioactivity originating within the plant. This environmental monitoring program verifies that measurable concentrations of radioactive material and levels of radiation are not higher than expected, based on the measurement of plant effluents and the analytic modeling of the environmental exposure pathways. In turn, the studies verify that the plant is in compliance with regulations and not exceeding the amounts defined in the Final Environmental Statements as providing very small risks to members of the public.

An extensive weekly and monthly monitoring program, which is required for each plant by its Radiological Effluent Technical Specifications (RETS), records when, if ever, radioactive contamination above natural background is detected outside the plant boundaries. Samples come from sources that range from lake, river, and well water for water-borne contaminants, to radioiodine and particulate dusts for airborne contaminants, to milk, fish, shellfish, and vegetables for contaminants that might be ingested as foods. In addition, direct radiation from each of 16 specific sectors of land surrounding the plant is measured by special radiation dosimeters that gauge the cumulative radiation dose at certain locations in each sector for each quarter year.

Results of all licensee measurements in their radiological environmental monitoring program are recorded in an annual radiological environmental report, which is submitted each May for the preceding calendar year. These reports for each year of operation of a power reactor are available for public inspection in Local Public Document Rooms (LPDRs; see Appendix 3 for listing.).

Independent from, but supplemental to, these licensee monitoring programs are two monitoring programs conducted by the NRC. In one, the direct radiation in the sectors surrounding each plant is measured independently by NRC dosimeters at locations similar to those of the licensee. The results of measurements for each power reactor site from this "NRC Direct Radiation Monitoring Network" are published quarterly in NRC documents, also available in the LPDRs.

In addition, NRR sponsors, through the five Regional Offices, contracts with 34 States to carry out environmental monitoring. The purpose of the State contracts is to establish policies and procedures for contracts and agreements with those States to independently monitor the environs of NRC-licensed facilities. Under these contracts and agreements, States provide assistance by collecting samples or making radioactivity measurements in the environs of NRC-licensed facilities. These measurements duplicate as closely as possible certain parts of the licensee's environmental monitoring efforts, but they are done independently of those programs. The results of the State's monitoring are used to check the accuracy of licensee monitoring programs and to aid in verifying the ability of the licensee to measure radioactivity in environmental media. In the future, results of the State's environmental monitoring will also be available annually in the LPDRs.

Hot Particle Contamination At Nuclear Power Plants

Hot particles are small, highly radioactive particles with high specific activity that have been detected at nuclear power plants since about 1985. The problem of hot particle contamination—discussed in the 1987 NRC Annual Report, pp. 35, 36—continued to receive regulatory attention throughout fiscal year 1988. A hot particle on or near the skin gives a high dose of beta radiation to a small area of skin. In some cases, hot particle contamination of workers has resulted in doses exceeding NRC regulatory limits for exposure of the skin.

In 1987, the NRC asked the National Council on Radiation Protection and Measurements (NCRP) to study the health significance of hot particle exposures and to provide recommendations based on the findings of this study. The NCRP provided an approved draft report to the NRC in June 1988; the draft is subject to revision and the final report is not expected until 1989.

Operational Safety Assessment

NRC headquarters staff participate with the Regions in the review of and follow-up to operational events at operating nuclear reactor facilities calling for identification of items of generic significance and for a determination as to whether an ordered derating or shutdown of a plant is appropriate. These reviews involve the evaluation of events against existing safety analyses, appraisal of plant and operator performance during events, review of licensee analyses, and assessment of any need for corrective action.

In fiscal year 1988, the staff, as part of the formalized program for the assessment of major incidents, assigned Augmented Inspection Teams to ascertain the facts surrounding the following operating reactor events:

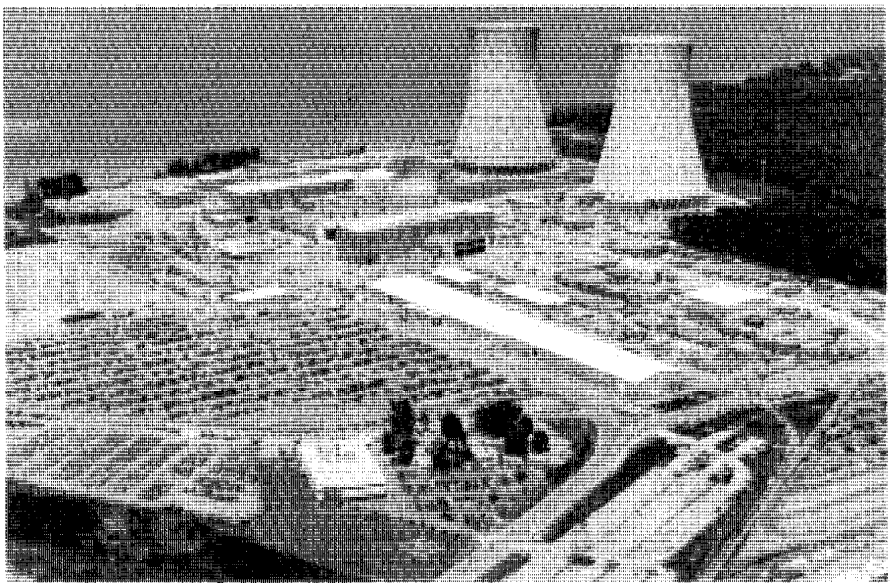
- Turbine Building Fire at Fort St. Vrain (Colo.), in October 1987.
- Main Steam Isolation Valve Problems at Perry Unit 1 (Ohio), in October and November 1987.
- Operational Performance Questions Following Loss of Off-site Power at the Pilgrim Station (Mass.), in November 1987.
- Flooding Due to Service Water System Isolation Valve Degradation at Salem Unit 1 (N.J.), in December 1987.
- Failure of Redundant Containment Isolation Valves to Close at Brunswick Unit 2 (N.C.), in January 1988.
- Reactor Vessel Overfill at Nine Mile Point Unit 2 (N.Y.), in January 1988.
- Dual Recirculation Pump Trip and Subsequent Core Power Oscillations at LaSalle Unit 2 (Ill.), in March 1988.
- Degraded Auxiliary Feedwater Flow at Catawba Unit 2 (N.C.), in March 1988.
- Failure of Main Steam Isolation Valves to Fully Close at Dresden Unit 2 (Ill.), in May 1988.
- Equipment and Motor-Operated Valve Problems at Brunswick Unit 2 (N.C.), in July 1988.
- Partial Fuel Pool Draining at Surry Unit 2 (Va.), in August 1988.

When generic problems are identified in the course of a staff review of reported events and problems, there are a number of responses that can be taken by the NRC. For example, Information Notices may be used to notify utilities of events or problems that could affect their plants. Utilities are then expected to determine whether the problems described could occur at their own plants and take appropriate corrective action. Bulletins have a similar function but further specify actions to be taken by utilities and require written confirmation when actions have been completed. In fiscal year 1988, the staff issued 110 Information Notices and 17 Bulletins, including supplements. Generic Letters may also be issued to address operational safety matters having broad applicability. In fiscal year 1988, the staff issued six Generic Letters of this type.

ANTITRUST ACTIVITIES

As required by law since December of 1970, the staff has conducted pre-licensing antitrust reviews of all construction permit applications for nuclear power plants and certain commercial nuclear facilities. (See "Procedures For Meeting NRC Antitrust Responsibilities," NUREG-0970, May 1985.) In addition, applications for amendments to construction permits or operating licenses that transfer ownership interest or operating responsibility in a nuclear facility are subject to antitrust review. In fiscal year 1987, the staff received three requests for license amendments pursuant to sale-leaseback proposals requiring antitrust review. The reviews associated with two of these requests were completed in fiscal year 1987, each concluding that there were no apparent antitrust problems. The third request was formally withdrawn by the licensee in fiscal year 1988.

On June 22, 1988, a suit was filed against the Commission by the Ohio Edison Company in United States District Court for the District of Columbia. The suit



The Perry nuclear power plant at Perry, Ohio, was the subject of two separate NRC staff actions involving antitrust licensing conditions, in 1988. Both actions were continuing at the close of the report period.

(Ohio Edison Co. v. Zech,et al.) was filed in conjunction with Ohio Edison's amendment request to suspend the antitrust license conditions attached to the Perry Nuclear Plant. Ohio Edison's complaint alleges that the Commission is unable to fairly adjudicate its request to suspend the antitrust license conditions because of Congressional pressure and possible legislative overruling of the Commission, should the Commission grant the amendment request. The case was still pending at the close of the report period.

In fiscal year 1988, a request was received from two licensees to suspend the antitrust license conditions attached to two jointly owned nuclear plants, the Perry and Davis-Besse nuclear plants, both in Ohio. The staff has received extensive public comment on this amendment request, as well as on the Ohio Edison request, and was reviewing the three outstanding requests to suspend or eliminate antitrust license conditions, at the close of the report period.

During fiscal year 1988, the Commission received two amendment requests from licensees regarding the formation of nuclear operating companies and three additional requests pursuant to amendments resulting from merger or other changes in ownership of nuclear power plants. The staff was reviewing the activities of each of the respective licensees involved in these amendment requests at the close of the report period, in order to ensure that these activities do not create or maintain any inconsistencies with the antitrust laws.

Remedies to antitrust problems usually take the form of conditions attached to licenses, and the Commission has the responsibility to enforce compliance with these antitrust conditions. During the latter part of fiscal year 1986, the staff issued a Notice of Violation (pursuant to the provisions of 10 CFR 2.201 of the Commission's Rules of Practice) against the owner of the Farley (Ala.) nuclear power plant. The Notice of Violation pertained to the antitrust license condition which directed the licensee to offer ownership access to the Farley plant. At the close of fiscal year 1988, after extensive negotiations involving the staff and each of the parties, the parties involved in this dispute reached a tentative settlement agreement that, if agreed upon by the Commission, would resolve all outstanding compliance issues raised in the Notice of Violation issued in 1986.

INDEMNITY, FINANCIAL PROTECTION AND PROPERTY INSURANCE

The Price-Anderson System

Under NRC regulations implementing the Price-Anderson Act, a three-layered system was set up to pay public liability claims in the event of a nuclear incident causing personal injury or property damage.

The first layer requires all licensees of commercial nuclear power plants rated at 100 electrical megawatts or more to provide proof of financial protection in an amount equal to the maximum liability insurance available from private sources. Currently, this amount is $160 million.

The second layer provides for a retrospective premium payment mechanism whereby the utility industry would share liability for any damages resulting from a nuclear incident in excess of $160 million. In the event of such an incident, each licensee of a com-

mercial reactor rated at 100 electrical megawatts or more would be assessed a prorated share of damages up to the statutory maximum of $63 million-per-reactor-per-incident. At present, the secondary financial protection layer is $7.06 billion (a figure derived from the 112 power reactors rated over 100 MW(e) which had been licensed to operate prior to the close of the report period times $63 million-per-reactor).

The third layer, Government indemnity, had formerly been fixed as the difference between the $560 million limit of liability and the sum of the first and second layers. Government indemnity for reactors was phased out for large power reactors, however, on November 15, 1982, when the sum of the first and second layers reached $560 million. The limit of liability for a single nuclearincident now increases without limit in increments of $63 million for each new commercial reactor licensed.

Price-Anderson Renewal

On August 20, 1988, after a five-year effort to renew the Price-Anderson Act, H.R. 1414 was enacted as P.L. 100-408, "The Price-Anderson Amendments Act of 1988." This Act, among other things, extends Price-Anderson for 15 years to August 1, 2002, increases the deferred retrospective premium from $5 million to $63 million-per-facility-per-incident and requires that the President establish a "study commission" to study means of fully compensating victims of a nuclear incident where the damages exceed the limit of aggregate public liability.

Indemnity Operations

As of September 30, 1988, 231 indemnity agreements with NRC were in effect. Indemnity fees collected by the NRC from October 1, 1987, through September 30, 1988, total $97,300. Fees collected since the inception of the program total $23,441,134. Future collections of indemnity fees will continue to be lower since the indemnity program has been phased out for commercial reactor licensees. No payments have been made under the NRC's indemnity agreements with licensees during the 31 years of the program's existence.

Insurance Premium Refunds

The two private nuclear energy liability insurance pools—American Nuclear Insurers and the Mutual Atomic Energy Liability Underwriters—paid policyholders the 22nd annual refund of premium reserves under their Industry Credit Rating Plan. Under the plan, a portion of the annual premiums is set aside as a reserve either for payment of losses or for eventual refund to policyholders. The amount of the reserve available for refund is determined on the basis of loss experience of all policyholders over the preceding 10-year period.

Refunds paid in 1988 totaled $7,668,241, which is approximately 40 percent of all premiums paid on the nuclear liability insurance policies issued in 1978 and covers the period 1987-1988. The refunds represent 74 percent of the premiums placed in reserve in 1978.

Utility Financial Qualification And Corporate Restructuring

NRC rules (10 CFR 50.33(f) and Appendix C to 10 CFR Part 50) provide for pre-licensing financial qualifications reviews and findings regarding electric utilities that apply for power reactor construction permits. Such pre-licensingreviews and findings are not required for utilities at the power reactor operating license stage. (For background, see the *1986 NRC Annual Report*, p. 150). Non-utility applicants, such as for non-power reactors, are reviewed for financial qualifications at both the construction permit and operating license stages. The NRC monitors utilities that experience severe financial difficulties at either the construction permit or the operating license stage to assure that such difficulties do not have negative safety impacts.

The NRC also reviews and approves electric utility plans for corporate restructuring to assess any impacts on licensed activities. The restructurings,actual or proposed, include (1) sale and leasebacks of nuclear power plants involving the utilities and outside investors, and (2) the formation of holding companies and utility subsidiaries.

Incentive Regulation of Electric Utilities

Economic performance incentives established by State public utility commissions (PUCs) are applicable to the construction or operation of about 45 nuclear power reactors owned by 30 utilities in 17 States. (For background, see the *1986 NRC Annual Report*, p. 150.) The NRC staff continues to monitor development of the incentives and periodically provides an updated report on all nuclear plant incentives to its Regional Offices. The staff maintains contact with the PUC staffs and the utilities responsible for implementing the incentives, in order to obtain the updated information and to consider possible safety effects of the incentives.

Property Insurance

The NRC requires its power reactor licensees to carry on-site property damage insurance to provide an

assured source of funding for cleanup and decontamination of a reactor plant following an accident. Such insurance is needed so that the pace and thoroughness of cleanup following an accident does not cause a threat to public health and safety because of lack of funds.

In 1987, the Commission revised its property insurance regulation to increase the amount of required insurance to slightly over $1 billion. In addition, the 1987 rule revision requires that any proceeds from this insurance must be expended first to stabilize, decontaminate, and clean up a reactor that has undergone an accident, when such action is required to protect public health and safety. To protect against claims from a licensee's creditors and bondholders, the insurance proceeds subject to this priority are required to be deposited with an impartial trustee, who will disburse funds for decontamination and cleanup.

Following promulgation of the 1987 amendments, the Commission was informed by the insurers offering the property insurance that they were able neither to find anyone to act as trustee nor to incorporate the trusteeship provisions in their policy language by the October 4, 1988 deadline required by the rule. The insurers also believe that the impartial trusteeship provisions of the rule may not accomplish the intended objective of sheltering insurance proceeds from claims by bondholders and creditors. Consequently, the insurers and representatives of the nuclear industry submitted, in June 1988, three petitions for rulemaking which seek to replace the trusteeship provisions of the rule with decontamination liability provisions which, petitioners believe, offer better protection of insurance proceeds from competing claims. The petitions also sought clarification of the stabilization and decontamination provisions of the rule. The Commission has initiated rulemaking to extend for 18 months the implementation date of the stabilization and decontamination priority and trusteeship provisions, so as to provide adequate time to consider these petitions.

The sixth annual property insurance reports submitted by power reactor licensees indicated that, of the 75 sites insured as of April 1, 1988, 67 are covered for at least the $1.06 billion required in the rule. The remaining eight sites have sought or been granted exemptions from the full amount of required coverage because of their small size or operating status. Sixty-four sites are covered for more than the amount required in the rule.

The NRC has been informed that, as of November 15, 1988, capacity provided by Nuclear Electric Insurers Limited-II (NEIL-II) will increase by $50 million to $825 million, in excess of $500 million. This brings total available property insurance capacity to $1.575 billion.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The Advisory Committee on Reactor Safeguards (ACRS), established by statute in 1957, provides advice to the Commission on potential hazards of proposed or existing reactor facilities and on the adequacy of proposed safety standards. The Atomic Energy Act of 1954 also requires that the ACRS advise the Commission with respect to the safety of operating reactors and perform such other duties as the Commission may request. Consistent with the Energy Reorganization Act of 1974, the Committee will review any matter related to the safety of nuclear facilities specifically requested by the Department of Energy (DOE). Also, in accordance with Public Law 95-209, the ACRS is required to prepare an annual report to the U.S. Congress on the NRC Safety Research Program.

The ACRS reviews requests for pre-application site and standard plant approvals, for each application for a construction permit or an operating license for power reactors, and for applications for licenses to construct or operate test reactors.

Consistent with the statutory charter of the Committee, ACRS reports, except for classified reports, are made part of the public record. Activities of the Committee are conducted in accordance with the Federal Advisory Committee Act, which provides for public attendance at and participation in Committee meetings. The ACRS membership necessary to conduct a balanced review is drawn from scientific and engineering disciplines and includes individuals experienced in metallurgical engineering, electrical engineering, mechanical engineering, structural engineering, reactor operations, and physics. (See Appendix 2 for listing of current membership.)

During fiscal year 1988, the Committee completed a report to Congress on the overall NRC Safety Research Program and reported to the Commission on the following specific aspects of the research program:

- Radioactive Waste Management Research.
- A Method to Establish Priorities for Research Activities.
- Research Related to Heat Transfer and Fluid Transport in Nuclear Power Plants.

The Committee also provided generic reports to the NRC and others on a variety of issues, including:

- Nuclear Power Plant Air Cooling Systems.
- The Development of Radiation Protection Standards.

- ACRS Recommendations on Advice to the Commission on Nuclear Waste Management.
- Embrittlement of Structural Steel.
- Need for Greater Coherence Among New Regulatory Policies.
- Q-List Technical Position.
- Fire Risk Scoping Study.
- The Babcock & Wilcox Owners Group Safety and Performance Improvement Program.
- Inservice Inspection of Boiling Water Reactor Pressure Vessels.
- Draft Safety Evaluation of the Westinghouse Topical Report, WCAP-10924, "Westinghouse Large-Break LOCA Best-Estimate Methodology."
- NUREG-1150, "Reactor Risk Reference Document."

The Committee's activities during the period included reports on the Tennessee Valley Authority's Management Reorganization, Restart of the Sequoyah (Tenn.) Nuclear Plant, Key Licensing Issues Associated with DOE-Sponsored Advanced Reactor Designs, the TVA Lessons Learned Effort, and Proposed Restart of the Pilgrim (Mass.) Nuclear Power Station.

In addition, the Committee provided advice to the NRC on proposed rules, criteria, or regulatory guides, consisting of:

- Proposed Final Regulatory Guide (Task EE 404-4) "Environmental Qualification of Connection Assemblies for Nuclear Power Plants."
- Proposed Resolution for Generic Issue 124, "Auxiliary Feedwater System Reliability."
- Requirements for Arbitrarily Postulated Jet Impingement Effects in the Break Exclusion Zone.
- Interim Policy Statement on Maintenance of Nuclear Power Plants.
- Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials."
- Proposed Rule on Fitness for Duty Program.
- Updated Policy Statement on Training and Qualification of Nuclear Power Plant Personnel.
- Proposed Resolution of USI A-47, "Safety Implications of Control Systems."

Members of the Advisory Committee on Reactor Safeguards are shown at the 330th meeting of the Committee, which took place on October 7, 1987. Pictured left to right are: seated, Dr. Paul G. Shewmon, Dr. Chester P. Siess, Vice-Chairman Dr. Forrest J. Remick, Chairman Dr. William Kerr, Dr. David Okrent, Mr. David A. Ward, and Dr. Dade W. Moeller. Standing are Mr. Glenn A. Reed, Mr. Carlyle Michelson, Mr. Charles J. Wylie, Dr. Martin J. Steindler, Dr. Harold W. Lewis, and Mr. Jesse C. Ebersole, Dr. J. Carson Mark was not present for the photo.

Members of the new Advisory Committee on Nuclear Waste are shown during their first meeting, on June 27, 1988. Pictured left to right are Dr. Clifford V. Smith, Jr., Dr. Dade W. Moeller, and Dr. Martin J. Steindler.

- Program to Implement the NRC Safety Goal Policy.
- Revision 2 to Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants."
- Proposed Revision of the ECCS Rule Contained in 10 CFR 50.46 and Appendix K.
- Proposed Generic Letter on Individual Plant Examinations and the Proposed Integrated Safety Assessment Program II.
- Proposed Commission Policy Statement on the Professional Conduct of Nuclear Power Plant Operators (SECY-88-57).
- Rulemaking on Emergency Planning and Preparedness.
- NRC Proposed Rule on Early Site Permits, Standard Design Certification, and Combined Licenses for Nuclear Power Reactors.
- Proposed Revisions of 10 CFR 20, "Standards for Protection Against Radiation."
- Proposed Revised Policy Statement on Nuclear Power Plant Staff Working Hours.
- Integration Plan for Closure of Severe Accident Issues (SECY-88-147).
- Proposed Resolution of USI A-17, "Systems Interactions in Nuclear Power Plants."
- Proposed Rulemaking Related to Maintenance of Nuclear Power Plants.
- Proposed Resolution of Unresolved Safety Issue A-45, "Shutdown Decay Heat Removal Requirements."
- Proposed Resolution of Generic Issue 99, "Improvement Reliability of RHR Capability in PWRs."

The Committee commented in reports on the NRC staff's proposed priority rankings for generic issues and on the effectiveness of programs related to generic and unresolved safety issues.

In performing the reviews and preparing the reports cited above, the ACRS held 12 full Committee meetings and 67 subcommittee meetings.

ADVISORY COMMITTEE ON NUCLEAR WASTE

In May 1988, the Commission approved the establishment of an Advisory Committee on Nuclear Waste. The new Committee advises the Commission on all aspects of nuclear waste management within the purview of NRC responsibility. Its primary focus is on waste disposal, but its work also includes other aspects of waste management such as the handling, processing, transportation, storage, and safeguarding of nu-

clear wastes, including spent fuel, nuclear wastes mixed with other hazardous substances, and uranium mill tailings.

The first members appointed to the new Committee by the Commission were Dr. Dade W. Moeller, former chairman and member of the Advisory Committee on Reactor Safeguards (ACRS); Dr. Martin J. Steindler, former ACRS member; and Dr. Clifford V. Smith, Chancellor of the University of Wisconsin. Dr. Moeller is serving as the Committee's first chairman.

The Committee held its initial meeting on June 27, 28, and 29, 1988. By the end of fiscal year 1988, it had considered and provided reports to the Commission on the following topics:

- Proposed Rule on Storage of Spent Nuclear Fuel in Casks at Nuclear Power Reactor Sites.
- Rulemaking Petition to Establish an Accident Dose Guideline in 10 CFR Part 60.
- Response to Questions on Proposed Yucca Mountain High-Level Waste Repository.
- Draft Generic Technical Position: Guidance for Determination of Anticipated Processes and Events and Unanticipated Processes and Events.
- Proposed Branch Technical Position Concerning Environmental Monitoring for Low-Level Waste Disposal Facilities.
- Proposed Commission Policy Statement on Regulatory Control Exemptions for Practices Whose Public Health and Safety Impacts are Below Regulatory Concern (BRC).
- Suitability of High Density Polyethylene High Integrity Containers.

Cleanup at Three Mile Island

Chapter 3

During fiscal year 1988, progress continued on the cleanup of the damaged reactor at Unit 2 of the Three Mile Island nuclear power plant (TMI-2) near Harrisburg, Pa. Defueling, decontamination, and the processing and shipment of radioactive waste all continued in parallel. It is required by law that these activities be covered in a separate chapter of the NRC annual report.

Defueling operations in the reactor vessel were performed from a shielded work platform located nine feet above the vessel flange. Long-handled tools and remotely operated equipment were used in defueling operations. As of the end of September 1988, the entire original core region had been defueled, including all 177 damaged partial length assemblies. Defueling and dismantling of the lower core support assembly was in progress at the end of the report period. Approximately 204,000 pounds (68 percent) of fuel and core debris have been removed out of an estimated total of 300,000 pounds. The steam generators, pressurizer, and hot legs have also been defueled. Principal areas remaining to be defueled include the reactor vessel lower head, baffle plate area, core bypass flow holes, and the decay heat drop line. Full completion of defueling is expected by mid-to-late 1989.

Shipment of core debris from the TMI site to the Idaho National Engineering Laboratory (INEL) continued as before. A total of 31 casks have been shipped to INEL, 15 of them during fiscal year 1988. These shipments have 191,300 pounds of debris, which is 64 percent of the estimated total to be shipped.

The submerged demineralizer system, originally used to decontaminate the water in the reactor building basement, has been removed from service. During its service life, it processed 4,566,000 gallons of water. The Defueling Water Cleanup System (DWCS) is currently being used to process water from the reactor coolant system and the "A" spent fuel pool. The EPICOR-II system processes the remainder of the contaminated water at TMI-2 and, through fiscal year 1988, had processed a total volume of 4,500,000 gallons.

When the reactor building basement was flooded, radionuclides were adsorbed and absorbed on concrete surfaces. The structural poured-concrete walls held the deposit primarily in a surface layer, while the hollow concrete block walls by the elevator shaft were permeated. Scarification, the abrasive removal of thin layers of concrete using ultra-high pressure water sprays, was used to reduce radioactivity levels in accessible structural walls. Holes were drilled in the hollow walls and they were flushed from the inside to leach out absorbed radionuclides.

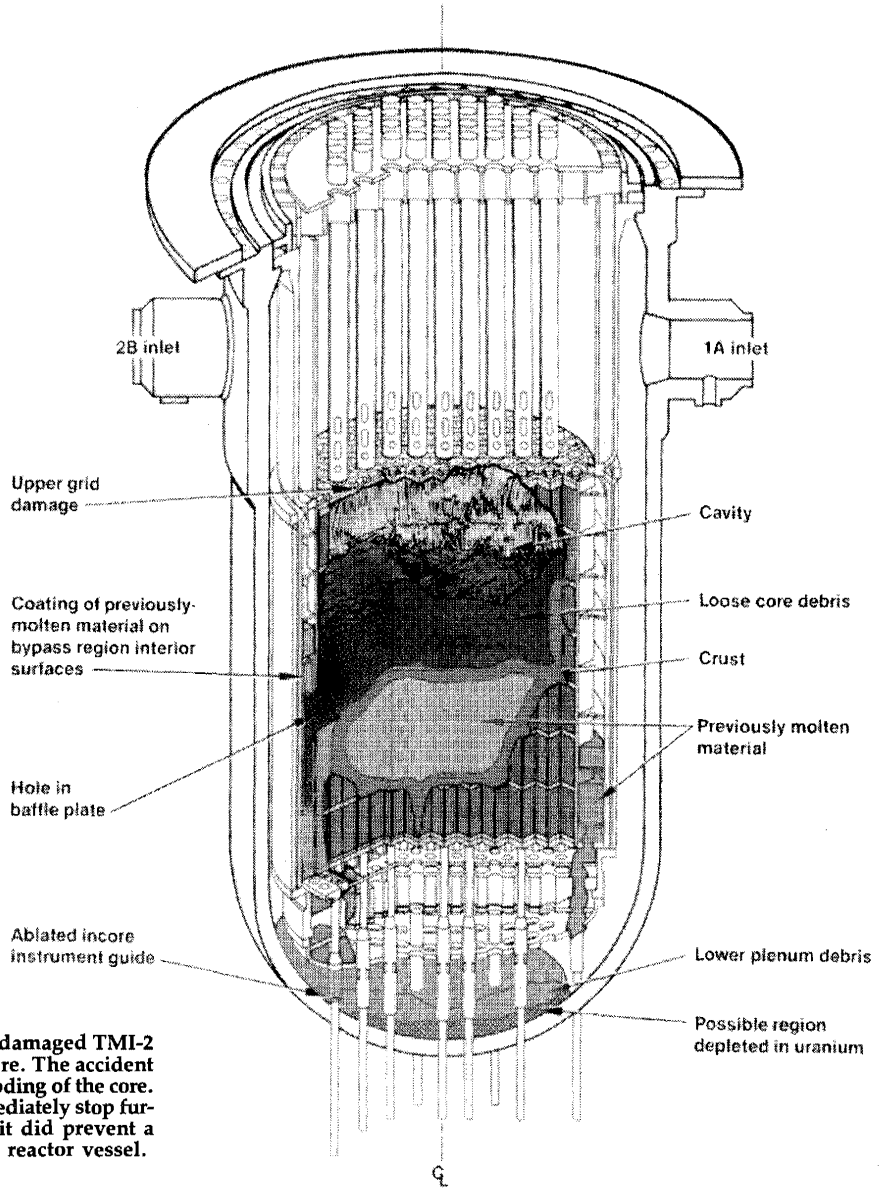
Scabbling (a mechanical abrasion and ablation process), steam vacuuming, and hands-on decontamination work continue in the auxiliary and fuel handling buildings. At the end of the fiscal year, 120 of 143 cubicles had been satisfactorily decontaminated. System flushes were in progress, with 61 of 76 identified system-flowpaths having been completed.

Dose rates to defueling crews remained low throughout the period. The exposure rates have averaged slightly less than 10 mrem/hour over the course of defueling thus far. Projected cumulative worker dose during calendar year 1988 was 960 person-rem. That was below the licensee's goal of 990 person-rem and less than the 1987 total of 975 person-rem.

The NRC continued on-site monitoring of the day-to-day cleanup operations at the TMI-2 site. The staff carried out reviews and inspections on the scene of licensee procedures, systems, equipment and operations. The on-site and Headquarters staff, in conjunction with the technical review branches, performed safety and technical reviews of license amendments, recovery operations plan changes, and licensee proposals for cleanup efforts to assure that the cleanup would proceed in a safe manner, in accordance with NRC regulations. In February 1988, the TMI-2 Project Directorate was terminated, and the inspection program for TMI-2 was assumed by the TMI resident inspection staff. Technical review and project management functions were assumed by a Headquarters project directorate.

In July 1986, GPU Nuclear Corporation (GPUN) submitted a proposal for disposing of approximately 2.3 million gallons of slightly radioactive water. The water was contaminated either during the March 1979 accident or during subsequent cleanup operations. The proposed method of disposal of the water is forced evaporation over a two-and-one-half year period. The residue from this operation—containing small amounts of the radioactive isotopes cesium-137 and strontium-90, and larger amounts of nonradioactive

TMI-2 Core End-State Configuration



The final state of the damaged TMI-2 reactor core is shown here. The accident was terminated by reflooding of the core. This action did not immediately stop further core melting, but it did prevent a melting through of the reactor vessel.

boric acid and sodium hydroxide—would require solidification and disposal as low-level waste. The staff evaluated the licensee's proposal together with eight alternative approaches, evaluating both the radiological and nonradiological consequences of implementing each alternative. The staff found that the licensee's proposal—to dispose of the water by forced evaporation to the atmosphere followed by on-site solidification of the remaining solids and disposal of the solids at a low-level waste facility—was an acceptable plan. The staff also concluded that none of the alternative methods of disposal was clearly preferable to the licensee's. The staff offered an opportunity for a hearing prior to taking final action on the licensee's proposal. The matter was pending before the Atomic Safety and Licensing Board at the end of fiscal year 1988.

In December 1986, the licensee proposed to place TMI-2 in an interim monitored storage condition for an unspecified period of time, after the completion of the current defueling effort. The licensee's term for this condition is "Post Defueling Monitored Storage." During this storage period, sampling and studies would be conducted to help decide on the best ultimate disposition of the facility. Should the decision be to

no longer use the facility for any purpose, then it would remain in the storage condition until Three Mile Island Unit 1, on the same island site, was ready to be decommissioned. Both facilities would then be decommissioned together. The NRC staff has begun the environmental review of the licensee's proposal. In April 1988, the staff published Draft Supplement No. 3 to the "Programmatic Environmental Impact Statement" (NURGE-0683), dealing with "Post Defueling Monitored Storage and Subsequent Cleanup." The staff assessed the licensee's proposal and six alternatives. The licensee's proposal and one of the alternatives—continuing and completing the cleanup without a storage period—were evaluated in detail.

The NRC staff concluded that both the licensee's proposed plan and the NRC staff-identified alternative for completion of cleanup are within the applicable regulatory limits and each could be implemented without significant environmental impact. Neither alternative was found to be clearly preferable from an environmental impact perspective. The staff must complete a final version of the impact assessment and also conduct a safety evaluation prior to taking any action on the licensee's proposal.

The Advisory Panel for the Decontamination of the Three Mile Island Unit 2, which is composed of citizens, scientists, and State and local officials, was formed by the NRC in 1980 to provide input to the Commission on major cleanup issues. (See Appendix 2 for a list of current members of the panel.) During fiscal year 1988, the panel held five public meetings in Harrisburg and Lancaster, Pa. The principal topic discussed during the meetings was the licensee's proposal to place the facility in long term storage at the conclusion of the current cleanup effort.

Financial Aspects of TMI-2 Cleanup

Funding by GPUN. (For background, see the *1987 NRC Annual Report,* p.44.) Revenues collected by GPU Nuclear Corporation's three operating subsidiaries in Pennsylvania and New Jersey continued to be expended on cleanup during 1988. Customer funding of the cleanup amounted to about $34 million in 1988 and is estimated to total approximately $250 million over the course of the cleanup effort. GPUN continues to provide cash advances from internal sources to alleviate any cash flow problem related to cleanup activities. The total 1988 advance is estimated at $20 million. The GPUN projections provided to NRC indicate a continuing GPUN commitment to provide such cash advances as needed. Continued improvement in GPUN's financial condition and cash flow position gives greater assurance that such cash advances will be made.

Cost Sharing Plan. During 1988, GPUN continued to receive cash payments from all suggested contributors in the TMI-2 cleanup cost sharing plan proposed by then Pennsylvania Governor Richard Thornburgh in July 1981 (see *1987 NRC Annual Report,* p.44). The Edison Electric Institute's (EEI) industry cost-sharing program paid its committed $23 million annual contribution in 1988, the fourth year of industry contributions through the EEI program. The NRC will continue to monitor the cleanup funding situation closely.

Operational Experience

Chapter 4

ANALYSIS AND EVALUATION OF OPERATIONAL DATA

Since its formation in 1979, the NRC Office for Analysis and Evaluation of Operational Data (AEOD) has provided, as one of its primary roles, a strong, independent capability for the analysis of operational data. The office serves as the focal point for the independent assessment of operational events and manages the review, analysis, and evaluation of reactor plant safety performance. It is also responsible for the NRC's Incident Response Program, Diagnostic Evaluation Program, Technical Training Center, and the Incident Investigation Program. Additionally, AEOD provides support for the Committee to Review Generic Requirements.

The office consists of two divisions: the Division of Operational Assessment which includes the Incident Response Branch, the Diagnostic Evaluation and Incident Investigation Branch, and the Technical Training Center; and the Division of Safety Programs which includes the Reactor Operations Analysis Branch, the Trends and Patterns Analysis Branch, and the Non-reactor Assessment Staff. AEOD reports directly to the Executive Director for Operations (EDO).

AEOD's activities involve the review and evaluation of operating experience in order to identify: significant events and the associated safety concerns and root causes; the trends and patterns displayed by these events; the adequacy of corrective actions taken to address the concerns; and generic applicability of these events and concerns. In performing these activities, AEOD's specific functions include:

- Analysis of operational safety data associated with all NRC-licensed activities and identification of safety issues which require NRC staff actions.
- Development and implementation of the agency program on reactor performance indicators for use by Regional and Headquarters management.
- Development of the NRC program for diagnostic evaluations of licensee performance and direction of the diagnostic evaluation teams.
- Development of policy, program requirements, and procedures for NRC incident investigations of significant operational events.
- Identification of needed operational data to support safety analysis activities, and development of agency-wide operational data reporting and retrieval methods and systems.
- Development of a coordinated system for feedback of operational safety information to NRC offices, licensees, and other organizations, as appropriate, and preparation of the Abnormal Occurrence Report to Congress.
- Development in consultation with other NRC offices of the NRC policy for response to incidents and emergencies, and assessment of the NRC response capabilities and performance.
- Development of an agency-wide technical qualification program for a broad range of technical positions within the NRC staff, and providing for technical training needed by NRC personnel through operation of the NRC's Technical Training Center at Chattanooga, Tennessee.
- Continuous manning of the NRC Operations Center to screen reactor and non-reactor events and other information reported to the Operations Center to assure the proper NRC reaction to reported events.
- Acting as a focal point for coordination of generic operational safety information and data systems with industry, foreign governments, and other agencies involved with the collection, analysis, and feedback of operational data.

Committee to Review Generic Requirements

All generic requirements proposed by the NRC staff related to one or more classes of reactors, including backfit requirements, must be reviewed by the Committee to Review Generic Requirements (CRGR). The Committee is made up of senior NRC managers acting independently of their line office function in advising the Executive Director for Operations on proposed new generic requirements. The current CRGR membership is:

Edward L. Jordan (Chairman), Director, Office for Analysis and Evaluation of Operational Data.

James H. Sniezek, Deputy Director, Office of Nuclear Reactor Regulation.

The NRC's Technical Training Center (TTC) in Chattanooga, Tenn., is a primary resource for the Office of Analysis and Evaluation of Operational Data in providing for the training of NRC personnel in reactor technology and operation. In the photo, NRC Commissioner Kenneth C. Rogers is briefed by TTC staffer Larry Bell on a Babcock & Wilcox simulator acquired during the report period. Commissioner Rogers was guest of honor at dedication ceremonies.

Robert M. Bernero, Deputy Director, Office of Nuclear Materials Safety and Safeguards.

Denwood F. Ross, Deputy Director, Office of Nuclear Regulatory Research.

Jack R. Goldberg, Deputy Assistant General Counsel for Enforcement, Office of the General Counsel.

Carl J. Paperiello, Deputy Regional Administrator, Region III Office.

The Committee seeks to eliminate unnecessary demands on licensee and NRC resources by ensuring that those proposing a new requirement can demonstrate a need for it. (See the *1983 NRC Annual Report*, pp. 1-3, for a full description of CRGR's structure and review process.) Through its review, the CRGR seeks assurance that a proposed requirement (1) is necessary for the public health and safety, or (2) is likely to result in a net safety improvement, and (3) is likely to have an impact on the public, industry, and government which is consistent with and justified by the safety improvement to be realized.

Following its review, the CRGR recommends to the EDO that the proposed requirements be approved, disapproved, modified, or conditioned in some way. The EDO considers CRGR recommendations, as well as those of cognizant NRC offices, in deciding whether a requirement shall be imposed. From its inception in November 1981 through September 1988, the CRGR has held 147 meetings and considered a total of 255 separate issues. In fiscal year 1988, the CRGR held 26 meetings and considered 52 issues, including 21 generic backfits in the form of four Rules, four Regulatory Guides, six Generic Letters, and seven Bulletins. A detailed listing of those issues follows:

Proposed NUREG and Regulatory Guide on Safeguards Event Reporting

Proposed Policy Statement on Nuclear Power Plant Maintenance

Proposed Final Resolution for Generic Issue 93, "Steam Binding of Auxiliary Feedwater Pumps"

Proposed Draft Resolution for Unresolved Safety Issue A-47, "Safety Implications of Control Systems"

Proposed Generic Letter on Operating Basis Earthquake Exceedance

Proposed NRC Bulletin on Steam Generator Tube Rupture

Proposed NRC Bulletin on Reactor Trip Breaker Mechanical Failures

Proposed Revision to Regulatory Guide 1.100 on Equipment Seismic Qualification

Proposed NRC Bulletin on Latching Problems in HFA Type Relays

Proposed NRC Bulletin on Boric Acid Corrosion Problems

Proposed Resolution for Unresolved Safety Issue A-40, "Seismic Design"

Proposed Generic Letter on Removal of Organization Charts from Technical Specifications

Proposed Rule on Fitness for Duty

Proposed Rule on Packaging and Transportation of Radioactive Materials

Proposed Rule on Emergency Planning for Fuel Cycle Facilities

Proposed Safety Evaluation Report on the B&W Reactor Design Reassessment

Proposed Commission Paper on Policy Issues for DOE-Sponsored Advanced Reactor Designs

Proposed Commission Paper on Standardization of Advanced Reactor Designs

Proposed Supplement to NRC Bulletin on Non-Conforming Fasteners
Proposed Supplement to NRC Bulletin on Motor-Operated Valve Problems
Proposed Rule on Emergency Planning for Fuel Load and Low Power Operation
Proposed Generic Letter on Individual Plant Examinations for Severe Accident Vulnerabilities
Proposed NRC Bulletin on Materials Fraud
Proposed NRC Bulletin on Safety-Related Pump Loss
Proposed Draft Resolution for Generic Issue 103, "Design for Probable Maximum Precipitation"
Proposed Amendment to 10 CFR Part 50.46 and Appendix J on Emergency Core Cooling System Requirements
Proposed Rule on Nuclear Power Plant Standardization
Proposed NRC Bulletin on Thermal Stresses in Piping Connected to Reactor Coolant Systems
Proposed Safety Evaluation Report on the B&W Owners Group Response to ATWS Rule Requirements
Proposed NRC Bulletin on Power Oscillations in Boiling Water Reactors
Proposed Supplement to NRC Bulletin on Materials Fraud
Proposed NUREG Revision on Off-site Emergency Plans Prepared by Licensees
Proposed Draft Resolution for Unresolved Safety Issue A-17, "Systems Interactions in Nuclear Power Plants"
Proposed Generic Letter on Removal of Fire Protection Requirements from Plant Technical Specifications
Proposed Amendment to 10 CFR Part 20, "Standards for Protection Against Radiation"
Proposed Generic Letter on Instrument Air System Problems
Proposed Rule on College Degrees for Licensed Reactor Operators
Proposed Draft Resolution for Unresolved Safety Issue A-45, "Shutdown Decay Heat Removal Requirements"
Proposed NRC Bulletin on Thimble Tube Thinning
Proposed Revision to Regulatory Guide 1.106 on Thermal Overload Protection for Motor-Operated Valves
Proposed Final Resolution for Unresolved Safety Issues A-3, A-4, and A-5, on "Steam Generator Tube Integrity"
Proposed Regulatory Guide on Lead Storage Batteries
Proposed Revision to Regulatory Guide 1.9 on Diesel Generator Reliability
Proposed Safety Evaluation Report on BWR Owners Group Emergency Procedure Guidelines, Revision 4
Proposed Policy Statement on Professional Conduct of Licensed and Unlicensed Nuclear Power Plant Operators
Proposed Generic Letter on Loss of Shutdown Decay Heat Removal
Proposed NRC Bulletin on Non-Conforming Circuit Breakers Information Briefing on Low-Level Waste Storage Methods
Proposed Rule on Nuclear Power Plant Maintenance
Proposed Policy Statement on Nuclear Power Plant Working Hours
Proposed Safety Evaluation Report on IDCOR Methodologies for Conduct of Individual Plant Examinations for Severe Accident Vulnerabilities
Information Briefing on EPRI Seismic Hazard Methodology for Central and Eastern United States

Annual Report to the Commission

In September 1988, AEOD submitted a comprehensive annual report to the Commission. The report was substantially changed in content and format from those of previous years to reflect AEOD's revised responsibilities stemming from the 1987 reorganization and its activities relative to the nuclear reactor industry. Consequently, the 1987 AEOD annual report comprises two sections: "Power Reactors" (AEOD/S805) and "Non-Reactors" (AEOD/S806). "Power Reactors" presents an overview of the operational experience of the nuclear power industry, with comments on the trends of some key performance measures. The report also includes the principal findings and issues identified in AEOD studies over the past year and summarizes information from Licensee Event Reports (LERs), the NRC's Operations Center, and Diagnostic Evaluations. The volume on "Non-Reactors" presents a review of the "Non-Reactor Events and Misadministration Reports" that were reported in 1987 and provides a brief synopsis of AEOD studies published in 1987. Each volume provides a status report of AEOD recommendations, and contains a list of AEOD reports issued for 1980-1987.

AEOD compared the 1987 industry average data on reactor trips, safety system actuations and failures, and other operations data with those of previous years to identify trends of industry performance. From 1984 to 1987, some key performance measures improved. The number of significant events at operating plants dropped sharply from an average of about 2.4 events-per-plant in 1985 to 1.6 in 1986 and 0.8 in 1987. The average number of unplanned automatic reactor trips-per-year decreased from 5.2 to 3.2-per-reactor. The average number of demands of the emergency core cooling systems and the emergency diesel generators decreased from 2.8 to 1.7. The frequency of plant shut-

downs required by plant Technical Specifications (TS) remained low. The number of risk significant events, as measured by the AEOD Accident Sequence Precursor Methodology, decreased (improved from 17 in 1984 to six in 1986). These trends suggest that overall nuclear plant operational safety is improving.

AEOD reviewed approximately 3000 LERs in 1987, covering reportable events and conditions. While the overall industry trends were improving, there were several plant-specific events that were significant and revealed deficiencies in operations, maintenance, and design.

AEOD Diagnostic Evaluation Teams performed evaluations at the Dresdenand McGuire facilities in 1987.

Analyses of Operational Experience

Domestic. The LER rule (10 CFR 50.73) became effective on January 1, 1984 (see the *1985 NRC Annual Report*, p. 61). The rule requires that the LERs describe in a reasonably complete and detailed manner all actuations of engineered safety features (ESF), including scrams (reactor shutdowns), all losses of safety function at a system level, all significant systems interactions, all plant TS violations, and all significant internal and external threats to plant safety.

The LERs provide the NRC with operational data with which to judge the safety of nuclear plants and potential problems at nuclear plants. To effectively manage and utilize the large quantities of LER reports, AEOD contracts with the Nuclear Operations Analysis Center (NOAC) at Oak Ridge, Tenn., which operates and maintains the Sequence Coding and Search System (SCSS), a computerized storage and retrieval system for LER data. SCSS encodes all the relevant technical information provided by the licensee in the LER with enough ''tags'' to assure ready retrieval of individual items. During fiscal year 1988, about 2700 LERs were added to the system. The latest increase brought the number of LERs added to the data base (since 1980) to more than 29,000.

Trends and patterns analyses are performed on the LER data to detect anomalous or deteriorating trends in the operation of the plants and reliability of the plant's safety equipment. The program is designed to detect, through statistical and engineering analysis, those trends or patterns in incidents of low individual significance that, taken together, may indicate an unrecognized safety concern. Several trends and patterns analysis reports on operational experience are summarized below. During fiscal year 1988, the NRC continued a trends and patterns analysis of selected components using data from the Institute of Nuclear Power Operations (INPO) Nuclear Plant Reliability Data System (NPRDS), industry's component-failure data base. The NRC also continued its program of studies focused on reactor trips, ESF actuations, system unavailability, and plant TS violations using the more detailed data provided under the LER rule. In 1988, the NRC integrated the data bases at the Idaho National Engineering Laboratory (INEL) for these four types of events and began the development of monthly and quarterly operational event summaries.

An evaluation report on NPRDS progress (January 1988, SECY-88-1) estimated that about two-thirds of the reportable failures occurring throughout the industry are being routinely reported. As a result, the NRC staff recommended that the program which assessed the completeness of reporting against component failures identified in LERs, be shifted to monitoring the NPRDS program for completeness and timeliness by specific plant evaluations and site visits at selected plants.

Foreign. During 1988, the NRC continued efforts to increase the number and usefulness of foreign experience reports that are received. Such reports supplement U.S. experience, particularly with regard to the effect of different safety equipment configurations, and of operator actions and degree of involvement required during normal or off-normal plant operations. With the help of the NOAC, the NRC continues to systematically screen and assess selected foreign information for its applicability to the U.S. program and to abstract it for computerized data filing. This file now contains information on more than 9,300 foreign events.

NRC also continued its participation in the exchange of operational event information with other countries through activities involving the Nuclear Energy Agency (NEA), the International Atomic Energy Agency (IAEA), and various bilateral agreements. In September 1988, the NRC participated in the annual IAEA/NEA meetings. A number of significant technical papers and events were identified which were relevant to U.S. reactor operations. The NRC continues to take an active part in the international Incident Reporting System (IRS), in effect since the late 1970s. The NRC submitted 44 reports to the system during fiscal year 1988 and reviewed about 120 reports submitted by other countries.

Engineering Analyses of Operational Experience

In 1988, AEOD issued a number of case studies, special studies, engineering evaluations, and technical reviews, as listed in Table 1.

Air Systems Problems at U.S. Light Water Reactors (NUREG-1275, Volume 2). In fiscal year 1987, AEOD

issued a case study report on Air Systems Problems at U.S. Light Water Reactors (C701). It provided a comprehensive review and evaluation of the potential safety implications associated with air systems. The study focused on degraded air systems and the vulnerability of safety-related equipment to common-mode failures associated with air systems. It presented the following recommendations to reduce risk, enhance safety, and improve plant performance:

Subsequent to issuance of the case study, additional safety significant events related to air systems problems occurred. As a result, the case study was updated to include new events, and it was published as NUREG-1275, Volume 2, in December 1987. The report was distributed to the industry via Information Notice 87-028, Supplement 1, in December 1987. Subsequently, NRC issued a generic letter (Generic Letter 88-14, August 1988) requesting that each licensee/applicant review NUREG-1275, Volume 2, and perform a design and operations verification of the instrument air system.

The Generic Letter (88-14) requires that licensees:

(1) Verify by test that actual instrument air quality is consistent with manufacturer's recommendations for the individual components served.

(2) Verify that maintenance practices, emergency procedures, and training are adequate to ensure that safety-related equipment will function as intended on loss of instrument air.

(3) Verify that the design of the entire instrument air system, including air or other pneumatic accumulators, is in accordance with its intended function, including verification by test that air-operated safety-related components will perform as expected in accordance with the design-basis, including loss of the normal instrument air system. This design verification is to include an analysis of current air-operated component failure positions to verify that they are correct for assuring required safety functions.

(4) In addition to the above, each licensee/applicant was requested to provide discussion of its program for maintaining proper instrument air quality.

To supplement the verification effort, AEOD has been working with industry (American Society of Mechanical Engineers [ASME]/American National Standards Institute [ANSI]) to develop an air system performance standard to assure satisfactory operation of pneumatic equipment at nuclear power plants.

Service Water System Failures and Degradations in Light Water Reactors (C801). This study provides a comprehensive review and evaluation of service water system failures and degradations observed in operating events in light water reactors from 1980 to 1987. The study focused on the identification of causes of system failures and degradations, the adequacy of corrective actions planned and implemented, and the safety significance of the operating events. The results of this review and evaluation indicate that the service water system failures and degradations have significant safety implications. These system failures and degradations are attributable to a great variety of causes, and have adverse impact on a large number of safety-related systems and components which are required to mitigate reactor accidents. Specifically, the causes of failures and degradations include various fouling mechanisms (sediment deposition, biofouling, corrosion and erosion, pipe-coating failure, calcium carbonate deposition, foreign material and debris intrusion), single failures and other design deficiencies; flooding, multiple equipment failures; personnel and procedural errors; and seismic deficiencies. Systems and components adversely affected by a service water system failure or degradation include the component cooling water system, emergency diesel generators, emergency core cooling system pumps and heat exchangers, the residual heat removal system, containment spray and fan coolers, control room chillers, and reactor building cooling units.

The frequencies of service water system failures and degradations as observed in operating events were found to be relatively high, as were bounding estimates on the potential core damage frequency identified in the operating experience review. These estimates indicated that the safety significance of service water system failures and degradations is high.

Since 1980, a number of generic communications have been issued by both the NRC and various industry groups to alert licensees to the various problems affecting service water system performance. Despite these communications (e.g., IE Bulletins and Information Notices, industry group reports, and vendor communications), many licensees continue to report generic service water problems.

To reduce both the frequency and potential consequences of operating events involving such failures and degradations, AEOD developed several recommendations which include: (1) performance testing, on a regular basis, of all heat exchangers which are cooled by the service water system and which perform a safety function, in order to verify heat transfer capability; (2) a requirement that licensees verify that their service water systems are not vulnerable to a single failure of an active component; (3) inspection, on a regular basis, of important portions of the piping of the service water system for corrosion, erosion and biofouling; and (4) reduction of human error in the operation, repair, and maintenance of the service water system.

Table 1. AEOD Reports Issued During FY 1988

CASE AND SPECIAL STUDIES

Designation	*Subject*	*Issued*
NUREG-1275 (Vol. 2)	Air Systems Problems at U.S. Light Water Reactors	12/87
C801	Service Water System Failures and Degradations in Light Water Reactors	8/88
S801	Significant Events that Involved Procedures	3/88
S802	Operational Experience Feedback Evaluation Rancho Seco Nuclear Generating Station, Restart	3/88
S803	AEOD Concerns Regarding the Power Oscillation Event at LaSalle 2 (BWR-5)	6/88
S805	Report to the U.S. Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data—1987 Power Reactors	9/88
S806	Report to the U.S. Nuclear Regulatory Commission on Analysis and Evaluation of Operational Data—1987 Non-Reactors	9/88

ENGINEERING EVALUATION

Designation	*Subject*	*Issued*
E710	Inadequate NPSH in Low Pressure Safety Systems in PWRs	10/87
E801	BWR Overfill Events Resulting in Steam Line Flooding	4/88
E802	Single Failures and Other Deficiencies Noted in Control Room Emergency Ventilation Systems	4/88
E803	Inadequate NPSH for High Pressure Safety Systems in PWRs	8/88
E804	Reliability of Recirculation Pump Trip During an ATWS	8/88
E805	Potential LOCA due to Energized Uncovered Pressurizer Heaters	9/88

TECHNICAL REVIEW

Designation	*Subject*	*Issued*
T710	Heating, Ventilating and Air Conditioning System Problems	11/87
T713	Mispositioning of "Reverse Acting" Valve Controllers	12/87
T712	Unplanned Criticality Events at U.S. Power Reactors Similar to That at Oskarshamn Unit 3 on July 30, 1987	11/87
T801	Perry Nuclear Plant Unit 1—Unexpected MSIV Closure and Re-opening	1/88
T803	Summary of Early Operational Experience of Foreign Commercial Nuclear Reactors (Proprietary)	5/88
T804	"Precursor" Operational Events which Occurred During the Period November 1, 1987 Through March 1988	5/88
T805	Insights from Significant Events in 1987	5/88
T806	Recent Operational Experience Trends at Fermi 2	5/88
T807	Technical Review Report—Recent Operational Experience Trends at Indian Point 2	6/88
T808	A Technical Basis for Granting Test Frequency Relief	6/88
T809	Blocked Thimble Tube/Stuck Incore Detector	6/88
T810	An Analysis of NPRDS Data for Hatch plant (Proprietary)	7/88

These recommendations have been forwarded to NRR and RES for follow-up.

Concerns Regarding the March 9, 1988 Power Oscillation at LaSalle Unit 2 (S803). This special report provides a review and evaluation of an event that occurred at LaSalle Unit 2 (Ill.) on March 9, 1988. The report concludes that the event "indicates serious deficiencies in the core stability analysis for LaSalle and perhaps other BWRs."

On March 9, 1988, an inadvertent error by an instrumentation technician resulted in a high "indicated" level to the feedwater level control system, causing the feedwater pumps to begin reducing flow. Realizing a valving error was made, the technician isolated the reference leg from the variable leg. This action resulted in a low "indicated" level spike. The level spike caused other level switches, utilizing the same reference leg, to also actuate, including the trip of the reactor recirculation pumps from an Anticipated Transient Without Scram (ATWS) signal.

Because of the rapid power reduction from 84 percent to approximately 40 percent when both recirculation pumps shut down, high-level alarms from the feedwater heater were received and the heaters began automatically isolating. That resulted in reduced feedwater temperature and the insertion of positive reactivity because of a negative moderator temperature

coefficient. Attempts to restart the recirculation pumps and re-establish feedwater heating were unsuccessful.

With the unit in a high control rod line condition (power was 85 percent before the event) and low-flow condition (natural circulation), the unit started experiencing neutron flux oscillations from rapid creation and collapse of voids in the core region. Approximately five minutes into the event, multiple high and low alarms were recorded by the local power range monitors. The average power range monitor (APRM) recorders indicated oscillations between 25 percent and 50 percent of full power with an approximate two-to-three-second period. Because of limitations of the APRM recorders, the actual neutron flux oscillations (approximately 75 percent power) were larger than the indications of the APRM recorders. The control room operators were in the process of manually scramming the unit, when an automatic scram occurred on upscale neutron trip (118 percent on APRMs).

The LaSalle event involved power oscillations caused by neutron flux/thermal-hydraulic instabilities of a magnitude that were not predicted by design analysis, unanticipated by the operators, and potentially in conflict with General Design Criterion (GDC) 12.

Since these oscillations were not predicted to occur at LaSalle, little guidance and training had been provided for operator detection and response.

In light of the uncertainties, AEOD recommended that BWR licensees implement procedures to: (1) immediately insert control rods to below the 80 percent rod line following reduction or loss of recirculation flow or other transients which result in entry into potentially unstable regions of the power/flow map; (2) increase recirculation flow during routine reactor startups and insert some control rods prior to reducing recirculation flow below 50 percent during shutdowns to avoid operation in potentially unstable areas of the power/flow map; and (3) immediately scram the reactor if actions (1) or (2) above are not successful in preventing and suppressing oscillations. AEOD has also recommended that the agency reassess GIs B-19 and B-59 and ATWS mitigation in light of the LaSalle operating experience.

This report formed the basis for the following agency actions:

(1) The Office of Nuclear Reactor Regulation (NRR) issued Bulletin 88-07, "Power Oscillations in BWRs" to all BWR licensees on June 15, 1988, requiring them to provide procedures addressing power oscillations.

(2) NRR and the Office of Nuclear Regulatory Research (RES) are currently evaluating the generic implications of power oscillations in BWRs.

(3) NRC Chairman Zech has requested the Advisory Committee on Reactor Safeguards (ACRS) to review this operating event. The joint ACRS Subcommittees on Core Performance and Thermal-Hydraulic Phenomenon will lead this effort.

Trends and Patterns Analyses Of Operational Experience

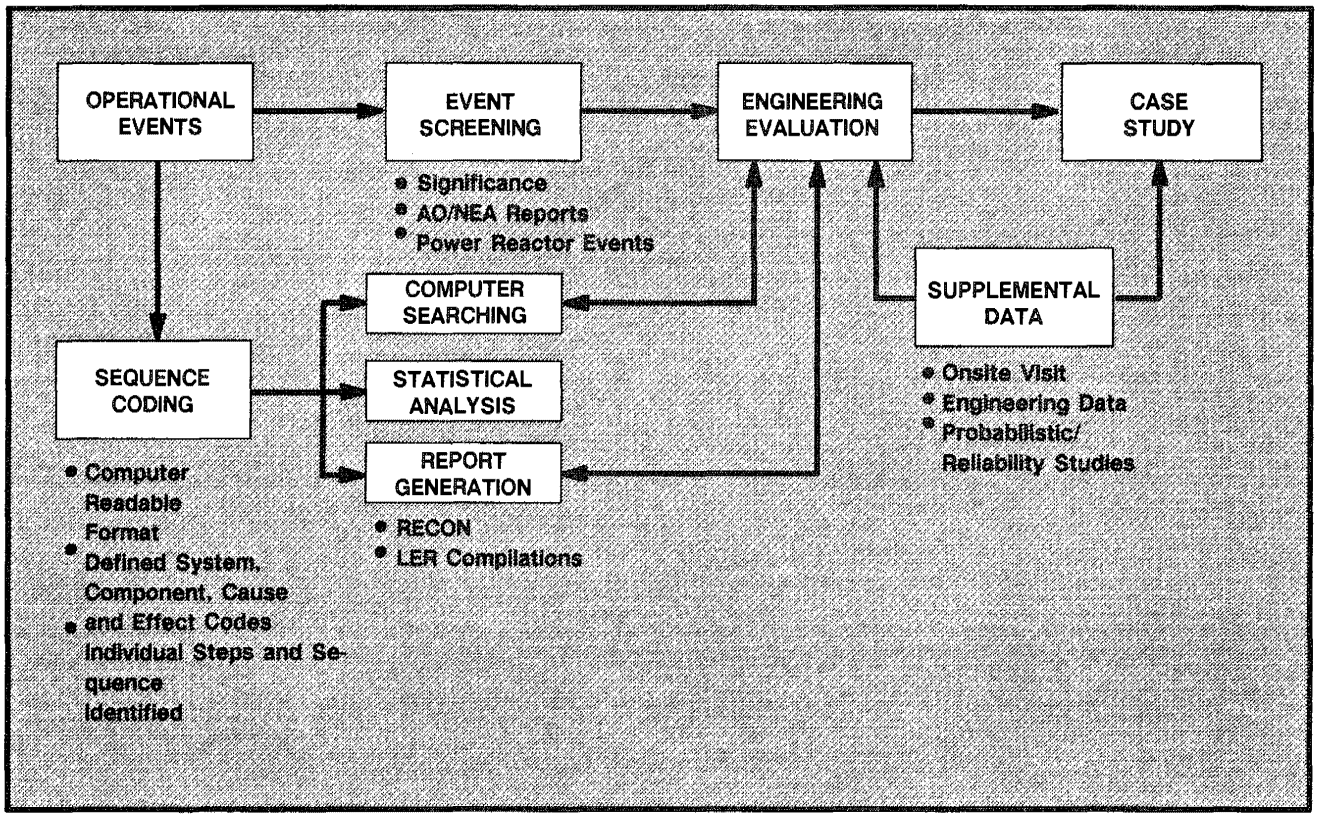
Analysis of Operational Events Involving Technical Specifications. In 1988, AEOD analyzed trends and patterns of LERs related to Technical Specifications (TS—technical requirements set forth in the license). The objectives of this project were: (1) to identify and catalogue TS-related LERs, (2) to categorize and evaluate the events reported in these LERs, (3) to identify any issues arising from the evaluation which appear to have generic safety significance or which relate to the ongoing Technical Specifications Improvement Program, and (4) to look for trends in the results obtained from the analysis of the data obtained in objectives (1) through (4).

The study of LERs involving Technical Specifications for 1984 (737 LERs), 1985 (1,189 LERS), 1986 (1,257 LERs) and 1987 (1,505 LERs) indicates that the distribution of TS-related reports was determined by TS violations (93 percent). Shutdowns (6 percent) and other types of events account for the balance. The average reported violation rate-per-plant rose from 7.4 violations in 1984 to 10.7 violations in 1985, remained relatively constant (10.2 violations-per-plant) in 1986, and increased to 11.4 violations in 1987. This increasing trend is distributed among three sources: (1) relatively high violation rates for short periods by a small group of mature plants that experience events repeatedly, (2) a slight increase in the average violation rate for the remaining mature plants, and (3) a clear contribution from newly licensed plants.

TS-related reports reflect plant conditions that vary widely in safety potential. To reflect this variance, the events were assessed qualitatively in terms of low, medium, and high ranking. The number of TS violations considered to be of relatively high safety potential actually decreased between 1985 and 1986. The increase was mainly in the "medium" safety category.

The number of completed shutdowns required by TS was relatively low. An estimated 4 to 5 percent of total industry unavailability was related to TS-required shutdowns. The systems most responsible for TS-required shutdowns were the reactor coolant system in pressurized water reactors (PWRs), and the reactor recirculation system in BWRs. Most of the shutdowns took place so that sources of unidentified leakage could be isolated and repaired.

AEOD Analysis and Evaluation Program



Operational Experience Feedback Report—Progress in Scram-Reduction. This report considered all unplanned reactor shutdowns or "scrams," both manual and automatic, at U.S. LWRs that had received an operating license (OL) before January 1, 1988, and that had accumulated critical hours during any calendar year (1984 through 1987). For the purposes of this report, a reactor scram was defined as an actuation of the reactor protection system (RPS), whether automatic or manual which resulted in control rod motion. RPS actuations without control rod motion, which occur in large numbers while the reactor is shut down, are not included. This report evaluated the systems initiating the unplanned scrams, the power level, and the concurrent ongoing activities at the time of the scram. General scram causes were evaluated for the entire period covered by the study and a representative sample of root cause data was analyzed to determine the root cause of both hardware failure and human error initiated scrams. The major concentrations of unplanned scrams in terms of numbers and normalized frequency were identified. The analysis of unplanned scrams was presented based on scrams at new plants and mature plants.

Each of the nuclear steam supply system (NSSS) vendor owners groups reviewed scram-reduction programs to assess the approach each used to reduce unplanned scrams. Areas where additional efforts are required were discussed in the report.

The analysis of unplanned reactor scrams for the period January 1984-to-December 1987 revealed significant industry improvement. The reduction in the overall industry scram rate was due to significant reduction in the scram rate at mature reactors in the population. The improvement in scram rate related to the learning curve for new plants was a secondary contributor to the decrease.

The most significant scram-reductions can be attributed to the improvements in the main feedwater system. A reduction by a factor of two was effected at Westinghouse-designed reactors because of fewer feedwater system hardware failures. Improvements in the scram rates for the electrical distribution system were noted in each year since 1985. Electrical distribution systems improvements were the result of reductions in both hardware and human error initiation rates. Finally, the downward trend noted for spurious

scrams originating within the RPS itself was the result of a lower scram rate resulting from reduced human error in testing and maintaining the RPS.

Equipment failures in the balance of plant (BOP) systems were found to be the primary cause of unplanned reactor scrams. The main feedwater and main turbine are the systems primarily responsible for the majority of BOP initiated scrams. Human errors by plant staff in operations, maintenance and surveillance testing were the second most important contributor to unplanned scrams. Roughly 25 percent of all unplanned scrams for 1984 through 1987 was attributed to human errors.

Every unplanned scram represents a direct challenge to plant safety systems and personnel. The challenge is compounded for scrams from high power when recovery is complicated by additional equipment failures or personnel errors. The scram rate for this type of scram trended downward over the four-year period, and accounted for about 9 percent of the total scram rate.

Improving equipment reliability in BOP system (i.e., power conversion and support systems) continues to be the most important path to further scram-reduction. In addition to general industry efforts to improve maintenance, both preventive and corrective, problems with feedwater-regulating valves, main feedwater pumps and main turbine electrohydraulic control are sufficiently generic in nature to warrant coordinated industry attention.

The report concluded that further scram-reduction across the industry should continue to be a priority goal for both regulators and licensees, in order to improve plant safety directly and indirectly. Reaching the stated industry goal will likely require effort and investment at a higher rate than has thus far been expended. As additional improvements are realized, it is likely that the remaining tasks will be increasingly difficult because the effects of improvement will not be as clearly visible as they were in earlier programs.

Trends and Patterns Analysis of Engineered Safety Feature Actuations. All licensed commercial nuclear power plants in the United States contain systems that are designed to control and mitigate occurrences that might challenge the integrity of the reactor system or harm plant personnel or the general populace. Generally known as ESF, these systems include those designed to (1) control reactor core reactivity, (2) isolate the containment and control its pressure, (3) isolate the reactor coolant system, (4) supply emergency cooling to the reactor fuel, (5) remove residual decay heat, (6) provide emergency power, (7) assure habitability of the control room, and (8) control radioactivity releases to the environment.

From January 1, 1985, to January 1, 1988, over 6,000 ESF actuations were reported. These actuations span more than 80 systems in 109 commercial power reactors. During 1988, AEOD prepared a report that presents a summary of this operating experience and formulates recommendations to reduce challenges to safety equipment and improve the efficiency of the ESF reporting requirements.

The analysis focused on ESF actuations that did not include the actuation of the RPS. The reactor water cleanup (RWCU) system, automatic isolation, and safety considerations were studied separately in AEOD Engineering Evaluation E705.

Overall, the trends and patterns of ESF actuations show a decline and leveling off in the rate of challenge of these safety systems during the last year or so:

- The rate-per-reactor of ESF event sequences decreased approximately 29 percent between January 1, 1985, and January 1, 1988, to about 10 sequences-per-year.
- Average unplanned actuations on a per-plant basis declined as follows: ECCS by almost 50 percent, to one event-per-year, emergency power (EP) system by 29 percent, to about one event-per-year; heating, ventilation and air conditioning systems (HVAC) by 36 percent, to about five sequences-per-year. A large part of these improvements can be attributed to the early resolution of operational problems at new plants.
- The rate-per-reactor of event sequences that were unneeded (relative to a valid initiation signal) to perform a safety function declined about 40 percent, to less than seven sequences-per-year.
- The trend in the rate of ESF sequences involving a single system on a per-plant basis showed a general decrease, while the rate for the more complex sequences (about 20 percent of total) remained relatively constant.

The industry-wide patterns have generally remained the same during each year. The system involved with the most sequences, especially with those actuated because of an invalid (unneeded) safety signal, was the HVAC. Approximately 50 percent of the reported sequences included the HVAC system, 10 percent involved the electric power (EP) system, and 6 percent involved the emergency core cooling system (ECCS).

The report concluded that, in general, there is no compelling need for strong regulatory action to address safety concerns with ESF actuation frequencies because the trends are down. Overall, the trends and patterns of ESF event sequences show that the rate of challenge of these safety systems slowly declined and leveled off

Table 2. Non-Reactor Reports Issued During FY 1988

Designation	*Subject*	*Issued*
S703	Special Study Report on Overexposure Events Involving Field Radiography	10/87
T711	Review of Data on the Teletherapy—Misadministrations Reported to the State of New York	11/87
T714	Distribution of Information Notices and Other "Mass Mailing" Information to Licensees That Have Users at Locations Remote from the Headquarters Location	11/87
S807	Review of Events at Large, Pool-Type Irradiators	09/88
N801	Report on 1987 Non-Reactor Events	09/88
N802	Medical Misadministration Report—Medical Misadministrations Reported to NRC for the Period January 1987 through December 1987	09/88

during the last year or so. Thus, in general, deterioration of safety equipment reliability by frequent challenge of the equipment has been reduced, and plant safety levels have increased.

Analyses of Non-Reactor Operational Experience

In addition to the screening and analysis of reactor operating experience, the AEOD reviews the non-reactor operational experience associated with the activities and facilities licensed by the Office of Nuclear Material Safety and Safeguards (NMSS) and by the Agreement States. AEOD also conducts studies from a human factors perspective of non-reactor and medical misadministration data files.

During fiscal year 1988, the AEOD issued two survey reports which contain a review of all 1987 non-reactor and misadministration reports. The staff also issued two special study reports: one report contained an evaluation of the causes of radiography overexposures in field radiography; the second report surveyed the operating experience at large, pool-type irradiators. Two technical reviews were also published. The non-reactor reports issued in fiscal year 1988 are listed in Table 2.

Medical Misadministrations Reported to NRC for the Period January 1987 through December 1987. A total of nine therapy and 414 diagnostic misadminstrations were reported to NRC in 1987. Six of the therapy misadministrations involved teletherapy, and three involved brachytherapy. Of the 414 diagnostic misadministrations, five involved the administration of therapy range dosages of iodine to patients. The findings of the report indicated that:

(1) Both the teletherapy and the brachytherapy misadministrations reported in 1987 might have been prevented by quality assurance procedures directed to verifying dose calculations, type of treatment, and patient identification.

(2) Essentially all of the diagnostic misadministrations involved either the administration of the wrong radiopharmaceutical or the administration of a radiopharmaceutical to the wrong patient.

The number, type, and cause of the diagnostic misadministrations are about the same as reported in previous years. The primary cause of misadministrations involving the administration of millicurie amounts of iodine to patients was the failure of licensees to exercise adequate control over the administration.

Report on 1987 Non-reactor Events. The survey of 1987 non-reactor events shows that, as in previous years, most 1987 non-reactor events concerned incidents of modest overexposure, lost or abandoned sources, or leaking sources. For these types of events, the 1987 data do not differ substantially from the same types reported in prior years.

Radiography Overexposure Events Involving Industrial Field Radiography. AEOD undertook a study of reports of overexposures of radiographers involved in field radiography to characterize the causes of the overexposures in support of a rulemaking on radiography. Data reported by NRC licensees and Agreement State licensees were used. Both groups of licensees experience about the same rate of overexposures.

There were a total of 34 reports from NRC licensees and 54 reports from Agreement State licensees in 1987. About 35 to 40 percent of the overexposures were caused by equipment problems. Virtually all of the events could have been avoided if the radiographer had made a proper radiation survey as required by regulation.

Review of Events at Large Pool-type Irradiators. AEOD studied the operating experience at large pool-type gamma-irradiators as background in developing new regulations on irradiators. The study reviewed reports of events by NRC licensees and NRC inspectors, as well as data reported by Agreement States.

The study found that about 0.12 event-per-irradiator-year was reported; most of the events reported were precursor events in which there was no evidence of damage to the radioactive sources or decrease in the level of safety of the facility. Events of greater significance had a reported frequency of about 0.01 event-per-irradiator-year. It was suggested that consideration be given to specifying requirements for reporting breakdowns in access control systems, periodic inspection of the source movement and suspension system, systems to detect source leakage, and feedback of information on operational events.

ABNORMAL OCCURRENCES

The NRC prepares a quarterly Report to Congress on Abnormal Occurrences (NUREG-0090 series), which also serves to communicate significant event information to licensees, other government agencies, and the public. (These reports may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Post Office Box 37082, Washington, D.C. 20013-7082, or the National Technical Information Services, 5285 Port Royal Road, Springfield, Va. 22161. Copies are also available for public inspection and/or copying at the NRC Public Document Room, or at Local Public Document Rooms throughout the country (see Appendix 3).)

There were five abnormal occurrence (AO) reports issued in fiscal year 1988—NUREG-0090, Vol. 10, No. 1 (January-March 1987), Vol. 10, No. 2 (April-June 1987); Vol. 10, No. 3 (July-September-1987), Vol. 10, No. 4 (October-December 1987), and Vol. 11, No. 1 (January-March 1988). Vol. 10, No. 1 (January-March 1987) was issued in October 1987; all of the abnormal occurrences (AO) described in that report occurred during fiscal year 1987 and were covered in the *1987 NRC Annual Report*, pp. 55-57. The remaining four reports describe five AOs at nuclear power plants, 16 AOs at other NRC licensees (industrial radiographers, medical institutions, industrial users, etc.), and four AOs reported by Agreement State licensees. The reports also contain updated information for certain AOs which had been previously reported.

The AOs reported in the four quarterly reports are listed in Table 3 and are described below. Some of the events resulted in escalated enforcement actions, including civil penalties, by the NRC. (See Chapter 1 for a listing of all civil penalties imposed by the Office of Enforcement during the report period, with capsule descriptions of the reasons therefor.)

Nuclear Power Reactors

Significant Degradation of Plant Safety at Oyster Creek. On April 24, 1987, while the reactor was being shut down, the licensee began to purge the containment nitrogen atmosphere so that entry could be made into the drywell. In order to accelerate the deinerting process, the group shift supervisor authorized the blocking open of the torus-to-drywell vacuum breaker valves. This rendered the containment vulnerable to steam bypass of the suppression chamber, which could have resulted in containment failure had a LOCA occurred. Furthermore, blocking open of the suppression chamber-drywell vacuum breakers resulted in the plant being in an unanalyzed condition. The event was caused by personnel error resulting from deficiencies in management and procedural controls. Safety review procedures were changed, personnel were retrained, and management was reinstructed on proper review and oversight. The NRC imposed a civil penalty which was paid by the licensee.

Steam Generator Tube Rupture at North Anna Unit 1. On July 15, 1987, North Anna Unit 1 (Va.) was manually tripped from 100 percent power because of

Table 3. Abnormal Occurrence Reports Issued During FY 1988

OCCURRENCES AT NUCLEAR POWER PLANTS

AO number	*Subject*	*NUREG-0900 Issue*
87-14	Significant Degradation of Plant Safety at Oyster Creek	Vol. 10, No. 3 March 1988
87-15	Steam Generator Tube Rupture at North Anna Unit 1	Vol. 10, No. 3 March 1988
88-1	Potential for Common-Mode Failure of Safety-Related Components Due to a Degraded Instrument Air System at Fort Calhoun	Vol. 11, No. 1 July 1988
88-2	Common-Mode Failures of Main Steam Isolation Valves at Perry Unit 1	Vol. 11, No. 1 July 1988
88-3	Cracked Pipe Weld in Safety Injection System at Farley Unit 2	Vol. 11, No. 1 July 1988

OCCURRENCES AT OTHER NRC LICENSEES
(Industrial Radiographers, Medical Institutions, etc.)

AO number	*Subject*	*NUREG-0900 Issue*
87-9	Medical Diagnostic Misadministration	Vol. 10, No. 2 November 1987
87-10	Medical Therapy Misadministration	Vol. 10, No. 2 November 1987
87-11	Medical Diagnostic Misadministration	Vol. 10, No. 2 November 1987
87-12	NRC Order Issued to Remove a Hospital's Radiation Safety Officer	Vol. 10, No. 2 November 1987
87-13	Significant Breakdown in Management and Procedural Controls at an Industrial Radiography Licensee	Vol. 10, No. 2 November 1987
87-16	Therapy Medical Misadministration	Vol. 10, No. 3 March 1988
87-17	Failure to Report Medical Diagnostic Misadministrations	Vol. 10, No 3 March 1988
87-18	Suspension of a Well Logging Company's License	Vol. 10, No. 3 March 1988

Table 3. Abnormal Occurrence Reports Issued During FY 1988

(continued)

OCCURRENCES AT OTHER NRC LICENSEES (Industrial Radiographers, Medical Institutions, etc.)

AO number	*Subject*	*NUREG-0900 Issue*
87-19	Suspension of an Industrial Radiography Company's License	Vol. 10, No. 3 March 1988
87-20	Suspension of License of an Oil and Gas Well Tracer Company	Vol. 10, No. 4 March 1988
88-4	Medical Diagnostic Misadministration	Vol. 11, No. 1 July 1988
88-5	Breakdown in Management Controls at Georgia Institute of Technology Research Reactor Facility	Vol. 11, No. 1 July 1988
88-6	Release of Polonium-210 from Static Elimination Devices Manufactured by 3M Company	Vol. 11, No. 1 July 1988
88-7	Medical Therapy Misadministration	Vol. 11, No. 1 July 1988
88-8	Medical Therapy Misadministration	
88-9	Significant Widespread Breakdown in Radiation Safety Program at Case Western Reserve University Research Laboratories	Vol. 11, No. 1 July 1988

OCCURRENCES AT AGREEMENT STATE LICENSEES

AO number	*Subject*	*NUREG-0900 Issue*
AS 87-3	Radiographer Overexposure	Vol. 10, No. 2 November 1987
AS 87-4	Hospital Contamination Incident	Vol. 10, No. 3 March 1988
AS 87-5	Therapy Medical Misadministrations	
AS 88-1	Radiation Injury to Two Radiographers	Vol. 11, No. 1 July 1988

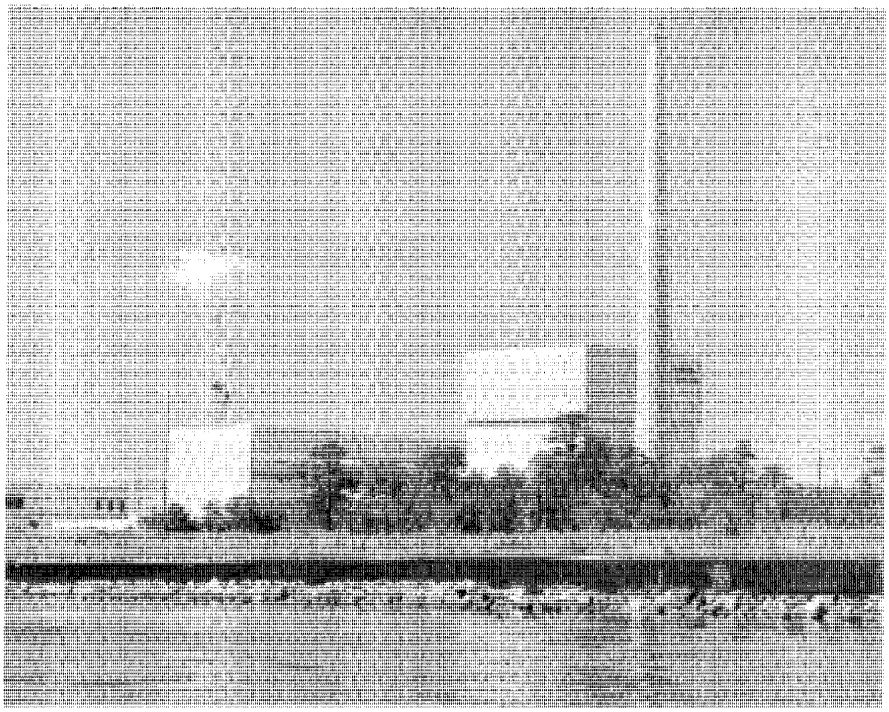
a steam generator tube rupture. It is estimated that a total of 0.16 curie of radioactivity was released. There was no detectable increase in normal background levels of radioactivity at the site boundary in the affected sector(s). The release was less than 1 percent of plant TS limits. The primary-to-secondary leak in this event was estimated to be between 550-to-637 gallons-per-minute. The cause of the tube rupture was fatigue caused by flow-induced vibration. Corrective actions taken to prevent recurrence included steam generator modifications, tube plugging of affected tubes, and modification of downcomer flow resistance surveillance, as well as changes in procedures.

Potential for Common-Mode Failure of Safety-Related Components Due to a Degraded Instrument Air System at Fort Calhoun. On September 23, 1987, while the licensee was performing a surveillance test of emergency diesel generator (EDG) 2, the EDG tripped off as a result of high temperatures in the engine cooling water system. Investigation revealed water in the instrument air system.

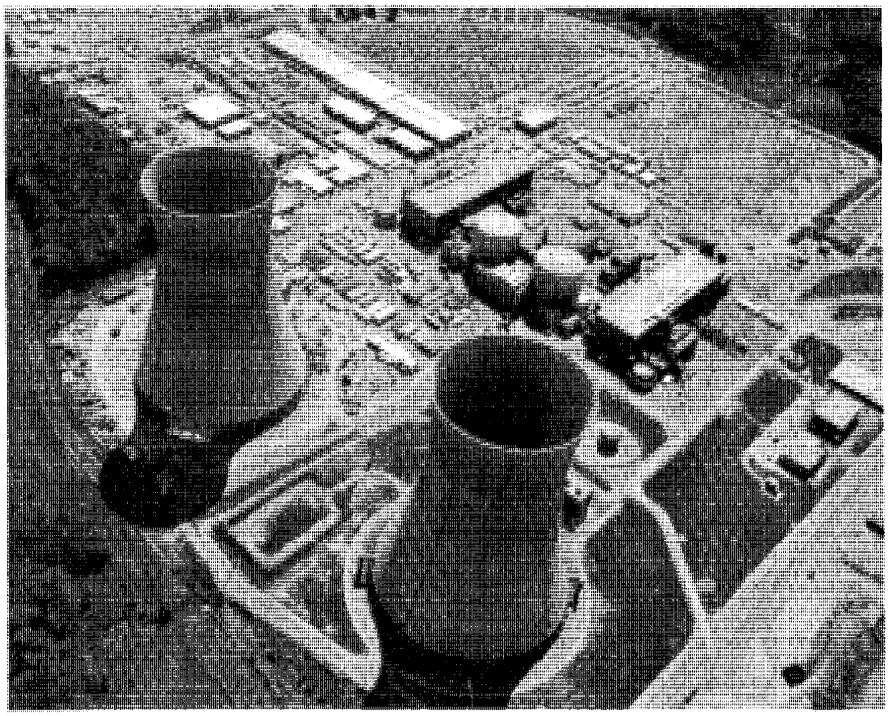
This fault resulted in a potential for common-mode failure of redundant EDG 1 and other safety-related components at the plant. The water caused a residue to form in a pilot valve which directs air into an air motor used to open and close a radiator exhaust damper. Failure of the exhaust damper to open due to a sticking pilot valve led to inadequate cooling of the EDG and caused the high EDG temperature. The root cause of the event was a breakdown in the ability of management to control activities that affect quality at Fort Calhoun. Corrective actions included isolating or removing instrument air/fire protection interfaces and more frequent inservice testing inspections of the instrument air system.

Common-Mode Failures of Main Steam Isolation Valves at Perry Unit 1. On October 29 and November 3, 1987, Perry Unit 1 (Ohio) experienced a common-mode failure during testing of the "D" steam line main steam isolation valves (MSIVs). Both the inboard and outboard "D" MSIVs failed to close within the required time limit.

On October 29, 1987, as part of the startup test program, the licensee tested each of the eight MSIV valves (two on each steam line). The two valves on the "D" steam line and one on a second line failed to close in the five-second test period. Subsequent testing, however, showed the valves to meet the test criteria, and the unit remained in operation. On November 3, 1987, two MSIVs again failed to close within the time limit, caused by sticking of fast closure dual solenoid air pilot valves. Elastomer discs and O-rings in the solenoid valves showed significant deterioration and degradation, caused by prolonged high temperature due to steam leaks in the vicinity of the solenoids. On November 29, 1987, an inboard valve on a steam line would not close because deteriorated materials had remained in the solenoid valve when it was rebuilt early in November. Corrective actions included increasing testing frequency for MSIVs, modifying maintenance procedures for solenoid valves, repairing steam leaks, and increasing monitoring to detect steam leaks.



A number of the abnormal occurrences reported in 1987 resulted in enforcement actions in 1988. One such occurrence involved a degradation of plant safety at the GPU Nuclear Coporation's Oyster Creek plant at Toms River, N.J., shown here.



Repeated failure of main steam isolation valves at the Toledo Edison-Cleveland Electric Company's Perry Unit 1 nuclear power plant at Perry, Ohio, resulted in NRC-directed corrective actions during the report period. The two reactor units at Perry are shown. Unit 1 is to the right; Unit 2 is not yet operational.

Cracked Pipe Weld in Safety Injection System at Farley Unit 2. On December 9, 1987, an unisolable leak was discovered in a safety injection system pipe while Farley Unit 2 (Ala.) was being restarted after a refueling outage. Investigation showed that the pipe crack was caused by thermal fatigue related to a leaking check valve. The event was significant because the potential existed for a common-mode loss of more than one ECCS pipe, had the piping been subjected to a design basis earthquake or a severe water hammer. Corrective actions included replacing the piping and verifying that the new piping was moving as predicted during heatup.

Other NRC Licensees

Medical Diagnostic Misadministration. On January 21, 1987, a 66-year old female at Halifax-South Boston Community Hospital, South Boston, Va., received 782 microcuries of I-131 instead of a 100-microcurie dose usually given for a thyroid scan. No adverse effects to the patient are expected by the licensee from the reported misadministration. The dose to the whole body was estimated as 0.37 rem and a thyroid tissue dose as 625 rems. The misadministration was caused by the nuclear medicine technician's misinterpretation of the dose calibration value. Corrective actions included reinstructing the technician on proper procedures.

Medical Therapy Misadministration. From April 20-22 1987, a patient treated with the cobalt-60 teletherapy unit at St. Peter s Medical Center, New Brunswick, N.J., received 600 rads to the lumbar spine area which was not the proper, prescribed treatment site. The licensee stated the dose would have no detrimental clinical effect, given the patient's current disease state (i.e., breast cancer with metastasis to the bone). The misadministration was caused by several human errors. Corrective actions by the licensee included training sessions for all technologists and probation for the two technologists involved in the misadministration.

Medical Diagnostic Misadministration. On May 20, 1987, a patient at the National Institutes of Health, Bethesda, Md., received 120 millicuries of technetium-99m pertechnetate rather than the prescribed radiopharmaceutical, 10 millicuries of gallium-67 citrate. The patient experienced no adverse effect from this misadministration. The event occurred because the radiopharmacist did not read labels on stock solutions and failed to assay for activity before administering the medicine to the patient. Corrective actions by the licensee included retraining of radiopharmacy personnel in checking labels and assaying radio pharmaceuticals in a dose calibrator before dispensing them.

NRC Order Issued To Remove a Hospital's Radiation Safety Officer. On June 15, 1987, the NRC issued an "immediately effective" Order to Milford Memorial Hospital, Milford, Del. The action was based on (1) the falsification of daily constancy checks of the dose calibrator by the licensee's two technologists, and (2)

the falsification of records of Radiation Safety Committee meetings by the Radiation Safety Officer (RSO), for about 15 years. The cause of these occurrences appears to be a lack of adequate management control by the licensee and a lack of integrity on the part of individual members of the licensee's staff. The NRC Order required removal of the RSO. Licensee corrective actions included suspension of the RSO, and conformance with various restrictions specified by the NRC Order.

Significant Breakdown in Management and Procedural Controls at an Industrial Radiography Licensee. On June 17, 1987, the NRC issued an "immediately effective" Order modifying the license of the United States Testing Company, Inc., Unitech Services Group (USTU), San Leandro, Cal., which required the licensee to temporarily cease all operations until certain specified corrective actions were taken. At the time, USTU was licensed by the NRC and several Agreement States to perform industrial radiography. In-depth special safety inspections identified numerous radiation safety violations. The root cause of the violations appears to be widespread disregard for compliance with regulatory requirements. Corrective actions included retraining radiographers and hiring a consultant to assess program deficiencies.

Medical Therapy Misadministration. On August 24, 1987, the NRC was notified that a 75-year-old patient at Parkview Memorial Hospital, Fort Wayne, Ind., received two radiation exposures to the wrong part of his body. The patient was examined by a physician and no medical side effects were noted as a result of the misadministration. The event was caused by personnel errors on the part of two technologists. Corrective actions by the licensee included implementing a QA program, followed by a decision to terminate its cobalt-60 teletherapy program.

Failure To Report Medical Diagnostic Misadministrations. On August 24, 1987, the NRC issued an Order To Show Cause Why the License Should Not Be Modified to the Edward Hines, Jr., Veterans Administration Hospital, Hines, Ill. This action was taken after NRC investigators determined that the Assistant Chief Physician of the Hospital's Nuclear Medicine Service: (1) failed to ensure that two diagnostic misadministrations of radioactive pharmaceuticals were reported to the NRC as required; (2) made a false statement to a Veterans Administration Investigatory Board and to NRC investigators; (3) destroyed evidence; and (4) attempted to impede the NRC investigation by influencing the testimony of a witness.

The misadministrations were caused by failure of the licensee's management and staff to adequately control its program. Corrective actions by the licensee included reassigning the Assistant Chief Physician to other duties and using an outside auditor to monitor its Nuclear Medical Service.

Suspension of a Well Logging Company's License. On September 8, 1987, the NRC issued an "immediately effective" Order to Log-Tec of Cleveland, Okla., that suspended the NRC license, ordered all byproduct material to be placed in locked storage, and ordered the licensee to show cause why the license should not be revoked.

During August 1987, an inspection showed several apparent violationsassociated with use and possession of sealed radioactive sources. The sole proprietor first said that the sources had not been used since about June 1986. Later, when confronted with evidence to the contrary, he not only admitted the violations, but also admitted that he had used the sources after June of 1986.

The root cause of the violations was a serious breakdown in the licensee's management controls. The licensee requested that the license be terminated. The license was revoked on February 23, 1988.

Suspension of an Industrial Radiography Company's License. On September 21, 1987, the NRC issued an "immediately effective" Order suspending the license of Finlay Testing Laboratories, Inc., Aiea, Haw. The Order required the licensee to suspend all activities authorized by the license and to place all byproduct material in the licensee's possession in locked storage.

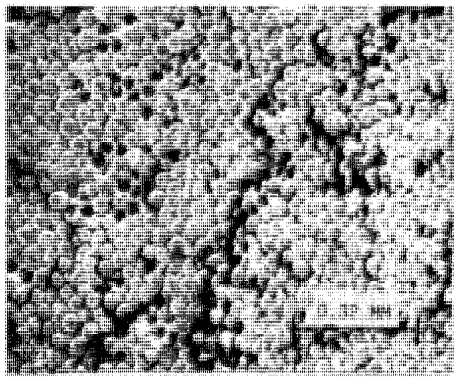
During inspections and investigations conducted in September 1987, it was determined that, contrary to NRC and Department of Transportation regulations, the licensee's employees had placed a radiographic exposure device containing radioactive material in luggage that was transported on commercial passenger and military cargo/passenger aircraft without the required shipping papers and labels for these shipments. The causes of the violations included a disregard for licensee procedures and for NRC license conditions and regulations. Licensee corrective actions included complying with the suspension Order. The license was terminated on May 13, 1988.

Suspension of License of an Oil and Gas Well Tracer Company. On October 30, 1987, the NRC issued an "immediately effective" Order suspending the license and an Order to Show Cause why the license should not be revoked to Tracer Profiles, Inc., of Oklahoma City, Okla. During March 1987, several violations of NRC requirements were found. Subsequently, the company vacated its offices and moved to a new location without notifying the NRC. The license was suspended because the licensee failed to fulfill its commitments to the NRC and because of its apparent inability and unwillingness to comply with NRC regulatory requirements.

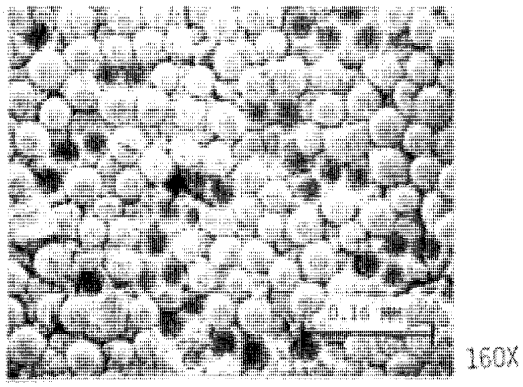
Medical Diagnostic Misadministration. On November 23, 1987, at Veterans Administration Medical Center, Albuquerque, N.M., a patient was administered 50 millicuries of technetium-99m instead of the three millicuries of thallium-201 prescribed by the physician. The licensee reported that there were no deleterious effects to the patient. The misadministration was caused by a student technologist's selecting the wrong syringe from the dosage cart. Corrective actions by the licensee included reprimand of the student technologist, new procedures for radiopharmaceutical labeling and handling, retraining of personnel, and improved supervision.

Breakdown in Management Controls at Georgia Institute of Technology Research Reactor Facility. Over a period of time until January 20, 1988, there were numerous failures to comply with NRC regulatory requirements at the Georgia Tech. research reactor. Inspections identified non-compliances in the areas of procedures, following procedures, and record-keeping. On December 16, 1987, an NRC inspector learned of a contamination event that occurred in August 1987. The licensee had failed to make a thorough review of the contamination event to determine its causes, and had not implemented any corrective actions to prevent recurrence. On January 20, 1988, NRC issued an "immediately effective" Order Modifying License requiring the licensee to cease irradiation experiments until certain conditions were met. The licensee voluntarily shut down the research reactor on February 15, 1988, and committed not to restart the reactor without NRC concurrence.

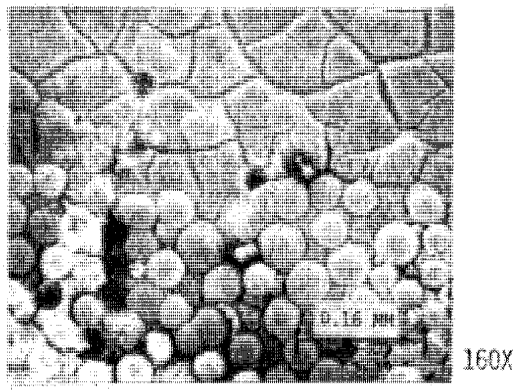
Release of Polonium-210 from Static-Elimination Devices Manufactured by 3M Company. On January 21, 1988, at the Ashland Chemical Company, Easton, Pa., and subsequently at various other locations, it was found that static-elimination devices manufactured by the 3M Company, St. Paul, Minn., had failed and had caused radioactive contamination.



Low magnification SEM photograph showing missing microspheres (dark dots).



This higher magnification fractograph showing the areas of missing microspheres.



Cracked microspheres and a definite "reptile skin" cracking of the epoxy is seen in this fractograph.

The photos above, called fractographs, show, in various magnifications, the leakage of polonium-210 that caused the recall by the 3 M Company of Statis Elimination Devices because of radioactive contamination. No adverse health effects were associated with the leakage (see Chapter 5).

The Po-210 in these devices is contained in microspheres of zirconium pyrophosphate that have been plated with nickel and held in place with an epoxy adhesive. A postulated cause of the failures is moisture or solvents in the environment that affect the epoxy adhesive which holds the radioactive material in the device. The licensee is investigating the cause of the failures. Plants where contamination has been found have been cleaned up. All 3M Company devices are being returned to the manufacturers, with a few exceptions permitted by NRC. No adverse health effects are expected because of the defective devices, and none have been found.

Medical Therapy Misadministration. On February 4, 1988, a technician at the Medical X-Ray Center, Sioux Falls, S.D., miscalculated the prescribed dosage, and a patient was administered 7.5 millicuries of phosphorus-32, instead of the 4.0 millicuries of the same radiopharmaceutical prescribed by the physician. There were no apparent effects to the patient and blood counts several weeks later showed normal blood elements. The technician administering the dose was reinstructed in the proper technique for calculating therapy doses and for reviewing the physician's written orders prior to administering the doses.

Medical Therapy Misadministration. On February 23, 1988, the NRC was notified by St. Joseph's Hospital, Milwaukee, Wis., that a patient with a 10-year history of bladder cancer received a cobalt-60 radiation dose of 2,000 rads to the wrong side of his pelvis. The radiation therapist had prescribed treatment to the dorsal spine and left pelvis. However, a therapy technologist preparing the patient for therapy had marked the right pelvis. The physicist, the chief technologist, and the dosimetrist did not notice the error. The patient exhibited no adverse after-effects as a result of the misadministration. The licensee agreed to develop and implement procedures requiring its staff to thoroughly review all aspects of therapy prescriptions and treatment (1) during the initial dose calculations, (2) just prior to initial treatment, and (3) during weekly chart checks.

Significant Widespread Breakdown in Radiation Safety Program at Case Western Reserve University Research Laboratories. The violations occurred in the licensee's research program activities, not in medical care and treatment of patients. NRC inspections during November and December 1987 identified about 20 violations of NRC requirements, involving the training of laboratory personnel, radiation safety practices, and control and oversight of the laboratories using radioactive materials. These violations and failure to adequately correct past violations demonstrated a serious and widespread breakdown in the management of the licensee's radiation safety program. Following suspension of all NRC licensed work, the licensee retained an interim Radiation Safety Officer, provided training to laboratory workers, and expanded the work of its consultant to review all laboratories for compliance with university and NRC requirements. Extensive programmatic changes were made to the licensee's radiation safety program. There was no evidence that any workers or members of the public received a significant radiation exposure as a result of the violations found in the licensee's radiation safety program. The fine imposed by NRC was paid on March 22, 1988.

Agreement State Licensees

Radiographer Overexposures. On December 9, 1986, an industrial radiographer and a radiographer's assistant, employed by Northwest X-Ray, Idaho Falls, Idaho, received overexposures while performing radiography in a multilevel hot cell at the Chemical Processing Plant at INEL near Idaho Falls. Both individuals were examined by INEL's Medical Director. No signs of injury were found. The assistant was released from further medical treatment, and the radiographer will be followed medically for several months. The overexposures were caused by the radiographer's failure to follow procedures. Corrective actions by the licensee included reinstruction to all radiographic personnel on radiation safety and procedures.

Hospital Contamination Incident. On June 2, 1987, a patient at Buffalo General Hospital, Buffalo, N.Y., was administered a 200-millicurie therapy dose of iodine-131. On June 3, 1987, the patient suffered a cardiopulmonary arrest and died. During an attempt at resuscitation in the patient's room by 16 staff members, contaminated blood and urine were spilled; no radiation surveys of the clothing of those present were done. Even though the contamination was extensive, subsequent thyroid bioassay showed no radiation uptake by involved staff, and the highest personnel monitoring badge reading was 30 millirems, for one of the nurses. The incident was caused by deficient procedures, inadequate training, and inadequate management control. Corrective actions by the licensee included revising procedures.

Medical Therapy Misadministrations. On August 5, 1987, the New York State Department of Health, Bureau of Environmental Radiation Protection was notified of a series of therapy misadministrations to patients at Northern Westchester Medical Center, Westchester County, N.Y.

Investigation disclosed that a dosimetrist had made numerous serious errors in calculating cobalt teletherapy treatment times for patients. There were 22 cases in which actual therapy doses delivered to pa-

tients differed from the prescribed doses by more than 10 percent. The largest error found was an administered dose about 2.4 times the prescribed dose. Some patients receiving excessive doses had exhibited physical symptoms apparently attributable to the exposures. The misadministrations were caused by errors in calculations. Corrective actions by the licensee included quality assurance measures and steps to prevent the dosimetrist who made the errors from making future treatment calculations.

Radiation Injury to Two Radiographers. On November 16, 1987, each of two radiographers at North Shore X-Ray and Testing Company, Houston, Tex., received large overexposures, in the range of 860-1,940 rems, on the skin of one ankle. The apparent causes of the accident were that the source was in an exposed position and also that radiation surveys had not been properly conducted. Corrective actions by the licensee included stressing the importance of using the survey meter to employees performing radiography.

PERFORMANCE INDICATOR PROGRAM

The Performance Indicator (PI) Program for operating commercial nuclear power plants, approved by the Commission in December 1986, is under the direction of AEOD, and is closely coordinated with NRR, RES, and the Regions. The program provides an additional view of operational performance and expands the NRC's ability to recognize areas of poor and/or declining safety performance in operating plants. However, it is only a tool—to be used in conjunction with other informing sources, such as inspections—in providing the bases for NRC management decisions regarding the need to adjust plant-specific regulatory programs.

The seven PIs currently monitored in the program are automatic scrams while critical, safety system actuations, significant events, safety system failures, forced outage rate, equipment forced outages-per-1,000 critical hours, and collective radiation exposure. PI data for each operating plant are presented in the form of charts and tables, and are provided to the Commission and NRC management in quarterly reports. The reports are available in the NRC Public Document Room. (For the definition of PIs, data sources and presentation methods, see the *1987 NRC Annual Report*, pp. 63 and 64).

It is recognized that PIs have limitations and can be subject to misinterpretation. The application of PIs for purposes and in ways other than those intended has the potential for running contrary to the NRC objective of ensuring operational safety. Consequently, during the report period, the Commission issued policy guidance to NRC staff regarding the proper applications of PIs.

In fiscal year 1988, the staff continued ongoing developmental activities for improving the PI program, including better methods for presenting data and developing of additional indicators. Staff reported on the status of the program and results of the developmental activities to the Commission in SECY-88-103, April 15, 1988, requesting approval to use the causes of events (cause codes), including licensed operator error, other personnel error, maintenance problems, design/installation/fabrication problems, administrative control problems and random equipment failures as PIs in the program. In conjunction with cause codes, the staff proposed that licensee corrective actions including training, procedures, discipline, management changes, design modifications, and equipment replacement/adjustment be used in the program. Staff also recommended approval of its plan to proceed with action for implementing an indicator of safety system unavailability (safety system function trends). This indicator, developed largely through the efforts of the RES staff, is an aggregate of the estimated unavailabilities of seven important safety systems in a plant.

In response to SECY-88-103, the Commission directed the staff to demonstrate the effectiveness of cause codes and safety system function trends as PIs, and develop new indicators of maintenance performance. The staff plans to present the final results to the Commission in the first quarter of fiscal year 1989.

Maintenance Performance Indicator Effort. During the fiscal year 1988 report period, the staff was engaged in a major effort with respect to maintenance PI development. The effort served two purposes: (1) to develop measures of nuclear plant maintenance, and (2) to report preliminary results to the Commission, for the reason that results of this effort can affect the development of the proposed maintenance rule. The task involved three phases. Phase one, begun in May 1988, involved selection of candidate trial maintenance indicators, selection of the nuclear plants to be used to collect data, and the selection of validation criteria by which the candidate indicators would be evaluated.

The second phase, conducted from July through August, 1988, involved the collection of data at 13 sites for 13 candidate indicators. Data evaluation and verification required an extensive amount of effort and resulted in an understanding of current plant maintenance monitoring practices at the sites that were visited. It was found that licensees generally monitor process maintenance indicators (e.g., corrective maintenance backlog), but they fail to monitor measures of maintenance effectiveness (e.g., out-of-service instances for equipment).

Phase three was validation of possible indicators using the data collected at plants and obtained from NPRDS. Preliminary results indicate that data obtained at the plants do not show a consistent pattern from one plant to another. Also, the maintenance process indicators do not exhibit the desired consistency and correlation with maintenance effectiveness. As such, process indicators are not very useful for industry-wide monitoring by the NRC. However, use of NPRDS to obtain data for maintenance effectiveness indicators has to dateprovided some encouraging results. Although no specific indicator has been fully validated across a number of plants, the extent of the correlations observed thus far shows merit for indicator use. Developmental and validation work will continue in this area.

INCIDENT INVESTIGATION PROGRAM

The Incident Investigation Program (IIP) was established by the EDO and approved by the Commission to assure that the NRC's investigation of significant events would be timely, thorough, well coordinated, and formally administered. The scope of the IIP includes the investigation of significant operational events involving reactors and non-reactor activities licensed by the NRC. The IIP's primary objective is, in general, to ensure that operational events are investigated in a systematic and technically sound manner, and, specifically, to gather all available information pertaining to the causes of the events—including those involving the NRC's activities—and to provide appropriate feedback regarding what has been learned from the events by the NRC, the industry, and the public.

Given its focus on the causes of operating events and the identification of associated corrective actions, the IIP process contributes to nuclear safety by providing for a complete technical and regulatory understanding of significant events. The IIP generates two investigatory responses based on the safety significance of the operational events. Both are provided by an NRC team put together to determine the circumstances and causes of an operational event. For an event of potentially major significance, an Incident Investigation Team (IIT) is established by the EDO, made up of Headquarters directed team complemented by Regional staff, as appropriate. The investigation of less significant operational events is conducted by an Augmented Inspection Team (AIT), which consists of Regionally directed teams complemented by Headquarters personnel and, in some cases, by personnel from other Regions. Of the more than 4,000 reportable events which have occurred during fiscal year 1988, no event was judged to have a sufficiently high level of safety significance to warrant an IIT investigation. AITs dispatched during fiscal year 1988 are shown in Table 4.

IIT Training Program. The purpose of this program is to provide IIT candidates with comprehensive guidance and methodology for conducting systematic and technically sound investigations. The training program was developed by AEOD following discussion with representatives of the National Transportation Safety Board, Federal Aviation Administration, and National Aeronautics and Space Administration. The training course includes an intensive two-week curriculum that includes an overview of the IIT, perspectives drawn from previous IITs, IIT investigation guidelines, and analytical techniques. The second IIT training course was completed in October 1987. A total of 25

NRC staff members attended the course and were organized into five student teams with a team leader for each to investigate a simulated incident. At the conclusion of the course, each team presented its findings and conclusions to senior NRC managers during a simulated Commission briefing.

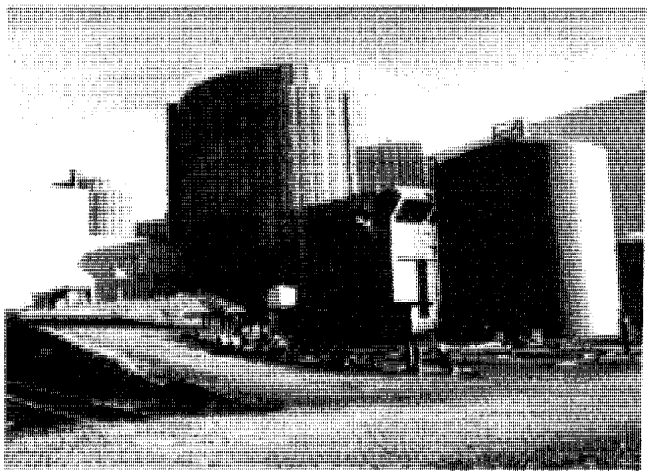
DIAGNOSTIC EVALUATION PROGRAM

The Diagnostic Evaluation Program (DEP) provides an assessment of licensee performance at selected reactor facilities. The DEP evaluates the involvement of licensee management and staff in ensuring safe plant operations, the effectiveness of their actions and the root causes of safety-related performance problems. The DEP supplements the licensee assessment information provided by the Systematic Assessment of Licensee Performance (SALP) Program, PI Program, and the routine and special inspections performed by the NRC Headquarters and Regional Offices, and it helps NRC senior management make more informed decisions concerning the need for NRC and licensee actions to improve plant safety.

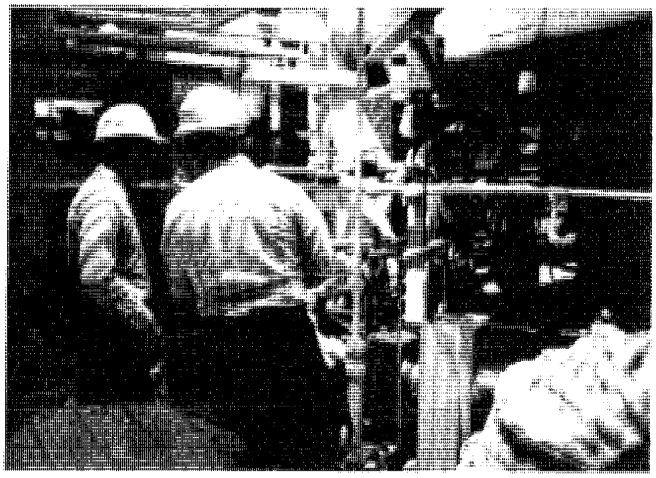
When a diagnostic evaluation is approved for a specific reactor facility, a Diagnostic Evaluation Team (DET) is authorized and established by the EDO. The DET consists of experienced technical staff members from other Headquarters offices, experienced Regional and resident inspectors, and contractors, if appropriate. Team members are selected in all cases so as to provide an unbiased and independent assessment of plant performance. The evaluationprocess involves observation of plant activities, in-depth technical reviews, employee interviews, equipment walkdowns, and programmatic reviews in a number of functional areas important to safety such as maintenance,

Table 4. Augmented Inspection Teams (AITs) Dispatched in FY 1988

Event Date	*Plant & Unit*	*Event*	*AIT Criteria*	*Report Date*	*Report*
10/02/87	Fort St. Vrain	Turbine Building Fire	Involves Significant Systems Interactions	10/29/87	50-267/87-26
10/29/87	Perry 1	Failures of MSIVs	Potential Common Mode Failure of Safety-Related Equipment	01/22/88	50-440/87-24 (DRS)
11/12/87	Pilgrim	Loss of Off-site Power	Repetitive Problem	12/14/87	50-293/87-53
11/29/87	Perry 1	MSIV Failure to Stay Closed	Broader Industry Implications	02/10/88	50-440/87-27
12/22/87	Salem 1&2	Flooding of Service Water System	Design Adequacy of Service Water System Isolation Valves	02/20/88	50-272/88-02 50-311/88-02
01/02/88	Brunswick 1&2	Failure of Containment Isolation Valves	Loss of Containment Integrity; Potential Common-Mode Failure	01/27/88	50-325/88-03 50-324/88-03
01/04/88	Indian Point 2	Steam Generator Boiled Dry	Event Involved Significant Deficiencies in Operation	03/14/88	50-247/88-03
01/20/88	Nine Mile Pt. 2	Vessel Overfill	Involved Systems Actions and Questions Pertaining to Operational Performance	03/08/88	50-410/88-01
01/22/88	Ashland Chemical Corp.	Polonium 210 Contamination	Potential Adverse Generic Implications; Radioactive Contamination	03/10/88	99990001/ 88-01
03/09/88	LaSalle	Dual Recirculation Pump Trip	Event Involved Safety Significant Deficiencies in Operation	05/16/88	50-373/88-08 50-414/88-14
03/10/88	Catawba 2	Degraded AFW Flow	Potential Common-Mode Failure; Generic Safety Concern	04/13/88	50-414/88-14 50-414/88-14
05/17/88	Dresden 2	Failure of MSIVs	Safety Significance—Root Cause of MSIVs Failure to Fully Close on Loss of Air	06/30/88	50-237/88-13
05/17/88	Surry 1	Refueling Cavity Floor Seal Failure (Not Reported to NRC Until 09/01/88)	Uncovering a Suspended Spent Fuel Assembly with Subsequent Cladding Damage and Radiation Hazards	09/30/88	50-280/88-34 50-281/88-34
07/05/88	Brunswick 1	High Pressure Coolant Injection	Multiple Equipment Failure Problems	08/17/88	50-325/88-27
09/29/88	Oyster Creek	Loss of Shutdown Cooling Events	"A" and "B" Isolation Condensers Declared Out-of-Service	—	50-219/88-80



The McGuire nuclear power plant, operated by the Duke Power Company at Cowans Ford Dam, N.C., was selected by NRC senior managers for diagnostic evaluation, both as a learning experience for NRC personnel and as a means for improving the agency's diagnostic evaluation team (DET) effectiveness. The plant is shown at left; an evaluation team at right.



surveillance and testing, management involvement, conduct of operations, safeguards and security, plant modifications and design changes, radiation protection, quality assurance, and corrective actions.

Diagnostic Evaluation at McGuire Nuclear Station (Duke Power Company). The NRC decided in June 1987 that additional information was needed regarding the overall performance of Duke Power Company (Duke) and its nuclear operations. Although regular NRC sources (SALP, PI, inspections) indicated that the Duke plants operated well, there were inconsistencies between the perceived strengths and capabilities of the Duke organization and actual plant performance which frequently involved significant and repeated problems in operations, maintenance, and other areas important to safety. In addition, NRC senior managers believed that Duke was a strong utility from which the NRC could learn. The McGuire (N.C.) nuclear power plant was chosen for the diagnostic evaluation of the Duke nuclear program.

The DET confirmed the NRC's perceptions of Duke and concluded that overall performance at the McGuire plant was a SALP Category 2 with an improving trend. As had been expected, the team observed a number of strengths in Duke's organization which contributed to the gains in performance. The team found overall corporate management leadership, direction, and support to be good. Clear direction was provided through corporate and department level goals and action plans; performance was tracked and reviewed monthly; corporate support staff and nuclear station staff worked together effectively to develop and apply new or improved technologies, management systems, and programs. The overall climate, culture, and attitude throughout the plant and corporate organizations were also found to be positive, with high morale, attention to quality, good communications, and a strong loyalty to the company. The overall technical capabilities of the staff were judged to be good. The nuclear support staff was technically competent, with significant operating plant experience, while the Design Engineering Department was found to be a large and knowledgeable resource. Corporate staff involvement in nuclear industry committees and organizations also promoted awareness and understanding of industry operating problems and improvement programs applicable to McGuire.

The functional areas involving operations, maintenance, and testing were found to have a number of noteworthy programmatic strengths and some programs were considered above the industry average in overall quality. Good morale was found among the operators and good communication and cooperation between operations and support groups. In addition, the preventive maintenance program was found to be comprehensive, and the completion of surveillance tests was ensured by an integrated scheduling group at the facility.

Notwithstanding these strengths, a number of programmatic weaknesses, technical problems, and concerns were identified in each of the functional areas. In maintenance, for example, weak root-cause determinations, combined with the lack of a formal integrated failure-trending program, resulted in recurring common-cause bearing damage for five of the six McGuire auxiliary feedwater pumps. Significant deficiencies were found in the Inservice Testing Program for safety-related check valves and some air-operated valves. The Inservice Testing Program deficiencies resulted in the failure to detect check valve failures in the auxiliary feedwater system and the steam supply system to the turbine-driven auxiliary feedwater pump. The team found that poor technical reviews—resulting from weak involvement by the Design

Engineering Department in the development of the initial Inservice Testing Program and, subsequently, in the development of a comprehensive action plan to address check valve failures—were a significant underlying cause of the identified testing deficiencies. Lack of adequate management review and weaknesses in the technical capabilities of the QA surveillance group were also found to be important underlying causes for administrative limits regarding reactor coolant system and pressurizer cooldown rates being exceeded on a recurring basis.

Although the DET determined that the performance at McGuire was improving, the team concluded that the improvement efforts were being slowed by several factors. Foremost among these was the limited utilization of the Design Engineering Department in the evaluation of plant operating problems and programs. Although Duke's Design Engineering Department was a large and capable resource, it was not being fully utilized in the day-to-day support of the operating plants because of attitudes within both that department and the nuclear production departments which tended to limit design engineering involvement. Other factors of concern included the near-term limitations on the contributions of QA for enhancing plant safety performance and some instances of inadequate performance of construction and maintenance department personnel because of inadequate training. The team was also concerned about the potential for reduced corporate oversight, direction, and leadership for the operating nuclear stations resulting from competing demands coming from Duke's growing outside business interests.

Duke responded to the findings and issues raised by the team in a positive and constructive manner which was considered indicative of Duke's strong desire to improve the performance of the McGuire Nuclear Station.

Evaluation of the Independent Management Appraisal of the Turkey Point Nuclear Plant. In April 1988, the EDO directed AEOD to lead a formal NRC evaluation of an Independent Management Appraisal (IMA) of Florida Power & Light (FP&L) Company's Turkey Point nuclear plant. FP&L had committed to the appraisal and this commitment had been confirmed by NRC Order EA 87-85, dated October 19, 1987. FP&L contracted with ENERCON Services, Incorporated to perform the appraisal and the IMA report was submitted to the NRC in April 1988. AEOD staff were assigned, together with NRR and Region II personnel, to determine whether the appraisal of Turkey Point and FP&L was of sufficient scope and depth to assure that the significant problems adversely affecting Turkey Point performance, together with the underlying causes, had been identified and accurately described.

The evaluation was conducted by a team of NRC Headquarters and Regional personnel which documented the results of its evaluation in June 1988. The team found that the IMA was generally performed in a competent and complete manner and that the IMA report was forceful and focused on relatively high-level management issues—such as obtaining highly qualified managers with proven track records and realigning the organizational structure for technical support. The NRC team determined that the report lacked supporting details collected by the IMA team, such as maintenance and training deficiencies, that might be needed to fully understand the problems and causes for developing corrective actions. In addition, root causes of problems were not always pursued in terms of corporate management responsibilities. The NRC team concluded that many of the identified root causes had their origin in a lack of effective FP&L corporate leadership and direction and an inappropriate level of corporate management decision-making for the plant. It was concluded that the IMA report downplayed the extent and significance of corporate management root-cause responsibility.

The IMA report indicated that, except for a few specified areas, staffing and resources at Turkey Point were generally adequate and the workload (plant changes and improvement programs) should be adjusted to match the resources available. The NRC team considered that this approach would not adequately support necessary improvement programs in addition to normal plant operation. For example, it appeared that there was a lack of adequate resources in maintenance.

The NRC team concluded that the IMA report, together with the additional supporting details from ENERCON and the team report, would provide an adequate basis for FP&L to understand Turkey Point's significant problems and their root causes. The team made 11 recommendations to supplement the IMA and to enlarge FP&L's understanding of the causes for Turkey Point's performance problems and the actions that should be taken to address them.

Diagnostic Evaluation of the Enrico Fermi Atomic Power Plant (Fermi 2). In June 1988, NRC senior managers determined, during a detailed review of the regulatory and operational history of Fermi Unit 2 (Mich.), that additional information was needed to make a more informed assessment of overall plant performance and the effects of recent corrective actions taken by the Detroit Edison Company to improve safety at the plant. Consequently, a diagnostic evaluation of Fermi Unit 2 was conducted during the period August 22 through September 16, 1988. Issuance of a report is expected early in fiscal year 1989.

TECHNICAL TRAINING PROGRAM

The NRC Technical Training Center (TTC) was established to develop and implement policy and programs for technical training of the NRC staff. The TTC provides technical training for resident inspectors, Region-based inspectors, Operator License examiners, Headquarters operations officers, Project Managers, Technical Managers, and other NRC technical staff. Although it is located in Chattanooga, Tenn., the TTC is part of AEOD at NRC Headquarters.

The TTC provides technical training in broad areas of reactor technology and specialized technical training. The reactor technology curriculum consists of a spectrum of courses involving both classroom and full-scope reactor simulator training, covering all of the major U.S. reactor vendor designs—Westinghouse (W), General Electric (GE), Babcock and Wilcox (B&W), and Combustion Engineering (CE). The specialized technical training curriculum comprises a number of courses in engineering support, health physics, safeguards, and inspection or examination techniques.

During fiscal year 1988, the TTC conducted or coordinated a total of 113 courses in the reactor technology areas and 50 in the specialized technical training area for a total of 1,640 students. A number of students in qualification programs attended multiple courses. These courses represent a total of 209 course-weeks, 140 of which were associated with reactor technology training and 69 with specialized technical training. A summary of the fiscal year 1988 data is seen below (C-W is course-weeks and can generally be correlated with TTC staff effort or contractor dollars required to conduct training).

The TTC has maintained and improved separate, parallel curricula for each of the four major U.S. reactor vendor designs. A number of significant modifications in the reactor technology curriculum were made during the year for the following courses: GE Technology Course R-106B, GE Technology Course R-306B, GE Advanced Technology Course R-506B, GE Simulator Course R-606N, GE Simulator Refresher Course and Examiners R-701B, GE Technical Managers Course R-906B, W Technology Course R-304P, W Advanced Technology Course R-504P, and Reactor Concepts. In addition, the TTC completed development of full course series (300-level technology followed by 500-level advanced technology followed by 600-level simulator) in both the B&W and CE design. The major modifications in the course manual for the GE and W vendor designs were associated with revising the course manuals to reflect the systems of the reference simulators for these courses.

A number of new initiatives in reactor technology were developed and implemented during the year. Simulator training in the area of Emergency Operating Procedures (EOPs) became very important. This training started with some special EOP Simulator Courses for training groups of Regional EOP inspectors. Additional EOP Simulator Courses were provided in each of the four reactor vendor designs in support of the Accelerated EOP Inspection Program. EOP Simulator Courses for several teams which conducted special inspections of all BWRs with the Mark I containment design were also given. Finally, the EOP training expanded into the training program associated with operator license examiners.

New courses were developed in support of reactor technology training for the NRR staff. These consisted of a short series of courses, including a two-week classroom course followed by a special one-week simulator course. The initial presentation was in W technology. Discussions with NRR senior management resulted in some adjustments of the objectives and content of the short series. A revised short series was conducted in both W and GE technology.

TTC developed new training in the area of severe accidents. Training related to degraded core accidents, previously contracted to the reactor vendors, was incorporated within new Severe Accident Overview Seminars which were scheduled as requested by Regional and program offices. The initial presentation, associated with W technology, was conducted in Region I. Since a great deal of new information concerning severe accidents became available during the

Area	*Courses*	*Students*	*C-W*	*Percent C-W*	*Percent Students*
Reactor Technology Training	113	1040	140	67	63
Specialized Technical Training	50	604	69	33	37
Totals:	163	1644	209	100	100

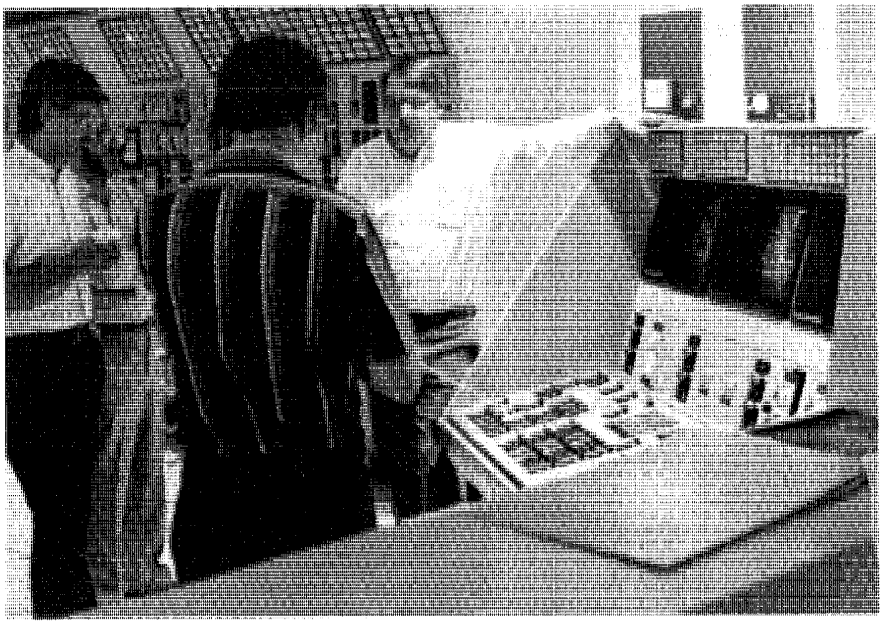
year, the seminars were changed to a cooperative effort involving the TTC, RES, and Brookhaven National Laboratory. The course material incorporated new information concerning severe accident methodology and insights, and the TTC staff received training in these areas. Several cooperative seminars in severe accidents are planned for the next fiscal year.

An expanded curriculum for operator license examiner training was coordinated with the Operator Licensing Branch (OLB). It now includes an extended series of courses consisting of the traditional full-course series and two additional courses designed specifically for operator license examiners. The additional courses consist of an Integrated Facility Operations Simulator Course and an EOP Simulator Course. They are intended to give qualifying operator license examiners additional simulator operating experience with normal facility operations as well as additional first-hand experience with facility EOPs. The development of additional operator license examiner training in written, simulator, and walkthrough examination techniques was developed jointly by members of the TTC and OLB staffs and funded through TTC task order contracts. This additional training will be available for presentation early in fiscal year 1989.

Validation of the need for training and careful management of the schedule allowed a major schedule revision which reduced the number of full-course series in W and GE technology from the original projection of four each to three. This allowed space for simulator refresher training for inspectors and for presentation of a special BWR technology course in Mexico in support of the Mexican Comision Nacional de Seguridad Nuclear y Salvaguardias (CNSNS).

Significant progress was made in ensuring the availability of reactor simulator time for the training of NRC staff. During the fiscal year, a contract was negotiated with Power Safety International, a subsidiary of B&W acting as an agent for the Washington Public Power Supply System. The contract resulted in the delivery to the TTC of the B&W simulator originally built by Singer-Link for the Washington Nuclear Plant (WNP) unit 1. Maintenance and operational support for the B&W simulator was supplied by GE through a modification to the Black Fox (a nuclear unit originally planned by Public Service Company of Oklahoma) simulator contract. The NRC is now leasing three full-scope simulators with options to purchase. Access to simulator time is available in the amount of 2,000 hours-per-year for the Black Fox simulator and 4,000 hours-per-year for both the W Standardized Nuclear Unit Power Plant System (SNUPPS) and B&W simulators. Access to simulator time for the CE vendor design continued to be supplied through a contract for time on the CE Calvert Cliffs simulator, in Windsor, Conn.

Specialized technical training, separate from reactor technology training, continued to be provided by making available to NRC employees a few places in regularly scheduled courses. Such courses typically contain students from a wide variety of organizations and are, therefore, not tailored to meet NRC needs. During the fiscal year, a total of 21 such courses involving 37 course-weeks were made available to the NRC staff. Specialized technical training is also provided through contracting for courses which are attended only by NRC employees or selected contractors. These courses are typically customized to meet



Several new courses and curricula were added to programs offered at the NRC's Technical Training Center at Chattanooga, Tenn. In the picture, Bill Thurmond is instructing technical managers in the use of control devices and displays associated with boiling water reactors.

specific NRC needs. During the fiscal year, 29 of these courses involving 32 course-weeks were made available to the NRC staff. Major courses of this type included the Electric Technology and Codes, Independent-Measurements, Non-Destructive Examination, Eddy Current Testing, and Motorized Valve Actuators Courses.

A number of specialized technical training initiatives under way at the end of the fiscal year included courses in Non-Power Reactor Technology Training, Radiotherapy, and Cold Chemistry Review, as well as courses being made available through the Occupational Safety and Health Act. Program responsibilities for certain courses in the specialized technical training curriculum have been shifted from other organizations to the TTC in some cases. Incident Investigation Team training, previously sponsored by Diagnostic Evaluation Incident and Investigation Branch (DEIIB); the Inspecting for Performance Course, previously sponsored by NRR; and Site Access and Site Access Refresher Training, previous sponsored by NRR, will be funded and managed by the TTC commencing with fiscal year 1989.

The NRC began the development of revised qualification programs for its technical personnel in fiscal year 1988 and will continue these activities through the coming years. Since the technical training needs of headquarters technical positions were not as well known as those of the Regional technical positions, a plan was developed to define these headquarters needs over a period of time. This plan was designed to identify the headquarters technical positions for which qualification programs should be developed and to provide a process for defining the qualification and technical training requirements for these technical positions. This plan was issued in February, 1988 and had a number of phased milestone dates. The Program Offices which participated in the plan were NRR, NMSS, and AEOD. Phase 1 of the plan called for identification, analysis, and grouping of similar positions within Program Offices and was completed in April 1988. Phase 2 called for identification of training needs for the groups identified in Phase 1 and was completed in June 1988. Phase 3 called for analysis, reconciliation, and feedback of earlier input and was completed in August 1988. Phase 4 calls for formalization of the qualification and training requirements, as appropriate, by the Program Offices and is scheduled for completion early in fiscal year 1989. In addition to the work done by the Program Offices to develop the products for the different phases of this plan, considerable instructional design consulting expertise was made available to the process by the Office of Personnel.

INCIDENT RESPONSE

Events Analysis. The NRC maintains a 24-hour-a-day, 365-day-a-year Operations Center in Bethesda, Md. The Operations Center is the NRC's center for direct communications, through dedicated telephone connections, with licensed nuclear power plants and certain fuel cycle facilities, providing the capacity to receive reports of, and to deal with, significant events at these facilities. The Center receives about 4,000 notifications each year from its licensees, primarily nuclear power plant operators. During the first nine months of 1988, there were 210 incidents (nine alerts and 201 unusual events) reported to the Operations Center under the NRC emergency classification system.

The staff at the Operations Center evaluates telephone notifications and, depending on the safety significance of the event, notifies appropriate NRC Headquarters personnel and other Federal agencies. In all cases, the NRC Regional Office in the area from which the facility is reporting the event is notified. Response to an event may vary from simply recording the circumstances of the event for later evaluation to immediately activating response organizations within Headquarters and the affected NRC Region. Upon activation, these response organizations monitor the event to ensure that appropriate actions are being taken to protect the health and safety of the public. The NRC recognizes that the agency's role is secondary to those of the licensee and off-site organizations, whose immediate responses are definedin their own emergency plans.

Each of the 4,000 events reported each year to the Operations Center by a licensee is evaluated to determine whether it bears any generic implications for other nuclear facilities. Event reports are screened for this purpose early during the first working day after receipt. Follow-up of plant specific events is accomplished by the appropriate Region. Where an event indicates significant systems interaction and raises questions as to plant safety, an AIT or an IIT may be formed. Events that may be significant from a generic standpoint receive additional in-depth evaluation and, if appropriate, the NRC issues a generic correction, such as an Information Notice or Bulletin, to potentially affected licensees and construction permit holders.

Operations Center. Considerable resources are needed to maintain a prompt incident response capability, which entails continuous staffing by well trained individuals with appropriate facilities and tools

Among the accident scenarios simulated in NRC Operations Center exercises in 1988 was one involving the Trojan Unit 1 nuclear power plant at Prescott, Ore. The photo shows, in the foreground, the Reactor Safety team chief (l.) and the Protective Measures team chief (r.) feeding information to the display panels (right background) in the Executive Team room. The information comes in from the Trojan plant and NRC Region V Operations Center in San Francisco, Cal., is analyzed by the team chiefs and relayed to the Executive Team for evaluation and response. At the center in the Executive Team room is NRC Executive Director for Operations, Victor Stello, Jr., in his role as Executive Team Director for the exercise.

to receive information, assess that information, and communicate with other involved parties. During 1988, the Operations Center was involved in several actual events which, while not requiring complete activation, necessitated the use of the Operations Center's capabilities. The Operations Center was staffed to monitor the on-site explosion and fire of the auxiliary transformer event at Palo Verde Nuclear Power Plant in Arizona and to follow the electrical fire in a control panel event at Calvert Cliffs Nuclear Power Plant in Maryland. The telecommunications capability of the Operations Center was used by NRC management in teleconference discussions of a number of events that were potentially significant but not enough to warrant staffing of the Operations Center.

During 1988, a number of exercises dealing with various accident scenarios and involving the Operations Center were conducted in order to confirm and maintain the capabilities of the agency response personnel. Most of the scenarios were concerned with reactor plant incidents. The exercises included full-scale exercises at the Rancho Seco Nuclear Power Plant (Cal.), River Bend Nuclear Power Plant (La.), Cook Nuclear Power Plant (Mich.), Nuclear Fuel Services-Erwin Fuel Cycle Facility (Tenn.), and three computer-generated reactor accident simulations. All of these exercises were supported through the Operations Center. Throughout the year, tours of the Operations Center were frequently provided for representatives of other NRC offices, industry, State and local government, and foreign countries. The tours included detailed descriptions of the NRC response role and typical activities within the Operations Center during an exercise or event.

Regional Response Capability. Each Regional Office also maintains its own incident response capability and an incident response center that is designed to work with the Headquarters program. The extent of Regional Office response to an incident would be based on a pre-defined classification of the event. A Regional base team and a Regional site team are assembled for a significant event. Headquarters and the Region monitor licensee performance until a decision is made to dispatch a team on the site. An initial site team of 12 to 18 specialists led by the Regional Administrator normally arrives at the site some two-to-eight hours after being dispatched. Once the site team is fully briefed by licensee management and the resident inspector, and is prepared to carry out its assignments, the Chairman of the NRC or his designee would consider transferring appropriate responsibility and authority to the Regional Administrator.

Each Region has its own supplement to agency procedures for the NRC Incident Response Plan providing specific implementation details. During fiscal year 1988, Headquarters and the Regions worked together to standardize the regional supplements and reinforce the agency-wide response capability. Regional response capabilities are assessed annually, and the Regions participate in several exercises each year, at least one of which includes Headquarters participation. In the event of an extended NRC response, the initial site team would be augmented by a number of team members from outside the Region.

Coordination with Other Federal Agencies. The Incident Response Branch (IRB) participated actively in many Federal emergency response planning and

response activities directly involving other Federal agencies in 1988. These activities included:

- **National Response Team (NRT).** The Environmental Protection Agency-sponsored NRT is responsible for national planning and coordination of Federal preparedness and response activities for hazardous materials incidents. It provides a mechanism for consensus-building among its member agencies on Federal policy questions, particularly related to the Clean Water Act and Superfund (Comprehensive Environmental Response, Compensation, and Liability Act). NRC has been particularly active in the NRT's preparedness activities and revisions to the National Contingency Plan (NCP).
- **Interagency Group on Energy Vulnerability.** NRC has participated regularly in this group, led by the Department of Energy, whose purpose is to focus on national policy issues relating to the vulnerability of U.S. energy systems and to develop policy options to assure adequate energy security for the nation at a reasonable cost.
- **COSMOS-1900.** The NRC was actively involved in the extensive Federal preparations for the possible September 1988 re-entry of COSMOS-1900, the Soviet satellite powered by a nuclear power reactor. NRC helped prepare supplementary procedures for the Federal Radiological Emergency Response Plan (FRERP) and offered NRC radiation monitoring and analytical capabilities and a communications network to distribute the information that would have been generated if the re-entry had affected the United States. In late September, the satellite containing the reactor was successfully boosted to a higher orbit, obviating the concern about re-entry.

Emergency Response Data System (ERDS). The ERDS concept provides for licensee activated transmission of preselected plant data from the licensee to a computer at the NRC Operations Center during emergencies at commercial nuclear power plants. Implementation work on ERDS was initiated during 1988, including final adoption of the hardware and software requirements for the system and beginning procurement of the required hardware. Several briefings and meetings were conducted for various Congressional committees, members, and staff regarding H.R. 1570, legislation which would have mandated an ERDS. Although the legislation did not pass, implementation is currently under way with voluntary licensee participation. Efforts on arranging licensee participation have included briefings for the Nuclear Utility Management and Resources Committee (NUMARC) and various individual utilities. Completion of the user-interface software and the establishment of several plant connections are expected in 1989; the remaining plant connections are expected over a two-to-three-year period.

Continuity of Government (COG) Program. During 1988, IRB developed, with the assistance of Systems Research and Applications Corporation, guidance needed to establish the COG program at Headquarters and the Regions. The program deals with the NRC's role in a national security emergency. On June 30, 1988, NRC issued Manual Chapter 0601, "Continuity of Government Program," which defines the objectives of the COG program and the authorities and responsibilities for the activities to be performed and a COG handbook, the Appendix to Manual Chapter 0601, which describes the NRC's role in support of Federal COG operations and the responsibilities of NRC emergency teams in carrying out that role. This program will be implemented within the NRC during the next several years. The IRB also developed a proposed rule, 10 CFR Part 50.54(dd), "Licensee Action During National Security Emergency," issued for comment on July 7, 1988, to allow licensees to take action that departs from approved Technical Specifications, during a national security emergency.

Emergency Response Training. IRB issued for comment NRC incident response training requirements for both Regional and Headquarters response personnel and developed a course that covered the technical training requirements for reactor accident protective measures assessment (Protective Measures Manual, NUREG/BR-0132). The course covered standardized procedures and computer codes for assessment of public protective actions, projection of consequences, accessing weather information and interacting with other Federal response organizations. This training course has been presented to Headquarters and the Regions. As a result, all NRC response personnel with responsibilities for assessing protective measures during a reactor accident will have a common basis for their assessments, using the same tools and procedures.

A similar training and procedure development program is under way for the reactor safety personnel responsible for assessing reactor conditions and accident mitigation. A pilot course is under development in cooperation with NRC's Office of Regulatory Research and the Technical Training Center which is designed to assure that the response staff is kept abreast of ongoing severe accident research and is prepared to perform an independent assessment of operator actions. The course will include core-damage sequences, severe accident phenomenology, severe accident insights, event classification, and Emergency Operating Procedures (EOPs). Training development programs for response management, fuel cycle accidents, and materials accidents are planned for 1989.

During 1988, approximately 400 NRC response personnel were trained by IRB and Regional Emergency Response Coordinators with respect to the NRC role, incident response functions, and severe reactor accident analysis, based on the "Pilot Program: NRC Severe Reactor Accident Incident Response Training Manual" (NUREG-1210).

IRB has continued to support the Federal Emergency Management Agency (FEMA) effort to train State and local response personnel. Instruction on reactor concepts and accidents has been presented at several FEMA courses at the Emergency Management Institute in Emmitsburg, Md.

Emergency Response Technical Tool Development. IRB continued to develop tools to assist in assessing the severity and possible consequences of reactor accidents. "Source Term Estimation During Incident Response to Severe Nuclear Power Plant Accidents" (NUREG-1228) was completed in 1988. This new method of estimating off-site consequences of reactor accidents is based on consideration of dominant accident conditions. Development continued on a new consequence projection code for use in response to a reactor accident. A draft of the code was issued to Headquarters and the Regions for trial use. The code includes the NUREG-1228 source term estimation methods and is designed to be used by responders who may not have extensive backgrounds in source term estimation.

IRB is developing a Reactor Safety Assessment System (RSAS) for use bythe Reactor Safety Team to assist in assessments of core status, in development of actions to restore plant stability, and in verifying the success of mitigative actions during emergencies at nuclear power plants. The RSAS system will provide the capability to represent, collect, store, and process the knowledge and plant specific information required for the assessments.

The RSAS concept consists of generic models containing core protection knowledge for PWR and BWR types and will have the capability to extend the models to plant-specific versions. The knowledge base in RSAS includes critical safety function success criteria, available success path options, operational considerations from each of the NSSS vendors' emergency procedure guidelines, transient recognition rules, and severe accident insights.

RSAS development work in 1988 concluded with the testing of a PWR prototype using a Combustion Engineering plant. Extension of this system to selected PWR plant-specific versions and the development of the BWR generic model are planned for 1989.

Nuclear Materials Regulation

Chapter 5

The NRC's Office of Nuclear Material Safety and Safeguards (NMSS) and NRC's five Regional Offices administer the regulation of nuclear materials, as distinct from nuclear reactor facilities (discussed in Chapters 2 and 3). The NRC regulates nuclear materials by conducting three broad programs: fuel cycle and material safety, discussed in this chapter; materials and facilities safeguards, discussed in Chapter 6; and waste management activities, discussed in Chapter 7.

Activities covered in this chapter include licensing, inspection, and other regulatory actions concerned with (1) the conversion of uranium ore concentrates (after mining and milling) to uranium hexafluoride; (2) conversion of enriched uranium hexafluoride to ceramic uranium dioxide pellets and their subsequent fabrication into light water reactor fuel; (3) production of naval reactor fuel; (4) storage of spent reactor fuel; and (5) production and use of reactor-produced radioisotopes ("byproduct material").

Highlights of actions completed during fiscal year 1988 include:

- More than 100 licensing activities dealing with fuel cycle plants and facilities.
- Approximately 100 fuel facility inspections and 2,800 material licensee inspections, which identified almost 1,900 violations.
- Seven team assessments at major material licensee facilities.
- More than 5,000 licensing actions on applications for new byproduct materials licenses and amendments or renewals of existing licenses.

FUEL CYCLE LICENSING AND INSPECTION

Fuel Cycle Licensing Activities

Licensing actions associated with the possession and use of source and special nuclear material continued to require significant staff effort. Special nuclear material licenses were issued at reactor sites to allow early receipt and storage of new fuel before the receipt of the operating license.

By the end of this fiscal year, the NRC had completed more than 100 fuel cycle licensing actions. Table 1 shows the number of licensing actions by category.

Efforts to Improve Fuel Cycle and Materials Safety

In October 1986, NRC published an independent "Materials Safety Regulation Review Study Group Report," in which recommendations were made for improving the efficiency and effectiveness of the fuel cycle and materials safety regulatory programs. The NRC staff evaluated this report, offered its own ideas, and initiated several improvements. The NRC staff:

- Increased coordination with other Federal agencies, such as the Occupational Safety and Health Administration (OSHA) and the U.S. Environmental Protection Agency (EPA), to ensure that there were no "regulatory gaps" among the agencies.
- Initiated a rulemaking effort and a contractor study to provide better accountability of generally licensed devices.
- Continued work on a radiographer equipment rule and the third-party certification of radiographers.
- Completed more operational safety team assessments, expanding the program to include major materials licensees and a uranium mill.
- Began a pilot program for using performance evaluation criteria to identify factors that could lead to future operational safety problems with material licensees.
- Drafted technical positions for improved safety in areas such as chemical safety, fire safety, management controls/quality assurance, and safety-related instrumentation and maintenance.
- Increased training requirements for license reviewers and inspectors, in radiological and in non-radiological safety areas.
- Held numerous workshops and seminars to improve communications within the Agency and between NRC and its licensees.

Table 1. Fuel Cycle Licensing Actions Completed in FY 1988

Category	*No. of Actions*
Uranium Fuel Fabrication	40
Uranium Hexafluoride Production	10
Fresh Fuel Storage at Reactor Sites	7
Critical Mass Materials	10
Interim Spent Fuel Storage	8
Storage of Reactor Low-Level Waste	3
Uranium Fuel Research & Development	5
Advanced Fuel Research & Development	2
Other Source Material	6
Radiological Contingency Planning	10
Decommissioning	2
Remedial Actions	1
All Categories	104

- Issued a newsletter to fuel cycle and nuclear material licensees to inform them of NMSS regulatory and programmatic initiatives of importance to them.

Regulation of Uranium Enrichment

On April 22, 1988, the Commission published in the *Federal Register* an Advance Notice of Proposed Rulemaking on the regulation of uranium enrichment. The Commission is considering the addition of new regulations (10 CFR Part 76) specific to uranium enrichment. The construction and operation of uranium enrichment facilities currently would be licensed under the Commission's regulations in 10 CFR Part 50, which pertain to all types of production or utilization facilities, including nuclear power plants. The *Federal Register* Notice presented the Commission's analysis of the applicability of Part 50 and other pertinent regulations to uranium enrichment facilities. The Notice also presented general design criteria specific to uranium enrichment facilities and posed questions to elicit comments on whether a separate set of regulations for uranium enrichment licensing is desirable.

The NRC received comments from 14 different organizations and the staff was analyzing these comments at the end of this fiscal year.

NRC staff continued informal discussions with URENCO, Ltd., a group of companies established in 1971 in the Federal Republic of Germany, the Netherlands, and the United Kingdom to pursue possible establishment of a uranium enrichment facility in the United States, to be licensed by the NRC. URENCO has indicated that it is discussing a partnership agreement with Duke Power Company and Fluor Daniel, for the purpose of introducing URENCO gas centrifuge technology into the United States.

West Chicago: Kerr-McGee Rare Earths Facility

At the direction of the Atomic Safety and Licensing Board, the staff issued a Draft Supplement to the Final Environmental Statement on the West Chicago, Ill., facility. Comments received are being evaluated to prepare the Final Supplement for issuance in fiscal year 1989. At issue are decommissioning and the on-site stabilization of thorium-bearing wastes. Concurrent with this action, the NRC received a draft proposed amendment of the Agreement between the State of Illinois and the NRC which would extend the jurisdiction of the State over radioactive materials, to include the type of waste at the West Chicago site. If NRC approves the amendment to the State Agreement, Illinois would assume jurisdiction over the site and the proposed disposition of the waste. (See the *1986 NRC Annual Report*, p. 88, for background.)

West Valley Demonstration Project Oversight

Through 1988, the Commission staff continued its safety oversight activities at the West Valley Demonstration Project (WVDP) near Buffalo, N.Y., which the U.S. Department of Energy (DOE) manages. The WVDP's purpose is to demonstrate the solidification and preparation of high-level radioactive waste for disposal in a Federal repository. Removing dissolved

cesium from the supernatant (i.e., liquid) portion of the waste is the first phase of solidification and began in early 1988. The cesium that is removed will be combined ultimately with the sludge (i.e., solid) portion of the high-level waste, which contains most of the other radionuclides. Beginning in 1992, the combined wastes will be solidified in borosilicate glass.

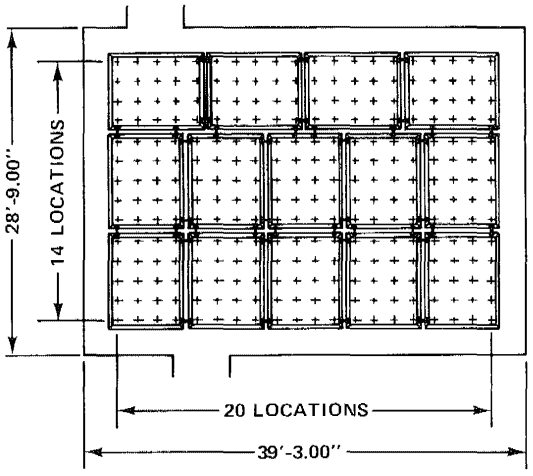
The staff monitors public health and safety aspects of the WVDP by frequently inspecting the West Valley site and by reviewing Safety Analysis Reports that DOE submits. DOE normally submits a separate Safety Analysis Report for each segment of the waste solidification process. The staff reviews each submittal and issues a corresponding Safety Evaluation Report, drawing conclusions about the public safety implications of the process segment in question. In 1988, the staff issued a Safety Evaluation Report for the final segment of the cesium-removal process, making some recommendations but concluding that the operations would not endanger public health or safety. Before hot startup of the cesium-removal process, the staff conducted a week-long monitoring program involving specialists in fire protection, effluent control, emergency planning, welding, and quality assurance to assess DOE's operational readiness. The team made some suggestions, but concluded that DOE was prepared to operate the process safely. The staff is continuing to monitor the cesium-removal activities and is beginning the safety analysis review for sludge processing and glassmaking.

Interim Spent Fuel Storage

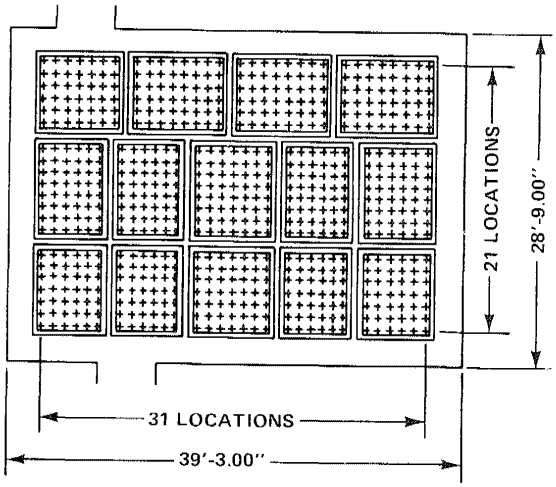
The Nuclear Waste Policy Act of 1982 (NWPA) established the requirement that utilities take primary responsibility for interim storage of their spent fuel until a Federal repository or monitored retrievable storage (MRS) installation is available. Such a facility is, by current estimates, a decade or more away. Thus, utilities are continuing to develop plans for providing additional storage capacity as they approach the current storage limits of their reactor pools.

Where possible, utilities continue to re-rack spent fuel pools, a measure that has extended storage capacity for most reactors into the 1990's. Besides re-racking, some utilities are considering rod consolidation as a means of increasing pool capacity. On-site dry storage of aged spent fuel in modular units is also being considered as a means of meeting storage needs.

In 1986, NRC issued the first two licenses for dry spent fuel storage to the Virginia Electric Power Company (VEPCO) for its Surry nuclear power plant and to the Carolina Power and Light Company (CP&L) for its H.B. Robinson nuclear power plant. The NRC staff continued to monitor developments as the facilities were constructed and storage cask and canisters were fabricated. Design changes led to additional technical reviews and license amendments.



ORIGINAL SPENT FUEL
STORAGE RACK ARRARNGEMENT



MODIFIED SPENT FUEL
POOL ARRANGEMENT

Because a permanent or retrievable spent fuel storage facility will not be available for at least several years, utilities continued in 1988 to make plans to expand existing storage capacity by means of "re-racking." A typical re-racking scheme for on-site spent fuel pools is shown above.

In March 1988, the NRC staff issued letters of approval with related safety evaluations for two topical reports. Nuclear Assurance Corporation (NAC) submitted the first report for its model storage/transport (S/T) dry spent fuel storage cask design—a stainless steel and lead cask design with a capacity of 26 PWR fuel assemblies. FW Energy Applications, Inc., a Foster-Wheeler company, submitted the second topical report for its model modular vault dry store (MVDS). The MVDS is a concrete modular vault design with a capacity of 83 PWR or 150 BWR assemblies per module. In September 1988, the NRC staff issued a letter of approval, with a related safety evaluation for a modified NAC cask design. In this case, the cask body design was that of the NAC S/T cask, but a new fuel basket design and analyses were submitted for the storage of consolidated PWR fuel rods in 28 steel canisters. This cask has the capacity to store fuel rods from 56 PWR assemblies.

The NRC staff is reviewing five topical reports on dry storage casks of varying designs submitted by NAC, Transnuclear, Inc., Combustion Engineering, Nuclear Packaging, Inc., and General Nuclear Systems, Inc., and one topical report on a modular concrete and stainless steel canister dry storage system that NUTECH, Inc., submitted. If NRC staff finds these reports acceptable, a utility may reference them in a license application or in an amendment to an existing 10 CFR Part 72 license, to expedite the review of a proposed dry storage system or a proposed modification to an existing system.

To further streamline the licensing process for use of spent fuel dry storage casks at reactor sites, the NRC staff has initiated rulemaking through amendments to 10 CFR Part 72. The rulemaking is consistent with that contemplated by Congress in the NWPA for "use at the sites of civilian nuclear power reactors without, to the extent practicable, the need for additional site-specific approvals by the Commission." Draft criteria and standards have been prepared to provide for formal certification of dry spent fuel storage cask designs and for the use of certified casks by reactor operators, under a general license. The proposed rule is expected to be published for public comment in fiscal year 1989.

Technical Staff Training

An intensive effort to increase the technical training opportunities of the staff began in this fiscal year. Working with NRC's Technical Training Center and the Regions, NMSS began several parallel efforts:

- The training requirements for fuel cycle and materials inspectors were revised to include additional courses in the radiological and non-radiological risk areas.
- Arrangements were made with the OSHA and local universities to allow NRC employees to attend fire protection, chemical safety, and hazardous materials courses.
- Formal training requirements for NMSS Headquarters staff were drafted and were being integrated with other Agency training needs.
- Coordination with the Office of Governmental and Public Affairs continued, as NMSS and Regional staff attended several courses with their Agreement State counterparts. Included were courses in health physics, well-logging, and inspection procedures.

MATERIALS LICENSING AND INSPECTION

The NRC currently administers approximately 8,200 licenses for the possession and use of nuclear materials in applications other than the generation of electricity or operation of a research reactor. The program is designed to ensure that activities involving such uses of radionuclides do not endanger the public health and safety. The NRC Regional Offices administer all materials licenses, with the exception of exempt distribution licenses and sealed-source and device design reviews.

The NRC completed nearly 5,300 licensing actions during this fiscal year. Table 2 shows the number of new licenses issued, amendments completed, and license renewals issued by Headquarters and each Region. In addition, the 29 Agreement States administer about 16,500 additional licenses and NRC Regional staff completed more than 2,000 inspections of materials facilities. Table 3 shows the number of NRC byproduct material licenses by type of use.

Naturally Occurring and Accelerator-Produced Radioactive Materials (NARM)

In an August 1987 memorandum, the Conference of Radiation Control Program Directors (CRCPD) once again urged that the NRC seek legislative authority to regulate NARM. (The CRCPD comprises Radiation Control Directors from all States and territories.) NARM includes radionuclides such as radon and radium.

Because NARM exists in the environment, in homes, in medical institutions, in consumer products, and in industrial applications, the issue of Federal control over NARM is very old and very complex. In March 1988, the NRC published a report entitled "Naturally Occurring and Accelerator-Produced Radioactive Ma-

Table 2. Byproduct Licensing Actions for FY 1988

NRC	New Licenses	Amendments	Renewals	Sealed Sources/Devices	Total
Region I	220	1,071	304	0	1,595
Region II	87	425	142	0	654
Region III	179	1,418	510	0	2,107
Region IV	71	153	336	0	560
Region V	20	135	37	0	192
HQ	18	44	12	81	155
Total	595	3,246	1,341	81	5,263

terials —1987 Review'' (NUREG-1310). The report presented a review of NARM sources and uses, as well as associated incidents and problems. It provided a review of previous Congressional and Federal agency actions on radiation protection matters, in general, and on NARM in particular, to develop an understanding of existing Federal regulatory activity regarding ionizing radiation and control of NARM. In addition, State controls over NARM were reviewed. With this as background, eight questions were examined in terms of whether the NRC should seek legislative authority to regulate NARM. The assessment of these questions served as a basis for developing and evaluating five options. The evaluation of those options led to two recommendations.

NUREG-1310 contains a conclusion that ''the unregulated NARM risks are not rising to a level that would suggest they should be the next target of Congressional legislation.'' In May 1988, the Commission met with the NRC staff, the Chairman of the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), and the Chairman of the CRCPD. In a July 1988 letter, the Commission decided to refer the issue of Federal regulation of NARM to CIRRPC, since that body was created to coordinate Federal policy on radiation and is able to make recommendations on the appropriate designation of responsibilities for regulation of NARM. Subsequently, CIRRPC agreed to study the issue of Federal regulation of NARM and committed to completing its study by early 1990.

Oversight Program

In the first full year following the 1987 reorganization of NRC (see Chapter 1 of *1987 NRC Annual Report*), NMSS became responsible for more than 100 full-time equivalent (FTE) units of Regional fuel cycle and materials licensing and inspection activity.

To ensure that the programs were technically sound, consistent, and efficient, and to provide useful technical guidance, NMSS and the Regions expanded the National Program Review process. The process included accompaniments of inspectors, workshops for fuel cycle and materials staffs, a Headquarters/Regional meeting on policy and budget issues, program assessment visits, and monthly conference calls on generic materials safety issues. Numerous activities took place throughout the year on Regional licensing, inspection, enforcement, and incident response.

Industrial Uses

Reactor-produced radionuclides are used extensively throughout the United States in both civilian and military industrial applications, such as industrial radiography, manufacture of gauging devices, gas chromatography, and well-logging. The general public also uses them in various consumer products such as household and industrial smoke detectors. The NRC's evaluation, licensing, and inspection program is designed to ensure that these activities pose no undue risk to the public health and safety.

Industrial Radiography. This form of non-destructive testing uses radiation from byproduct material sources to examine the internal structure of materials. NRC's radiography licensees perform testing within fixed radiography facilities or at temporary job sites. Portable devices can contain radiation sources of up to 200 curies of iridium-192 or up to 100 curies of cobalt-60. Devices at fixed facilities can contain sources of up to several hundred curies. At the end of this fiscal year, NRC had issued 276 active radiography licenses; of these, 67 were for operations in fixed facilities and 209 for use at temporary job sites.

Table 3. Distribution of Byproduct Material Licenses by Type of Use

Use	*No. of Licenses*
ACADEMIC	79
MEDICAL	
Medical Institutions and Private Practice	2,017
Eye Applications	52
Mobile Nuclear Medicine	20
Teletherapy	254
Veterinary	5
In Vitro Testig Laboratories	109
Nuclear Pharmacies	46
Medical Product Distribution	23
Pacemakers	78
All Medical	2,604
COMMERCIAL/INDUSTRIAL	
Well-Logging	151
Field Studies	3
Gauges and Measuring Systems	2968
Commercial Manufacturing and Distribution	182
Nuclear Laundries	4
Leak Testing and Instrument Calibration	94
Waste Disposal	18
General License Distribution	83
Exempt Distribution	149
Radiography	276
Irradiators	235
Research and Development	722
Civil Defense	31
All Commercial/Industrial	4,916

After the Materials Safety Regulation Review Study Group (MSRRSG) published a recommendation that NRC reconsider radiographer certification, the American Society of Nondestructive Testing (ASNT) formed a special task group to develop a formal certification program. NRC expended considerable effort on this in 1988, working with the task group to develop an acceptable program. The task group developed three draft working papers for the certification package: (1) "ASNT Certification Program and Qualification Requirements for Industrial Radiation Safety Personnel"; (2) "Code of Ethics for Radiographers Certified by ASNT"; and (3) "ASNT Certified Radiographer Program Complaint and Hearing Procedure." At its Fall 1988 meeting, the ASNT Board of Directors approved (with some modification) the certification program package presented by the task group. Implementation of the program will depend on NRC's endorsement and supporting rulemaking effort.

The NRC completed action on a contract with the State of Texas to develop a radiography examination question bank. Texas uses this question bank in its State agency-administered testing program to verify that radiographers working for State agencies are adequately trained in radiation. NRC has considered adopting a regulatory program, similar to that implemented by Texas, as an alternative to the ASNT Certification Program. ASNT has also indicated that it might incorporate the Texas examination into its program.

In February 1988, the Commission unanimously approved publication of proposed amendments to 10 CFR Part 34 for improving the reliability and safety of radiographic equipment. The amendments would require the use of audible alarming dosimeters by radiographic personnel, and would require reporting of equipment failures to NRC. Because of numerous re-

quests, NRC extended the public comment period an additional 90 days, to August 1988, recognizing that: (1) the proposed rule is considered to be important; (2) the rule would effect major changes in existing equipment; and (3) the industry needed additional time to estimate life-time costs.

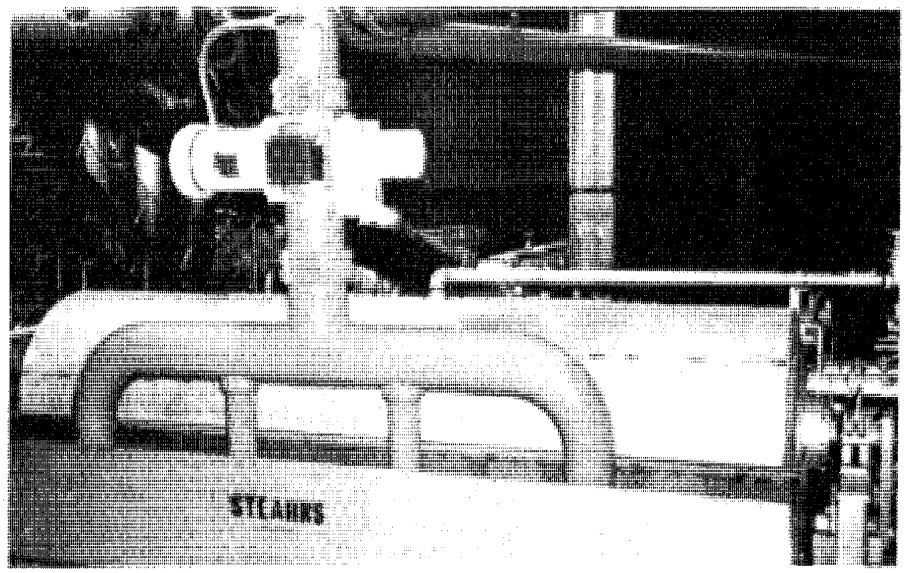
General License Effectiveness. There are two types of NRC licenses for byproduct, source, and special nuclear materials: specific and general. Specific licenses are documents issued only to individually named persons or organizations, after application and NRC review. General licenses take effect without the issuance of license documents to particular persons. However, the manufacturer of products to be distributed to these "general licensees" must apply to the NRC for a specific license. Before issuing this type of specific distribution license, the NRC conducts a thorough safety analysis of the product. If the product meets the criteria for a general license and the regulations contained in 10 CFR Parts 32, 40, and 70, the NRC grants the applicant a specific license for distributing the product to general licensees.

An estimated 200,000 devices are used throughout the country under the general license provisions. The bulk of these are relatively low-hazard devices, such as the tritium exit signs used in office buildings and in aircraft. Experience has also shown that the more hazardous devices—the gauges that contain radioactive sources—have been able to survive trials of explosion, fire, and even the weight of heavy earth-moving equipment, with sources intact.

The NRC continued its efforts to improve the regulatory framework for the distribution of source, byproduct, and special nuclear materials under a general license. One initiative involves entering into a computer system all transfers of devices and materials as reported to the NRC via quarterly reports from the specific licensees authorized to distribute to general licensees. This national registry improves the tracking of devices and users of the devices in the United States. Another initiative is a proposed rulemaking that would create a registration and reporting program for nuclear gauges, more hazardous than other generally licensed devices. Within the framework of such a rule, NRC would periodically send a notice to each general licensee, who would respond by indicating that the gauge is still in use or by reporting to whom it had been transferred. Non-respondents would be contacted by telephone and/or field inspection. A third initiative involves an examination of broader issues associated with the general license program, such as: Should generally licensed devices be required to be tested by a third party? What are the appropriate quality assurance requirements for the design and manufacture of generally licensed devices? What is the appropriate upper bound on curie content of generally licensed devices? What are acceptable uses and environments for generally licensed devices?

The staff has budgeted for a mail survey of approximately 2,000 general licensees in fiscal year 1989. One major benefit of this survey would be the establishment of a regulatory presence vis-a-vis the general licensees.

Source/Device Registration. The NRC and the Agreement States maintain a sealed-source/device registration program which helps to expedite the licensing review process when new requests for sources or devices are received. During this fiscal year, the staff completed more than 80 safety evaluations for radioactive sources and containment devices. The computerized registry system for approved sealed sources



The in-line density gauge at the top of the photo is used at a paper factory to control the flow of slurry during operations. The gauge, which is attached to the vertical flow-pipe, consists of a radionuclide source (at right) and a detection device (left, with label visible).

and devices is revised twice a year, producing 200 reports to NRC Regional Offices, Agreement States, the Center for Devices and Radiological Health (CDRH), and the Atomic Energy Control Board of Canada. This fiscal year, approximately 30 special reports were produced for the NRC and other government users. Two comprehensive regulatory guides (10.10, 10.11) are widely used to augment the registration program.

NMSS staff assisted State, local, and Indian tribe program staffs with auditing sealed-source/device registrations of Agreement States and provided instructors at training programs. The NRC is working with the CDRH and the CRCPD to incorporate the CDRH "Radioactive Materials Reference Manual" into the NRC's computerized registry. This will be done to help the Agreement States improve management of source/device designs which contain naturally occurring and accelerator-produced radioactive materials.

Irradiator Rule. The staff worked on a proposed rule to specify radiation safety requirements and license requirements for the use of licensed radioactive materials in large irradiators. The safety requirements would apply to large panoramic irradiators and certain underwater irradiators. The rule would not cover self-contained irradiators, instrument calibration, teletherapy, or non-destructive testing (i.e., radiography). NRC will encourage industry and the general public to comment on the proposed rule, which is planned for publication in the spring of 1989.

New Uses of Byproduct Material. The Commission resolved the issue of licensing neutron-irradiated topaz for distribution to unlicensed persons. Several alternatives were considered in the effort to find a balance between avoiding unjustified exposures to the public and allowing distribution of a product in large demand which has an acceptably small radiological consequence to the consumer. It was determined that NRC will license only the distribution of finished, cut topaz. The staff plans to control distribution of these gems to two basic groups of applicants: domestic reactors and commercial importers. Both groups of applicants will be subject to similar regulatory requirements. The NRC has received three applications for licensing consideration pursuant to the conditions in 10 CFR Parts 30 and 32. Since receipt of the applications, NRC conducted two pre-licensing site visits to review instrumentation and procedures. As of the end of September 1988, the NRC staff had completed its findings on one application and will issue a license.

The NRC, the Federal Aviation Administration, and the Agreement States worked together to resolve a technical licensing issue on another new use of byproduct material in a system designed to detect explosives in baggage. This device uses a moderated californium-252 source (Cf-252) that activates nitrogen (a component of all known explosives). Once the Cf-252 source activates nitrogen, the system detects nitrogen's emissions; personnel then remove the baggage alleged to contain the explosives. This type of system for detecting explosives is planned for use in several major international airports across the country. During the reporting period, the staff completed and issued the environmental assessment on this device, with a finding of no significant impact.

Medical Uses

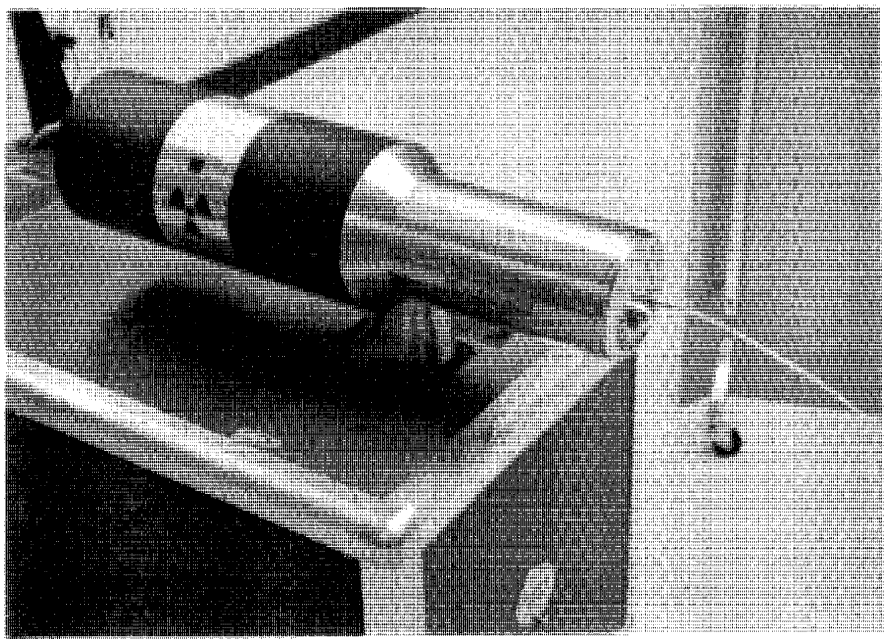
Medical Program Improvements. The NRC has increased its emphasis on the safe medical use of byproduct material. The first phase of the improvement program included increased staffing of Headquarters operations and improved communications with other Federal agencies and medical organizations. The next phase will include increased Regional staffing and inspection frequency for medical-use licensees.

Training Standards. The NRC requested public comment on the appropriate training and experience criteria for all individuals who participate in the medical use of byproduct material. NRC has also hired a contractor to study training programs, accreditation and certification programs, and State requirements for accrediting such training. The NRC may revise its training and experience criteria after analyzing the comments and the contractor's report.

Quality Assurance in Medical Uses. In response to reports of numerous errors involving medical uses of byproduct materials, the NRC published for comment a prescriptive rule to require specified procedures for basic quality assurance. The basic quality assurance rule addressed simple human error, particularly in communications, assumptions, and calculations, where serious errors originate. The public comments that NRC received indicated that a prescriptive rule would prove unworkable for licensees, because of widely different individual circumstances, and the fact that many licensees already have effective quality assurance programs to help people avoid errors.

The Commission directed the staff to develop a performance-based rule for public comment. The staff began drafting a rule that will require licensees to implement basic quality assurance procedures to avoid errors, and that will allow flexibility in the design of the procedures. The staff also began to develop a regulatory guide to accompany the rule, and a pilot program to test the rule and regulatory guide in trial use.

Advisory Committee on the Medical Uses of Isotopes. The Advisory Committee on the Medical



The instrument shown is one of several which now permit the use of radioactive material (in this case, iridium-192) in the treatment of intercavital or interstitial cancers without the danger of radiation exposures to medical personnel during the treatment. The German-designed "remote afterloader" shown carries up to 12 catheter tubes to be inserted near the cancerous tissue. The radioactive material in the barrel of the device can be run through the catheters until it is in place in the tissue. The entire operation is controlled and timed with the use of a computer in an adjacent room.

Uses of Isotopes (ACMUI) was established in July 1958. The ACMUI comprises qualified physicians and scientists who consider medical questions referred to it by the NRC staff and provide expert technical advice on the medical uses of byproduct material. The ACMUI also advises the NRC staff, as required, on matters of policy. During this fiscal year, ACMUI met to discuss the Commission's proposed quality assurance rules for medical uses, and presented its conclusions at a Commission meeting on April 1988. The ACMUI also helped the NRC staff develop resolutions of technical issues that licensees raised. Membership of the committee is shown in Appendix 2.

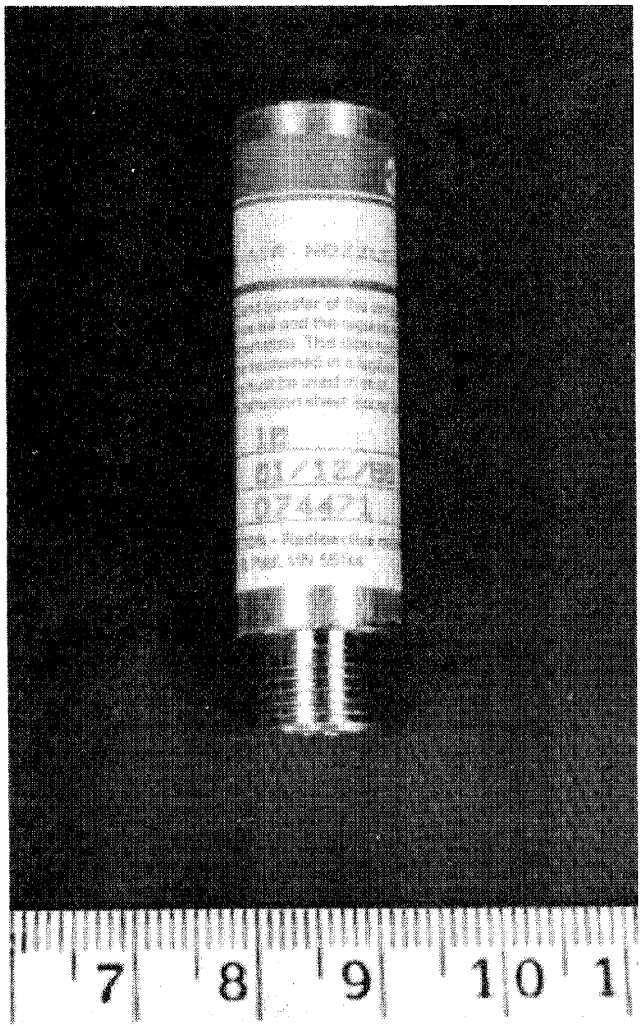
EVENT EVALUATION AND RESPONSE

The NRC continued to review and analyze operational safety data from nuclear fuel facilities and materials licensees. NRC also maintained its ability to respond to events at these facilities. The Agency conducted an exercise of its Protective Measures Team on April 12, 1988. This exercise, which included the Chairman, the Executive Director for Operations (EDO), staff from several offices and from other agencies, such as the Federal Bureau of Investigation, simulated a criticality accident at a fuel cycle facility. The exercise was designed to train the participants in their responsibilities. A post-exercise critique allowed participants to recommend improvements in NRC's ability to respond to future events.

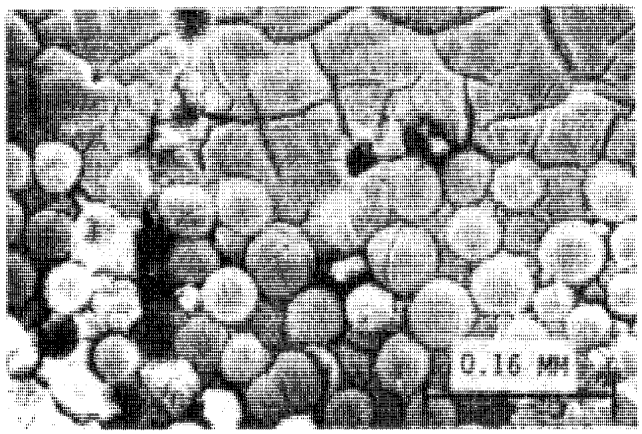
The staff continued its work on an Emergency Preparedness Rule for fuel cycle and other materials licensees. The rule will require about 30 licensees to have emergency plans, to notify local authorities in case of an accident, and to recommend protective actions for the public when necessary. The staff forwarded the final rulemaking to the Commission in July 1988 and the Commission approved the rule with certain modifications. The staff was working to resolve several technical and policy issues as the fiscal year ended.

Response to Significant Events

Polonium-210 Contamination from Static Eliminators. The failure of polonium-210 static eliminators that the Minnesota Mining and Manufacturing Company (3M) manufactured and widely distributed to general licensees was first apparent when contamination was noted at the Ashland Chemical Company facility at Easton, Pa. in January 1988. The incident required NRC to determine the scope of the problem and the implications for radiological health and safety to both employees of the general licensees involved and members of the general public. The NRC issued four Immediately Effective Orders, including one to 3M requiring 3M to stop distributing the static elimination device and one to about 22,000 general licensees requiring them to stop using the static elimination devices and to return them to 3M for testing. These actions prevented the potential contamination of various products, including consumer products such as food, beverages, cosmetics, and medical supplies. NRC did not find any indications that the public had been harmed because the device failed.



The polonium-210 static eliminator shown above (ruler is in centimeters) is similar to units manufactured by the 3M Company which proved faulty. Contamination from leaks in the units caused the NRC to halt production and order recall of the units. Below is enlarged "fractograph" showing in detail the deterioration of the epoxy adhesive holding the zirconium pyrophosphate microspheres containing the polonium-210.



NRC also provided guidance to other Federal agencies, NRC Regional Offices, Agreement States, and licensees. The guidance included radiological dose and risk assessments, background for bioassay sampling and assessment, and remedial action plans to protect against the spread of radioactive contamination.

Cesium-137 Contamination from Waste Encapsulation and Storage Facility (WESF) Sources. The staff has provided support to the Agreement State of Georgia since June 1988, when one of Georgia's commercial irradiator licensees experienced widespread contamination at its facility. The contamination was apparently caused by the failure of one or more cesium-137 sources, which are used to sterilize medical products. Radiation Sterilizers, Inc. (RSI) in Decatur, Ga., possesses 252 WESF sources, each containing approximately 50,000 curies of cesium-137 as cesium chloride, a highly soluble salt. DOE produced the WESF sources and leased them to RSI, and is managing the decontamination and recovery operations at the RSI facility in Decatur.

NRC's support included providing technical assistance, conducting contamination checks of products that RSI sent out before the incident was discovered, acting as liaison with the Food and Drug Administration (FDA), and ensuring that the three other irradiators that NRC and two Agreement States authorized to use WESF sources took appropriate actions. NRC also closely monitored DOE's efforts to identify the failed source(s) and the cause(s) of the failure in order to determine what additional actions the other three WESF users might need to take.

Performance Evaluation Factors

Region III completed a trial program to examine potential performance evaluation factors at materials licensee facilities, on the basis of 98 routine materials inspections.

These performance evaluation factors, like the reactor program's performance indicators, are used to help improve licensee performance. However, the type of information applicable to the materials program is broader because of the wider spectrum of activities covered and because the information available on equipment performance and operating conditions is not as data-intensive. Rather, types of information available are primarily early subjective warnings or the precursors of slumping licensee performance (mainly in management-related areas.)

From these 98 inspections, the Region III staff identified 13 licensees who exhibited signs of lapsing performance, such as lack of management controls and

inadequate staff training. Follow-up actions by the Regional staff ranged from telephone discussions with the licensee to imposition of new license conditions, depending on the specific case.

The staff has now expanded this pilot program to all five Regions. NMSS issued a directive in July 1988 calling for each Region to conduct a one-year program using performance evaluation factors, to help NRC identify early symptoms of slipping performance.

Operational Safety Team Assessments

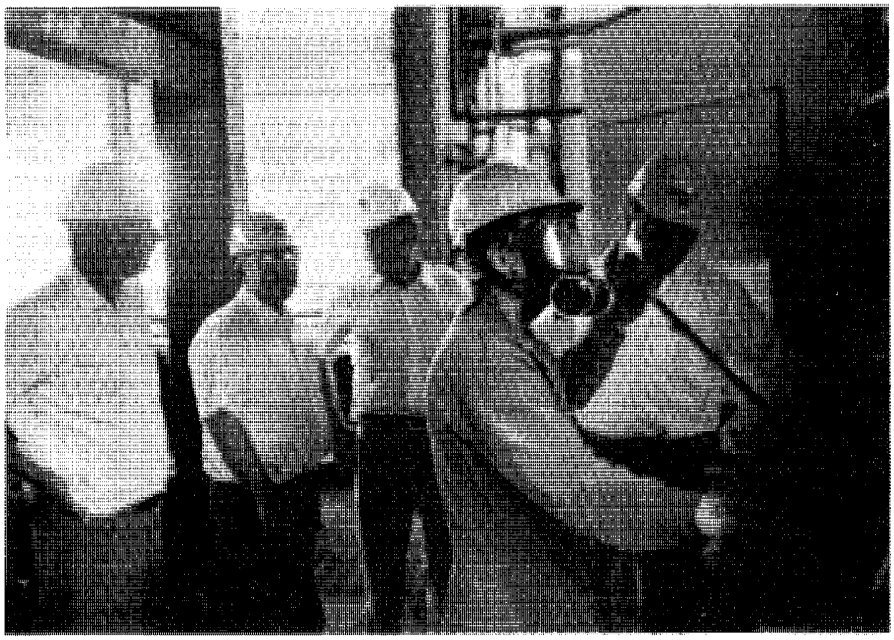
The NMSS staff expanded its use of operational safety team assessments to include six large materials licensees and one uranium mill. These assessments differed from routine inspections because they used a team of experts (in such areas as fire protection, radiation safety, emergency preparedness, safety-related instrumentation and maintenance, and criticality safety) to evaluate licensee performance and to learn generic lessons and apply that new knowledge at similarly licensed facilities. The assessment teams included representatives from the Regions, NRC Headquarters, and other Federal agencies, such as OSHA and the Mine Safety and Health Administration. The seven facilities chosen were Teledyne (N.J.), Squibb (N.J.), Westinghouse-Waltz Mills (Pa.), Mallinckrodt (Mo.), 3M (Minn.), Dow (Mich.), and the Pathfinder Uranium Mill (Wyo.).

COMMUNICATIONS

Interaction with Licensees and Industry Groups

As one of its many efforts to improve communication with its fuel cycle and materials licensees, NMSS initiated a newsletter. This publication provided licensees information on the programs, actions, and initiatives of NMSS, to help them meet license requirements. It listed pertinent regulatory guides, recent rulemakings, and significant enforcement actions NRC took against materials licensees.

The staff also held several workshops and seminars with various categories of licensees. Region II staff hosted a fuel cycle workshop in October 1987, which included management representatives from most fuel cycle facilities. A major focus of the workshop was a review of planned NRC actions resulting from the recommendations of the MSRRSG and the findings of the NRC operational safety team assessing fuel cycle facilities. The NRC established the Study Group, and the team performed assessments as a direct result of the January 1986 accident at the Sequoyah Fuels Facility in Oklahoma. (See the *1987 NRC Annual Report*, p. 70, for background.) This accident involved the release of a large quantity of uranium hexafluoride from a ruptured cylinder. At the workshop, NRC staff presented a summary of new initiatives and regulatory activities based on lessons learned'' from the activities of the Study Group and the safety teams, to improve



NRC Operational Assessment Teams, which include expert representatives of both the NRC and other agencies, were sent to selected facilities in 1988 to evaluate licensee performance and to learn lessons of relevance to other facilities. In the photo, a typical team is observing a procedure at the Pathfinder Uranium Mill in Wyoming, whereby 55-gallon containers are being filled with "yellowcake'' (a uranium oxide, U308, produced at an early stage in reactor fuel fabrication).

From left to right are Strat Murdock, Pathfinder plant environmentalist; Harry Pettengill from the NRC's Uranium Recovery Field Office in Colorado; Robert Hopkins, plant manager, Stanley Maluchnik, plant technician; and Vandy Miller from the NRC's Office of Governmental and Public Affairs.

management controls, chemical safety, fire safety, safety-related instrumentation and maintenance, and emergency preparedness in the fuel cycle area.

This was the first NRC-sponsored workshop that brought management representatives of fuel cycle facilities and NRC staff together to discuss safety and safeguards topics. A sampling of attendees' views indicated that the workshop was worthwhile and that it should be repeated periodically.

Other Regions hosted similar workshops for other categories of licensees, e.g., irradiator licensees, radiographers, well-loggers, and broad licensees. There were also presentations on Agency policy and regulatory initiatives at national meetings of the Society of Nuclear Medicine, the American College of Medical Physics, the Veterans Administration, and the CRCPD. In addition, the staff worked with a subcommittee of the ACMUI to improve communication during the development of a Quality Assurance Rule on the medical uses of byproduct materials.

Interaction with Other Agencies

In regulating fuel facilities and nuclear materials licensees, NRC's activities often intersect with the activities of other international, Federal, and State agencies.

Participation in International Activities. NRC works with the International Atomic Energy Agency (IAEA); members of NRC staff represent the U.S. on various IAEA subcommittees and advisory groups making policy and standards decisions affecting the nuclear fuel cycle and nuclear materials programs. In this role, the NRC staff raised the issue of neutron-irradiated gemstones at the international level, which led to the revision of a draft regulatory guide on controlling consumer products, to include discussion of irradiated gemstones. A second issue is the extension, contemplated by IAEA and the International Commission on Radiological Protection (ICRP), of the basic principles of radiation protection to low probability events (accidents). The NRC also shares information with other countries on contamination events involving materials licensees.

IAEA, in cooperation with the Argonne National Laboratory and the NRC, is organizing a training course for developing countries that need programs to regulate the use of sealed sources and radioactive materials in medicine, industry, and research. The purpose of the course is to provide training and guidance in organizing and implementing practical radiation protection programs to ensure the safe use of sealed sources containing radioactive material.

Participation with U.S. Agencies. NRC staff worked with several Federal agencies on a variety of issues. As the fiscal year ended, NRC staff was completing a Memorandum of Understanding (MOU) with OSHA to delineate the general areas of responsibility of each agency and to describe the efforts of OSHA and NRC to protect workers at facilities licensed by the NRC. As part of the MOU, OSHA is participating in operational safety team assessments at certain NRC-licensed facilities, and OSHA is training designated NRC staff in non-radiological safety areas. Conversely, if NRC personnel identify safety concerns within areas of OSHA responsibility during the course of radiological and nuclear safety inspections, they will bring the matters to the attention of licensee management. The NRC will notify OSHA of any problems that persist.

NRC worked with the EPA through the NRC/EPA Interface Council. Joint activities include team assessments and the cleanup of contaminated sites.

The NRC increased its coordination and cooperation efforts with FDA's Center for Drugs and Research (CDR) and the CDRH. The NRC staff coordinated a combined information-sharing meeting with the U.S. Department of Transportation (DOT) and FDA's CDR, on problems involving molybdenum-99/technetium-99m generators. Subsequently, the NRC staff attended an FDA meeting with the generator manufacturer (an Agreement State licensee), to discuss prompt solutions to this problem. NRC met with the CDR director and his staff in July 1988 to promote better cooperation between the agencies and to improve data sharing. The staff held other meetings to discuss areas of overlapping authority and mutual interest. The NRC has increased its effort to inform CDRH of NRC teletherapy incidents and published an information notice on a problem with a brachytherapy device that CDRH identified. Increased sharing of technical information between NRC and the two FDA centers is providing NRC licensees access to NRC and FDA policy interpretations and is improving NRC's understanding of how FDA works.

The NRC also worked with DOE on a number of issues, e.g., West Valley, spent fuel storage issues, and WESF capsules. More detailed discussions of these activities appear earlier in this chapter.

NRC staff continued to participate in the development of industrial consensus standards, such as the American National Standards Institute standards for self-luminous light sources, irradiators, radiography, and facility-shielding designs. The standards serve as guides to aid manufacturers, consumers, and the general public.

The NRC and the States coordinate activities on issues of mutual concern such as events, incident response, emergency preparedness, cleanup of sites, and certain training activities.

Safeguards and Transportation

Chapter 6

In compliance with provisions of the Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974, the NRC regulates safeguards for licensed nuclear materials, facilities, and activities, to assure protection of the public health and safety and to promote the common defense and security. In this regulatory context, "safeguards" denotes measures that are taken to deter, prevent, or respond to the unauthorized possession or use of significant quantities of special nuclear material (SNM) through theft or diversion, and to protect against radiological sabotage of nuclear facilities. Radiological sabotage refers to deliberate acts that could endanger the public health and safety by exposing the public to radiation. In general, safeguards for licensed nuclear fuel facilities and non-power reactors (NPRs) emphasize protection against theft or diversion of SNM, whereas safeguards for power reactors stress protection against radiological sabotage. (SNM and strategic special nuclear material (SSNM) are technical designations for certain types, quantities, and/or isotopic compositions, defined by formula, of various nuclear materials. In general, SSNM is high-enriched uranium (HEU) or plutonium.)

During fiscal year 1988, NRC safeguards requirements were applied to 110 power reactors, 53 NPRs, and 25 non-reactor nuclear facilities. They were also applied to 70 shipments of spent fuel, 19 shipments of SNM involving more than one but less than five kilograms of HEU, and two shipments of SNM involving five or more kilograms of HEU.

The Federal Government regulates safety in the transportation of radioactive materials primarily through the NRC and the Department of Transportation (DOT). These two agencies have delineated their respective regulatory responsibilities in this area through a Memorandum of Understanding. Shipments that occur within the United States also come under regulation by the States in certain circumstances. For international shipments, DOT is the designated U.S. authority and is responsible for implementing International Atomic Energy Agency (IAEA) standards. The NRC advises DOT on technical matters.

STATUS OF SAFEGUARDS AND TRANSPORTATION

Reactor Safeguards

Power Reactors. The NRC's safeguards regulations were implemented at 110 licensed power reactors. Also, a vital equipment/area guidelines study and report was completed and published as NUREG-1178. The cost analysis for implementation of proposed changes in vital area requirements was completed and published as NUREG/CR-5036. The Commission staff conducted this study (1) to reevaluate the guidelines and bases used to determine the vital equipment and areas to be protected against radiological sabotage in nuclear power plants and (2) to recommend revised guidance.

Non-power Reactors (NPRs). Fifty-three licensed NPRs were subject to the NRC's safeguards regulations. Efforts continued toward converting 25 NPRs from the use of HEU to low-enriched uranium (LEU). At the end of the fiscal year, one NPR licensee had completed its conversion program; 10 NPR licensees were funded and were in the process of being converted; eight NPR licensees were awaiting funding; two NPR licensees were in the process of decommissioning; and one NPR licensee was deciding whether to continue reactor operations. The remaining three NPR licensees have submitted "unique purpose" applications to the Commission. The NRC regulation associated with this effort states that implementation, if required, would be deferred until U.S. Department of Energy (DOE) funding is available, and that a licensee can be exempted from conversion if the Commission finds that the reactor has a "unique purpose" requiring use of HEU.

Regulatory Effectiveness Review (RER) at Power Reactors. The NRC staff, assisted by U.S. Army Special Forces personnel, continued the RER program, evaluating the practical effectiveness of safeguards for vital equipment at licensed reactors. RERs are conducted to assure that safeguards programs, as implemented by power reactor licensees, are effective against the design-basis threat for radiological sabotage

defined in 10 CFR 73.1. Reviews were conducted at 14 power reactors. RERs have led to the identification of strengths and weaknesses in licensees' programs. Commonly noted strengths include effective routine access control features and good rapport and coordination with local law enforcement agencies. The most common problem areas identified in RER reports concern vital area barriers, intrusion detection and alarm assessment systems, and armed response drills. In view of this, Information Notice No. 88-41, describing common types of weaknesses, was sent to all nuclear power reactor licensees. Problems and issues raised in RER reports are resolved through voluntary actions of licensees or through licensing or enforcement actions, as appropriate.

Reactor Safeguards Inspections. Inspectors from the NRC's five regional offices conducted 324 inspections at operating power reactors, 10 pre-operating inspections at facilities where an application for license has been submitted to the NRC, and 28 inspections at NPRs (i.e., test, research, and training reactors). In addition, resident inspectors at operating power reactors continued to augment the safeguards inspection program at their respective sites. Enforcement actions resulting from NRC inspections are treated in Chapter 1 and listed in Appendix 6.

Fuel Cycle Facilities

The number of licensed non-reactor nuclear facilities subject to NRC safeguards requirements was 25, of which 10 are major fuel fabrication facilities. The activities at these 25 facilities include full-scale reactor fuel production, pilot plant operations, decommissioning efforts, and the storage of sealed items. Fifteen of the facilities maintained both physical security and material control and accounting systems. Of these 15 facilities, four had holdings of formula quantities of SSNM, requiring the implementation of extensive physical security and material accountability measures.

By August 9, 1988, the four licensees holding formula quantities of SSNM had fully implemented three near-term physical protection improvements recommended by the NRC/DOE Comparability Review Team and approved by the Commission. These improvements require 100-percent search of personnel and hand-carried packages entering the protected area, night-qualification in all assigned weapons for security force personnel, and the use of armed guards at material access area portals during operation. These measures, in addition to several other improvements recommended by the Review Team and approved by the Commission, are being codified in a current rulemaking action.

Other major activities in the area of safeguards for fuel facilities included reviews of fundamental nuclear material control (FNMC) plans submitted by licensees processing low-enriched uranium under the new 10 CFR 74.31. Six licensees are subject to these requirements. The plans from two licensees were approved before fiscal year 1988, and the remaining four plans were approved during fiscal year 1988. Licensees using formula quantities of SSNM have submitted FNMC plans as required by the new material control and accounting reform rule in 10 CFR 75.51. The staff is reviewing these plans. In all, the NRC staff received and completed actions on approximately 125 safeguards licensing matters associated with fuel facilities.

Inspection at Fuel Cycle Facilities. Material control and accounting inspections were conducted at the 10 major fuel fabrication facilities; with physical security inspections took place at eight of the 10, including the four that possess formula quantities of SNM. In addition, special safeguards inspections were conducted at the four facilities possessing formula quantities of SNM, to ensure that the licensees had implemented the three near-term improvements mentioned above.

Transportation

Spent-Fuel Shipments. The NRC approved 26 transportation routes with respect to acceptable protection against radiological sabotage. Seventy spent-fuel shipments were made over these routes. To keep the public informed about spent-fuel shipment routes, the NRC publishes a document entitled "Public Information Circular for Shipments of Irradiated Reactor Fuel" (NUREG-0725), containing information on approved routes. The most recent, Revision 6, was published in April 1988.

All reactor spent fuel in storage at the former fuel reprocessing plant at West Valley, N.Y., has been returned to the reactor sites where it was generated, with the exception of approximately 27 metric tons under title to DOE. DOE plans to ship this fuel to its Idaho Nuclear Engineering Laboratory for research and development purposes. Other spent-fuel shipping projects included the rail transport of fuel from the Cooper Nuclear Station in Nebraska to the General Electric spent fuel storage operation near Morris, Ill. Agreement by General Electric to receive and store approximately 1,000 fuel assemblies from this reactor was the result of a fuel supply contract held by the utility since the beginning of reactor operations. Receipt of this fuel will essentially fill the Morris pool under its present storage configuration.

SSNM Shipments. Two export shipments involving five or more kilograms of HEU were made during fiscal year 1988. There were also three exports, 11 foreign shipments which transited the United States, and five

domestic shipments—each involving less than five but more than one kilogram of HEU.

Shipment Route Surveys. NRC regional personnel continued to work with local law enforcement agencies to conduct field surveys of routes proposed for shipments of spent fuel or SSNM. Twenty-six routes were analyzed through 39 states, involving more than 3,000 miles of routes. The NRC brochure entitled "Information Package on Spent Nuclear Fuel Shipments for Law Enforcement Agencies" (NUREG/BR-0020) was distributed to local officials and agencies during these surveys.

Tracking International Shipments of SNM. NRC regulations requiring licensees to comply with the provision of the Convention on the Physical Protection of Nuclear Materials became effective on March 26, 1987. Licensees shipping the materials defined under that convention began making notifications thereafter. NRC forwarded the information to the Department of State for appropriate international notifications. Through September 30, 1988, there have been approximately 351 actions. It is expected that this figure will continue to increase to approximately 1,000 actions per year.

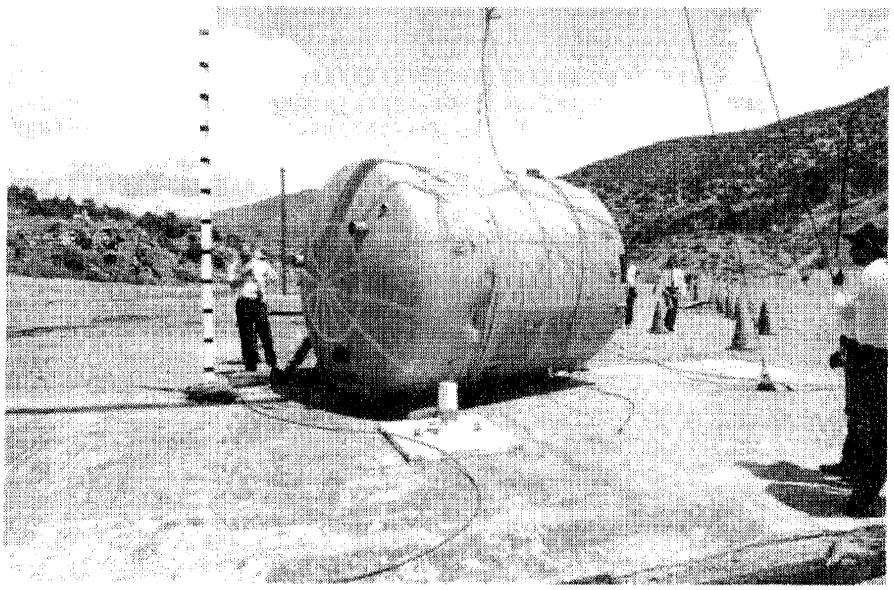
Transport Inspection and Enforcement. In the safeguards area, the NRC continued to inspect selected domestic shipments and the domestic segments of import and export shipments of spent fuel. Increased emphasis was placed on inspecting spent fuel imports. No significant problems were identified from inspections carried out during this report period.

The NRC also continued its transportation-related safety inspection program. The total effort involved more than 1,000 individual inspections covering byproduct, source, and SNM licensees; fuel cycle facilities; and shippers of spent reactor fuel.

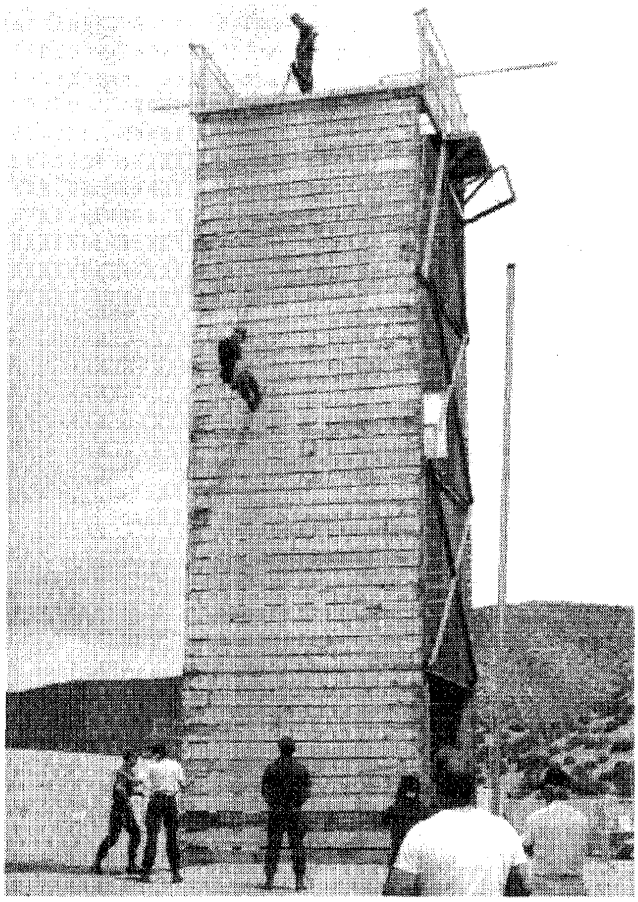
TRUPACT-II Shipping Container. The NRC staff has met several times with DOE representatives and DOE contractors on the development and testing of full-scale TRUPACT-II packages. These packages will be used to transport contact-handled transuranic (TRU) wastes from DOE facilities to the proposed Waste Isolation Pilot Plant in Carlsbad, N.M. One prototype package has been subjected to a series of impact, puncture, and fire tests as specified in NRC regulations. As a result of these tests, the package design is being modified and retesting is scheduled to begin in December 1988. DOE expects to submit an application for the package to the NRC early in 1989.

Incident Response Planning and Threat Assessment

The NRC staff assesses threats to NRC-licensed facilities, materials, and activities, and prepares the NRC's incident response plans for responding to actual thefts of nuclear material or radiological sabotage of nuclear facilities or activities. The staff maintains close and continuing contact with the intelligence community, including participating in regular interagency meetings of Federal agencies concerned with terrorism. Also, on a daily basis, the staff reviews and evaluates intelligence reports on terrorist activities and incidents, and assesses any reported threats against licensees. Particular attention is paid to foreign terrorist groups, their activities, and their possible relationship to activities sponsored by foreign states. On the basis of the NRC's review and interaction with other



In this full-scale puncture testing of a prototype TRUPACT-II package, the package is free-dropped one meter onto the steel cylinder on the pad.



Security training instructors from various NRC-licensed facilities attended a two-week Firearms and Tactical Training Course in June 1988 at the Department of Energy's Central Training Academy in Albuquerque, N.M.

agencies, the staff formally documents its analysis of the foreign and domestic threat environment every six months to assure the adequacy of the NRC's current design-basis threat statements. The staff discerned no significant change in the threat environment addressed by the NRC's current safeguards regulations. The Commission, as part of its reconsideration of the design-basis threats, continued to solicit other agencies' views of the domestic threat environment as it relates to the protection of domestic nuclear facilities.

Two techniques are employed in assessing reported threats to the NRC's licensees. Internally, the NRC Information Assessment Team, composed of headquarters and regional personnel, promptly assesses all reported threats and recommends appropriate response actions to NRC management. Additionally, an interagency team, the Communicated Threat Credibility Assessment Team, which is jointly funded by the NRC and the DOE, conducts analyses of written or recorded threats.

Incident response plans detail the NRC response to reported acts of theft or radiological sabotage involving licensed materials or facilities. In 1988, the procedures were revised to reflect the 1987 headquarters reassignment of safeguards responsibilities. A successful exercise was conducted in April 1988.

The staff continued its analysis of safeguards events in order to identify trends, patterns, and anomalies. The "Safeguards Summary Event List" (NUREG-0525), a compilation of safeguards events, was revised in its entirety in July 1988 (Rev. 14). Commencing in October 1987, licensees began submitting Safeguards Event Logs quarterly to the NRC. Staff analysis of the event data is intended to identify generic and site-specific trends and patterns for use by the licensees and the NRC in improving safeguards performance.

NRC/IAEA Interaction

The IAEA terminated safeguards inspection programs at the Westinghouse LEU fuel fabrication plant in Columbia, S.C., the Salem Unit 1 power reactor in New Jersey, and the Turkey Point Unit 4 power reactor in Florida. However, the NRC continued to report accounting data on a monthly basis for the Westinghouse plant, as well as for the LEU fuel fabrication plants of Babcock & Wilcox at Lynchburg, Va., of Advance Nuclear Fuel Corporation at Richland, Wash., of Combustion Engineering at Windsor, Conn., and of General Electric (GE), at Wilmington, N.C. Also, with regard to GE-Wilmington, the IAEA notified the U.S. of the selection of that facility for the application of safeguards pursuant to the U.S./IAEA agreement commencing in January 1988. Following the entry into force of the GE Facility Attachment in February, routine inspections were initiated in March, a physical inventory verification was performed by the IAEA in August, and a test program of unannounced inspections by the IAEA was implemented in September 1988.

In May 1988, representatives of the NRC, IAEA, and other U.S. agencies met in Washington, D.C., at the annual implementation meeting, to discuss IAEA safeguards issues. Also in May, NRC representatives participated in an IAEA-sponsored seminar in Vienna, Austria, on physical inventory verification practices and procedures at U.S. and Canadian facilities.

REGULATORY ACTIVITIES AND ISSUES

NRC/DOE Physical Protection Comparability of SSNM

New requirements have been developed to strengthen physical protection measures for fuel cycle licensees possessing formula quantities of SSNM. This action was prompted by a recent study comparing the NRC's security requirements with the Department of Energy's recently upgraded security systems for comparable facilities. The amendments to NRC's regulations will strengthen safeguards by requiring:

(1) Security system performance evaluation through tactical response force exercises.

(2) Night-firing qualification for guards using all assigned weapons.

(3) A 100-percent search of personnel and packages entering the protected area.

(4) The posting of armed guards at material access area control points.

(5) The addition of a second physical personnel barrier around the protected area.

(6) A revision of the design-basis threat at these fuel facilities to include land vehicles as a means of transportation by adversaries attempting to steal nuclear material and the implementation of measures to prevent vehicles from forcibly entering the protected area.

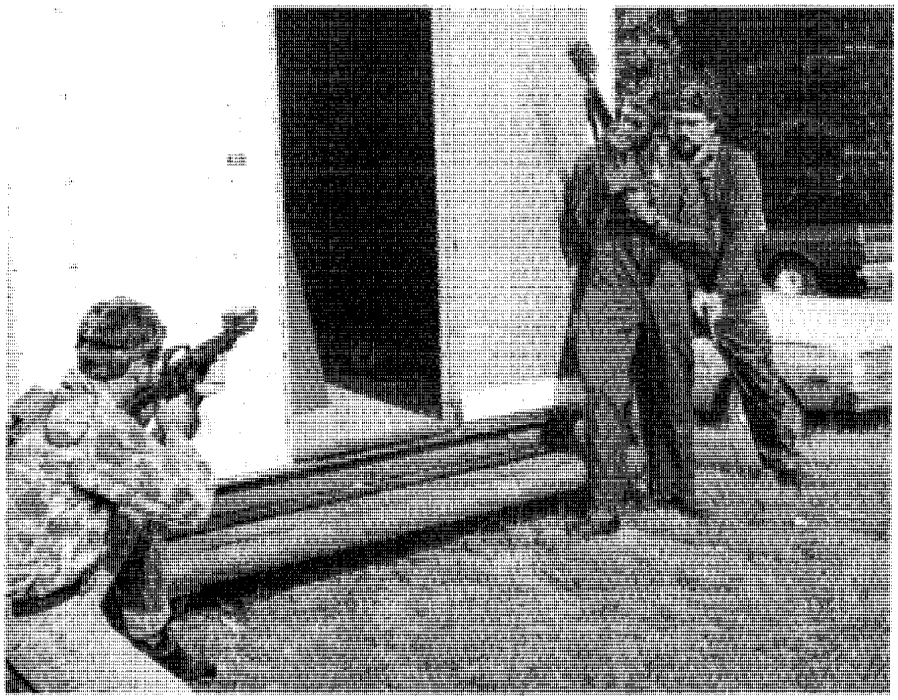
A proposed rule was published for comment in December 1987, and a final rule is under Commission review.

Enrichment of Non-radioactive Isotopes

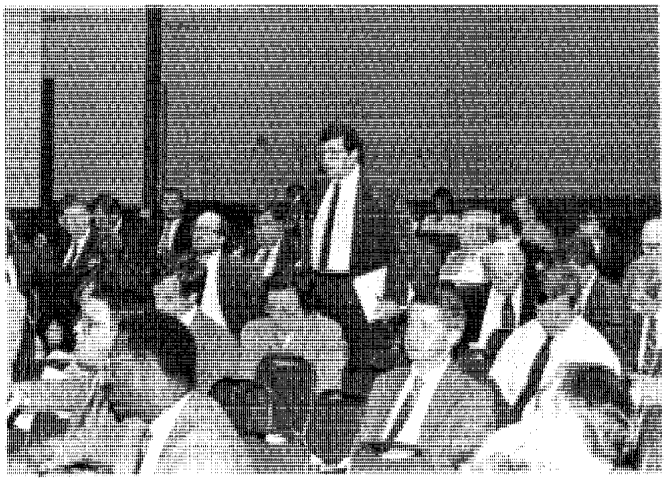
A commercial company has applied for a license for enriching non-radioactive isotopes. The applicant is acquiring the use of enrichment technology and equipment under a special arrangement with the DOE. Although the facility would not be licensed to possess SNM, other than as contamination in the equipment acquired from DOE, the equipment is capable of enriching uranium and, therefore, an NRC license is required. In this unique licensing action, the NRC has developed security measures to protect against the surreptitious enrichment of fissile nuclear material. A combination of licensee controls and NRC inspections will be used to provide protection at this facility.

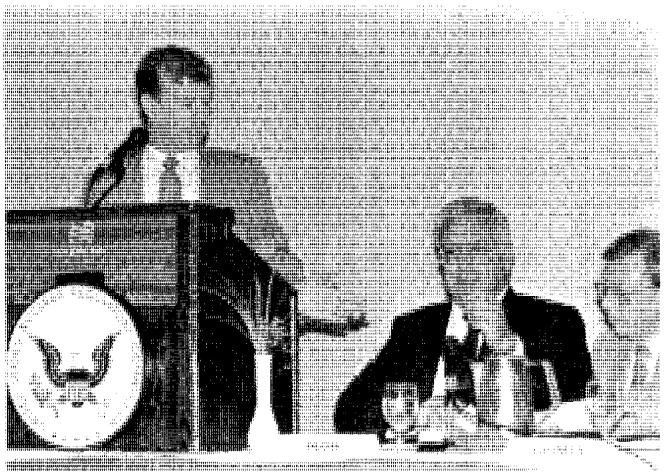
Fitness for Duty at Power Reactors

Certain reactor safeguards programs were previously designed to ensure the trustworthiness and reliability of persons who have access to nuclear power plants. In order to further assure the trustworthiness and reliability of these persons, the Commission published in the *Federal Register* (53 FR 36795) on September 22, 1988 a proposed rule that would require licensees authorized to operate nuclear power reactors to implement a fitness-for-duty program. The general objec-



Laser-equipped weapons and detector harnesses add realism to a security force tactical training exercise conducted in September 1988 at the Babcock & Wilcox facility in Lynchburg, Va.





A public meeting to explain and discuss the NRC's proposed fitness-for-duty rule was held in Rockville, Md., in October of 1988. At left, an attendee poses a question for the panel. At right are Dr. J. Michael Walsh (at the podium), Director of the Office of Workplace Initiatives, National Institute on Drug Abuse; Loren Bush (seated at center), with the NRC's Office of Nuclear Reactor Regulation (NRR); and Brian Grimes (seated at right), Director of NRR's Division of Reactor Inspection and Safeguards.

tive of the program is to provide reasonable assurance that plant personnel with unescorted access to protected areas in nuclear power plants are not under the influence of any substance, legal or illegal, or mentally or physically impaired from any cause that interferes with their ability to perform their duties safely and competently.

Access Authorization at Nuclear Power Plants

On March 8, 1988, the Commission published in the *Federal Register* (53 FR 7534) a proposed policy statement, "Nuclear Power Plant Access Authorization." The Commission is considering either issuing a policy statement endorsing industry-developed guidelines or promulgating a rule codifying access authorization provisions. Public comments on the policy statement versus the rulemaking option were specifically requested. The Commission is currently evaluating these alternatives.

Use of Deadly Force to Prevent SSNM Theft

A generic letter was sent on October 28, 1988 to fuel cycle facility licensees who possess, use, import, export, or transport formula quantities of SSNM. The letter advised them of the staff's strengthened position on the use of deadly force by licensee guards to prevent theft of SSNM, and presented five generic conditions under which the use of deadly force would be warranted. Licensees will be able to modify their response procedures, guard orders, training plans, and tactical defense plans in terms of this guidance.

IAEA Regulations on Transportatation of Radioactive Materials

The NRC issued proposed rule changes to 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." The changes, in combination with a parallel revision of the hazardous materials transportation regulations of the DOT, will bring U.S. domestic transport safety regulations at the Federal level into conformance with relevant portions of the IAEA design and performance requirements, to the extent considered feasible. This consistency not only facilitates the free movement of radioactive materials between countries for medical, research, industrial, and nuclear fuel cycle purposes, but also contributes to safety by concentrating the efforts of the world's experts on a single set of safety standards and guidance (those of the IAEA) from which individual countries can develop their domestic regulations. The experience of every country that bases its domestic regulations on those of the IAEA can be applied by every other country with consistent regulations to improve its safety program. The major proposed changes to 10 CFR Part 71 are:

(1) Additional accident test requirements for certain packages.

(2) Expansion of the radionuclides with listed limits for the quantity of radioactive material in a single package.

(3) Changes in the listed limits.

(4) Simplification of the fissile material transport classes.

(5) Revision of the requirements for shipment of low-specific-activity materials.

(6) Inclusion of the criteria for air transport of plutonium.

TECHNICAL ASSISTANCE

Approximately $2.6 million was spent on safeguards technical assistance contractual projects. Some of these projects are:

- Nuclear Materials Management and Safeguards System (NMMSS). This project, jointly funded with DOE, provides for the operation and maintenance of an accounting system for all licensed SNM in the U.S., including materials both of a U.S. and a foreign origin. Material is tracked from facility to facility on a continuing basis from original refinement to eventual disposal. Export/import transactions are also tracked. Selected data, based on NMMSS output, are also furnished to the IAEA in fulfillment of this nation's international obligations.

- Safeguards Analytical and Technical Services. This project provides analytical and technical support to all NRC regions by assisting inspectors in evaluating licensee capabilities to measure nuclear material properly. Specifically, the project analyzes samples from licensee inventories, checks licensee ability to correctly analyze and measure known materials, and prepares material standards for analytical standardization.

- Techniques to Evaluate the Effectiveness of Fitness-for-Duty Programs at Power Reactors. The objective of this project is to develop criteria and methodology for evaluating the effectiveness of licensee fitness-for-duty (FFD) programs. The project will also develop valid indicators of FFD program effectiveness at power reactors. In developing a defensible model of an effective FFD program, the project will identify strengths and weaknesses in current nuclear industry and other industry programs, as well as emerging state-of-the-art approaches to FFD and employee assistance programs.

Waste Management

Chapter 7

The Office of Nuclear Material Safety and Safeguards (NMSS) manages and coordinates NRC's regulation of all commercial high-level and low-level radioactive waste and uranium recovery activities. Specifically, NMSS functions include:

- Developing the criteria and the framework for regulating high-level waste (HLW), including determining the technical bases for licensing HLW repositories.
- Providing program management for NRC's responsibilities under the Nuclear Waste Policy Act of 1982 (NWPA), as amended.
- Leading the national effort to regulate and license commercial low-level waste (LLW) disposal facilities.
- Developing guidance and providing technical assistance to States and compacts to ensure that the goals of the Low-Level Radioactive Waste Policy Amendments Act (LLRWPAA) of 1985 are met.
- Providing national program management for licensing and regulating uranium recovery facilities and associated mill tailings.
- Reviewing and concurring in significant U.S. Department of Energy (DOE) decisions related to inactive mill tailings sites and the licensing of stabilized tailings piles for monitoring and maintenance programs.

HIGH-LEVEL WASTE PROGRAM

Highlights of the High Level Waste Program

On December 22, 1987, the Nuclear Waste Policy Amendments Act (NWPAA) was enacted. The NWPAA redirected the nuclear waste program by, among other actions, terminating site-specific activities at the Hanford, Wash., and Deaf Smith, Tex., sites and authorizing DOE to characterize the Yucca Mountain, Nev., site for development of the first repository. The NWPAA also suspended site-specific activities with respect to a second repository, and directed DOE to report to Congress between 2007 and 2010 on the need for a second repository.

NRC staff continued its work to ensure that the milestones of the NWPA can be met and focussed its review efforts—after enactment of the NWPAA—on the Yucca Mountain site. NRC's policy is that, in the absence of any outstanding unresolved safety issues, the NRC will support DOE schedules for meeting NWPA requirements as set forth in the DOE's Mission Plan and Project Decision Schedule (PDS). During the year, the NRC commented to DOE on the Draft 1988 Mission Plan Amendment issued in June 1988.

On January 8, 1988, DOE issued the Consultation Draft Site Characterization Plan (CDSCP) for the Yucca Mountain site, to receive comments from the NRC and the State of Nevada which would help DOE produce a higher quality Site Characterization Plan (SCP). In May 1988, the NRC issued final point papers developed after its review of the CDSCP. The NRC also met with DOE to resolve concerns about the CDSCP. This interaction is an effort to identify and resolve potential licensing issues as early as possible before the DOE submits a license application for authorization to construct a repository.

Other significant accomplishments include the issuance of three Technical Positions that provide guidance to DOE. Two proposed rulemakings were published, indicating amendments to 10 CFR Parts 51, 60, and 61, which modify the Commission's regulations. NRC staff also continued to play a key role in developing a negotiated rulemaking (amending 10 CFR Part 2) on the licensing procedures and schedule, including submittal and management of records and documents related to the licensing of a high-level radioactive waste repository (i.e., development of the licensing support system).

Finally, in October 1987, the NRC executed a contract with Southwest Research Institute in San Antonio, Tex., which established the Center for Nuclear Waste Regulatory Analysis (CNWRA), a federally funded research and development center. The CNWRA was established for three basic purposes: avoidance of conflict of interest between NRC and DOE subcontractors; provision for long-term continuity in technical assistance and research; and provision

The aerial view is of the Southwest Research Institute at San Antonio, Tex., where the Center for Nuclear Waste Regulatory Analysis, under contract to the NRC, initiated an extensive research and analysis program dealing with problems related to high-level radioactive wastes.

of a central contracting capability for performing and integrating all aspects of the HLW licensing program. During its first year, the Center has laid out and implemented a program to develop technical and analytical capabilities, including the initiation of a research program, and has begun a systematic analysis of the entire high-level waste management system under the NWPAA.

Regulatory Development Activities

The staff continued to refine regulatory requirements, in order to improve the effectiveness of the licensing process for NRC reviewers, adjudicatory boards, and the DOE. Consequently, three rulemaking actions continued during this reporting period. First, proposed amendments to 10 CFR Part 61 were published requiring disposal of "greater than Class C" (GTCC) wastes in an HLW repository if no other suitable disposal facility is available. This rule provides containment requirements for wastes with radionuclide concentrations greater than the Class C limits in Part 61. It would alleviate the need to classify some of the GTCC wastes as HLW and some as non-HLW.

Second, NRC published proposed amendments to Parts 51 and 60, specifying the conditions for NRC adoption of DOE's repository environmental impact statement (EIS). These proposed amendments specify that the NRC will adopt DOE's EIS to the extent practicable, unless substantive new information or new considerations have arisen and have not been addressed by DOE in a supplemental EIS. This will complete all the rulemakings required for conformance with the NWPA.

Third, the staff continued to assist in development of the negotiated rulemaking to amend 10 CFR Part 2 on licensing procedures and schedules, including the submission and management of records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste. Section 114(d) of the NWPA provides three years, with a possible extension of 12 months, for the NRC to reach a decision on a construction authorization for such a high-level waste repository. Streamlining of the licensing procedures and ready access to all pertinent information must be assured if the Commission is to make its decision within this time frame. DOE has already committed to develop an electronic information management system which would be used to facilitate the licensing process. The proposed rule, developed through a negotiated rulemaking process by representatives from DOE, NRC, the States, and industry, is scheduled to be published for public comment in the *Federal Register* early in fiscal year 1989.

The staff has also followed developments on the U.S. Environmental Protection Agency's (EPA) activities in response the Federal Court's invalidation of the EPA standards.

Finally, NRC identified several topics which may require rulemakings in future years. Most of these involve clarification or amplification of the requirements in 10 CFR Part 60.

Regulatory Guidance Activities

NRC's regulatory guidance for high-level waste is directed mainly at the Commission's regulations. NRC staff also continued to play a key role in reducing areas of high technical uncertainty; i.e., areas in which standard testing or analysis methods are not available or in which existing methods are controversial. The staff's regulatory guidance is provided in Technical Positions (TPs), which contain criteria for acceptable methods of demonstrating compliance with 10 CFR Part 60.

The following TPs were published in final form or for public comment during fiscal year 1988:

- Final TP—"Items and Activities in the High-Level Waste Geologic Repository Program Subject to 10 CFR Part 60 Quality Assurance Requirements" (NUREG-1318).
- Draft TP for public comment—"Post-Closure Seals in an Unsaturated Media."
- Draft TP for public comment—"Guidance for Determination of Anticipated Processes and Events and Unanticipated Processes and Events."

Further, the staff managed the development of contractor documents (NUREG/CRs) that will support future TPs in the areas of geochemistry, geology/geophysics, hydrology, performance assessment, quality assurance, geotechnical engineering/design, and waste package engineering.

Pre-license Application and Site Characterization Review Activities

NRC's pre-license application review and consultation process is a major mechanism for giving guidance to DOE before submittal of the repository license application. This guidance process is intended to identify and resolve staff concerns with DOE's program that could become licensing issues if not resolved. The NWPAA has enabled NRC and DOE staffs to concentrate their efforts on the Yucca Mountain site.

As previously noted, DOE issued the CDSCP for the Yucca Mountain site in January 1988, so the NRC and the State of Nevada could comment on it and thereby assist DOE to produce a higher quality site characterization plan (SCP). In March, NRC released draft point papers on the staff's preliminary concerns, and in May, the staff issued its final point papers. In these, NRC identified certain objections to DOE starting work. These were in the areas of identification of alternative conceptual models; establishment of a qualified quality assurance (QA) program; and potentially adverse effects of the exploratory shaft facility on waste isolation and other site characterization activities. Concerns resulting from NRC's CDSCP review were the major focus of, and stimuli for, consultation between the NRC and DOE in 1988. During the year, NRC and DOE held four technical meetings to discuss these concerns.

After DOE issues its SCP (scheduled to be issued in fiscal year 1989), the staff will review DOE's semiannual progress reports (required by the NWPA), the more detailed study plans and procedures which implement the SCP, reports that document the results of DOE's work, and DOE testing activities and data collected by it (on-site review). NRC staff also continues to attend technical meetings with DOE and other parties such as the State of Nevada, to discuss resolution of specific NRC concerns in staff reviews.

Quality Assurance Activities

The CDSCP gave the NRC staff its first opportunity to provide comprehensive comments on the DOE QA program. Other significant staff activities include the resolution of numerous QA open items, review of the Yucca Mountain Project Office QA Plan, and observation audits to evaluate the implementation of DOE's QA program.

The staff review of the CDSCP resulted in one "objection," the highest level of staff concern. This objection stated that the staff had an insufficient basis for expressing confidence in the DOE QA program and that the data collected under the existing program was of questionable use for licensing. Furthermore, it was agreed that DOE would start no new work until the NRC staff had gained more confidence in the DOE QA program.

To gain more confidence in this program, the NRC staff prepared a plan which included schedules for submittal of DOE and DOE contractor QA plans, implementation audits, and NRC staff review actions to accept DOE's QA program. DOE refined this plan. NRC staff then met with DOE staff and both agreed to this plan.

Also, since passage of the NWPA, NRC identified more than 100 QA open items through site visits, formal meetings, audit reports, and document reviews. The DOE and NRC staffs met and resolved most major open items and agreed to a master list of 10 remaining open items, to be tracked until they are resolved.

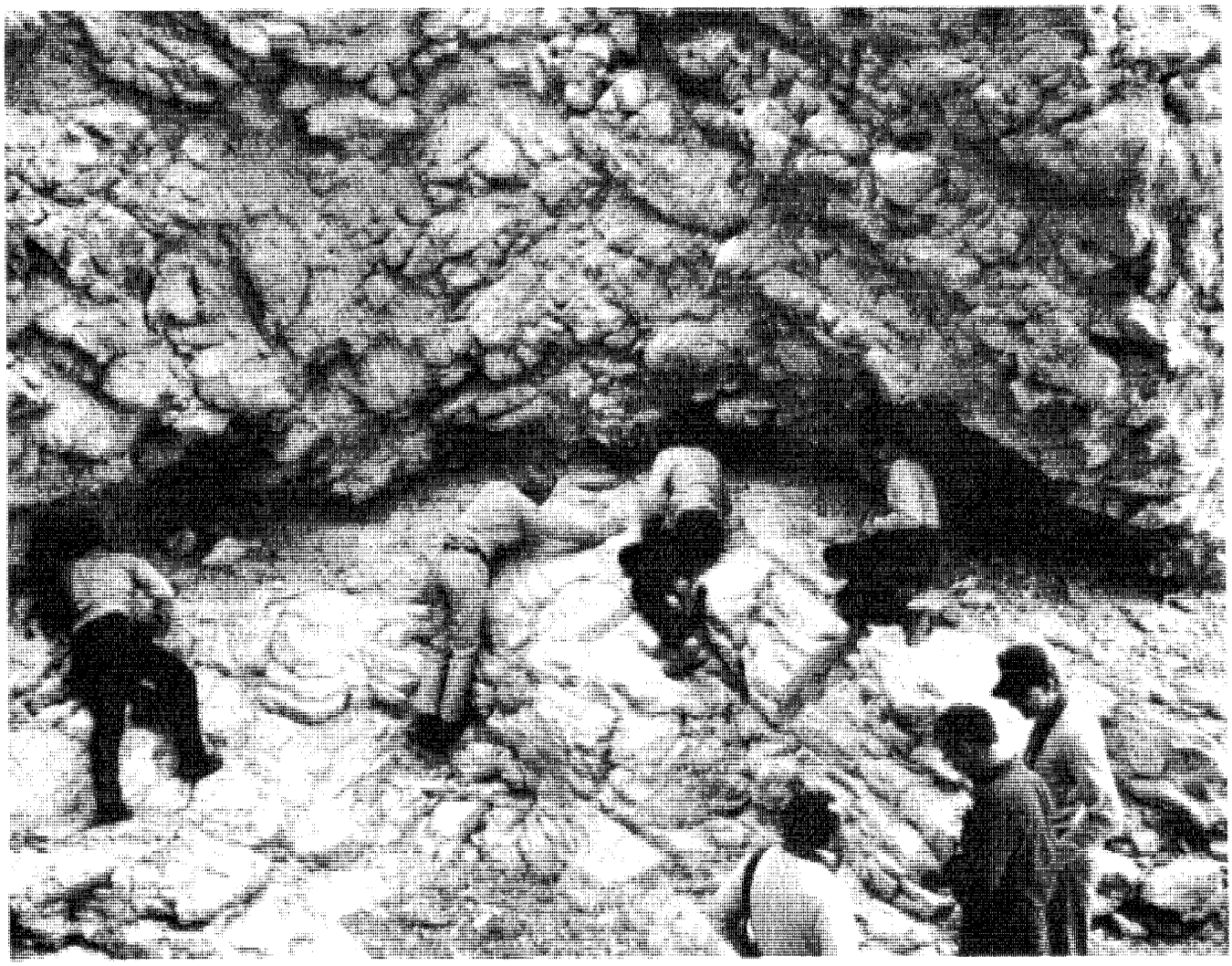
The staff also reviewed and accepted the Nevada Nuclear Waste Site Investigation (NNWSI) QA Plan (hereafter QA Plan) after agreement on resolution of all QA Plan open items. This is the first formal acceptance by the staff of any DOE QA program document in the HLW repository program. The QA Plan is a

document which defines criteria that each of the NNWSI program participants must meet to comply with the NRC regulations in 10 CFR Part 60. It is organized to follow the 18 criteria of Appendix B to 10 CFR Part 50, and it interprets how these criteria are to be applied to the site characterization phase of the repository. Unlike a QA program for an engineered facility, the QA Plan made a number of interpretations of the Appendix B criteria to be applied to the scientific investigations associated with the site characterization phase of the repository. This QA Plan establishes a framework upon which other DOE contractors' QA plans can be developed.

Finally, the staff continues to conduct observation audits to evaluate the effectiveness of the DOE audit program and the implementation of QA by DOE audit contractors. The staff has performed eight observation audits which cited improvements needed in the DOE audit process. DOE has committed to respond to and correct these shortcomings.

DOE Mission Plan and Project Decision Schedule

Section 301 of the NWPA requires DOE to submit to Congress a Mission Plan, delineating how the activities the NWPA requires will be implemented. Section 114(e) of the NWPA requires DOE to prepare and update, in cooperation with affected Federal agencies, a Project Decision Schedule (PDS) for those activities. Any Federal agency that determines it cannot comply with a deadline in the PDS must prepare a written explanation of the reason for this inability and submit the explanation to DOE and the Congress.



Reports on the site-characteristics of the proposed Yucca Mountain high-level waste site continued under intense review at the NRC, the Department of Energy, and other agencies during 1988. Studies cover a wide area and variety of earth structures. Above, members of an NRC technical team examine a low-angle detachment fault at Mormon Point in Death Valley, Cal.; the fault is believed to be similar to formations at Yucca Mountain.

In June 1988, DOE prepared a Draft 1988 Mission Plan Amendment to inform Congress of its plans for implementing the provisions of the NWPAA for the waste management program. NRC provided comments to DOE on the Draft Amendment in September 1988. In commenting on the Draft Amendment, the NRC expressed concern that DOE's schedule for near-term program activities, including in-situ site characterization, is being compressed while DOE's schedule for subsequent program milestones, such as the submittal of a license application to the NRC, remains unchanged from the schedule in the June 1987 Mission Plan Amendment. The NRC's concern is that compression of the schedule for near-term activities could make it difficult for DOE to develop a complete and high-quality license application. As the NRC has stated, a high-quality license application is required in order for NRC to complete its review of the application within the three-year period provided under the NWPAA. In view of this concern, the NRC requested that the final Mission Plan Amendment specifically acknowledge DOE's commitment to develop a complete and high-quality license application, even if this would require more time for collecting necessary information and would result in subsequent delays in submitting the license application.

State Interactions

After enactment of the NWPAA, the NRC staff continued its interactions with the State of Nevada. State representatives attended NRC/DOE workshops and technical meetings held during 1988 and also observed most of the DOE QA audits which the NRC staff observed. The NRC staff routinely sends significant HLW documents to Nevada. The State receives a weekly notice of NRC/DOE upcoming meetings, upcoming Commission meetings, and Advisory Committee on Nuclear Waste meetings at which topics concerning the HLW program will be discussed. The NRC also announces these upcoming meetings on a toll-free telephone recording accessed by the general public. Notices of availability of significant HLW documents are sent to several hundred parties who have expressed an interest in keeping abreast of the HLW program.

Finally, Nevada asked that the NRC staff review its QA program to determine its acceptability. The staff is reviewing the Nevada QA manual, which will facilitate Nevada's participation, since it will help to ensure that the activities Nevada undertakes, if such topics are raised during the licensing hearings, are "quality assured" work.

Center for Nuclear Waste Regulatory Analysis

The Center for Nuclear Waste Regulatory Analysis (CNWRA) completed its first year of operations on October 14, 1988. In accordance with the NRC's three-year "phase-in" plan, in Year 1 the startup and planning activities of the CNWRA were emphasized. In addition to the physical aspects of implementing the CNWRA, an effective organizational structure—including applicable management and control techniques—was established. The CNWRA began to develop its technical and analytical capabilities; initiated four research projects as well as a three-year transportation risk study; and began to develop the "Program Architecture." The Program Architecture is defined as a systematic analysis of the entire high-level waste management system addressed in the NWPA, as amended, including at-reactor storage, any interim storage such as monitored retrievable storage, defense and commercial high-level waste programs, and transportation, as well as the repository. It covers the entire life cycle of the regulatory program, from pre-license application through construction, operation, and closure.

Waste Confidence

In October 1979, the Commission initiated a generic rulemaking to assess the degree of assurance that radioactive waste can be safely disposed of, when such disposal or off-site storage would become available, and whether radioactive waste can be safely stored until off-site disposal or storage is available. The generic rulemaking became known as the "Waste Confidence" proceeding. In August 1984, the Commission issued five findings deriving from the proceeding. In its decision, the Commission committed itself to review the five findings at least every five years until a repository is available. August 31, 1989, will be the five-year anniversary of the original decision and findings.

In August 1988, the Commission requested that the staff and General Counsel establish a Review Group composed of individuals from the Office of the General Counsel (OGC), NMSS, NRR, and RES to review the Waste Confidence findings, and to provide a response to the Commission in a timely fashion, so that the Commission can meet its commitment. The re-evaluation of the findings by the Review Group was under way at the close of the report period; a Commission decision is scheduled for December 1989.

LOW-LEVEL WASTE MANAGEMENT

Within the framework of this program, the NRC continues to meet the statutory mandates of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (LLRWPAA).

The NRC staff is continuing to develop performance assessment capabilities to prepare for the licensing of new LLW disposal facilities. Performance assessment involves quantitative evaluation of disposal facility and site performance in relation to the performance objectives in 10 CFR Part 61. This effort includes the development of an LLW Performance Assessment Strategy describing acceptable use of performance assessment results in support of license applications. The strategy details NRC's plan to develop the necessary performance assessment capabilities by mid-1989. It was distributed in October 1988 to solicit comments from interested parties.

Regulation and Guidance

The NRC staff continued its efforts to develop regulations and to provide guidance that will assist States and compacts in developing the LLW disposal capacity required by the LLRWPAA. In January 1988, NRC updated the "Standard Review Plan for Alternatives to Shallow Land Burial" (NUREG-1200) and the "Standard Format and Content Guide" (NUREG-1199) for the staff to use in its review of license applications.

Section 6 of the LLRWPAA authorizes the NRC to grant emergency access to any non-Federal LLW disposal facility, when necessary to eliminate an immediate and serious threat to the public health and safety or to the common defense and security. On December 15, 1987, the NRC issued a proposed rule (10 CFR Part 62) establishing criteria and procedures for making determinations on requests for emergency access. The public comment period on this proposed rule ended in February 1988, and the final rule will be published early in fiscal year 1989.

Technical Assistance to Agreement States

The NRC staff provided assistance to a number of Agreement State programs related to LLW management. This assistance included participation in Agreement State program reviews, response to specific inquiries related to waste management, and development of guidance designed to facilitate State regulation of LLW disposal.

Compact Compliance

The LLRWPAA established a series of milestone dates that regional compacts and non-member States must meet to ensure their continued access to existing disposal facilities, located in South Carolina, Nevada, and Washington. The most recent milestone date, January 1988, was for submitting siting plans to DOE and States that will contain disposal sites. All regional compacts and non-member States, except New Hampshire, North Dakota, and Vermont, and the Commonwealth of Puerto Rico have submitted siting plans on time.

The next major milestone date is January 1990. By this date, regional compacts and non-member States must either: (1) submit to the NRC or an Agreement State a complete license application for a new LLW disposal facility or (2) submit to the NRC a written certification by the Governor of the affected State, that the State itself will provide for storage, management, or disposal of any LLW generated in the State after December 31, 1992. The NRC staff is considering whether any action is necessary on the certifications, beyond those actions directly stated in the LLRWPAA, and will continue to pursue the matter with DOE and sited States.

Work with Other Federal Agencies

The NRC and EPA staffs continued their work on resolving the mixed low-level radioactive and hazardous waste ("mixed waste") issue to remove uncertainty on the applicability of the Resource Conservation and Recovery Act to NRC-regulated activities. The two staffs focussed their efforts on an administrative approach, and issued a series of NRC/EPA joint guidance documents on identification of mixed waste, siting of a mixed-waste facility, and land disposal technology. Both agencies are continuing to simplify the "dual regulatory" process by developing additional guidance documents.

No disposal facility in the United States has been licensed by the NRC for LLW disposal and permitted by EPA for hazardous waste disposal. Therefore, facilities that produce mixed waste must rely on interim storage. Such storage must comply with NRC and EPA requirements. A joint guidance document on mixed-waste storage is scheduled to be completed in fiscal year 1989. The Division of Low Level Waste Management and Decommissioning (LLWM) staff is also working with EPA staff to develop guidance on sampling and testing of mixed waste received at disposal facilities. A draft of the joint guidance on sampling and testing is expected to be ready in fiscal year 1989.

The NRC staff has consulted with the DOE LLW staff in three areas: (1) coordinating management of the national low-level commercial waste program—on efforts such as identifying alternative disposal methods and developing data bases; (2) reviewing the closure and disposition of waste at West Valley, N.Y., under the West Valley Demonstration Project Act; and (3) reviewing DOE's policy and plans on GTCC waste disposal. The staff provided a task plan to DOE and its contractors at West Valley in April 1988, and offered DOE general guidance on acceptable approaches to justifying a site-specific transuranic limit and a waste classification system.

Status of Current Facilities

The staff worked toward the renewal of licenses for disposing of special nuclear material (SNM) at Barnwell, S.C., and Hanford, Wash. Renewals will be granted in keeping with the recent guidance that LLWM staff developed on licensing of SNM disposal. The Agreement States encompassing the Barnwell and Hanford sites license disposal of source and byproduct material at these sites. NRC completed the Hanford renewal in late 1988; it will complete the Barnwell renewal in late 1989. Only the State of Nevada licenses the Beatty, Nev., waste disposal site, since SNM is not disposed of at this site in quantities requiring an NRC license. The NRC staff has provided assistance to the State of Nevada on renewal of the Beatty license and development of an adequate closure plan.

The NRC staff completed work in 1988 on renewing the license for the disposal of special nuclear material (SNM) at the Hanford, Wash., nuclear waste disposal facility. When SNM is involved, only the NRC, and not the Agreement State, can license its disposal.

URANIUM RECOVERY AND MILL TAILINGS

The NRC licenses and regulates uranium mills, "heap leaching" facilities, ore-buying stations, commercial in-situ solution mining operations, and uranium-extraction research and development projects. The NRC also evaluates and concurs in DOE's remedial action plans for cleaning inactive uranium mill tailings sites and contaminated properties in the vicinity of these sites. The NRC Uranium Recovery Field Office (URFO), part of NRC Region IV, is located in Denver, Colo. This location enhances the Agency's ability to carry out its regulatory role by virtue of proximity to the uranium industry and the affected States.

The staff continued its involvement in the Uranium Mill Tailings Remedial Action Program (UMTRAP) at inactive sites, as required by Title I of the Uranium Mill Tailings Radiation Control Act of 1978.

Regulatory Development

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), which was enacted to prevent or minimize environmental hazards from active or inactive mill operations, requires the EPA to develop radiation standards for mill tailings sites and the NRC to develop regulations for uranium recovery operations, consistent with the EPA standards. The NRC promulgated its regulatory requirements for uranium mill tailings sites in 1980, but was embargoed by Congress from spending funds to implement its requirements until 1983—the date by which EPA was mandated to promulgate its final standards. The final EPA standards were issued in October 1983. The NRC then embarked on a two-step process to conform its regulations (10 CFR Part 40) to these standards.

The first step, completed in October 1985, was modification of NRC regulations on radiological protection and long-term stabilization of mill tailings sites, to conform to the EPA standards. The second step incorporated the EPA ground-water standards. The NRC's proposed rule addressing ground-water protection was published July 8, 1986. The final rule was published November 13, 1987. The NRC also issued an advance notice of proposed rulemaking for licensing the custody and long-term care of uranium mill tailings sites, covering commercially licensed as well as UMTRAP sites. The final rule should be in place by the end of calendar year 1989.

The NRC staff continued its work on regulatory guides for uranium recovery operations by completing studies in meteorological measurement and in bioassay. It has continued work on regulatory guides on long-term stabilization and erosion protection for mill tailings piles, earthen covers for radon attenuation, and performance of tailings-pile cover materials.

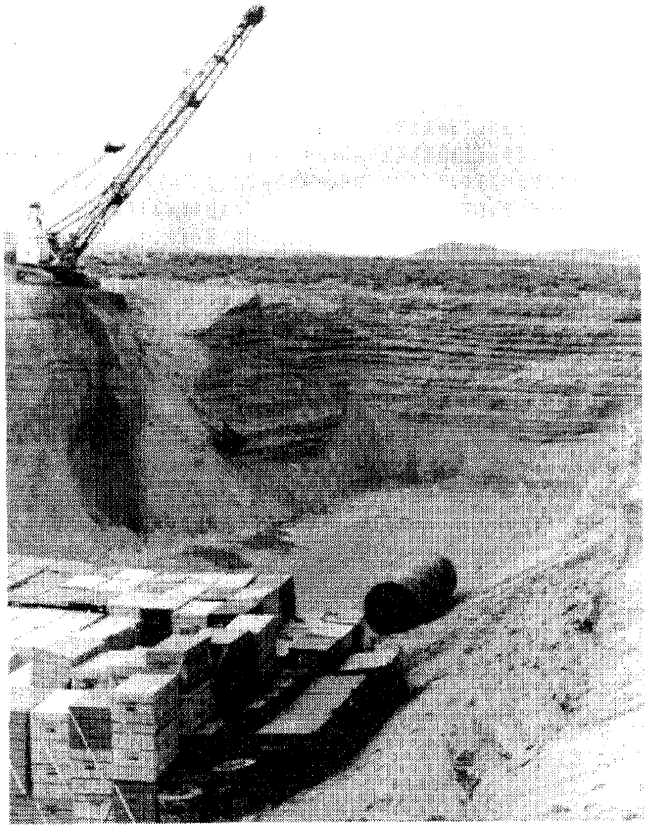
Licensing and Inspection Activities

The Uranium Recovery Field Office (URFO) performed 37 inspections of uranium recovery facilities. URFO issued a new possession license to the U.S. Energy Corporation for an ion-exchange unit in Wyoming. In other regulatory actions, the URFO staff completed 2 license renewals, 58 major license amendments, and 69 minor license amendments.

Of the 34 NRC-licensed uranium recovery facilities, 19 are uranium mills; 3 are either heap leach or other byproduct recovery operations; 8 are research and development solution mining operations; and 4 are commercial in-situ facilities. Only seven of the licensed facilities were in operation at the end of fiscal year 1988: three uranium mills, two research and development solution mining operations, and two commercial-scale solution mining facilities. Given the economic state of the uranium industry, few new facilities are expected to be licensed, except for solution mining operations. The NRC has three new commercial-scale solution mining applications under review, and three more are expected in fiscal year 1989. Over the next few years, much of the casework confronting the uranium recovery program will be in the areas of remedial activity and decommissioning, including remediation for ground-water contamination.

Technical Assistance to Agreement States

Section 274 of the Atomic Energy Act of 1954, as amended, authorizes the Commission to enter into agreement with the Governor of any State to relinquish to that State the Commission's authority over source materials and byproduct materials associated with



The NRC must review and concur in proposed remedial actions to be taken at some 22 uranium mill tailing sites in 12 States across the country. (The tailings are a waste product of the milling process and are radioactive.) During 1987, the NRC reviewed a final certification of remedial plans for a site near Canonsburg, Pa., and a construction design for erosion protection and a radon barrier for a site near Burrell, Pa. The photo above shows Department of Energy contractors conducting an aquifer test at the Canonsburg site. Below are the erosion-protection/radon-barrier filter materials, before emplacement, at the Burrell site.

uranium recovery facilities. The NRC currently has such agreements with three States: Colorado, Texas, and Washington.

The NRC conducts periodic reviews of the Agreement States' licensing and inspection programs to determine their compatibility with NRC programs. The NRC also provides training and technical assistance to the Agreement States to help them fulfill their regulatory responsibilities. During fiscal year 1988, the NRC reviewed the uranium recovery licensing program of the State of Texas, examining that State's programs for mills, commercial solution mining facilities, and research and development solution mining facilities. The NRC also provided technical assistance to the Agreement States on both generic issues and site-specific licensing issues.

Remedial Action at Inactive Sites

The NRC continued its involvement in UMTRAP at inactive mill tailing sites, as required by Title I of UMTRCA. The NRC is a cooperating agency and is required by UMTRCA to concur in remedial actions that DOE plans at inactive mill tailings sites. As part of this responsibility, the NRC staff completed 60 review actions. These included two Comparative Analysis of Disposal Site Alternatives Report (CADSAR) reviews, eight draft or final Remedial Action Plan (RAP) reviews, nine design reviews, six inspection plan reviews, one RAP modification review, two Surveillance and Maintenance Plan (SMP) reviews, and 10 other site-specific reviews. In addition, the NRC staff prepared four Technical Evaluation Reports (TERs) documenting its review of DOE's remedial action selection for the Durango, Colo.; Tuba City, Ariz.; Green River, Utah; and Grand Junction, Colo., sites. Inspections of remedial action activities were performed at the Canonsburg, Pa.; Shiprock, N.M.; Salt Lake City, Utah; Durango, Colo.; and Lakeview, Ore. sites.

The NRC initiated a major generic effort to streamline the NRC review process so as to more efficiently utilize limited resources. In four areas, the NRC reached agreements with DOE that will significantly streamline NRC reviews. Implementation of the agreements will require revising the Memorandum of Understanding with DOE and preparing a technical position on standard format and content of DOE documents. Both of these actions are to be completed early in fiscal year 1989. Other generic efforts were directed toward providing guidance on the revised EPA ground-water standards for this program. The staff initially reviewed and commented on the proposed standards and on DOE's proposed policy for implementing the standards. Subsequently, the staff developed draft TPs on: (1) information needed to demonstrate compliance with the proposed standards and (2) alternate concentration limit applications. In addition, the staff has developed a draft TP on design of soil covers for stabilization of uranium mill tailings sites. The staff also completed seven reviews of minor generic DOE submittals.

DECOMMISSIONING OF NUCLEAR FACILITLIES

On June 27, 1988, the Commission published amendments to its regulations containing requirements for decommissioning nuclear facilities. The amendments pertain to financial assurance and record-keeping for decommissioning and to procedures for terminating licenses. The new requirements became effective on July 27, 1988, although holders of existing licenses subject to the financial assurance requirements have until July 27, 1990 to provide the necessary financial assurance certifications.

NRC staff activities have focussed on developing the guidance that licensing staff and licensees need to implement the new requirements. The NRC staff has developed a draft "Standard Format and Content Guide" and "Standard Review Plan" for review of financial assurance mechanisms; these are available for interim use by licensees and reviewers during the public comment period. The NRC staff has also developed policies and procedures for the licensing staff conducting the reviews.

NMSS staff has continued to assist the Office of Nuclear Reactor Regulation (NRR) licensing staff in the review of decommissioning plans for shutdown power reactors. The staffs have developed a protocol for the transfer of licensing responsibility from NRR to NMSS as the decommissioning review process proceeds.

Communicating with Government and the Public

Chapter 8

The NRC's Office of Governmental and Public Affairs (GPA) serves, on behalf of the Commission, as a primary liaison with Federal and State agencies, Indian and local community organizations, the news media, Congress and the international community. Reporting directly to the Commission, GPA completed a first year's effort during the report period toward meeting one of the agency's long term goals, as set out in the NRC Five Year Plan—to ensure that the NRC has effective external communications and relations, and cultivates a coordinated and effective intergovernmental approach to nuclear safety. Through GPA's extensive contacts and interactions, the NRC will continue to sustain the two-way communication which fosters successful cooperation between the agency and its many and varied constituents.

PUBLIC COMMUNICATION

Public Information

The GPA staff provided the news media and the public with information on NRC actions throughout the year by disseminating press releases, reports, decisions, orders, fact sheets, and other informational materials. In addition, the staff handled thousands of requests from the news media and the public for more detailed explanations of NRC actions and arranged for the news media to interview the Commissioners and other staff members to gain more in-depth information. Several press conferences were conducted on major actions. In the Regions, staff members also assisted the news media at public meetings, Licensing Board hearings, and emergency exercises.

Headquarters and Regional Offices issued more than 400 public announcements that covered situations such as proposed fines imposed on licensees, public hearings and workshops, and changes to regulations. Although press releases are issued primarily to the news media, press releases are also distributed directly to the scientific community, the industry, and the general public. The staff responded to a large number of inquiries and letters from the general public. In addition to answering specific questions by phone and letter, fact sheets and other pertinent materials were sent in many cases to provide a broader picture of NRC programs. The staff prepared a new fact sheet on the NRC's research program.

Partners in Education. More than 150 NRC employees served as volunteers at some 25 public schools in Montgomery County, Md., and at various schools in the District of Columbia and northern Virginia during the school year.

Within the framework of the National Partnership in Education Program initiated in 1983, NRC employees helped the schools by tutoring, lecturing, judging science fair projects, assisting with science experiments, helping students in an English for Speakers of Other Languages Program, participating in career awareness seminars, serving as mentors and role models, and counseling students and faculty. The volunteers have backgrounds in law, engineering, mathematics, physical sciences, accounting, biology, and health sciences.

Consumer Affairs. The NRC's third annual observance of National Consumers Week, coordinated by GPA between April 24 and 30, 1988, featured special consumer assistance talks by Donna Crocker, Executive Director, Prince Georges County (Md.) Consumer Protection Commission, and Dr. Frank Porter, Chairman, Howard University's Department of Consumer Education and Resource Management, Washington, D.C.

Headquarters Public Document Room

Persons interested in detailed information about commercial nuclear facilities have found the NRC's principal Public Document Room (PDR) an invaluable source of useful materials. The PDR is located at 2120 L Street, N.W., Washington, D.C. The specialized research center houses significant documents on nuclear regulation which have been made available to the public. Users of the center can have documents reproduced for a nominal fee.

Researchers in the PDR can examine copies of a wide variety of materials: NRC reports; transcripts and summaries of meetings; licenses and amendments; existing and proposed regulations; and correspondence on technical, legal, and administrative matters. Most of these documents are related specifically to nuclear

In February 1988, the NRC inaugurated a pilot project which provides six local public document rooms (LPDRs) with computerized direct access to all of the agency's publicly available documents. At top left, Carol Torrens, of the Monroe County (Mich.) Library System conducts a search of NRC Headquarters data base on behalf of a library patron. At right, Sandra Northern stands by at NRC Headquarters in Bethesda, Md., to assist in the search. Monroe County is the site of the Detroit Edison Company's Enrico Fermi Unit 2 nuclear power plant.

power plants—their design, construction, operation, and inspection—and to nuclear materials, including the use, transport, and disposal of radioactive wastes. The PDR features extensive accession listings and an on-line bibliographic data base available for staff and public use.

The Headquarters PDR contains about 1.6 million documents, and the collection is enlarged by an average of 260 new items every day. During an average month, the PDR serves about 1,290 users. The staff retrieves an average of 2,850 files of documents or microfiche per month for researchers on-site and provides about 2,612 documents in response to letters and telephone requests. The public purchased 4 million pages of documents and about 10,000 microfiche cards in fiscal year 1988. During an average month, there were about 2,500 user sessions on the PDR's on-line computer data base.

Persons wishing to use or obtain additional information regarding the holdings, file organization, reference, reproduction services, and procedures of the PDR may call (202) 634-3273 or write to the U.S. Nuclear Regulatory Commission, Public Document Room, Washington, D.C. 20555. A "Public Document Room Users' Guide" and "Public Document Room File Classification System Guide" are available upon request. In addition, orientation sessions are provided for individuals or groups interested in using the facility, and training sessions are scheduled regularly for users in how to search the PDR automated bibliographic retrieval system (an on-line card catalogue).

Local Public Document Rooms

There are six Local Public Document Room (LPDR) libraries particpating in a pilot project which is likely to bring about fundamental change in the 17-year-old LPDR program. (See Appendix 3 for a roster of all LPDRs and associated licensed facilities.) Under the project, started in February 1988, the participating libraries and their patrons are given on-line access to the publicly available portion of the NRC's computerized Nuclear Documents System (NUDOCS, see Chapter 11), as well as supporting microfiche of over a million records entered into the system since 1981. The six libraries were provided computer hardware, software, and telecommunications lines to enable them to access the NUDOCS data base, which is available Monday through Friday from 7:00 a.m. to 8:00 p.m. Eastern time. Library staffs received NUDOCS training during a three-day workshop conducted in Bethesda, Md., and Washington, D.C., in January 1988. Throughout the year, the LPDR staff in Bethesda furnished the participating libraries with numerous reference tools and other assistance, and also made themselves available to help via the toll-free LPDR hotline (800-638-8081).

The six libraries in the project are those at the Louisiana State University in Baton Rouge, La. (LPDR for the River Bend nuclear power plant), the California Polytechnic State University in San Luis Obispo, Cal. (LPDR for the Diablo Canyon plant), the State University of Pennsylvania in Harrisburg, Pa. (LPDR for the Three Mile Island and Peach Bottom plants), the Monroe County Library System in Monroe, Mich. (LPDR for the Fermi plant), the University of North Carolina in Charlotte, N.C. (LPDR for the McGuire plant), and the White Plains Public Library in White Plains, N.Y. (LPDR for the Indian Point plant).

Through the pilot project, the NRC has, for the first time, enabled members of the public to have local access to detailed licensing and operational information —such as inspection reports, emergency plans, safety analyses reports, and licensee event reports—on all nuclear power plants, and not only those near their communities; in addition, the public has access at these venues to records pertaining to fuel cycle facilities, waste disposal facilities, and other material received or generated by the NRC in its regulatory role.

LPDR document collections are usually located in university or public libraries which have copying facilities and which are open to the public during the evenings and on weekends. The NRC provides financial support to most LPDR libraries maintaining large power reactor collections, performs periodic audits of the collections, and conducts workshops for the public at LPDR sites. The toll-free telephone line is available to library staffs and individuals seeking guidance with respect to collection content, search strategies, the use of reference tools and indices, and locating and retrieving information at LPDR facilities.

Commission History Program

The Commission History Program studies the origins and evolution of regulatory policies and programs. The History Office is currently preparing a sequel to its book, *Controlling the Atom: The Beginning of Nuclear Regulation, 1946-1962,* published in 1984 by the University of California Press. The new volume will cover the period from 1963 into the early 1970s, a time of great expansion and controversy in commercial nuclear power. Like the first volume, it is intended to serve as a reference for general readers as well as the agency staff.

CONGRESSIONAL OVERSIGHT

NRC witnesses participated in 30 hearings before committees and subcommittees of the 100th Congress during the period from October 1, 1987, through September 30, 1988. NRC staff testified on a wide range of topics including a variety of legislative proposals to restructure the agency. All of the hearings in which the NRC personnel participated are listed in Table 1.

COOPERATION WITH THE STATES

The NRC's contacts with regional, State, and local agencies, and with Indian tribes, for purposes other than inspection, enforcement, or emergency planning, are administered through the Office of State, Local and Indian Tribe Programs (SLITP) of GPA. These include the Office of the State Agreements Program and various liaison and cooperative programs that are administered in accordance with policies and procedures

Table 1. Congressional Hearings at Which NRC Witnesses Testified—FY 1988

Date	*Committee*	*Subject*
10/01/87	Committee on Energy & Commerce Subcommittee on Energy and Power	NRC's Legislative Proposals (House)
10/08/87	Committee on Environment & Public Works Subcommittee on Nuclear Regulation (Senate)	Office of Investigations
10/08/87	Committee on Environment & Public Works Subcommittee on Nuclear Regulation (Senate)	Office of Inspector & Auditor
10/14/87	Committee on Interior & Insular Affairs Subcommittee on Oversight & Investigations (House)	Backfit Rule
10/16/87	Committee on Energy & Commerce Subcommittee on Energy and Power (House)	Nuclear Waste Legislation
10/20/87	Committee on Environment & Public Works Subcommittee on Nuclear Regulation (Senate)	NRC/Industry Regulatory Interface
10/29/87	Committee on Environment & Public Works Works Subcommittee on Nuclear Regulation (Senate)	Legislative Proposals Affecting the Organization of NRC
11/10/87	Committee on Energy & Commerce Subcommittee on Energy and Power (House)	Nuclear Plant Aging
11/19/87	Committee on Energy & Commerce Subcommittee on Energy and Power (House)	Oversight of DOE's Production Facilities
11/21/87	Committee on Governmental Affairs Committee on Energy & Natural Resources Subcommittee on Energy Regulation (Senate)	Wright-Patterson AFB Americium-241 Leaks
12/07/87	Committee on Interior & Insular Affairs Subcommittee on General Oversight & Investigations (House)	WPPS-1 Conversion to Production Reactor
12/16/87	Committee on Foreign Affairs (House)	Proposed U.S./Japan Agreement for Nuclear Cooperation
01/07/88	Committee on Foreign Affairs (Senate)	Pilgrim Plant Restart
03/01/88	Committee on Small Business Innovation (House)	Small Business Research Program
03/02/88	Committee on Environment & Public Works (Senate)	NRC FY 1989 Budget

Date	*Committee*	*Subject*
03/03/88	Committee on Interior & Insular Affairs Subcommittee on Energy & the Environment (House)	NRC FY 1989 Budget
03/09/88	Committee on Interior & Insular Affairs Subcommittee on General Oversight & Investigations (House)	Sabotage and Terrorism of Nuclear Power Plants
03/16/88	Committee on Science, Space & Technology Subcommittee on Energy Research & Development (House)	NRC's HTGR Activities
03/28/88	Committee on Energy & Natural (Senate)	DOE's Civilian High-Level Radioactive Waste Disposal Program FY 1989 Budget
03/30/88	Committee on Appropriations Subcommittee on Energy & Water (House)	FY 1989 Appropriations for NRC Development
04/21/88	Committee on Energy & Commerce Subcommittee on Oversight & Investigations (House)	TVA's Nuclear Programs
04/26/88	Committee on Interior & Insular Affairs Subcommittee on Energy & the Environment (House)	NRC Reorganization Proposals
04/27/88	Committee on Governmental Affairs (Senate)	Restructuring the NRC
05/12/88	Committee on Interior & Insular Affairs Subcommittee on Energy & the Environment (House)	Transportation of High-Level Waste
05/12/88	Committee on Governmental Affairs (Senate)	Restructuring the NRC
5/25/88	Committee on Public Works & Transportation Subcommittee on Surface Transportation (House)	High-Level Waste Transportation
06/16/88	Committee on Energy & Commerce Subcommittee on Oversight & Investigations (House)	Substandard Fasteners
06/16/88	Committee on Energy & Commerce Subcommittee on Energy & Power (House)	Licensing Reform
08/03/88	Committee on Energy & Commerce Subcommittee on Energy & Power Improvement (House)	H.R. 4140, "Nuclear Investigations Act of 1988"
10/06/88	Committee on Interior & Insular Affairs & Subcommittee on Oversight & Investigations (House)	NRC's Approach to Drug & Alcohol Abuse

established by Headquarters and implemented primarily by the Regions.

SLITP reviewed the policies and programs of the former Office of State Programs in light of the NRC Strategic Plan. The NRC report, "The U.S. Nuclear Regulatory Commission Program With State and Local Governments and Indian Tribes" (NUREG-1309), was the result of this examination. The report discusses NRC's constituencies and the various roles those constituencies play in helping to ensure safety; the NRC training program for the States; and communications between NRC and State and local governments, Indian tribes, and other Federal agencies. It also identified initiatives to improve program effectiveness with respect to training, State involvement in the early development phase of new regulatory requirements and guidance, sharing of experience between States, and NRC participation in key constituency groups. NUREG-1309 was widely distributed to State, local government, and Indian tribe officials as well as to staff of national and regional organizations representing those entities.

The Director of State, Local and Indian Tribe Programs and the SLITP staff briefed the Commission on his organization's program and the review in NUREG-1309 on February 3, 1988. This was the first time that the Commission had been briefed on NRC's liaison activities with State and local governments and Indian tribes and on the NRC State Agreements Program.

Conference of Radiation Control Program Directors. NRC Chairman Lando W. Zech, Jr. and Charles Tedford, Chairman of the Conference of Radiation Control Program Directors, Inc. (CRCPD) met at NRC Headquarters in July 1988. The CRCPD, which serves as a forum for addressing radiation protection at the Federal, State and local levels of government, had devel-

Members of the Conference of Radiation Control Program Directors, Inc. (CRCPD), met at NRC Headquarters in 1988 to discuss and coordinate matters of interest to State radiation control agencies. At this working session are, from left foreground, Mssrs. Floyd Galpin, of the U.S. Environmental Protection Agency; Terry Strong, of the State of Washington; Charles Hardin, CRCPD Executive Director; Charles Tedford, CRCPD Chairman; Edgar Bailey, of the State of Texas; Carlton Kammerer, of the NRC; and Michael Mobley, of the State of Tennessee.

oped a set of recommendations for presentation to Chairman Zech with respect to: expanding training of State and local radiation control personnel, supporting uniform regulation of naturally occurring and accelerator-produced radioactive nuclear material (NARM), providing uniform testing of industrial radiographers throughout the United States, improving the accounting of certain nuclear materials under general licenses, providing improved means of initial State input into NRC's consideration of issues affecting State and local licensing programs, working to retain staff in State and local programs, evaluating the need for financial surety from radioactive material licensees, and increasing NRC participation in nuclear power emergency exercises.

The CRCPD cooperated with the NRC staff in various activities. For example, CRCPD's electronic bulletin board was used to facilitate the flow of information on Federal, State and industry efforts to identify and deal with facility and product contamination caused by the leakage of polonium-210 microspheres from air-gun-type static eliminators in widespread commercial use. CRCPD also organized, at NRC's request, a NARM workshop for Federal and State officials and industry representatives, in conjunction with NRC's All Agreement States Meeting in Potomac, Md. in early October 1988.

National Governors' Association. This group (NGA) endorsed five recommendations of its Task Force on Nuclear Safety in 1987. These recommendations, concerning relationships among the States, the Federal Government, and industry in ensuring the safe design and operation of nuclear power units and off-site emergency response, were taken into consideration by NRC in drafting the proposed 1988 Policy Statement on Cooperation with State Governments. NGA also issued, in 1988, a "discussion draft" national energy policy to begin the dialogue for developing an effective national energy strategy.

State Agreements Program

A total of 29 States, under formal agreements with the NRC, assumed regulatory responsibility over byproduct and source materials and small quantities of special nuclear material. Negotiations for an agreement with the State of Maine are under way. As the fiscal year ended, there were about 16,500 radioactive material licenses in the Agreement States; they represent about 65 percent of all the radioactive materials licensees in the United States. (See map of Agreement States in this chapter.)

Review of State Regulatory Programs. The NRC is required by the Atomic Energy Act of 1954 to review Agreement State radiation control programs periodically to confirm they are adequate to protect public health and safety and compatible with NRC programs. Sixteen routine program reviews and two follow-up reviews were conducted in 1988. The NRC technical staff accompanied State inspectors to State-licensed facilities to evaluate inspector performance and examined selected license and compliance casework in detail as part of these reviews. Eight routine program visits were conducted in 1988 to maintain familiarity with Agreement State radiation control programs between program reviews and to provide an opportunity to discuss areas of concern on an informal basis. On a visit to the State of Nebraska, Arkansas Program Director Greta Dicus participated as part of the NRC initiative to promote exchanges of information and experience between State programs.

NRC Technical Assistance to States. The NRC provided technical assistance to Agreement States with regard to licensing, inspection, enforcement, and proposed statutes and regulations. Technical assistance ranged from responding to telephone requests for information to assisting in State reviews of license applications and State inspections. Agreement States are expected to maintain a core staff knowledgeable about materials radiation safety and to use in-State technical resources, such as advisory committees and consultants. Special or unusual radiation applications, however, may present radiation safety problems that need specialized expertise or knowledge. For States evaluating such problems, NRC experts are a valuable technical resource. An example of NRC technical assistance is the aid provided to the State of Georgia concerning a leaking radiation source at an industrial plant.

Training Offered by NRC. State radiation control personnel regularly attend NRC-sponsored courses to improve their technical and administrative skills and, thus, their ability to maintain high-quality regulatory programs. The NRC sponsored 10 short term training courses, attended by 188 State employees. Courses included such subjects as health physics, industrial radiography safety, nuclear medicine procedures, inspection procedures, well logging, radiation protection engineering, low-level radioactive waste project management, and nuclear materials. Individuals acquired on-the-job training in licensing and compliance in the States or in visits to NRC Regional and Headquarters offices.

Annual Agreement States Meeting. The annual meeting of Agreement State radiation control program directors was held in October 1988 at the William F. Bolger U.S. Postal Service Management Academy in Potomac, Md. Commissioner Kenneth Carr delivered the keynote address and challenged the Agreement States to help supplement Federal training funds by paying travel expenses for State employees who attend

In June 1988, Carlton Kammerer, NRC Director of State, Local, and Indian Tribe Programs, welcomed State radiation protection personnel to an NRC-sponsored Inspection Procedures training course, held at the Federal Emergency Management Agency (FEMA) Training Center at Emmitsburg, Md.

NRC-sponsored training courses. The meeting also covered technical topics such as low-level waste, materials safety, and operating events.

Regulation of Low-Level Waste. The NRC provided technical assistance to the States of California, Texas, Nebraska and New York in establishing their low-level waste regulatory programs and meeting the requirements of the Low-Level Radioactive Waste Policy Amendments Act of 1985. Technical assistance was also provided to the States of Pennsylvania, California, Nebraska, and New York on the promulgation of low-level waste regulations compatible with NRC regulations. Technical assistance on specific cases was provided to the States of New Hampshire, Utah, Colorado, Mississippi, and Nevada. South Carolina, Washington, and Nevada continue to participate in the NRC review of several topical reports on high-integrity containers, waste solidification processes, and computer codes used in implementing 10 CFR Part 61.

Regulation of Uranium Milling. The NRC assisted Agreement States in their programs for regulating uranium milling. This assistance included guidance on surety arrangements and on the Environmental Protection Agency's requirements.

Direct technical assistance was provided to the State of Texas on specific cases. Representatives from Texas, Washington, Utah, and Colorado participated in a workshop on uranium mill tailings disposal-related matters in March 1988.

Special Projects. State Agreements program staff published a report, "Funding the NRC Training Program for States" (NUREG-1311), giving its evaluation of the practice of NRC funding of State travel and per diem costs for State employees attending NRC courses, and considered options to make the training program more cost effective. As a result of this study, the staff will use, whenever possible, minimal-cost Federal and commercial training facilities. For example, the inspections procedures course in June 1988 was held at the Federal Emergency Management Agency (FEMA) National Emergency Training Center in Emmitsburg, Md., one of the minimal-cost training facilities identified in NUREG-1311.

State, Local, and Indian Tribe Liaison Activities

The NRC Five Year Plan calls for the agency to assume a more active role that includes outreach activities and fosters cooperation and communication between NRC and State and local governments and Indian tribe representatives, in order to promote a wider and deeper understanding of issues and activities related to nuclear safety.

Proposed Policy on Cooperation with States. On June 13, 1988, NRC published for comment a proposed policy statement entitled "Cooperation With States at Commercial Nuclear Power Plants and Other Nuclear Production or Utilization Facilities" (53 FR 21981). The proposed policy is intended to introduce uniformity in the handling of State requests to monitor and/or participate in regulatory oversight of these plants and facilities.

For more than 10 years, NRC has entered into memoranda of understanding with States on topics ranging from the stationing of State resident engineers at power plants to low-level waste (LLW) package and transport activities at licensed facilities. States have generally become more involved in recent years in activities related to the operation of power plants within and adjacent to their borders. States also play an important role with regard to non-radiological as-

pects of the plants, such as fire protection. The proposed policy encourages NRC to continue its close working relationship with the States and would allow State representatives to observe NRC inspections and entrance and exit meetings with licensees. The proposal would also allow States to participate in NRC inspections in close cooperation with NRC and establishes certain provisions States must fulfill in this regard.

Two agencies in the State of New York have asked NRC to allow them to observe activities at the Nine Mile Point Unit 1 nuclear power plant. Missouri has indicated it is interested in observing NRC inspectors at the Callaway nuclear power plant.

Illinois Department of Nuclear Safety personnel have had ongoing discussions with NRC staff relative to having its representative accompany NRC inspectors on a number of inspections at nuclear power plants in Illinois.

The observations would be considered part of a training program for the proposed resident engineer at the LaSalle nuclear power plant. Similarly, Massachusetts has sent representatives to observe certain NRC inspections at the Pilgrim nuclear power plant.

Although general guidance on negotiating memoranda of understanding and related agreements with States was adhered to in the past, no uniform guidance with respect to the scope of State involvement in NRC activities had been issued. All future requests for observations will be handled in a manner consistent with the provisions of the final policy statement.

Low-Level Radioactive Waste Compacts. The Low-Level Radioactive Waste Policy Amendments Act of 1985, enacted January 15, 1985, ensures that currently operating disposal facilities will remain available until the end of 1992, subject to specified limitations on volume of waste and to other requirements; establishes a system of incentives and penalties to promote steady progress toward new facility development; and, under title II, grants consent to seven interstate LLW disposal compacts, covering 37 States (see "Low Level Radioactive Waste Compact Status" map in this chapter). In 1988, Congress consented to the Appalachian Compact and began consideration of the Southwestern Compact. The act also directs NRC to provide additional guidance to the States to ensure that States have enough regulatory information to meet the milestone dates established by the act. This may include guidance on waste disposal methods other than shallow land burial, on the licensing of facilities, and on determining what waste is below regulatory concern. In addition, NRC is considering issuing guidance to States in meeting the 1990 date for certification of a State's preparedness to handle LLW generated within its boundaries. NRC also is continuing its program to assist the States in the review of compacts and enabling legislation and to provide States with training and other technical assistance.

State Liaison Officers. The NRC continues to use the State liaison officers (SLOs) appointed by Governors as its primary point of contact with regard to NRC activities. The proposed policy statement on cooperation with the States identifies the SLO as the primary State contact for all requests regarding observations of NRC inspections.

Region V SLOs met in Walnut Creek, Cal. on June 14 and 15, 1988. Discussions focussed on the States' concerns with LLW issues, radiography enforcement actions, Congressional initiatives, emergency response, high-level waste (HLW), and the proposed policy statement on cooperation with States. Staff from NRC Headquarters and the Regions spoke at the meeting, as did representatives from the National Conference of State Legislatures and the Western Interstate Energy Board.

SLOs also met this year at NRC's Region III offices in Glen Ellyn, Ill. on September 28 and 29. At that meeting speakers covered such issues as: recent radioactive contamination incidents, the decommissioning rule and plant life extension, LLW, economic regulation, and spent fuel storage. Speakers came from the Ohio Department of Health, the Illinois Department of Nuclear Safety, the Midwest LLW Compact Commission, the Michigan Public Service Commission, the Iowa Utilities Division, the Ohio Public Utilities Commission, the U.S. Department of Energy, and the NRC.

Regional State Liaison Officers. Each NRC Regional Office has a regional State liaison officer (RSLO) who acts as the Region's principal contact with State and local officials. RSLOs generally coordinate NRC's activities that involve State and local government or Indian tribes. RSLOs often attend and participate in local meetings when local issues under NRC purview are involved. Additionally, RSLOs address legislative groups, testify before State committees, and meet with State and local officials to address concerns and respond to questions. The RSLOs routinely respond to requests for information from SLOs and other State officials concerning nuclear power facilities or other areas under NRC's jurisdiction. RSLOs attend regional low-level radioactive waste compact commission meetings and monitor State progress in developing additional disposal capacity for LLW. In sum, the RSLOs implement NRC's policies and procedures on cooperation with States, local governments, and Indian tribes.

Outreach Activities. In keeping with the mandates of its Five Year Plan, NRC has continued to broaden its cooperative activities with the States and their organizations. Fifteen State legislators toured the NRC Operations Center in December 1987. The legislators were members of the Energy Committee of the National Conference of State Legislatures (NCSL).

Charles Hardin, Executive Director of the Conference of Radiation Control Program Directors (CRCPD) spoke to Commissioner assistants and NRC staff. The CRCPD consists of the radiation control program directors of 50 States and their staffs; it promotes cooperative programs with Federal agencies and between related agencies within each State.

Liaison with American Indian Tribes. NRC has continued to work with American Indian tribes on a government-to-government basis, thereby exercising its trust responsibilities as described in President Reagan's 1983 Indian Policy Statement. Until December 1987, when the Nuclear Waste Policy Amendments Act (NWPAA) was passed, NRC staff worked on a regular basis with the three affected Indian tribes, namely: Yakima Indian Nation (Washington), Confederated Tribes of the Umatilla Indian Reservation (Oregon), and Nez Perce tribe (Idaho). The NWPAA redirected the Department of Energy to abandon site characterization of the Hanford, Wash. and Deaf Smith, Tex. sites in favor of Yucca Mountain, Nev.

Since the program has been redirected, no formal petitions for affected status under the NWPAA have been filed with the Secretary of the Department of the Interior by potentially affected Indian tribes. However, NRC has closely followed tribal interest in the areas of HLW transportation, including the Western Shoshone Nation's claim to aboriginal land in Nevada under the 1863 Treaty of Ruby Valley.

Many of NRC's contacts with Indian issues and concerns take place through national American Indian organizations. These include the Council for Energy Resource Tribes (CERT), located in Denver, Colo. and the National Congress of American Indians (NCAI), located in Washington, D.C.

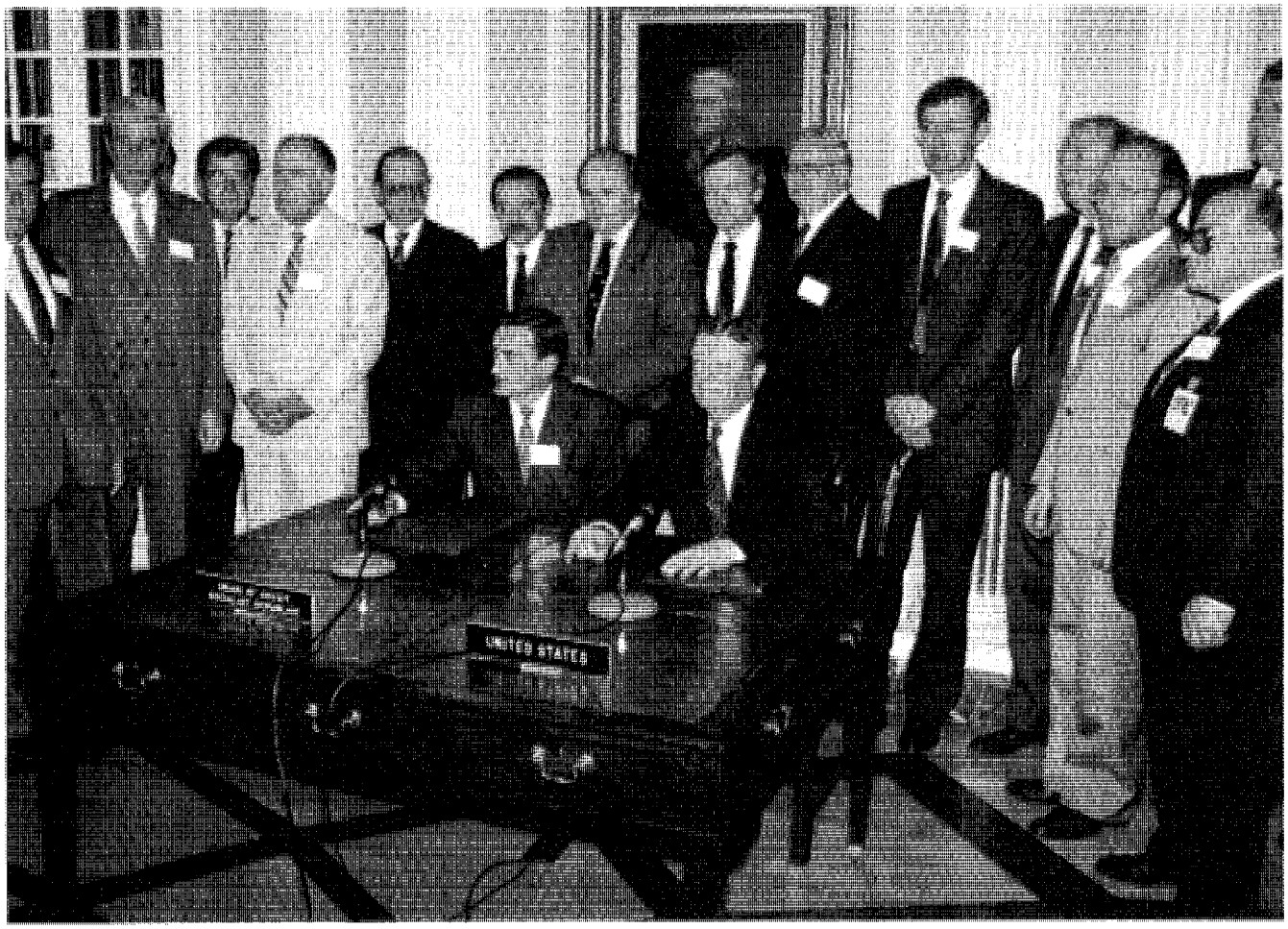
NCAI continued to represent tribal interests as a member of the HLW Licensing Support System (LSS) Advisory Committee. This committee is negotiating a rule designed to streamline the HLW licensing process through the development of an electronic information management system.

NCAI has also assisted NRC staff and Indiana University staff in revising a 1980 Survey of State Radiological Emergency Response Capabilities for Transportation Related Incidents (NUREG/CR-1620). NCAI helped develop a questionnaire to determine tribal emergency response capabilities and interactions with States. NCAI provided a letter of introduction endorsing the study and encouraging the cooperation of the 15 selected Indian tribes whose reservation boundaries are crossed by spent fuel shipment routes. The revised survey will be available in spring 1989.

INTERNATIONAL ACTIVITIES

The objectives of NRC's Office of International Programs are: to support international activities that contribute to the safe operation of licensed U.S. reactors and fuel cycle facilities and the safe use of nuclear materials; to improve worldwide cooperation in nuclear safety and radiation protection; to assist U.S. ef-

Representatives of the National Congress of American Indians (NCAI) were among the many American Indian groups with whom the NRC maintained regular liaison on nuclear matters in 1988. At center in the photo is Suzan Shown Harjo, Executive Director of NCAI, during a meeting with Carlton Kammerer, NRC's Director of State, Local, and Indian Tribe Programs, on Ms. Harjo's left. Others in the picture are members of Ms. Harjo's staff. Discussions dealt with the effects of nuclear waste repositories, transportation of nuclear materials and spent fuel, and related subjects on American Indian populations.

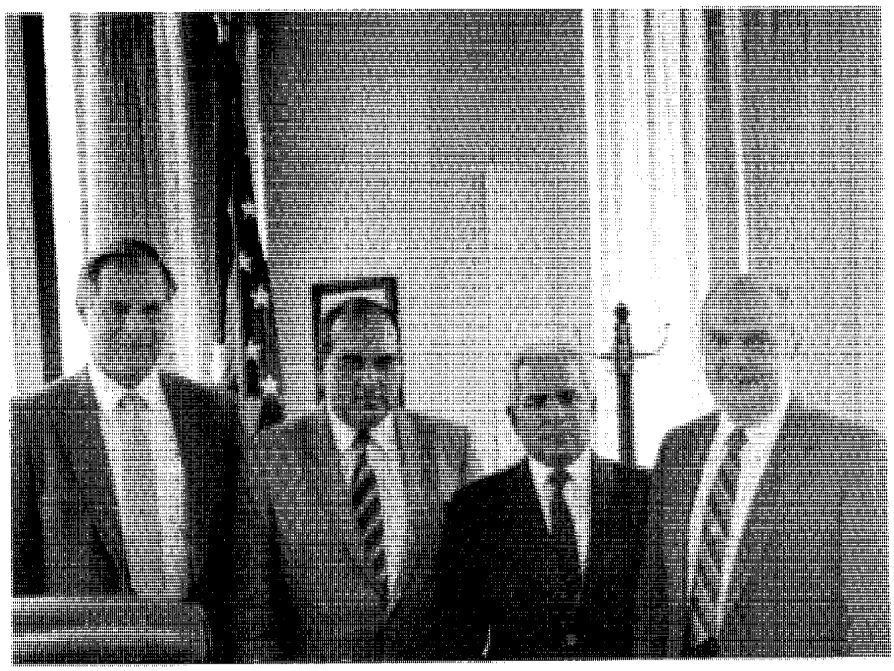


On April 25, 1988, NRC Chairman Lando Zech, seated at right, and Alexander Protsenko, Chairman of the U.S.S.R. State Committee for the Utilization of Atomic Energy, signed an historic Memorandum of Cooperation (MOC) in the Field of Civilian government-to-government exchange of civilian nuclear safety information. Standing behind Chairman Zech are NRC Commissioners Frederick M. Bernthal and Kenneth C. Rogers, and standing behind Chairman Protsenko is Evgeny Velikhov, Vice President of the U.S.S.R. Academy of Sciences and Science Advisor to Soviet General Secretary Gorbachev. Other senior U.S. and Soviet officials are in attendance.

forts to restrict U.S. nuclear exports to those materials that can be used only for peaceful purposes; to support the Commission's statutory responsibilities; and to support U.S. foreign policy and national security objectives. The Office of Governmental and Public Affairs is the Commission's primary organization for coordinating international programs and policies. Other NRC offices participate in international activities by contributing technical expertise and conducting research in this country and abroad.

NRC's international program in nuclear safety has traditionally included bilateral regulatory and research cooperation agreements and participation in multilateral research and other safety cooperation through the International Atomic Energy Agency (IAEA) and the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA). Power reactor safety has been the primary focus of these cooperative efforts, but increased attention is also being given to broader radiation protection matters and to waste management activities.

The Chernobyl accident and the global response to it significantly heightened the role of foreign policy regarding nuclear safety and placed new demands on the Commission, requiring more involvement in nuclear safety cooperation in general and significantly increasing prospects for cooperation in this area, particularly with the Soviet Union. In response to this, the Office of International Programs has reassessed its priorities to give increased attention to U.S.-Soviet bilateral activities and to reemphasize the importance of the IAEA in seeking a global consensus on nuclear safety and regulatory matters. Some of these efforts are outlined in greater detail in the discussion that follows.

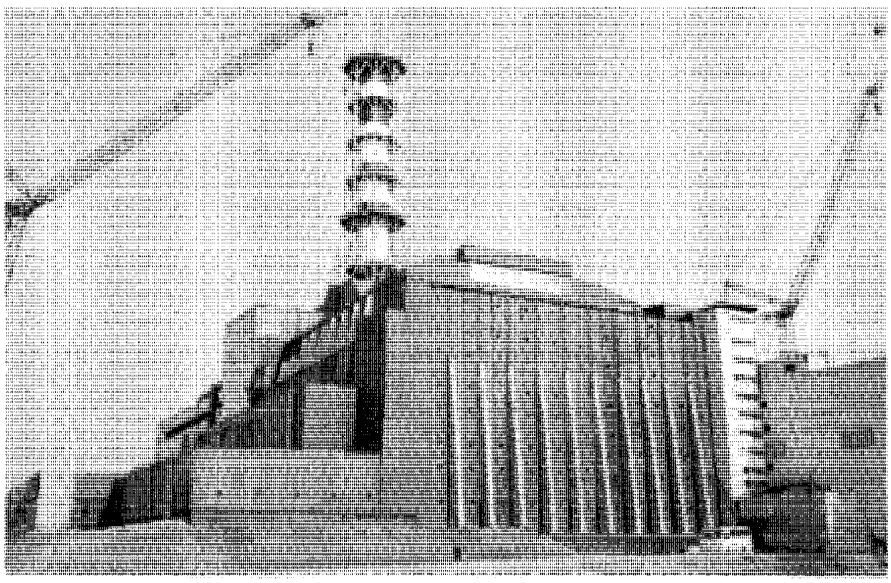


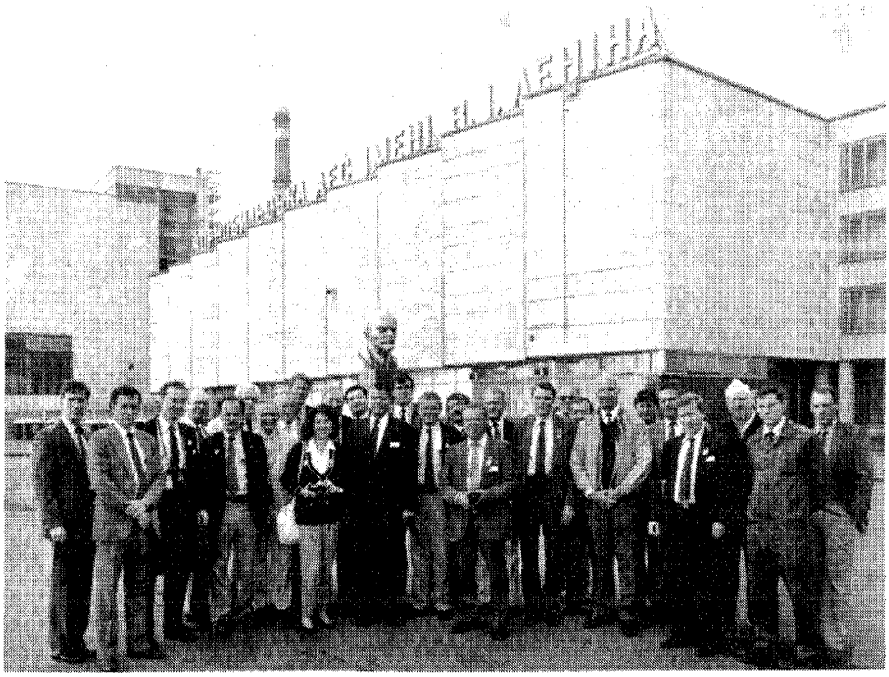
In May 1988, the first-ever visit by Cuban nuclear officials to the NRC took place when Vice Executive Secretary Javier Rosales Arias, of the Secretaria Ejecutiva para Asuntos Nucleares (center right), and Dr. Alejandro V. Bilbao Alfonso, Director of the Centro de Proteccion e Higiene de las Radiaciones (center left), held discussions at the NRC Region II Office in Atlanta and toured the McGuire nuclear power plant in North Carolina. At right is Region II Administrator J. Nelson Grace, who hosted the visit.

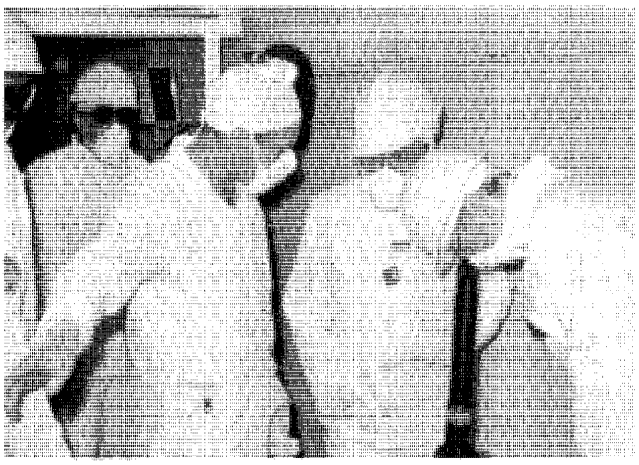
Highlights of Fiscal Year 1988

- Signed a Memorandum of Cooperation (MOC) between the United States and the Soviet Union in the field of civilian nuclear reactor safety and held the first meeting of the Joint Coordinating Committee, established under the MOC, in Moscow during the visit of Chairman Lando W. Zech, Jr.
- Hosted the first visit by Cuban nuclear officials to NRC and a U.S. power plant.
- Participated closely with the Executive Branch in discussions with Japan on the implementation of the new U.S.-Japan Agreement for Cooperation Concerning the Peaceful Uses of Nuclear Energy. Discussions focussed on reaching agreement on appropriate means to ship plutonium from Europe to Japan under the agreement.
- Participated in the 1988 IAEA General Conference held in Vienna from September 19 through 23 and chaired sessions at the IAEA Special Scientific Meeting on Radiation Protection and at the Scientific Program for Nuclear Safety during the conference.
- Participated in a post-accident review meeting on the Goiania accident in Rio de Janeiro. The review produced a list of lessons learned that might be applicable to the NRC regulatory process. Provided a consultant to Brazil to discuss U.S. regulations, liability, and emergency planning during Brazil's review of the Goiania accident.
- Sent experts to the IAEA and to Japan, France, the Federal Republic of Germany, the United Kingdom, the European Community, Italy, Spain, and Portugal to discuss strengthening international safeguards and physical security.
- Sent five U.S. experts to participate in four IAEA Operational Safety Review Team (OSART) missions to the Federal Republic of Germany, Spain, Italy, and Sweden.
- Worked with the IAEA to revise selected nuclear safety standards (NUSS) safety guides as a result of the Chernobyl accident.
- Participated at senior levels in the IAEA symposium on severe accidents held in Sorrento, Italy, where the IAEA International Safety Advisory Group made the first presentation of its "Basic Safety Principles for Nuclear Power Plants."
- Chairman Zech and the Deputy Executive Director for Operations (EDO) attended an NEA-sponsored top-level regulators' meeting outside Paris at which the heads of regulatory organizations in 13 NEA countries met to discuss ways of improving international consultation in regulation and licensing of nuclear power plants.

Coincident with the first meeting of the Joint Coordinating Committee on Civilian Nuclear Reactor Safety (JCCCNRS), held in August 1988 in Moscow, 15 U.S. representatives, headed by Chairman Lando W. Zech, Jr., visited a number of Soviet nuclear facilities, including the Chernobyl Unit 4 reactor plant, destroyed in the accident of April 1986. At top right is a photo of the entombed plant; below it is shown the U.S. delegation outside the plant. The photo below at left shows the NRC Director of the Office for Analysis and Evaluation of Operational Data, Edward Jordan, viewing the damaged reactor through a boroscope. Below right, NRC Deputy Executive Director for Operations, James Taylor (l.), and First Deputy Director of the Kurchatov Institute of Atomic Energy, N.M. Ponomarev-Stepnoy (r.)—the U.S. and U.S.S.R. Co-Chairmen of the JCCCNRS—sign the meeting's protocol detailing programs to be undertaken through 1990.







- Participated for the first time as Deputy Representative on the U.S. delegation to the Steering Committee of the OECD NEA which decides the program and budget for the Paris-based organization.
- Commissioner Thomas M. Roberts attended and addressed the International Conference on Thermal Reactor Safety (NUCSAFE) hosted by the French Nuclear Energy Society (SFEN), in October 1988 in Avignon, France. NRC participation also included senior technical staff who presented papers and took part in a number of panel discussions.

International Cooperation

U.S.-Soviet Civilian Nuclear Safety Cooperation. On April 26, 1988, the second anniversary of the Chernobyl accident, NRC Chairman Lando W. Zech, Jr. and Alexander Protsenko, Chairman of the U.S.S.R. State Committee for the Utilization of Atomic Energy, signed the Memorandum of Cooperation (MOC) in the Field of Civilian Nuclear Reactor Safety. This historic arrangement established a mechanism for government-to-government coordination of cooperative programs that focus on the safety of civilian nuclear reactors in both countries and that are based on the principle of reciprocity. A Joint Coordinating Committee on Civilian Nuclear Reactor Safety (JCCCNRS), consisting of six Soviet and six American Government representatives, was created as the governing body to implement the cooperative programs carried out under the auspices of the MOC. NRC Deputy Executive Director for Operations James Taylor serves as the U.S. Co-Chairmen of the JCCCNRS. At its first meeting in August 1988 in Moscow, the JCCCNRS proposed to conduct cooperative programs in 10 technical areas to be carried out in 1988, 1989, and 1990 through seminars, working group meetings, and document exchanges. An exchange of regulatory inspectors to U.S. and Soviet civilian nuclear power plants is also planned.

Coincidental with the first meeting of the JCCCNRS, NRC Chairman Zech headed a 15-member delegation to the Soviet Union. The delegation, which included the American JCCCNRS members and participants from the Departments of State and Energy, toured component manufacturing facilities, research centers, and several nuclear power plants. This was the first American team to tour the outer rooms of the sarcophagus built around the destroyed Unit 4 at Chernobyl, where they also observed drilling to retrieve core samples.

Czechoslovakia. Following previous discussions by Commissioner Frederick M. Bernthal in the autumn of 1987, Chairman Stanislav Havel of the Czechoslovak Atomic Energy Commission (CAEC) delivered to Chairman Zech a draft of a proposed MOC in the Field of Nuclear Energy Safety in September 1988 in Vienna. Czechoslovakia would like to commence nuclear safety cooperation with the NRC and Chairman Havel volunteered to come to the United States in early 1989 to sign an agreement. The text of the draft memorandum and a list of discussion topics proposed by the NRC staff are expected to be completed in time for an early spring Czechoslovak nuclear safety team visit to the United States.

Assistance to Goiania, Brazil. In September 1987 in Goiania, Brazil, junk dealers removed a radiotherapy machine containing cesium-137 from an abandoned hospital; the machine was broken into and the cesium was removed, resulting in the death of four people and the contamination of about 250.

As part of Brazil's effort to improve radiation protection and nuclear safety following the incident, the Brazilian Minister of Justice requested, a number of NRC regulatory guides, NRC NUREG publications, information notices, and other documents related to U.S. laws and regulations governing the handling and control of nuclear materials. Later, in response to another request from the Ministry of Justice, a staff member from the Office of the General Counsel (OGC) went to Brazil to discuss U.S. legislation regulating the use and disposal of radioactive material.

Bilateral Information Exchange Arrangements. The NRC participates in a wide-ranging, mutually beneficial program of information exchange and cooperative safety and research activities with its counterparts in the international community. Since 1974, when it instituted the program, the NRC has conducted most of its technical information exchanges through a series of general safety cooperation arrangements formally concluded with the regulatory authorities of Belgium, Brazil, China, Denmark, Egypt, the Federal Republic of Germany, Finland, France, Greece, Israel, Italy, Japan, South Korea, Mexico, the Netherlands, the Philippines, Spain, Sweden, Switzerland, Taiwan, the United Kingdom, and Yugoslavia.

The primary objective of these arrangements is to establish a formal channel for communication with foreign nuclear regulatory organizations to ensure prompt and reciprocal notification of reactor safety problems that could affect both U.S. and foreign nuclear facilities and to facilitate identification of possible "precursor events" that warrant further investigation. These arrangements also provide a framework for bilateral cooperation on nuclear safety, safeguards, waste management, and environmental protection. They also serve as the vehicle for the NRC to provide assistance in improving nuclear health and safety practices to developing countries operating power reactors supplied by the United States. The bilateral arrangements are normally effective for five years but contain provisions for renewal by mutual agreement.

U.S.-Taiwan Joint Standing Committee on Nuclear Cooperation. The annual meeting between the American Institute in Taiwan and the Coordination Council for North American Affairs (CCNAA) was held in Washington, D.C. in May 1988. Discussion topics included: current status and future plans for Taiwan's nuclear power program, Taiwan's waste management program, Taiwan's nuclear safety research programs, the status of NRC's programs, the U.S. advanced LWR program, and the status of the U.S. civilian waste management program, after which the discussions focussed on the status of the many cooperative projects between AIT and CCNAA. The two-day meeting adjourned with both sides agreeing that the many programs of cooperation are progressing well. CCNAA will host the 1989 meeting in Taipei.

Regulatory Meeting in Japan. An NRC technical team met with the Agency of Natural Resources and Energy (ANRE) of the Japan Ministry of International Trade and Industry (MITI) on May 12 and 13, 1988, in Tokyo, for the fourth regular meeting on nuclear regulatory matters. The meeting schedule coincided with Japan's first national nuclear safety month and proved one of the highlights of MITI's international safety activities. The meeting was held to exchange information on licensing issues. The meeting was very important to NRC-MITI cooperation as an alternative to MITI's providing NRC with large numbers of Japanese-language documents. After the meeting, the NRC regulatory team visited the Ohi (PWR) and Kashiwajaki (BWR) nuclear power stations for technical discussions and tours. A fifth information exchange meeting on nuclear power safety is scheduled for late autumn 1989 in Washington, D.C.

Renewal Agreement with Italy. In September 1988, Chairman Zech visited the National Committee for Nuclear and Alternative Energy Sources (ENEA) in Italy to sign the second renewal of the NRC-ENEA Agreement for the Exchange of Technical Information and Cooperation in Nuclear Safety Matters and to bolster U.S.-Italian ties in the nuclear safety area. The chairman met with Professor Colombo, president of ENEA, and Mr. Gianni Naschi, director of the Directorate for Nuclear Safety and Health Protection (ENEA/DISP), to discuss collaboration between ENEA and the NRC in the field of safety studies and research on the next generation of nuclear reactors.

Discussions with West Germany. Chairman Zech also visited the Federal Republic of Germany (FRG) for discussions to promote improved international coordination in nuclear regulatory practices, both bilaterally and through the Nuclear Energy Agency in Paris. Chairman Zech briefed the FRG on his safety team's trip to the Soviet Union, and the Chernobyl visit in particular, noting his hope that cooperation could lead to improvements in safety practices and also noting that the Soviets were very open and willing to listen to the team's suggestions. The FRG reported that it had also entered into nuclear safety discussions with the Soviet Union and had worked out an information exchange agreement. The chairman reported that the NRC was developing a cooperative program with Czechoslovakia and that the German Democratic Republic (GDR) appeared interested in safety cooperation. The NRC agreed to work closely with the FRG to exchange information on nuclear safety cooperation activities with other countries.

In August 1988, the NRC increased the scope of the cooperative agreement with the FRG by adding a new Technical Appendix to the cooperation arrangement with the Ministry of Environment, Nature Conservation and Nuclear Safety (BMU). The additional coop-

NRC Chairman Lando Zech (l.) signed the renewal of NRC's agreement for cooperation in the exchange of regulatory information with Professor Umberto Colombo, President of the National Commission for Nuclear and Other Energy Alternative Sources (ENEA), signing at right, in Rome, in September 1988.

erative activities would take place in the area of severe accident management. Issues covered include regulatory perspectives and practices, accident management strategies and their implementation, specific technical and analytic issues, and identification of issues needing research and development.

Canada. During 1988, the Fermi Unit 2 nuclear power plant in Monroe, Mich., was a source of controversy and parliamentary debate in the Province of Ontario. A leak that occurred during the summer at Fermi Unit 2 gave new impetus to the calls by local (Ontario Province) Canadian parliamentarians for an international review, in the form of an IAEA operational safety review of the plant. According to the Canadian press, acting Prime Minister Flora MacDonald concurred in the calls for an IAEA review of Fermi Unit 2, but indicated that any such request should be tendered to the IAEA by the U.S. Government.

In August 1988, Thomas E. Murley, director of NRC's Office of Nuclear Reactor Regulation, signed a decision denying a petition submitted by four members of the Canadian parliament pursuant to 10 CFR 2.206 regarding the operation of Fermi Unit 2. In his denial, Dr. Murley indicated that the deficiencies at Fermi identified by the petitioners were well known to NRC and had been addressed by regulatory actions already taken by NRC. Subsequently, in response to a letter from the Canadian External Affairs Minister, Secretary of State George Schultz confirmed the U.S. position that NRC is addressing the issue through regulatory actions.

In August 1988, Dr. Réné Levesque, president of the Canadian Atomic Energy Control Board (AECB), and other members of the board observed activities at the NRC Operations Center during the D. C. Cook emergency response exercise. The AECB is designing a similar center at its headquarters in Ottawa and was interested in the exercise from the perspective of information flow, communications, and decisionmaking. During the visit, GPA International Programs (IP) representatives discussed with Dr. Levesque the prospects of a bilateral information exchange arrangement between NRC and the AECB and a draft agreement was given to the Canadians in anticipation of reaching final agreement early in 1989.

NRC Renews Arrangement with Israel Atomic Energy Commission. On July 11, 1988, NRC Chairman Lando W. Zech, Jr., and S. Yona Ettinger, Director General of the Israel Atomic Energy Commission (IAEC) renewed a bilateral arrangement for exchange of technical information and cooperation in nuclear safety matters for an additional five-year period. This year marked the tenth year of bilateral cooperation between the NRC and the IAEC in nuclear safety matters.

U.S.-Korea Nuclear Bilateral Meeting. GPA/IP represented the NRC in October 1988 at the U.S.-Korea Joint Standing Committee on Nuclear and Other Energy Technologies (JSCNOET) in Seoul, Korea. Also represented on the U.S. delegation were the Departments of State and Energy and the Arms Control and Disarmament Agency. This meeting is held annually for the participants to discuss completed, ongoing, and projected cooperative projects. NRC plays a dominant role in the meetings since more than half of the agendum items are devoted to nuclear safety concerns.

Benefit of NRC International Cooperation. Through its bilateral international agreements, NRC receives valuable safety information from its many foreign partners. Examples of the information received over the past fiscal year are provided below:

(1) Cracks in emergency core cooling system (ECCS) piping at the Tihange nuclear power plant in Belgium and the Genkai nuclear power plant in Japan which are similar to cracks found at the Farley nuclear power plant in the United States.

(2) Wear and subsequent leaks in the instrumentation thimble tubes at the Tihange nuclear power plant which is similar in design to the South Texas nuclear power plant in the United States.

(3) Shaft cracking of reactor coolant pumps manufactured and operated in the FRG, which are similar to pumps being utilized at the Palo Verde nuclear power plant in the United States.

Foreign Assignees to the NRC Staff. The NRC work/training assignee program continues to be of strong interest to foreign regulatory organizations and the Commission. Ten countries sent 29 staff members to participate in the program. Although licensing activities related to engineering and system technology have continued to attract a number of participants, an increasing number of foreigners have been accommodated in activities related to the analysis and evaluation of operational data, safety programs, and waste management.

In an effort to streamline administration of the NRC foreign assignee program, GPA/IP is now requiring that in order to qualify for the program, foreign assignees (1) have English language certification prior to departure, (2) have a completed security plan prior to arrival, and (3) countersign and return an invitation letter covering terms of the assignment at least four weeks prior to departure to the United States.

Symposium on Nuclear Power Plant Aging. More than 500 nuclear scientists, engineers, and regulators from 16 countries studied the critical problem of nuclear power plant aging at an NRC-organized symposium in Bethesda, Md., from August 30 through Sep-

NRC Chairman Lando Zech is shown greeting representatives of the Chinese National Nuclear Safety Administration (NNSA), when the NNSA team visited the NRC to discuss technical issues in connection with construction of nuclear power plants near Shanghai. Chinese delegation members pictured are, left to right, Dasen Zhou, senior engineer, Beijing Institute of Nuclear Engineering; Wanli Zhong, Deputy Director, Division of Nuclear Power; Dr. Chengge Lin, Deputy Director General, NNSA; Yuman Zhang, Deputy Director General, NNSA; and Zhiyu Li, Director of Research, NNSA.

tember 1, 1988. Attendees heard from the principal regulators in the United States, a leading science adviser from the White House, and nuclear industry and regulatory leaders from around the world.

Underscoring the importance of the symposium, President Reagan sent a message to the symposium participants in which he stressed that meeting future demands for energy will require even more strenuous efforts to develop nuclear resources and to increase existing safeguards on their use. He commended the participants for their efforts to resolve these important issues pertaining to the progressive aging of nuclear power plants.

Participation in International Organizations and Conferences

IAEA General Conference. NRC Chairman Lando W. Zech, Jr., GPA Director Harold R. Denton, and GPA Director of International Programs James R. Shea participated in the 1988 IAEA General Conference held in Vienna from September 19 through 23, 1988. This year fewer difficult political issues dominated the meeting and a concerted effort was made to hold more technical sessions. NRC assumed a leadership role in the two scientific meetings. Chairman Zech chaired a session on operational safety; Harold Denton chaired a session on IAEA activities in radiation protection; and Richard Cunningham, of the Office of Nuclear Material Safety and Safeguards (NMSS), presented a keynote speech at a Special Scientific Meeting on Radiation Protection. An NRC staff member also presented a paper on severe accidents during the Scientific Session for Nuclear Safety.

IAEA Technical Committees and Symposia. NRC sent six participants, led by EDO Victor Stello, Jr., to the IAEA Symposium on Severe Accidents held in Sorrento, Italy, in March 1988. The IAEA's International Safety Advisory Group made the first presentation, "Basic Safety Principles for Nuclear Power Plants," at this meeting. An OECD/IAEA International Symposium on the Feedback of Operational Experience From Nuclear Power Plants was held in Paris in May 1988; four NRC staff members attended.

OSARTs and Other IAEA Technical Activities. NRC sent only one of its own staff members, an AEOD technical support expert, on an IAEA Operational Safety Review Team (OSART), to the Almaraz nuclear power plant in Spain. GPA/IP arranged to have four U.S. utility experts take part in OSARTs to the FRG, Spain, Italy, and Sweden. NRC is providing a cost-free expert to the Nuclear Safety Division of the IAEA and is supporting the IAEA's program of revising the nuclear safety standards (NUSS) safety guides in this post-Chernobyl era. NRC experts have shared experiences and written guides useful to other IAEA member states in many areas, including radiation protection, emergency planning, siting, performance indicators, probabilistic safety assessment, operational data, and waste management. GPA/IP staff held two consultations in Vienna with IAEA staff to obtain information and exchange views on Agency priorities and discuss nuclear safety, radiation protection, and technical cooperation issues in an effort to increase NRC's visibility at IAEA and to increase awareness among IAEA staff about NRC's programs and priorities, perhaps influencing IAEA safety and radiation protection programs.

Technical Safety Assistance. The NRC continued its practice of providing nuclear safety advice and assistance through the IAEA's technical assistance program and through its bilateral contacts with countries developing their own nuclear power programs. Technical assistance missions were undertaken to:

(1) *China* (to share specific expertise in safety practices):

- A three-week mission to give lectures on regulatory inspection and enforcement and to assist in the preparation of manuals on the installation and commissioning of mechanical and electrical equipment for nuclear power plants.
- Assistance to the National Nuclear Safety Administration (NNSA) on safety review in areas of mechanical design for the Qinshan and Guangdong nuclear power plants.

(2) *Egypt* (in preparation for possible development, design and construction of a nuclear power plant):

- A two-week course on reactor protection, instrumentation, control, and power system.
- A follow-up mission to assist in a project including the determination of meteorological conditions.

(3) *Mexico* (in preparation for start-up of its first nuclear power plant):

- A two-week BWR technology course.
- A four-week mission to Laguna Verde to evaluate the physical condition of Unit 1 fuel loading and start-up and to assess the readiness of the Commision Federal de Electricidad to operate the plant.
- Served as a consultant and a lecturer in an IAEA training course.

(4) *Yugoslavia* (to assist in development of a nuclear safety program at an operating PWR plant of U.S. origin and for future plants):

- Led a workshop on operator licensing examinations.

Activities in the OECD/NEA. The NRC also expanded its involvement in the reactor safety programs of the Nuclear Energy Agency (NEA) in Paris while maintaining its active participation in the IAEA's radiation protection and waste management activities. In June 1988, Chairman Zech and the Deputy EDO attended a meeting of top level regulators sponsored by the NEA just outside Paris. Fourteen nations met to discuss ways to improve international consultation in regulation and licensing of nuclear power plants. The key areas of discussion included probabilistic risk assessments, severe accidents and emergency preparedness, and operational safety.

In September 1988, the NRC extended its involvement in the NEA by sending the Assistant Director of International Cooperation to serve as Deputy Representative on the U.S. delegation to the Steering Committee of the NEA. (The U.S. representative is from the Department of Energy.) The NEA Steering Committee is the governing body of the NEA and makes decisions on program and budget for the following year. In addition, the Director of the Office of Research and the Director of the Office of Nuclear Reactor Regulation both represent the NRC on the NEA standing Committee on the Safety of Nuclear Installations (CSNI).

At the CSNI annual meeting, NRC advocated the importance of directing attention to the full range of operating reactor safety issues, including human factors, management organization, maintenance activities, and balance-of-plant studies. There was general sentiment and support for this view from the CSNI membership and strong endorsement from the French. NRC offered to host some meetings in the United States to husband NEA's budget resources. Mr. Eric S. Beckjord, Director of Research for NRC, was elected CSNI Vice Chairman for Research, and Principal Working Groups 2 and 4 were realigned—one concentrating on fuel cooling within the pressure vessel and one on containment of radioactivity under accident conditions. NRC proposed a multi-national research program to investigate the TMI-2 reactor vessel head. A sufficient number of key countries have now committed to this program.

Export-Import and Non-Proliferation Actions

NRC Export License Summary. Under the Atomic Energy Act of 1954, as amended, NRC is responsible for licensing the export of nuclear-related materials and equipment. This export authority extends to production and utilization facilities, to special nuclear and source material, to byproduct materials, and to certain nuclear-related components and other materials. In carrying out its responsibilities for exports, the NRC obtains the views and recommendations of other governmental agencies and departments, as required.

NRC issued 106 new export licenses and 44 minor amendments to these licenses. Of these cases, 42 involved routine exports of low-enriched uranium fuel for various power reactors around the world using uranium of U.S. origin or purchasing U.S. Department of Energy (DOE) uranium enrichment services. Discussions were held with Japanese officials concerning the proposed issuance of multi-year export licenses for routine fuel reloads for all Japanese light-water-

moderated power reactors. This step would reduce considerably the administrative burden of processing export license requests and would also conform with NRC's existing practice concerning exporting uranium fuel to other countries. The NRC also issued eight licenses authorizing the export of more than 485 kilograms of high-enriched uranium (HEU) for use in research and test reactors in the Euratom countries and in Romania, Canada, and Japan. However, shipments of HEU were temporarily disrupted when DOE suspended use of its safe, secure transport (SST) vehicle for the transport of privately owned material, pending a study of a safeguards plan for handling commercial HEU shipments. Following discussions between NRC and DOE safeguards officials, DOE resumed transporting commercial shipments and, during the latter half of 1988, two such shipments occurred. NRC continues to cooperate with the DOE Office of Security and Safeguards in a detailed review of comparability of special nuclear material protection during the transportation phase.

NRC Consultations with the Executive Branch on Nuclear-Related Export Matters. The NRC, in addition to its own licensing actions, consults with the Executive Branch on other exports of nuclear-related items. These involve nuclear-related export cases licensed by the Department of Commerce, Executive Branch requests for retransfers of source material originating in the United States and special nuclear material, and nuclear technology transfers. Cooperation with the Soviet Union and Eastern-bloc countries has increased in transfers of nuclear technology in the safety area as a result of the Chernobyl accident.

The NRC continues to actively participate in the interagency body that oversees the U.S. nuclear export control system. The cases involved are primarily Department of Commerce requests for commodities controlled for nuclear non-proliferation reasons. NRC became the coordinator for the efforts to update the Commerce Department's Nuclear Referral List. The NRC also participated in discussions on upgrading the related international trigger list of nuclear commodities, subject to multilateral export control requirements.

Because of recent concerns regarding the disposal of hazardous wastes, the NRC is presently reviewing the adequacy of its export and import regulations on nuclear wastes.

U.S.-Japan Agreement for Cooperation. In July 1988, after several years of negotiation, the United States and Japan implemented the Agreement for Cooperation Concerning Peaceful Uses of Nuclear Energy. The principal feature of the new agreement is its provision for advance programmatic approval for the reprocessing of spent U.S.-origin fuel and the use of any separated plutonium in approved Japanese facilities. Because of the long term nature of this approval (30 years) and the large amounts of plutonium involved, the NRC expressed concerns to President Reagan regarding the IAEA safeguards arrangements for material under the agreement. Subsequent discussions between U.S. Government and Japanese officials, in which the NRC has participated, have alleviated these concerns and the NRC will continue to monitor developments closely to ensure that the most advanced safeguards methods practical are adopted. Despite the NRC's concerns, there has been no interruption in the routine processing of Japanese export license requests.

NUKEM/Transnuclear Investigation. In late 1987, allegations surfaced in Europe regarding the possible diversion of significant quantities of sensitive nuclear material by the NUKEM and Transnuklear firms based in the Federal Republic of Germany (FRG). As a result, while the matter was under investigation, FRG authorities suspended indefinitely the operating licenses for both firms. The NRC then took steps to ensure that these developments did not interfere with the ability of Transnuclear (U.S.), a U.S. subsidiary of Transnuklear (FRG) and Transnuclear (Paris), to properly comply with its export licensing responsibilities for the several NRC licenses it holds. It was subsequently determined in Europe that the matter essentially involved certain irregularities in financial management and low-level nuclear waste disposal activities. No diversions of material were discovered. In any event, NRC concluded that the operations of Transnuclear (U.S.) were not affected by the developments in Europe and, accordingly, no actions were taken to modify in any way Transnuclear's NRC export licenses. NRC continues to monitor closely the export activities of all of its licensees to reduce wherever possible the risk of misuse of sensitive nuclear materials.

International Safeguards and Physical Security. In all pending export cases to be reviewed by the NRC, the staff reviews the implementation of the IAEA safeguards and physical security arrangements to be applied to the exports in the receiving country. These reviews are performed in compliance with U.S. nonproliferation laws to ensure that U.S. exports will be protected during transit and use in the importing country and that the exports will not be used for proscribed purposes, such as the making of nuclear explosives.

The NRC participates in U.S. Government efforts to assist the IAEA in improving its safeguards system. The U.S. Program of Technical Assistance to IAEA Safeguards and the U.S. Action Plan Working Group (APWG) are the primary programs in this area. Through the activities of these groups, the United States is able to participate in joint projects with other countries, and the IAEA itself, in support of the international safeguards system. Under the auspices of the

APWG, the NRC participated in bilateral and multilateral discussions on safeguards experience with Japan, France, FRG, the United Kingdom, and the European Community.

In support of its review of physical security arrangements of U.S.-controlled materials in other countries, the NRC participates in information exchange trips jointly with the Department of Energy to discuss national physical protection programs. In this regard, U.S. delegations visited Italy, Spain, and Portugal.

The NRC also participated in interagency and intergovernmental negotiations relating to the finalization of transportation and physical protection arrangements for the U.S.-Japanese Agreement for Peaceful Nuclear Cooperation, which took effect in July 1988.

Nuclear Regulatory Research

Chapter 9

Activities of the Office of Nuclear Regulatory Research (RES) provide an essential contribution to the regulatory process. The goal of the office is to ensure the availability of sound technical bases for timely rulemaking, and related decisions, in support of NRC licensing and inspection activities. RES also has responsibilities related to implementing Commission policies on safety goals and severe accident regulation, to resolving generic safety issues, and to reviewing licensee submittals regarding individual plant examinations and probabilistic risk assessments. It is also a RES function to conduct rulemaking, including the issuance of regulatory guides and rules that govern NRC licensed activities. (See "Regulations and Guides," on the following page.) Regulations issued by NRC in 1988 are listed in Appendix 4. Regulatory guides are described in Appendix 5, which includes a listing of those guides issued, revised, or withdrawn during fiscal year 1988.

This chapter summarizes RES activities during fiscal year 1988 under the following headings: Preventing Damage to Reactor Cores, Reactor Containment Performance and Public Protection from Radiation, Integrity of Reactor Components, Confirming Safety of Nuclear Waste Disposal, and Resolving Safety Issues and Developing Regulations.

Preventing Damage To Reactor Cores

The program for preventing damage to reactor cores and mitigating severe accident consequences encompasses the operations of the reactor as a system, including control of power level, maintenance of water in the reactor system, core cooling and heat removal, and maintenance of proper coolant temperatures and pressures. Also included are the establishment and maintenance of accident management programs designed to minimize the risk to the public in the event of severe accidents.

PLANT PERFORMANCE

Accident Management

The Office of Nuclear Reactor Regulation (NRR) and RES have prepared an accident management program plan which will be a key element in NRC's overall integrated plan for closing out severe accident issues. The accident management program effort will be closely coordinated with industry, with both industry and NRR surveying utility accident management capabilities at the outset. Based on these appraisals and on RES review of state-of-the-art research regarding accident management strategies, NRR and RES will define the appropriate scope and the managerial attributes relevant to acceptable accident management plans. With this guidance, each utility will be expected to develop accident management plans and capabilities. The object for industry is that each licensee shall have an accident management program framework in place that can be expanded and modified to accommodate new information as it is developed. The RES program will closely support this effort and will develop comprehensive an accident management evaluation strategy, employing data from such sources as the Individual Plant Examination (IPE) process, the Severe Accident Research Plan, the Containment Performance Initiative, the human factors program, and cooperative programs undertaken with industry and foreign participation.

Individual Plant Examinations. During the report period, NRC staff completed plans and recommendations for the Individual Plant Examinations (IPEs), an integrated systematic approach to examining each nuclear power plant now operating or under construction for possible significant risk contributors that might otherwise be overlooked. This task included preparation of a generic letter to initiate the IPE process—issued in November 1988 to all licensees—and a guidance document, to be issued early in 1989, indicating what the NRC staff will expect in the IPE submittals.

Multiloop Integral System Test (MIST)

The MIST program is a joint government/industry experimental attempt to develop extensive data on the thermal-hydraulic behavior of Babcock and Wilcox (B&W) reactors. Participants in the program are the NRC, B&W, the Electric Power Research Institute, and the B&W Owners Group. The experimental program is centered on tests conducted in the MIST facility, located in Alliance, Ohio, which is designed to operate at typical B&W plant pressure and temperature. The facility is a scaled "2-by-4" (two hot legs and four cold legs) model of a B&W lowered-loop nuclear steam supply system. The experimental data derived from MIST operations are useful in judging the accuracy of the NRC and industry thermal-hydraulic codes in predicting the behavior of B&W transients. Specifically, the data have proved sufficient to validate calculational models for a B&W small-break loss-of-coolant accident (LOCA). (The small-break LOCA data base satisfied the condition imposed by NUREG-0737 ("Clarification of TMI Action Plan Requirements," Item II.K.3.30.)

From December 1987 to the end of fiscal year 1988, some 58 tests were conducted in the MIST facility. The tests were designed to track and record thermal-hydraulic behavior in MIST during small-break LOCA transients, steam generator tube rupture transients, feed and bleed recovery procedures, the effects of noncondensible gas and reactor coolant pump operation on transient progressions, and conditions associated with station blackout. The Toledo Edison Company independently funded three additional MIST tests to obtain data by which to verify the RELAP5/MOD2 code, a best-estimate thermal-hydraulic code used by that utility to support a design change at the Davis-Besse (Ohio) nuclear power plant. The data compared well with RELAP5/MOD2 analyses, enabling the utility to satisfy NRC concerns about the design changes at Davis-Besse. In fiscal year 1988, data from four MIST tests were also used to verify the TRAC-PF1/MOD1 code, which is a best-estimate thermal-hydraulic code used by the NRC to predict the behavior of PWRs during transients. In fiscal year 1989, data analyses for the 58 MIST tests, as well as code analyses, will be published as NRC reports. Because the cost to date is less than originally budgeted, additional testing has been made possible by which to study various methods for dealing with station blackout, the effects of noncondensible gases, and the effect of reactor coolant pump operation on transient behavior. These tasks will move completion of the MIST program to the end of fiscal year 1989.

International Code Assessment Program

Anticipated transients are part of the design basis, i.e., taken into account in the original design, for nuclear power plants. Vendors of nuclear steam supply systems translate results from their own transient analyses into design criteria formulated to assure that plants can safely respond to design basis events. The NRC must be able independently to evaluate such vendor safety analyses, and this need has led to development of computer codes designed to evaluate a broad spectrum of plant designs and plant transients. The NRC has developed codes for BWR analysis (TRAC-

REGULATIONS AND GUIDES

NRC standards are primarily of two types:

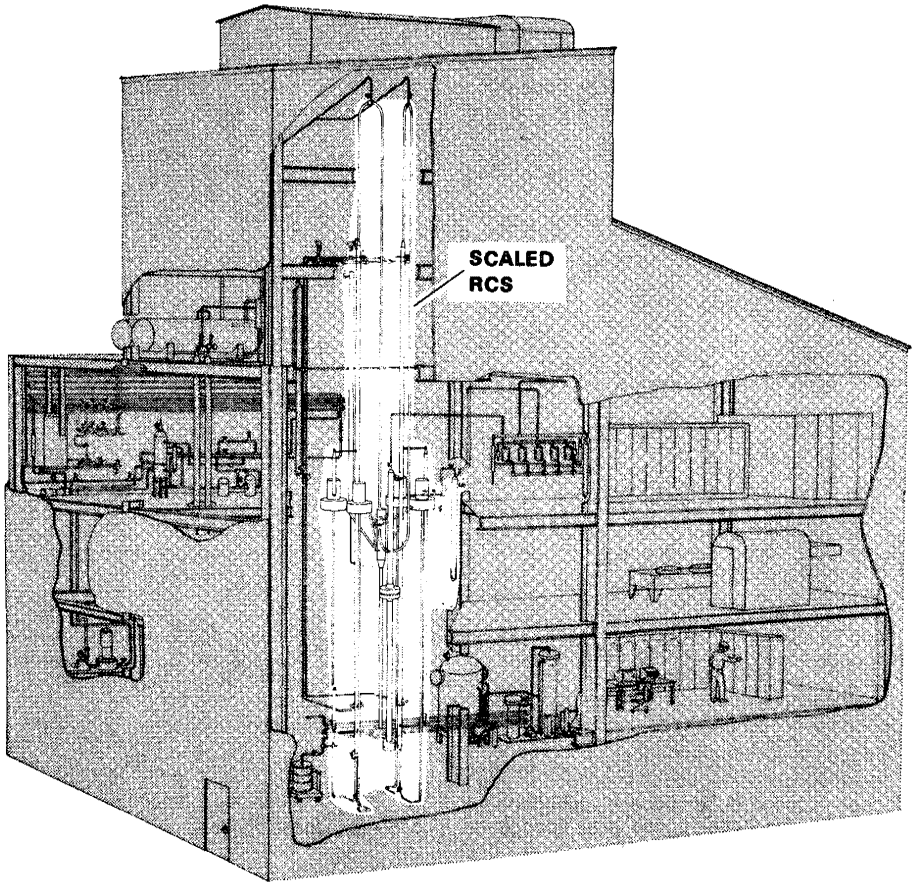
- Regulations, setting forth requirements that must be met by NRC licensees in Title 10, Chapter I, of the Code of Federal Regulations.
- Regulatory Guides, usually to describe methods acceptable to the NRC staff for implementing specific portions of NRC regulations.

When NRC proposes new or amended regulations, they are normally published in the Federal Register to allow interested persons time for comment before they are adopted. This is required by the Administrative Procedure Act. Following the public comment period, the regulations are revised, as appropriate, to reflect the comments received. Once adopted by the NRC, they are published in the Federal Register in final form, with the date they became effective. After that publication, rules are codified and included annually in the Code of Federal Regulations.

Some regulatory guides describe techniques used by the staff to evaluate specific situations. Others provide guidance to applicants concerning the information needed by the staff in its review of applications for permits and licenses. Many NRC guides refer to or endorse national standards (also called "consensus standards" or voluntary standards) that are developed by recognized organizations, often with NRC participation. The NRC makes use of a national standard in the regulatory process only after an independent review by the NRC staff and after review of public comment on NRC's planned use of the standard.

The NRC encourages comments and suggestions for improvements in regulatory guides and, before staff review is completed, issues them for comment to many individuals and organizations, along with the value/impact statements that set forth the objectives of each guide and its expected effectiveness and impact.

Multi-Loop Integral System Test (MIST)



The MIST facility at Alliance, Ohio, permits simulation testing of B&W lowered-loop plants. Testing began in 1985.

BWR, RAMONA) and PWR analysis (TRAC-PWR, RELAP); work on BWR modeling was halted during fiscal year 1988.

The current versions of the TRAC-PWR and RELAP codes were first released in December 1984. Since that time, they have been independently assessed through an International Code Assessment and Applications Program (ICAP). The ICAP program, with 14 countries participating, has provided grounds for a common understanding of code capabilities and limitations. In December 1987, agreement was reached on a plan to improve code performance through a joint, international effort toward producing the final versions of the PWR codes. The PWR modeling work is scheduled to be completed by the end of fiscal year 1989. The ICAP program itself will continue until 1991 with independent assessments of NRC's PWR codes.

ECCS Rule

On September 16, 1988, the NRC amended its regulations to allow the use of alternative methods to demonstrate that the emergency core cooling system (ECCS) would protect the nuclear reactor core during a postulated design basis loss-of-coolant accident (LOCA). The Commission took this action because, since the original rule was written in 1973/74, research has shown that the calculations performed under the original requirements resulted in estimates of cooling system performance that are significantly more conservative than estimates based on the knowlege developed later. The old "Appendix K" methods are conservative, and they do not result in an accurate calculation of what would actually occur in a nuclear power plant during a LOCA, a fact which may pro-

duce less than optimal ECCS design and operating procedures. In addition, the operation of some nuclear reactors was being unnecessarily restricted by the former rule, increasing the cost of electricity generation. The amendment, while continuing to allow the use of current methods and requirements, also allows the use of more recent information and knowledge to demonstrate that the ECCS would protect the reactor during a LOCA. The amendment—which applies to all applicants for, and holders of, construction permits or operating licenses for light-water reactors—also relaxes requirements for certain reporting and reanalyses that did not contribute to safety.

HUMAN PERFORMANCE

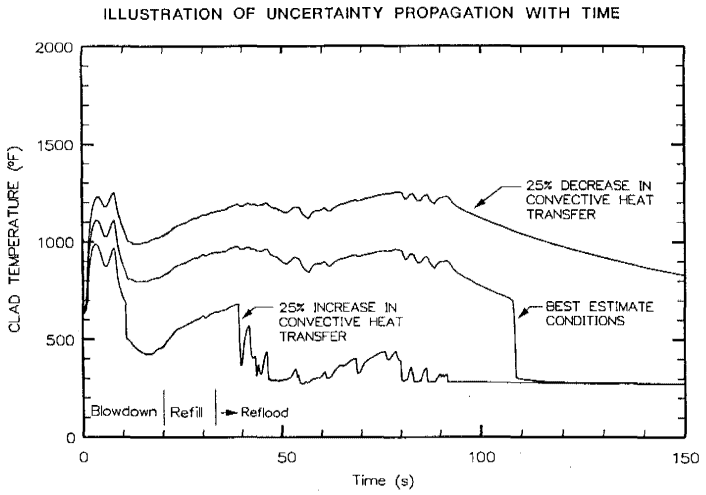
Operating experience, both in the power production industry and in such industrial operations as aviation and chemical processing, has shown that human performance can be a significant causal factor in major incidents and accidents. Consequently, considerable interest has been generated in gaining a better understanding of human performance in complex systems. At the NRC, human performance research is directed toward finding the technology to ensure the safe and effective commercial use of nuclear energy by human agents. The research proceeds by understanding, measuring, and monitoring the influences that affect human performance. Many factors shape human performance and behavior, including cognitive processes, qualifications, training, procedures, the interaction between the person and the machine, organization, and supervision.

The objectives of the research itself are (1) to broaden understanding of human performance, for the purpose of ensuring safe operations in the commercial nuclear industry; (2) to deepen understanding of the causes of human error, for the purpose of precluding and counteracting its adverse effects on safe nuclear operations; and (3) to provide the technical basis for relevant nuclear regulatory requirements, recommendations, and guidance. The research is divided into three general categories: human factors research, reliability assessment research, and performance indicators research.

Human Factors Research

Activity in human factors research during the report period included coordinating with other NRC offices regarding human factors research needs in developing a research program plan (SECY-88-141) addressing human factors problems. Recommendations from the 1988 National Research Council report were factored into the research program plan, which sought to develop improved data and the research tools to support specific licensing actions—as well as inspections of the quality of human performance at nuclear power plants—and to support more general regulatory decision-making in the area of personnel use. The program comprises six topic areas, including human-machine interface, procedures, organization and management, qualifications and training, human performance, and the ongoing human reliability program discussed below.

Work in the human-machine interface area focuses on advanced control room design and expert systems;



In September 1988, the NRC amended a rule concerning methods used to evaluate emergency and core cooling systems (ECCS). To support the revised ECCS rule, the NRC demonstrated a method called the code scaling, applicability, and uncertainty evaluation methodology, emphasizing practical engineering approaches that can be used to quantify computer code uncertainties. The graph illustrates a "best estimate" calculation of the peak cladding temperature for an summed cold leg large-break loss-of-coolant accident in a Westinghouse four-loop pressurized water reactor.

work on Human Factors Generic Issue I.D.4, "Control Room Design Standards," was completed during the report period. In the aftermath of the Chernobyl accident in the Soviet Union, a study of procedural violations and their possible consequences was initiated. Fiscal year 1988 milestones included the development of (1) a process model of nuclear power plant organization and the mechanisms by which organization and management practices influence plant safety, and (2) survey and observational instruments for acquiring organizational and management status information from plants. Work in the other areas will be initiated in fiscal year 1989.

Reliability Assessment Research

This continuing RES program provides the tools and data necessary for (1) assessing human performance in ways adaptable to plant probabilistic risk assessment (PRA) studies and (2) systematically applying the results of those studies to the resolution of generic issues and consequent regulatory decision-making. Major activities of fiscal year 1988 research included (1) implementation of an automated data management system, the Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR), for collecting, collating, storing, and retrieving human error probability and hardware failure rate estimates for use in PRAs; (2) bench testing an artificial intelligence-based Cognitive Environment Simulation (CES) for analyzing decision-making or "intention-formation" aspects of nuclear power plant personnel behavior; (3) field-testing a Cognitive Reliability Analysis Technique (CREATE) for applying CES outputs in probabilistic assessments of cognitive error; (4) developing a detailed procedure for fully integrating behavioral science expertise into the PRA process, in order to more accurately estimate the overall impact of human performance on plant risk; and (5) developing procedures for treating common-cause failures in safety and reliability studies.

Performance Indicators Research

Research in this area continues in support of the NRC's development of significant indicators of plant safety performance. The overall NRC program on plant performance indicators is led by the Office of Analysis and Evaluation of Operational Data (see Chapter 4). RES supports the program through the development of two kinds of indicators: (1) risk-based indicators to help monitor the current safety performance and trends of nuclear power plants, and (2) programmatic indicators that quickly monitor changes in trends of plant safety performance. An example of a risk-based indicator is the unavailability of selected safety systems. The indicator was developed in fiscal year 1988 and was being validated at year's end.

Reactor Containment Performance and Public Protection from Radiation

To ensure that existing regulations related to severe accidents (i.e., siting regulations, general design criteria, emergency planning requirements) adequately protect the public, research is needed to confirm the technical bases upon which the regulations are founded. These bases include the behavior of fission products released from melting fuel, the temperatures and pressures produced during a core-melt event, and the capabilities of containment buildings to retain radioactive materials during such events. The behavior of radioactive materials released to the environment (movement in air and water, uptake by plants and animals) is also an important consideration in protecting the public from radiation. With these kinds of data, the Commission is better able to confirm the adequacy of its requirements for the siting, design, construction, and reliability of those safety systems installed to mitigate the effects of severe accidents, and also to determine when and where improvements in the regulations are necessary.

SOURCE TERMS

Fission Product Behavior

"Source terms" are identifications of the quantity, timing, and energy of radioactive materials released to the environment following a postulated severe reactor accident. The NRC has long conducted research in this area to help define and focus accident management concerns, containment performance improvements, and individual plant examinations for previously undetected risks.

Fission products deposited on the reactor coolant system's structural surfaces during a severe reactor accident may subsequently heat up these surfaces as they decay. The increase in surface temperature may, in turn, result in the revaporization of the deposited fission products. The consequence may be an increase in the overall source term leaving the plant, in the event there is a containment failure or bypass. One of the factors affecting the extent of fission product revaporization is fission product chemical form. The chemical form(s) of a specific fission product influences

the volatility of that fission product, and thus its potential for revaporization. The phenomenon is particularly important in the event of a delayed containment failure accident, where, while the source terms may otherwise be small, the quantity of the revaporized fission products may become significant. An estimate of the extent of fission product revaporization and its impact on severe accident risks was made (as part of NUREG-1150), showing that the issue of fission product revaporization was risk-significant for certain plants.

At present, research is being conducted to develop theoretically based fission product chemistry models by which to predict fission product chemical forms during transport in the reactor coolant system and the containment. The mechanistic VICTORIA code is being developed to provide the capability to estimate the quantities of fission products and aerosols released from the reactor core, the extent of their transport through the reactor coolant system, the inventory of radionuclides (radioactive nuclei) available for release once debris is expelled from the reactor vessel, and the extent of fission product revaporization from the reactor coolant system. Another code, TRENDS, is being developed to estimate the partition of iodine between the aqueous phase and the gas phase in the containment, the production of organic iodide species, BWR suppression pool chemistry, and the extent of iodine revaporization and resuspension from containment surfaces and sumps. Taken together, the in-vessel code VICTORIA and the ex-vessel code TRENDS can address a spectrum of questions related to fission product release and transport within the reactor coolant system and the containment, including important risk questions related to revaporization of fission products and other questions related to off-site consequences.

Work is continuing on the ICEDF computer code validation tests being conducted at the Pacific Northwest Laboratory (PNL). The code was developed by PNL as part of an evaluation of the fission product retention effectiveness, during severe accidents, of light-water reactor (LWR) engineered safety feature (ESF) systems. More specifically, the code was developed to estimate the extent of aerosol particle retention in the ice compartments of PWR ice condenser containment systems. The test program includes investigation of particle attenuation in a PNL facility that includes a full-length (48-foot) arrangement of four equivalent ice basket columns (one full-size central column surrounded by four half-size columns and four quarter-corner columns). Valuable insights are being obtained concerning flow fields, as well as particle transport and dynamics, under conditions involving low flow rates and the mixing of hot air and steam with the head of cold air developed by the columns.

Besides the fission product research cited above, the NRC is participating in an internationally sponsored project called Advanced Containment Experiments (ACE). The program consists of three phases. Phase A deals with large-scale filtration tests, and Phase C deals with molten core-concrete interaction research. Phase B involves large-scale experiments to be conducted by the Westinghouse Hanford Company on the physical and chemical behavior of iodine in a containment that includes the presence of hygroscopic aerosols, steam, and water pools. Phase B of the ACE program is also expected to include a number of complementary smaller-scale laboratory experiments and supporting analytical work by participating countries and contractor laboratories In the United States, these contributions are being carried out at Oak Ridge National Laboratory. These laboratory experiments combined with the large-scale iodine experiments will provide a data base for validating containment iodine behavior codes such as the TRENDS code cited above.

Natural Circulation in Severe Accidents

Natural circulation in severe accidents refers to the buoyancy-driven steam circulation between the reactor core and upper-plenum region of a vessel (in-vessel circulation), with or without countercurrent flows in the hot legs and steam generators (ex-vessel circulation). This kind of multi-dimensional flow may exist during the core uncovery and core melt period of certain severe accidents in a PWR. If such flow should occur, it will provide a means of transferring the decay heat from the core to the upper-plenum structures, hot leg piping, and steam generator tubes. As a result, the reactor coolant system (RCS) pressure boundaries may be heated to high temperatures, which challenge their structural integrity.

Experiments sponsored by the Electric Power Research Institute (EPRI) at a 1/7-scale Westinghouse test facility indicated that multi-dimensional natural circulation does indeed exist under certain simulated accident conditions. Analyses using the COMMIX code (valid for intact-core geometry and single-phase flow) were compared with the Westinghouse data, and good agreement found. (For description of calculations analyses, see the *1987 NRC Annual Report*, pp. 134, 135.) However, uncertainties in these calculations are yet to be estimated or bounded, and future work is needed to validate the results.

CONTAINMENT STRUCTURAL INTEGRITY

Structural Tests

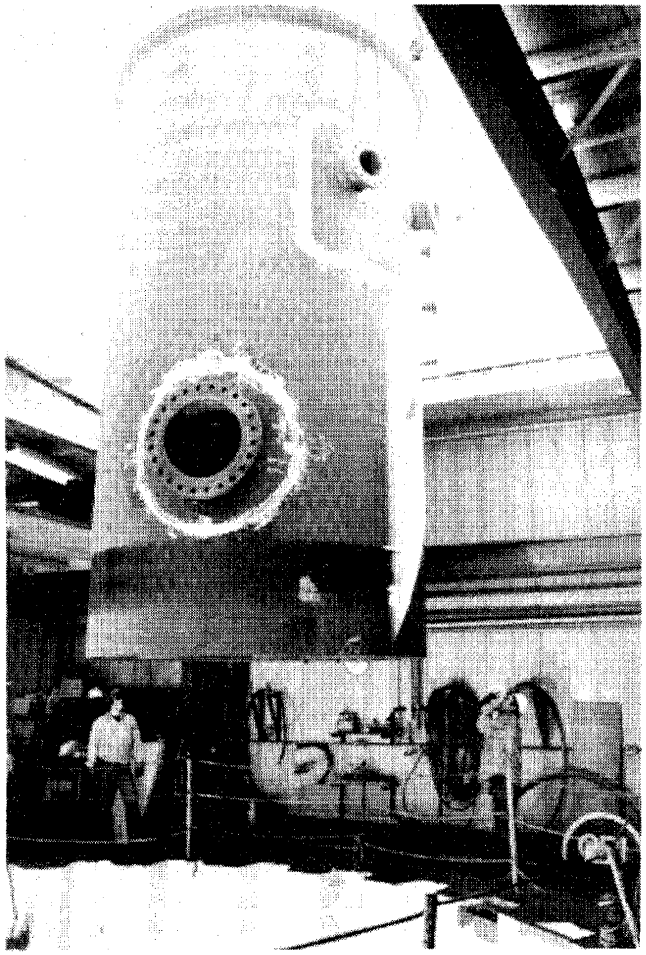
Activity has continued on a set of of programs whose objectives are to provide the data base required for the

qualification of methods for predicting the response of LWR containment buildings during severe accidents (those beyond design basis events) and extreme earthquakes. This set of programs is examining the modes of containment failure that would result in the release of radioactive materials beyond the containment boundary. These modes include structural failure of the containment building, leakage through or past the penetrations (electrical or mechanical), failure of containment isolation systems, or failure of the basemat by the molten reactor core.

The preponderance of effort was devoted to developing a complete understanding of the results from a 1/6-scale model of a reinforced concrete containment that was tested to failure in July 1987. (For description of the model, see the *1987 NRC Annual Report*, p. 135.) Post-test analyses centered on the measurements of strain and displacement taken at each discrete pressure step to evaluate the accuracy of pre-test predictions made using various analytical techniques. Nine organizations, including three from the United States, three from the United Kingdom, and one each from France, Italy, and the Federal Republic of Germany, made pre-test predictions and participated in the post-test evaluation. An initial comparison of results took place in connection with the Fourth International Workshop on Containment Integrity, held in Arlington, Va., in June 1988. A joint report, highlighting lessons learned by comparing predictions with results, was expected early in 1989.

Personnel Airlock Test. A full-size personnel airlock, obtained from a cancelled nuclear power plant, was tested at Chicago Bridge & Iron Research and Development Center in Plainfield, Ill., under contract to Sandia National Laboratories. The work is part of the containment integrity research sponsored by the NRC. The objective of the tests was to obtain structural data on the behavior of an airlock, especially the sealing surfaces, under severe accident conditions. In the tests, several load cycles were applied to the inner door of the airlock. The two most important load cycles were: (1) temperature held at approximately 400°F with pressurization up to 300 psig, and (2) temperature held at approximately 800°F with pressurization up to 300 psig.

No significant leakage was observed past gaskets in the inner or outer doors of the airlock for the test environment of 400°F and 300 psig. For the test environment of 800°F and 300 psig, a large portion of the gasket on the inner door was ejected from its groove at 150 psig, and from this point on the inner door measurable leakage was recorded. The pressurization continued to 300 psig, but no leakage past the outer door was detected. Although leakage past the inner door may occur under these conditions, the redundancy of the outer door prevented leakage to the outside environment, because the temperature of the outer door remained quite moderate for all tests. In addition to those above, tests were also performed on inflatable seals under severe accident conditions.



Tests to obtain structural data on personnel airlocks continued in 1988, using this specimen at the Chicago Bridge and Iron R&D Development Center at Plainfield, Ill. A variety of seals and gaskets have been tested for use at commercial power plants.

Inflatable seals are used to prevent leakage around the perimeter of airlocks and are fastened to the outer edge of the airlock doors. The seals are pressurized with air to seal the gap between the door and the airlock bulkhead. Inflatable seals are either currently installed or planned for use in 11 commercial power plant containment structures. Tests performed so far involved both aged (radiation and thermal) and unaged seals, at room temperature and at elevated temperatures representative of severe accident conditions.

Core Melt Progression And Hydrogen Generation

In-vessel core melt progression research is concerned with the state of the reactor core in a severe reactor

accident from the time of core uncovery up to the time of reactor vessel melt-through. The research also includes a determination of the mode of vessel failure. Sensitivity studies have shown that the uncertainties in the state of the core debris at the time of vessel failure produce the greatest uncertainties in the ex-vessel phase of an accident, including core-concrete interactions and direct containment heating. The state of the core in core melt progression is also the primary determinant of in-vessel hydrogen generation, fission product and aerosol generation and attenuation, explosive and non-explosive rapid steam generation, and the potential for successful recovery actions in accident management.

The information base on in-vessel severe accident behavior has been the series of severe fuel damage tests such as those performed in the Power Burst Facility (PBF) test reactor, which included extensive post-irradiation examination (PIE). Tests in the National Research Universal (NRU) reactor in Canada have provided full-length data on fuel damage during coolant boildown and have provided data on fission product release.

Analyses of the results of the DF-4 (BWR geometry) experiment in the Annular Core Research Reactor (ACRR) have yielded unique and significant data regarding the effects of the BWR boron-carbide control blades and the individual fuel-rod-containing channel boxes upon fuel damage and core melt progression.

In the program on the assessment and validation of the mechanistic MELPROG melt progression code—used in unrecovered accidents and in risk assessment—calculations and comparison with PBF and ACRR results, plus comparison with what we know from the Three Mile Island Unit 2 (Pa.) accident, are continuing. Analysis of the PWR reactor vessel failure by core melt attack has shown that the current models cannot determine whether failure of local vessel penetrations or gross vessel failure by creep rupture occurs first. Experiments and continued model development are under way to resolve this important question. And assessments, development, and improvement of MELPROG are continuing. The more mature mechanistic SCDAP has been applied extensively to the analysis of complex core damage accidents and experiments in the U.S. and abroad. BWR versions of MELPROG and SCDAP were developed and are being tested. Analytical support, primarily with SCDAP, was provided to the CORA out-of-pile fuel damage experiments, being carried out in the Federal Republic of Germany, that are providing much high-quality information for code assessment and improvement under international cooperative agreement.

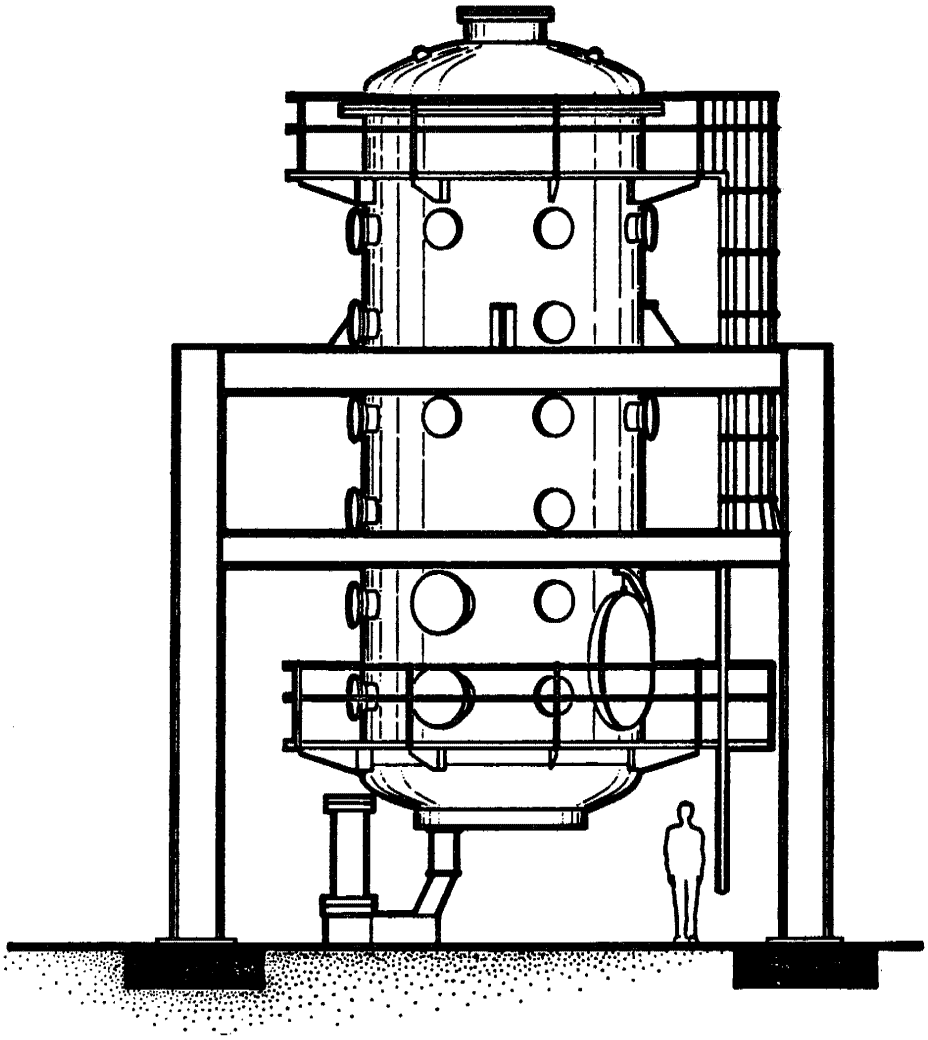
Core-Concrete Interactions

In those severe accident scenarios in which the reactor vessel fails, high-temperature core debris may fall into the reactor cavity, where it interacts with structural concrete. The consequences of these thermal and chemical core-concrete interactions may significantly impact containment loading, the modes of containment failure, and the radiological source terms. To characterize the threat to containment integrity and the nature of the ex-vessel releases, experiments are being performed, and mathematical models are being developed and assessed.

The CORCON code was developed as a best-estimate computational tool to calculate the physical and thermodynamic variables needed to characterize the progression of high-temperature core debris as it erodes concrete in the reactor cavity. CORCON MOD2 (released August 1984) includes the effects of heat and mass transfer, attack on structural concrete in the reactor cavity, and the influence of an overlying water layer. CORCON is incorporated in the NRC Source Term Code Package and has now been integrated into the CONTAIN and MELCOR codes. Improved models for the treatment of decay heat, time-dependent mass addition, and axial heat transfer to concrete have been developed. The code is being actively used in 17 research institutions throughout the world. Large-scale integral experiments with sustained induction heating were performed to study the effect of metallic zirconium present in molten stainless steel interacting with limestone and siliceous concrete. A summary review of available data on core debris-concrete interactions is being prepared in support of model validation.

The VANESA code models the physical and chemical processes that occur when gas bubbles generated by the decomposition of concrete pass through the molten debris pool and break at the surface. The WITCH tests of aerosol generation by mechanical processes and the GHOST tests of aerosol generation by vapor-condensation have been initiated, and data are being used to assess the VANESA code. The degree to which refractory radionuclides are thrown off from molten debris depends in part upon the relative vapor pressures of the pool constituents. A refined model, based on recent high-temperature measurements of chemical activity coefficients, is being prepared for incorporation in VANESA. VANESA has been linked to CORCON to form the CORCON/VANESA package.

A number of transient phenomena that may occur in the reactor cavity during, or closely following, primary vessel failure are now being investigated. Experiments to study the hydrodynamic behavior of core debris have been initiated to determine the manner in



The Surtsey facility for direct containment heating experiments, shown at right, is located at the Sandia National Laboratories. The 1:10-scale containment vessel is 11 meters high. The unit can be pressurized to 10 bars and heated to 120° C.

which it may spread and relocate within the reactor cavity. The ability of the BWR Mark I steel drywell shell to survive a core melt accident may depend upon such debris behavior. With respect to that same Mark I safety issue, studies of heat transfer from high-temperature melts to non-horizontal steel barriers have also been initiated.

High-Pressure Melt Ejection—Direct Containment Heating

In certain reactor accidents, degradation of the reactor core can take place while the reactor coolant system remains pressurized. Left unmitigated, core melt will slump and collect at the bottom of the reactor vessel. If molten core material attacks the bottom head of the reactor and a breach occurs, the core melt will be ejected under pressure. If the material should be ejected from the reactor cavity into surrounding containment volumes as fine particles, thermal energy would be quickly transferred to the containment atmosphere. The metallic components of the ejected core debris can further oxidize in air or in steam to generate a large quantity of chemical energy and further pressurize the containment. This is called direct containment heating (DCH).

A program was developed at Sandia to investigate core debris dispersed at various scales. The 1/20th linear scale system pressure injection tests (SPIT) and the 1/10th linear scale high-pressure screening tests (HIPS) have been completed. In fiscal year 1988, two experimental programs were continued—the Surtsey DCH test program at Sandia and the separate-effect test program at Brookhaven National Laboratory. Details on these programs are set out in the *1987 NRC Annual Report*, p. 137.

Experiments and analyses have been initiated to determine whether there exists some reactor coolant system pressure below which ejection of molten core from the failed reactor vessel will not pressurize the containment and challenge its integrity. Data are now being used to develop models for both lumped-parameter and finite-difference codes. DCH models and correlations have been developed and incorporated into the CONTAIN code. DCH-specific models were incorporated into the KIVA finite-difference code (KIVA-DCH) to provide a detailed description of particle behavior to guide the selection of parameters for the CONTAIN calculations.

Hydrogen Combustion

The hydrogen combustion program assesses both the consequences and methods used to control or mitigate deflagrations, diffusion flames, accelerated flames, transition from deflagration to detonations (DDT), and detonations that might be caused by hydrogen burns in a severe reactor accident. The HECTR lumped-parameter computer code was developed at Sandia National Laboratories and is used in the analysis of nuclear reactor accidents involving the transport and combustion of hydrogen. A flame propagation model was incorporated into HECTR. The HMS-BURN code, a three-dimensional finite-element analysis tool developed at Los Alamos, is also employed, to provide more detailed hydrogen transport and mixing calculations. HECTR models have been assessed using EPRI Large-Scale Hydrogen Combustion Nevada Test Site (NTS) experiments. The assessment of HECTR and HMS-BURN codes continues with the use of the data generated from the large-scale hydrogen transport experiments performed at the HDR facility in the Federal Republic of Germany.

Flame acceleration, deflagration-to-detonation transition, and detonation experiments have been analyzed and documented. A review continues of the effect of elevated temperature and high steam concentration on the various modes of combustion. The ZND detonation propagation model has been assessed, and newly developed flame acceleration and DDT correlations have been assessed against German, Canadian, and United States data.

REACTOR ACCIDENT RISK ANALYSIS

Review of PRAs

Probabilistic risk assessment (PRA) is now used by NRC staff to support the resolution of a wide spectrum of regulatory issues. For licensed plants, PRAs are sometimes voluntarily submitted by licensees in support of their specific proposed means for resolving such issues. For advanced plants, applicants are required to perform and submit PRAs as part of their overall license application. Reviews performed in fiscal year 1988 included the following:

Westinghouse SP-90. This PRA was submitted as part of an application for a Preliminary Design Approval for the Westinghouse SP-90 standard plant design. Two separate reviews were conducted, covering both the calculation of the frequency of an accident involving significant damage to the core, and the calculation of the consequences should such an accident occur.

Point Beach. This PRA was submitted by the licensee for the Wisconsin facility in rebuttal to some NRC staff calculations intended to substantiate a decay heat removal issue. The review delineated differences between the NRC and licensee in the assumptions, methodology, and details of plant design.

Diablo Canyon. In order to comply with a license condition, the licensee for Diablo Canyon (Cal.) has developed a Long-Term Seismic Program. As a part of the program, the licensee is performing a Level 1 PRA. Because the seismic portion of this work involves the development of some new PRA methodology, the NRC staff review is proceeding in parallel with the successive stages of the PRA, as it proceeds. The review was continuing at the close of the report period.

Completion and Review of Reactor Risk Reference Document

In February 1987, the NRC issued the draft version of NUREG-1150, "Reactor Risk Reference Document," as well as a series of supporting contractor reports, for public comment. The draft report assessed the risks from possible severe core damage accidents in five U.S. nuclear power plants. The five plants studied are Surry (Va.), Zion (Ill.), Sequoyah (Tenn.), Peach Bottom (Pa.), and Grand Gulf (Miss.). The report discussed the implications of the five risk assessments on regulatory issues such as the technical bases for present emergency planning regulations and implementation of the Commission's Safety Goal and Severe Accident Policy Statements. Two NRC-funded reviews of the draft report were obtained and published as NUREG/CR-5000 and NUREG/CR-5113. In addition, the American Nuclear Society sponsored and published a review of the draft report.

While the review process was under way, the NRC staff and supporting contractors have been updating the five risk analyses. The updates are intended to

reflect the present plant design and operating characteristics, improve the methods used, and incorporate new experimental calculational data on severe accidents resulting from the research programs of NRC and others. At present, the analyses of core damage frequency have been completed, with documentation of results in progress. Analyses of containment performance and overall risk were still under way. Completion of the work, related documentation, and staff summary report were scheduled for early 1989.

New Staff Computer Tools

Risk Sensitivity Analysis. In regulatory decision-making, it is always necessary to ask what impact a proposed modification to plant hardware or procedures will have in terms of risk. Generally, one of the appropriate ways to answer the question is by examining existing PRAs, revising the parameters affected by the proposed change, reworking the analyses, and observing the alteration in predicted core damage frequency and attendant public risk. Such calculations are currently being done to help set the priorities which dictate the allocation of agency resources, and also in regulatory analyses of generic safety issues and unresolved safety issues (USIs), discussed later in this chapter. Still other uses, as for targeting inspection activities, are are also emerging.

The System Analysis and Risk Assessment System (SARA) was conceived to address the regulatory needs described above and also to provide the NRC with reliability data that are currently available only on large mainframe computers. The development of high-performance microcomputers has provided greater capacities to interact with extensive data bases for a large number of users. During fiscal year 1988, a draft users' manual and executable code module were given limited distribution, and a course was held to train staff personnel in the use of the code. SARA was one of the tools used by the generic issues program; in still another program, many outstanding Multi-Plant Actions (i.e., MPAs that have been imposed by NRC but not yet implemented by the licensee) were analyzed and documented. SARA was also extensively applied in an NRC study of the safety significance of changes in motor-operated-valve failure rates. It is expected that SARA will provide a useful framework for future use by the NRC as PRAs become available and are periodically updated.

In-Plant Accident Analysis. In support of the NRC staff performance and review of PRAs, a new, fast-running computer model for in-plant severe accident analysis has been developed. The model—MELCOR (Version 1.7)—analyzes such accidents from initiating event, such as a pipe break, through core degradation and welding and containment failure (i.e., when all core and containment protection systems have failed). The code makes use of simplified versions of more comprehensive codes (e.g., CONTAIN), permitting analysis of a large number of accident sequences of importance in PRAs. MELCOR Version 1.7 has seen use in the staff's NUREG-1150 effort described above, and in the staff's ongoing PRA of the LaSalle (Ill.) BWR. In parallel with actual use of the code, validation exercises are being performed, comparing code calculations with the results of experiments and the known consequences of the TMI accident.

Off-site Consequence Analysis. In coordination with the NRC staff work on NUREG-1150 discussed above, a new model for assessing the consequences of radioactive releases has been developed. The model, MACCS (Version 1.5), has the capability to treat radionuclide releases lasting for a short time or a prolonged period, including the effect of a change in wind direction at the reactor during the release, and to sample the variability of precipitation intensity from the meteorological data at the reactor site.

MACCS incorporates newer and more realistic models for projections of health effects, those developed for NRC since the publication of WASH-1400 (1975) and BEIR-III (1980), and it also takes in account estimates of long-term (chronic) radiation exposure from continued use of a contaminated environment, emergency response and radiation protection measures, and economic impact assessments.

In July 1988, modifications to the MACCS were suspended so that the model could be used in the final version of NUREG-1150; an independent code verification exercise was performed on this version. Public release and publication of documentation associated with the model was planned for April 1989, as of the close of the report period.

SEVERE ACCIDENT POLICY IMPLEMENTATION

This program area seeks to define ways to apply the results of research on severe reactor accident issues directly to the regulatory process. Modifications of rules regarding siting, emergency planning, and containment design are representative of the kinds of changes in NRC regulation that can come out of severe accident research.

Emergency Preparedness

On April 20, 1987, the NRC published in the *Federal Register* (52 FR 12921) a proposed rule on emergency

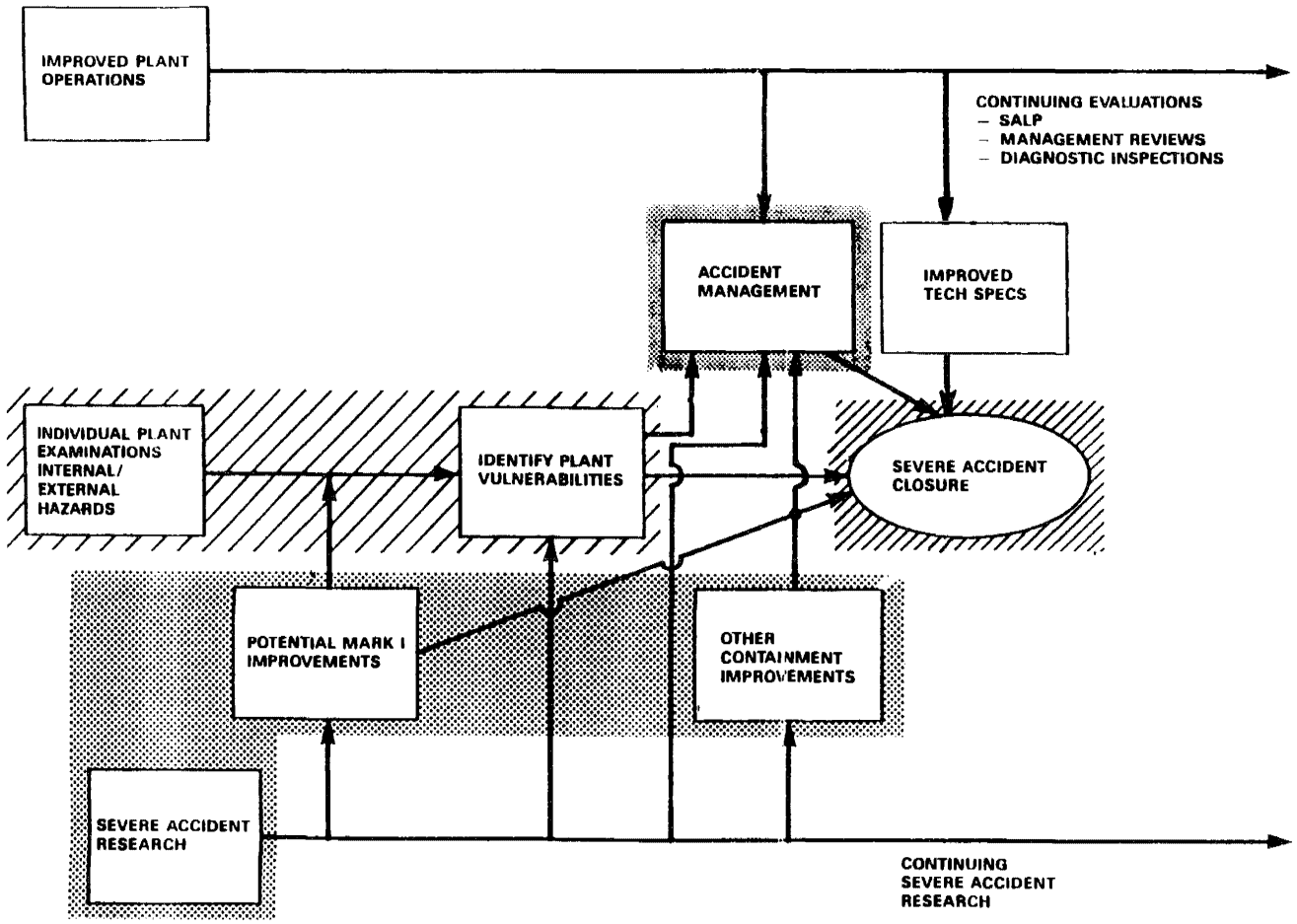
preparedness for fuel cycle and other radioactive material licensees. The rule would apply to about 30 large nuclear facilities. The facilities that would be required to comply with this regulation are those at which it was deemed credible that there could be a release of radioactive material large enough to require the support of off-site response organizations to protect the public. The rule would require, among other things, prompt notification of off-site response organizations in case of a serious accident, procedures and equipment for coping with the emergency, and training and exercises for response personnel. A final rule was submitted for Commission consideration on July 15, 1988.

On November 3, 1987, a final rule—one dealing with situations wherein State and/or local governments would not participate in emergency planning—was published in the *Federal Register* (52 FR 42078). In September of 1988, the criteria for utility off-site planning and preparedness (NUREG-0654; FEMA-REP-1, Rev. 1, Supp. 1) were published as a final report.

Earlier, on May 9, 1988, the Commission had published in the *Federal Register* (53 FR 16435) a notice of proposed rulemaking that would establish more clearly what emergency planning and preparedness requirements are needed for fuel loading and low-power testing of nuclear power plants. Approximately 1,700 public comment letters were received and evaluated. The final rule on this aspect of plant startup was published on September 23, 1988 (53 FR 36955).

Mark I Containment Improvement Program

Probabilistic risk assessment (PRA) studies have been performed for a number of BWRs with Mark I containments. Although the PRA studies do not show the BWR Mark I plants, as a class, to be risk "outliers"



The diagram illustrates the components of the NRC severe accident integration plan. The top line (unshaded boxes) contains items that are the responsibility of the NRC's Office of Nuclear Regulatory Regulation, including the continued improvement of the systematic assessment of licensee performance (SALP) provess and review of improved technical specifications. The middle line (cross-hatched boxes) shows items that are the responsibility of the regulated industry. The bottom line (shaded boxes) are items that are the responsibility of the NRC's Office of Nuclear Regulatory Research, which makes recommendations regarding potential improvements to certain containment features.

(outside the risks accounted for in plant design) relative to other plant designs, they do suggest that the Mark I containment could be challenged by a large-scale core melt accident, principally because of its comparatively smaller size. However, estimates of the likelihood of containment failure under such conditions are based on uncertain calculations deriving from complex accident conditions, and so experts in the field differ in their assessments of the probability.

The containment performance improvement effort is a main element of the integrated approach to resolving severe accident issues. Other main elements include (1) the Individual Plant Examinations (IPEs), (2) improved plant operations, (3) severe accident research program, (4) examination of external events, and (5) a program on accident management.

The staff has concluded that the best way to reduce overall risk in BWR Mark I plants is to pursue a balanced approach using accident prevention, accident management, and accident mitigation. The balanced approach includes (1) accident prevention—those features or measures that are expected to reduce the likelihood of an accident occurring; (2) accident management—those features or measures that the operating staff can use to control the course of an accident and return the plant to a controlled, safe state; and (3) accident mitigation—those features or measures that can reduce the magnitude of radioactive releases to the environment in the event of an accident.

As part of this program, a public workshop was held February 24-26, 1988, for researchers, industry representatives, and members of the public to discuss such Mark I containment issues as possible shell melt-through, reduction of accident probabilities, mitigation of consequences, and so forth.

Although staff assessments are not yet complete, the following safety enhancements tentatively appear attractive in terms of their potential risk reduction capability, as well as of implementation costs: (1) expedited staff attention to existing ATWS (referring to the safety issue called "Anticipated Transient Without Scram") and station-blackout requirements; (2) assurance of a backup water supply to the residual heat removal and other containment systems, e.g., drywell sprays, with normal and emergency a.c. independent pumping capability; (3) a hardened venting capability, with the capability for opening and reclosing it independently of normal and emergency a.c. power; (4) improved reliability of the automatic depressurization system; and (5) improved emergency operating procedures. The staff expected to complete the Mark I assessment and make its recommendations to the Commission early in 1989.

RADIATION PROTECTION AND HEALTH EFFECTS

The NRC maintains a program of research and standards development in radiation protection intended to ensure continued protection of workers and the public from radiation and radioactive materials in connection with licensed activities. The program is currently focused on improvements in health physics measurements and the review of dose reduction research performed by other Federal agencies and industry. A goal is to provide acceptable performance standards for the many measurements required of licensees. The program also contributes to monitoring licensee performance in areas such as occupational dose and use of new dose reduction techniques.

The primary focus of the health effects research program is to reduce the uncertainty associated with estimating health effects from exposure to radiation. Currently the staff reviews research funded by other agencies, such as the Department of Energy (DOE) and the Department of Health and Human Services, and attempts to improve understanding of this critical area. Improved risk estimations are needed for establishing radiation protection policy and standards, for assessing severe accident consequences, and for implementing agency safety goals. A feasibility study has been initiated to determine whether the extensive data available on cellular and molecular effects can support a defined upper limit to health risk estimates at low doses.

Brookhaven National Laboratory ALARA Center

The Brookhaven National Laboratory (BNL) ALARA Center, funded by the NRC, continued its work of surveillance of DOE and industry dose reduction efforts and ALARA ("as low as reasonably achievable": the generalized objective in dose reduction) research. The center is recognized by the nuclear industry and others as a major source of information on new and effective dose reduction techniques, and its publications are standard references for ALARA planning. BNL has published a series of reports (NUREG/CR-3469) discussing dose reduction in various aspects and activities of nuclear plant operation. In fiscal year 1988, BNL focused on high dose worker groups and development of an international dose reduction data base. The center reported that continued application of dose reduction techniques is working to reduce occupational radiation exposure. A clear reduction in exposures is observable in countries with dose reduction research programs, such as Japan, the Federal Republic of Germany, Canada, Sweden, France, as well as the United States.

Emergency Environmental Sampling

A report (NUREG/CR-5212) on emergency environmental sampling and analysis for radioactive material facilities was published in August 1988. The report describes how to do sampling and analysis after an accidental airborne release of radioactive material. It was written to give guidance to the about 30 major radioactive material facilities that are required to have emergency plans for responding to accidents that could cause significant radiation doses off-site. The report was prepared when the environmental sampling and analysis that followed a January 1986 release of uranium hexafluoride at a one such facility showed the need for improvement.

Worker Dose Data Base

Responding to a request of the National Cancer Institute, the NRC staff prepared a paper for the Commission discussing the alternatives available, and the resources required, to ensure the availability of appropriate occupational dose data to carry on studies of possible health effects. The action paper recommended that the NRC amend its regulations to require certain types of licensees, including nuclear power plants, to report occupational dose data to the NRC that would be useful for a variety of purposes, including studies of possible health effects. The proposed new 10 CFR Part 20 (see below) includes the needed changes in recording and reporting requirements; the NRC will continue to work with the National Cancer Institute and the industry in determining what specific elements ought to be included in the data base.

Occupational Exposure Data System

The NRC continues to maintain and update the occupational exposure data that are computerized in the Radiation Exposure Information Reporting System (REIRS). The system has been in operation since 1969, when the Atomic Energy Commission began requiring certain licensees to submit reports on occupational radiation doses received by monitored individuals. (Exposures received as a result of medical procedures are not reported.) The system provides a permanent record of the information and facilitates analyses of the two types of required reports—annual statistical summaries and individual termination reports.

A preliminary compilation of summaries of the annual statistical reports for 1986 revealed that about 220,000 persons were monitored that year, of whom about 50 percent received measurable doses. The workers received a collective dose of 47,000 person-rems, which is an average annual dose of 0.4 rem per worker among those receiving a measurable dose. Of the persons monitored, about 90 percent worked in nuclear power plants, and they incurred 90 percent of the total annual collective dose. The annual collective dose incurred by nuclear power plant workers continues to decline. Preliminary study of the exposure data reported by nuclear power plants for calendar year 1987 indicate that the collective dose declined somewhat to a value of 41,000 person-rems, even though eight additional plants were reporting.

A second kind of exposure report required of certain NRC licensees provides identification and dose data each time a monitored individual terminates work at the licensed facility. Such information is now maintained for some 360,000 persons, most of whom worked at nuclear power plants. The computerization of these data enables the NRC staff to respond quickly to requests for individual exposure histories and to analyze the data for trends. The data also help ensure that transient workers moving from plant to plant do not receive doses in excess of regulatory limits. For example, further analysis of the data reported for 74,200 persons terminating employment during 1984 revealed that 7,400 of them had worked at two or more nuclear power facilities and that none of them had received doses in excess of the regulatory limits as a result of their multiple employment.

Improvement of Health Effects Models

Considerable progress has been made in the development of models for predicting early health effects resulting from combined internal and external radiation in the case of severe accidents. Three NUREG/CR reports published in the report period reflect that progress:

(1) NUREG/CR-5025, "Experimental Studies of the Early Effects of Inhaled Beta-Emitting Radionuclides for Nuclear Accident Risk Assessment" (November 1987), which summarizes a series of experiments concerning the effects of linear energy transfer and temporal radiation dose patterns to the lung from inhaled beta-emitting radionuclides. The results were used in the development of mathematical models for predicting death from radiation pneumonitis.

(2) NUREG/CR-5067, "Early and Continuing Effects of Combined Alpha and Beta Irradiation of the Lung" (March 1988), which summarizes an experiment to determine the effects of combined alpha and beta irradiation of the lung. Results were used to validate models for pulmonary functional morbidity and lethality from radiation pneumonitis and pulmonary fibrosis and to

determine the relative biological effectiveness of alpha radiation for these effects.

(3) NUREG/CR-5198, "Inhaled PuO_3 and/or Total-Body Gamma Radiation: Early Mortality and Morbidity in Rats and Dogs" (August 1988), which summarizes a series of experiments designed to determine the effects of whole body gamma radiation and combined inhalation of insoluble alpha-emitting radionuclides.

The three reports came out of a program designed to improve assessment of consequences of severe accidents involving release of large quantities of radioactive materials. Two additional reports in the series (including a comprehensive model for risk assessment) will be published in fiscal year 1989.

Work on revising and updating NUREG/CR-4214, "Health Effects Model for Nuclear Power Plant Accident Consequence Analysis," continued in 1988.

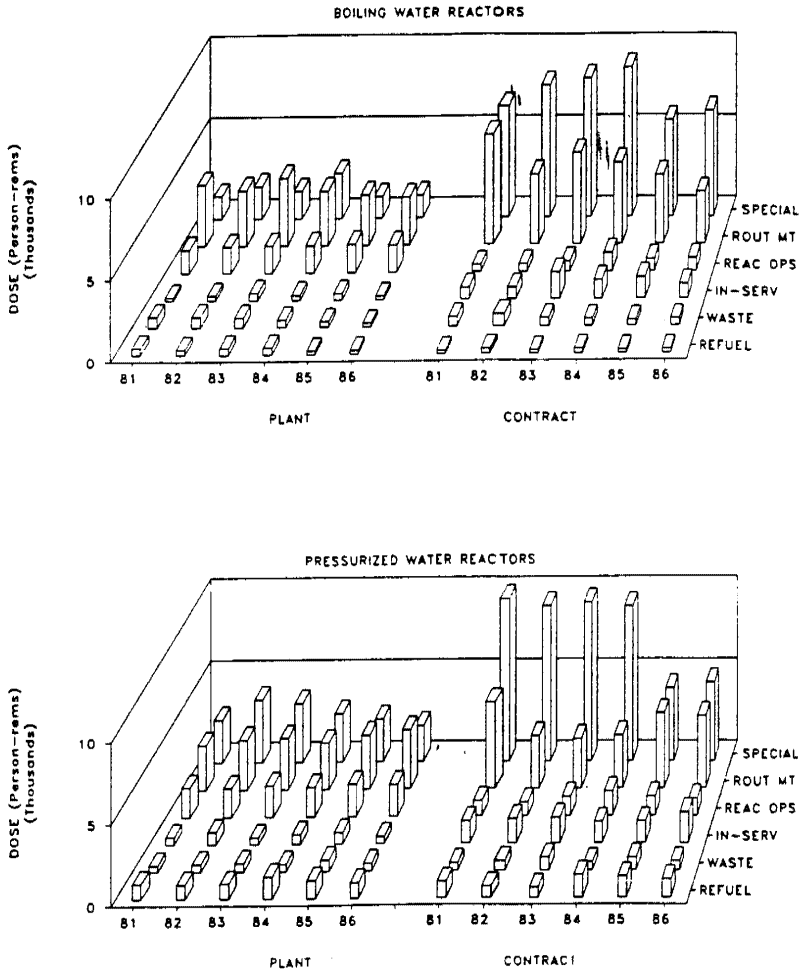
Changes to Radiation Protection Guidelines

Revision of 10 CFR Part 20. During fiscal year 1988, the staff completed the preparation of a revision of 10 CFR Part 20, Standards for Protection Against Radiation, which contains the basic requirements for protecting workers and members of the public from radiation resulting from NRC-licensed activities. The revision was carried out as a high priority task by an interoffice working group under the oversight of a steering committee composed of senior management and a legal advisor. The NRC will publish the final rule in early fiscal year 1989.

Major changes from the current Part 20 include:

(1) Elimination of quarterly dose limits for workers.

(2) Elimination of the age-prorated cumulative dose limit (5[N-18]).



These diagrams show trends in collective radiation dose incurred at nuclear power plants by work function and personnel type (plant employees and contract employees) from 1981 to 1986, as reflected in an NRC summary of statistical reports for those years. The NRC studies also showed that the collective dose incurred by plant workers continued through 1987.

(3) Requirements for limiting the sum of both internal and external doses when both components exceed 10 percent of the dose limits.

(4) An explicit dose limit for members of the public.

(5) Updated intake and concentration limits for both workers and members of the public.

Accreditation of Personnel Disimetry Processors

In February 1988, the final rule requiring accreditation of personnel whole body dosimeter processors became effective. This is an ongoing program that requires re-accreditation of processors every two years. The accreditation is performed under the National Voluntary Laboratory Accreditation Program (NVLAP), operated by the National Institute of Standards and Technology (formerly NBS), and is expected to maintain the quality of whole body dosimeter processing by requiring processors to meet the performance requirements of a national consensus standard. A draft regulatory guide that provides direction on meeting the requirements of the final rule is currently in preparation.

Testing of personnel extremity dosimeter processors against a draft national consensus standard in this area is continuing, with a view to establishing an accreditation program under NVLAP similar to that for personnel whole body dosimeters. A second set of tests are under way and it is expected that a final set of tests will begin as soon as the draft standard has been adopted in final form.

Study of Urinary Tract Effects from Uranium Exposure

In August 1988, the National Institute of Occupational Safety and Health (NIOSH) completed for the NRC a final report on a medical study of urinary tract effects in workers at Nuclear Fuel Services in Erwin, Tenn. The work was funded by NRC because of reports that workers exposed to uranium at the plant were experiencing unusually high rates of kidney and urinary tract diseases and disorders. The NIOSH investigators concluded that occupational exposures to uranium did not cause persistent, currently detectable disorders at the plant and that other environmental factors should be investigated.

Interpretation of Bioassay Measurements

A regulatory guide is in preparation that would endorse the methodology presented in NUREG/CR-4884 for the estimate of intake from both *in vivo* and *in vitro* bioassay measurements. This guide will fulfill the need for a consistent approach to the interpretation and assessment of individual intakes of radioactive material by exposed individuals.

Criteria for Establishing Tritium Bioassay Program

Guidelines for the development and implementation of a bioassay program for licensees that handle or process tritium, either as pure gas or in various chemical compounds, was published during the report period. Regulatory Guide 8.32 provides information on the scope, types, and frequency of tritium bioassay programs conducted by licensees. A table is also included that provides activity and concentration levels below which no tritium bioassay program is warranted.

Bioassy at Uranium Mills

Revision 1 to Regulatory Guide 8.22 was published in order to take into account new techniques and the results of research on the detection and retention of uranium that have arisen since the publication of the original guide. The revised guide describes a bioassay program that is acceptable to the NRC for uranium mills and some portions of uranium conversion facilities. The guide also describes working conditions under which employees should be included in a bioassay program.

Testing of Performance Standard for Radiobioassay Labs

The testing of radiobioassay laboratories against a draft performance standard was completed, and the draft standard was issued for a trial use period. The several rounds of testing that were conducted using volunteer laboratories indicated that about half of the labs could not pass all the performance criteria. Therefore, the NRC has initiated a project to examine these areas giving the labs the most difficulty, in order to determine if the problem lies with the standard or with the laboratories.

Safety Requirements for Industrial Radiographic Equipment

A proposed rule that will incorporate the requirements of American National Standard N432, "Radiological Safety for the Design and Construction of Apparatus for Gamma Radiography," was published for comment in March 1988. Numerous

responses were received and were under consideration at the close of the report period. A final rule was scheduled for publication in fiscal year 1989.

Internal Dosimetry

A report (NUREG/CR-5223) was published during the period describing the work completed on a feasibility study to design and construct a scintillation fiber radiation detector for *in vivo* endoscopic internal dosimetry. The instrument uses an alpha/beta particle-sensitive plastic scintillation fiber, optically coupled to a photomultiplier, to measure the scintillation output. An aspect of the dosimetry calling for further research is the reduction of light loss in long fibers.

External Dosimetry

The computer code SADDE (Scaled Absorbed Dose Distribution Evaluator) has been developed to supplement the existing VARSKIN code. VARSKIN is used for calculating radiation dose from radioactive contamination on the skin. The application of the VARSKIN code has been limited to radionuclides for which critical data had previously appeared in the scientific literature. SADDE allows the user to calculate necessary input data for VARSKIN for any radionuclide. The code and its application will be described in a supplement to NUREG/CR-4418 (VARSKIN) in early fiscal year 1989.

In addition to defining methods for calculating radiation doses to the skin, work is progressing in defining the effects of irradiation of the skin from very small radioactive particles ("hot particles"). This work is being carried out in light of recent exposure events at Commission-licensed facilities and a recent report by the National Council on Radiation Protection and Measurement (NCRP) emphasizing the need for a better understanding of these effects, and their relative importance within the universe of known health effects resulting from radiation exposure. (See discussion of hot particle contamination in Chapter 2, under "Safety Reviews.") The results of this work as well as other ongoing work by non-government groups will be considered by the Commission in re-examining its regulatory requirements with respect to radiation exposure of the skin.

Embryo/Fetal Dose From Maternal Intake

A study has been initiated by the NRC to improve understanding of the contribution of maternal radionuclide burdens to prenatal radiation exposure. The information is relevant both to compliance with the proposed 10 CFR Part 20 (see below) and to the assessment of consequences of accidental releases of radionuclides.

NRC's regulations at the present time do not specify a dose limit for the embryo/fetus. A proposed revision of 10 CFR Part 20 would limit the dose for the entire gestation period to 500 millirems. Because this subject is sensitive and involves consideration of non-technical issues—such as invasion of privacy and equal employment opportunity—the NRC position has been one upholding informed consent. Revision 2 to Regulatory Guide 8.13, published in December 1987, consists of three parts: an introduction, an instructor's guide, and a pregnant worker's guide. A table, which includes information on effects produced by other agents, such as cigarette smoke and alcohol, has been added to help put risks to the unborn child in perspective.

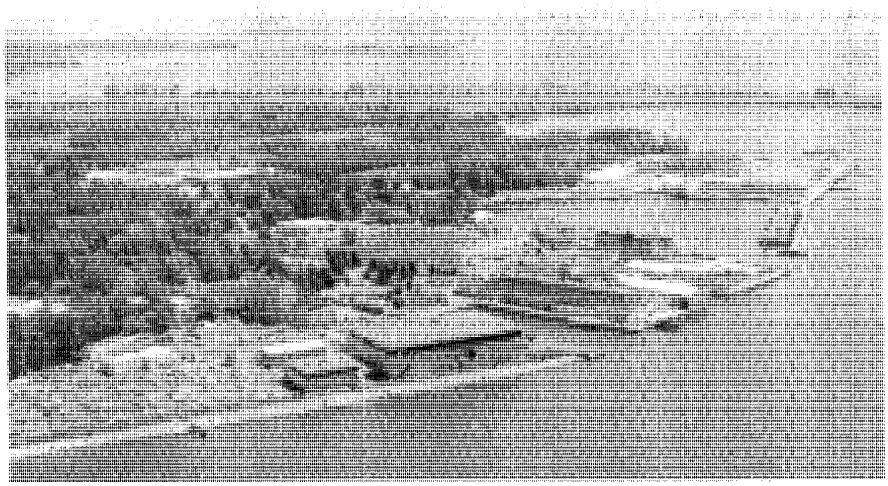
Integrity of Reactor Components

That sector of NRC research activity dedicated to the integrity of reactor components examines reactor plant systems and components to see that they perform as designed, and that they continue to do so over the life of the plant. Reactor safety depends on maintaining the integrity of the reactor system pressure boundary, i.e., keeping it free from damage and leak-tight. Failure to maintain pressure boundary integrity could compromise operators' ability to cool the reactor core and could lead to a loss-of-coolant accident accompanied by release of hazardous fission products.

REACTOR VESSEL AND PIPING INTEGRITY

Pressure Vessel Safety

The reactor pressure vessel is the key element in the primary pressure boundary. It houses and supports the reactor core and provides channelling of the coolant water from the inlet piping, through the core, to the outlet piping. It is also the only element of the primary pressure boundary for which the engineered safety systems are not designed to provide protection in case of rupture. Because of the importance of the reactor pressure vessel, there is a continuing effort to develop and refine the technical bases for evaluating the vessel and ensuring continued safe operation. This effort addresses the methods for judging the potential for vessel fracture under operating and postulated accident loads, the effects of the reactor operating environment on vessel integrity, and the mechanisms controlling vessel degradation.



The U.S. Navy's David Taylor Research Center at Annapolis, Md., shown here, is one of several facilities involved in NRC's continuing pressure vessel fracture-evaluation research. In 1988, the David Taylor Center continued to appraise and revise methods for determining ductile fracture resistance in various laboratory specimens of steel.

Methods for evaluating the potential for vessel fracture must encompass both normal operating conditions and postulated accident conditions. They must also take account of the full range of material behavior—fully ductile to fully brittle—and the reactor operating environment. In this regard, there were three areas given special emphasis in NRC-sponsored research during the report period: fracture evaluation, radiation embrittlement, and surveillance dosimetry.

Fracture Evaluation. The NRC's fracture evaluation research includes both both analytical and experimental effort. During fiscal year 1988, the research included work on developing and refining analysis methods and evaluation criteria for reactor pressure vessels fabricated with welds that could be susceptible to low-energy ductile fracture, developing crack arrest data and analyses, and designing pressurized thermal shock experiments (PTSEs) by which to assess low-energy ductile fracture and stainless steel cladding effects.

NRC's regulations require that precautions be taken to avoid non-ductile failure of the reactor pressure vessel. They also require that the ductile fracture resistance remain above a specific limit, as measured by the material's "Charpy V-notch upper-shelf" energy. If the upper-shelf energy falls below the 50 ft.-lb. regulatory limit, a detailed analysis must be performed to demonstrate that an adequate margin against failure is ensured, or the vessel must be thermally annealed. There are some vessels currently in service with welds in which the Charpy V-notch upper-shelf energy is projected to fall below the existing regulatory limit before the end of the vessel's design life. These welds are commonly called "low upper-shelf" welds. Research has begun to determine whether there is a firm technical basis justifying continued operation below the 50 ft.-lb. limit and to validate the salutary effects of thermal annealing.

During fiscal year 1988, the Oak Ridge National Laboratory (ORNL), under the Heavy Section Steel Technology (HSST) program, performed a detailed review of the basis for the 50 ft.-lb. limit and of the margins that have been included in the evaluation criteria developed by the American Society of Mechanical Engineers (ASME). The results of this review show that the 50 ft.-lb. limit has a firm technical basis, but the way in which margins have been included in the proposed evaluation criteria may be unnecessarily restrictive. Also during the period, work was performed jointly by the U.S. Navy's David Taylor Research Center at Annapolis and the U.S. Naval Academy to appraise and revise the methods for determining a steel's ductile fracture resistance from laboratory specimens. This work also examined methods for extrapolating laboratory test results to pressure vessel evaluations. Results show that the current American Society for Testing and Materials (ASTM) test and data analysis procedures are overly restrictive and that more realistic limits on the test data lead to a reasonable, yet still conservative, procedure for extrapolating the data.

Under certain postulated accident conditions, a pressurized water reactor (PWR) pressure vessel could be subjected to severe cooling rates coupled with a high internal pressure. This combination of thermal and pressure stress, called pressurized thermal shock (PTS), could pose a serious challenge to the integrity

of some older pressure vessels that have developed a significant degree of embrittlement from years of neutron irradiation. In fiscal year 1985, the NRC's regulations were amended to establish a limit on irradiation damage that could not be exceeded unless detailed analyses showed that continued operation would be safe. In 1987, regulatory guidance on performing these analyses was issued. Although the rule amendment and regulatory guidance provide reasonable assurance that potential PTS accidents will not lead to PWR vessel failure, the actual margin against failure is affected by uncertainties in several of the analysis assumptions and input parameters. Research has continued on several fronts to validate these assumptions and inputs, and to determine the actual margin against failure inherent in the PTS analyses.

The HSST program continues to perform most of the NRC's PTS research. The research in recent years has been focused on crack arrest evaluations and on benchmark experiments to define specific details of postulated PTS accidents and the possible vessel fracture associated with them. Reactor pressure vessel analyses for postulated PTS loading have shown that the steel's ability to arrest a rapidly propagating crack, termed "crack arrest toughness," can be very important in demonstrating adequate margin against failure of some pressure vessels. The NRC's crack arrest research seeks to advance the state of the art in crack arrest analysis models, to provide the experimental data needed to validate these analyses, and to justify changes in the existing ASME crack arrest toughness curves. As part of this effort, large specimen tests—the so-called wide plate crack arrest tests—were initiated to provide the needed crack arrest data. The second series of wide plate experiments was completed in 1988, and the results suggest that the ASME curves could be modified and extended to higher crack arrest toughness values. Analysis of these results will continue, with the possibility that a few additional tests will be needed, to develop the technical bases needed to justify changes to the ASME curves.

Two PTS experiments have been performed which provide the data needed to validate the NRC's PTS analysis procedures. However, two major issues remain to be resolved. The first is that it is possible that low-energy ductile fracture could contribute to the failure of vessels containing low upper-shelf welds. And the second is that current PTS analysis procedures do not adequately address this possibility. The results of the second pressurized thermal shock experiment (PTSE-2) indicate that ductile tearing is not adequately accounted for in the existing analyses. However, the relatively low strength of the PTSE-2 material may be contributing to this indication, and it may be that actual reactor pressure vessel welds would not behave in the same way. Another PTSE has been designed to resolve this issue. The final PTSE is to address the possible effects on vessel failure of the stainless steel cladding applied to the inner surface of reactor pressure vessels. Current technical opinion is divided on the possible effects. The NRC's guidance has been that cladding will not have a detrimental effect on fracture resistance, although the effects on the thermal stress analysis must be included. Recent research results suggest that, in some cases, cladding could have a detrimental effect on fracture initiation. The final PTSE has been designed to resolve this issue. These PTSEs will be performed during 1990-1991.

Radiation Embrittlement. Neutron radiation embrittlement of reactor vessels has been found to be higher in many plants than previously thought. The NRC's regulatory documents are being updated to reflect this new information. Also, research is being performed to examine the factors that control neutron radiation embrittlement and to develop additional data useful in updating the regulatory documents. As a related effort, the effects of low-temperature, low-flux irradiation on the integrity of reactor pressure vessel supports is being evaluated.

The embrittlement of reactor vessel materials is characterized by changes in a "reference temperature for nil-ductility transition," which can be characterized as follows. For many reactors now in operation, the toughness of certain vessel materials at room temperature is too low to permit full pressurization of the vessel with adequate safety margins. As temperature is raised, toughness increases, slowly at first, but then, at the "reference emperature," much more rapidly. At normal operating temperatures, vessel materials are quite tough.

To monitor radiation embrittlement in reactor vessels, specimens of the most radiation-sensitive materials are exposed in surveillance capsules positioned inside the vessel near the wall. Destructive tests of these specimens, when the capsule has been withdrawn after several years of exposure, provide the data for thorough study of the relationship of embrittlement to neutron fluence and material composition.

In May 1988, the NRC published Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," containing a correlation of the shift in reference temperature to neutron fluence and copper and nickel contents. Analyses of the surveillance data base by two independent investigators furnished the technical basis for the guide. Public comment reflected general agreement with the findings, and there was further peer review by two national standards committees that were using the guide as a basis for their standards. More recently, the guide was checked against the considerable body of surveillance

data received since the original correlations were made, and it was found to be satisfactory. The maintenance and analysis of this data base is done by ORNL on contract with the NRC.

Publication of the guide has considerable impact on operating plants, because most of them will find that radiation embrittlement is worse than originally thought. The worst examples of this are plants having medium copper, high nickel welds in the reactor vessel beltline, opposite the core, where the neutron fluence is highest. This means that the reactor vessel will have to be warmed up more carefully before full pressure is applied. The NRC regulates this procedure through review of the pressure-temperature limits in the Technical Specifications of each plant.

Work has begun to amend the PTS rule, 10 CFR 50.61, to make the formula for reference temperature in the rule consistent with that in the guide. When the amended rule becomes effective in 1990, a few plants will have reached the screening criterion given in the rule sooner than had previously been projected. At the close of the report period, they were undertaking flux reduction measures to slow the accumulation of neutron fluence in the reactor vessel wall.

In addition to analyzing the surveillance capsule specimen data, the NRC is evaluating radiation embrittlement in certain research programs. These research efforts use test reactors to provide accelerated embrittlement of various reactor pressure vessel materials, so that many different variables can be evaluated in a relatively short period of time. In fiscal year 1988, results from the fifth series of test reactor irradiations performed in the HSST program were analyzed. They indicated that the ASME's method for accounting for radiation embrittlement effects on fracture toughness slightly underestimates the actual loss in fracture toughness. The impact of these results is being assessed, and the possibility of a change in ASME procedures is being considered. Other studies are under way to evaluate the effects of neutron irradiation on crack arrest toughness, stainless steel cladding fracture toughness, and low upper-shelf weld fracture toughness.

In 1986, the Oak Ridge National Laboratory discovered that surveillance specimens exposed to a low neutron flux for many years in their High Flux Isotope Reactor (HFIR) had suffered more embrittlement damage than projected, based on available embrittlement data. The HFIR surveillance specimens and resulting data were scrutinized in great detail, leading to the conclusion that the greater-than-expected embrittlement was due to a "flux effect" that had not been observed before. The data used in predicting the service life of the HFIR were based on materials test reactor (MTR) data from a test where the specimens were irradiated at an accelerated rate of neutron bombardment—a high flux. However, the HFIR vessel was exposed to a flux five orders of magnitude lower than the MTR irradiation fluxes. Apparently, the lower rate of bombardment was more embrittling to the steel, producing the unexpected damage.

Responding to questions of the Advisory Committee on Reactor Safeguards (ACRS), NRC staff initiated research to evaluate the impact of the low-flux embrittlement trends from the HFIR on reactor pressure vessel support structures. These support structures are constructed using materials similar to the HFIR vessel, and they are subject to similar temperatures and similar neutron irradiation levels. The initial investigation suggested that it was possible for some support structures to become brittle before the end of their design lives. Consequently, a more detailed analysis was undertaken in the current report period. That work also indicated that for some plants it is difficult to show an adequate margin against failure of the supports through to the end of their design life. However, there are large uncertainties in these results, principally the uncertainty over low-flux embrittlement and over the properties of the materials actually used in these structures. The effort to resolve all uncertainties and decide the proper course of action continues.

In order to determine the effects of actual power reactor operation on vessel supports, a program was initiated to determine the effect of low-temperature, low-flux irradiation on the mechanical properties of the neutron shield tank of the out-of-service Shippingport (Pa.) reactor. The Shippingport neutron shield tank (vessel support structure) provided an excellent opportunity to check for such an effect, because its material of construction is equivalent to the material used in present-day core support structures. (For further information, see below under "Aging of Reactor Components.") In addition to the work on the Shippingport neutron shield tank, efforts were under way to obtain samples from the decommissioned Belgian BR-3 neutron shield tank; other sources of suitable materials are also being sought.

Surveillance Dosimetry. An important aspect of the surveillance program to determine the degree of embrittlement in the pressure vessel of an operating nuclear power plant is the prediction of the amount of neutron radiation exposure (neutron fluence) of the vessel. Fluence determinations are made by calculations to compute the fluence, dosimetry measurements at key surveillance locations, and a consolidation of the measurements and calculations to reduce uncertainties of predictions at critical locations of the vessel. These predictions must be reasonably accurate in order to ensure that the plant is operating in conformance with NRC safety regulations.

A proposed regulatory guide identifying acceptable methods and assumptions for establishing pressure

vessel fluence was being prepared for publication for public comment at the close of the report period. The guide incorporates developments coming out of the surveillance dosimetry program.

Steam Generator Integrity

The Steam Generator Group Project at Battelle-Pacific Northwest Laboratories (PNL) has been using a out-of-service steam generator from an actual PWR facility as a test bed for measuring the effectiveness of eddy current (EC) inspection techniques for detecting and measuring flaws in steam generator tubing. In addition, tube segments removed from the generator were burst-tested to validate empirical models of remaining tube integrity developed earlier. Testing of EC techniques prior to the current report period is described in the *1987 NRC Annual Report*, pp. 111, 112.

In fiscal year 1988, based on results from this research, draft revisions of Regulatory Guides 1.83 and 1.121 for improved guidance on inservice inspection and plugging of steam generator tubes were prepared. Also, value-impact analyses for implementation of the improved recommendations were initiated.

Piping Integrity

Environmentally Assisted Cracking. A very significant problem encountered in boiling water reactors (BWRs) has been the intergranular stress corrosion cracking of austenitic stainless steel piping at weldments. This condition has been responsible for over hundreds of pipe-cracking incidents throughout the world over the last 10 years. Because these problems have resulted in extended and unscheduled outages—with extensive inspections, repairs and replacements, and significant occupation exposures—the NRC and the electric utility industry have devoted much research to their resolution. (For background on the issue, see the *1986 NRC Annual Report*, pp. 163, 164, and the *1987 NRC Annual Report*, pp. 112, 113.)

The use of alternative materials and other proposed actions to mitigate intergranular stress corrosion cracking has been investigated. Three different grades of stainless steel, Type 316 NG, Type 347, and CF-3, have been evaluated under a variety of environmental and mechanical loading conditions and found to be significantly more resistant to cracking than the materials commonly used for nuclear plant piping. However, tests have shown that, under certain water chemistry conditions, even these superior materials become susceptible to cracking. At normal reactor operating temperatures of approximately 290°C, cooling water containing low levels of dissolved oxygen (0.25 ppm) and sulfate (25-50 ppb) was found to significantly increase the susceptibility of these materials to stress corrosion cracking.

An extensive program has been carried out to demonstrate the strong interactions among dissolved oxygen and various impurities, as well as the effects of individual impurity species on stress corrosion of sensitized Type 304 SS in low-oxygen, high-temperature water. The data provide the basis for affirming the benefits of good water quality and the role of different impurities in stress corrosion cracking of sensitized austenitic stainless steels. By removing certain species from the water that provide cathodic reduction, crack growth can be suppressed or halted. A phenomenological model has been developed to aid in understanding and interpreting these data. Probably the most significant proposed action to mitigate stress corrosion cracking in BWR stainless steel piping is the use of "hydrogen water chemistry," which includes additions of hydrogen to lower oxygen levels in the coolant and maintaining very low levels of impurities.

The process of crack growth in weld-overlay repairs of cracked pipe has been studied in simulated BWR environments and at low strain rates. The test specimens were fabricated so that the crack would propagate through the original sensitized pipe material into the weld clad overlay. The results of the experiment indicate that cracks do not extend into the weld overlay, confirming the suitability of this type of repair.

A thermal aging program was initiated in 1982 to evaluate the long-term effects on degradation of toughness in cast stainless steel as a function of time of exposure, temperature, and material composition. Through 1988, results have been accumulating to allow a quantitative evaluation of the degree and significance of toughness loss at reactor operating temperatures and operational times. Also, the mechanisms responsible for the toughness loss are being identified by evaluating both laboratory-exposed specimens and specimens removed from actual components in nuclear power plants. A heat treatment has been devised for recovery of toughness. However, re-embrittlement during subsequent exposure occurs at a much faster rate than the initial aging embrittlement.

Erosion/Corrosion. Very significant pipe wall thinning has occurred in a number of steel piping systems of nuclear plants because of "erosion/corrosion" of the material from high velocity single-phase coolant water. (See discussion in Chapter 2, under "Safety Reviews.") This problem was highlighted at the Surry Unit 2 (Va.) plant, where part of the feedwater piping was thinned so severely that the pipe failed catastrophically. A survey was performed of 28 U.S. plants and two foreign plants to ascertain the general experience with erosion/corrosion and to establish the

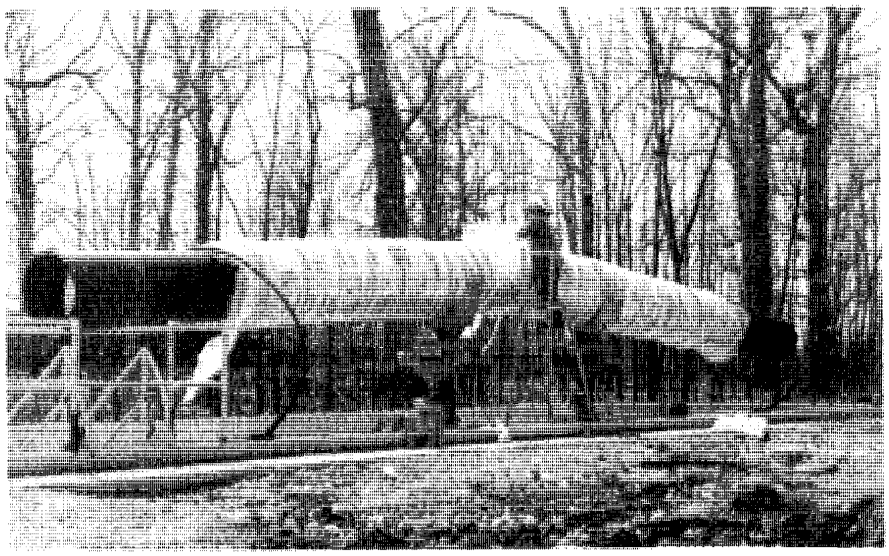
significant variables that might be related to the problem. These variables included feedwater velocities, pressures, temperatures, water chemistry histories, and materials. Survey results established that the problem exists to a significant degree.

A state-of-the-art review was performed on the available data and current mechanistic understanding of erosion-corrosion. It was observed that susceptibility depends strongly on the interaction of flow and environmental and material variables. Thus, one cannot usefully identify the critical limit of one variable, such as velocity or pH or geometry, for erosion-corrosion but must take account of all these factors together. A qualitative understanding has now been developed of the interaction of important variables; quantitative predictive methods have also been developed, but they are subject to considerable uncertainty.

Piping Fracture. With the discovery of inservice cracking of nuclear reactor piping came an increased interest in how such service-"degraded" pipe would behave under postulated accident conditions, i.e., would it leak or break? The question of leak or break behavior had been addressed for years without the emergence of a strong consensus. The NRC and the industry have undertaken parallel research efforts evaluating pipe fracture behavior. The industry's effort has focused on the behavior of stress corrosion cracks, and the NRC has addressed the broader question dealing with "leak-before-break" behavior for all piping.

The NRC has funded research addressing several aspects of pipe fracture, including analysis, material properties, and full-scale pipe fracture experiments. The Degraded Piping Program, conducted by Battelle's Columbus Division, has been the NRC's primary piping fracture research program. This four-year program, initiated in 1984, was completed in 1988; the final report is expected to be issued in early 1989. The research examined the load-carrying capacity of pipes containing cracks. Various piping materials and sizes were tested under typical reactor operating temperature and pressure. The results from analyses used to predict the load-carrying capacity were compared with the experimental results, and indicated improvements were made to the analyses in several areas. The results of this research have been used to validate the ASME's flaw evaluation procedures contained in Section XI of the Boiler and Pressure Vessel Code for stainless steel pipe and welds. They also were useful in developing similar evaluation procedures for flaws in carbon steel pipe and welds. The research program has produced six summary reports, 11 topical reports, and detailed data records for 67 pipe fracture experiments. A user-friendly computer code has been produced for analyzing cracked pipe that can be used in various regulatory analyses, and it has significantly expanded the material property data base for nuclear reactor piping materials.

In addition to many contributions to the piping fracture technology, the Degraded Piping Program results have identified several areas that warrant further study. Some of these are under investigation in other NRC-funded piping research programs, such as the International Piping Integrity Research Group (IPIRG) program. IPIRG is a consortium of government and industrial organizations formed to jointly fund research on the integrity of piping subjected to seismic and dynamic loading, as well as other piping integrity issues within the group's area of interest. In 1988, pipe fracture experiments were initiated on six-inch-diameter carbon and stainless steel pipe subjected to dynamic loadings. The work is continuing and moving toward performing dynamic pipe fracture ex-



NRC's pipe-fracture testing continued through 1988, exemplified by the test shown here. A section of stainless steel reactor pipe with a sample weld (at top center, being observed by the technician) is subjected to typical reactor operating temperature and pressure, in order to identify any leakage or fracturing.

periments on a typical piping loop configuration and using 16-inch-diameter carbon and stainless steel pipe, as well as testing the welds made on those materials.

The NRC is planning additional research in the area of piping fracture, and it is expected that the new studies will begin in 1989.

Inspection Procedures and Technologies

This program includes studies of improved methods for the detection and sizing of flaws during inservice inspection of carbon steel, wrought, and cast stainless steel piping and pressure vessels. It also includes studies of online continuous monitoring techniques (using acoustic emission) for crack growth and leak detection.

Improving the Detection and Sizing of Flaws. An improved method for more reliably detecting flaws and sizing them with greater accuracy in light-water reactor primary circuit components is called the SAFT-UT (Synthetic Aperture Focusing Technique for Ultrasonic Testing). The SAFT-UT technology is based on the physical principles of ultrasonic wave propagation and uses computers to process the data to produce high-resolution, three-dimensional images of flaws to aid the inspector in locating and sizing the flaw(s). The University of Michigan demonstrated the technology in the laboratory, and PNL has had the role of transferring the technology into a field-demonstrable real-time system. The SAFT-UT field system was assembled in 1985 and successfully demonstrated at a field site. The field system was made real-time in 1986 through the development of a real-time processor so that image analysis could be performed as the inspection is being conducted. Thus, decisions can be made on the presence, location, and size of flaws during the inspection. Also in 1986, a cooperative agreement was developed with Combustion Engineering for their technical and financial participation in the program for commercialization and field implementation of the technology. In 1987, the real-time SAFT processor was extended to provide real-time operation for thick section material, the tandem mode (for imaging the vertical extent of a flaw) was implemented on the real-time processor, and the tandem mode was modified for application to thick-section material. Work was performed in cooperation with Westinghouse and Consolidated Edison to aid in the resolution of an indication in the Indian Point Unit No. 2 (N.Y.) pressure vessel with the SAFT technology. The SAFT technology was transferred to Sandia National Laboratories, and the technology has been pulled together into a package for easy transfer to the nuclear industry. In 1988 system operation and demonstration was published, and the technology was evaluated for inspection of cast stainless steel.

Inservice Inspection System Qualification. Research work, national and international studies, and field experience over the last several years have indicated that inservice inspection, as currently practiced, is not always reliable or effective. NRC research results have indicated a need for qualification of the entire inservice inspection (ISI) process, including the personnel, procedures, and equipment, as described in the *1987 NRC Annual Report*, p. 115, 116.

In 1987, two mandatory appendices to Section XI of the ASME Code were being assessed by the appropriate ASME committees, with NRC participation. In 1988, one of the appendices—on personnel training and qualification—was approved and incorporated into the Code. The other appendix—on criteria for performance demonstrations—has been approved through the major committees and was in its final stages of approval and adoption. Other work in progress is concerned with assessing the overall effectiveness of current Code requirements for ISI, in order to ensure operational safety of the reactors. A technical basis is being laid down upon which to base new criteria for overcoming identified shortcomings.

Continuous Monitoring for Crack Growth and Leak Detection. Research has been under way to develop the use of acoustic emission (AE) for the continuous online monitoring of reactors to detect and locate crack growth and to estimate the severity of the cracking from the AE signals. Up to 1986, a large body of laboratory and field data had been developed to establish feasibility and methodology for inservice monitoring of reactors and for evaluation of data. In 1985 and 1986, a great deal of data from an intermediate-scale vessel test was thoroughly evaluated to upgrade and validate existing models and technology, as described in the *1987 NRC Annual Report*, p. 116.

In 1987, activities focused on technology transfer by developing an ASTM standard for continuous AE monitoring of pressure boundaries (E 1139), which has been approved, and by preparing a code case for the ASME Section XI Code for continuous monitoring of reactor pressure boundaries during operation, also covered in last year's annual report.

Evaluation of a stand-alone "Smart" system for AE leak monitoring was completed in 1988. The system is capable of accurate detection location and sizing of leaks in the pressure boundary. A detailed topical report was published to give details of the equipment, calibration, and operation procedures, and data analysis and evaluation procedures.

AGING OF REACTOR COMPONENTS

Aging Research

Aging is a key concern with currently operating plants and will clearly be crucial to any assessment of the safety implications of license renewal. Aging affects all reactor structures, systems, and components and has the potential to increase risks to public health and safety. There are significant uncertainties about aging-related degradation processes and about whether time-related degradation can be detected and managed before safety is impaired. Specifically, there is concern that multiple failures of age-related components could occur during transients or accidents and result in core melt and release of radiation. In the past, failures of safety components have occurred because of degradation processes such as corrosion, radiation, and thermally induced embrittlement of electrical insulation, pitting of electrical contacts, surface erosion, metal fatigue, oxidation, creep, binding, and wear. A number of these phenomena also cause deterioration of mechanical and civil engineering components.

The purpose of the aging of reactor components research program is primarily to establish the safety margins of operating plants as they progress through their design life, to define the aging mechanisms, to confirm existing and/or develop new detection and mitigation methods to prevent or mitigate the deleterious effects of the aging process, and to ensure that safety systems in nuclear power plants operate reliably. The secondary objectives of the program are to provide data helpful in evaluating the effectiveness of the industry's maintenance programs for reactor components and also to establish the technical bases for criteria to be applied in the processing of the anticipated licensee requests to extend the operating life of reactors past their initial 40-year operating license period.

The Nuclear Plant Aging Research (NPAR) program provides the information required to understand the effects that aging has on the safety function of electrical and mechanical components of commercial nuclear plants. For the NPAR program, aging refers to the cumulative degradation of a system or component that occurs with time, which, if unchecked, can lead to an impairment of continuing safe operation. The NPAR program provides systematic research effort to learn from operating experience and expert opinion, identify failures attributable to age degradation, predict safety problems resulting from age-related degradation, and develop recommendations for surveillance and maintenance procedures that will alleviate aging concerns. At the present time, NPAR consists of 15 separate, but integrated, projects that are studying the effects of aging on 20 individual mechanical and electrical components and six systems composed of such components. An additional 10 components and two systems have been targeted for study in the coming years. A phased approach to the research has been adopted to facilitate interim reviews and evaluations and to help arrange for availability of resources.

Based on the review of operating experience, including the available data base, expert opinions, and interactions with codes and standards committees, Phase I aging assessments were completed on the following safety-related components and systems:

(1) High-Pressure Emergency Core Cooling System

(2) Class 1E Distribution System

(3) Reactor Protection System

(4) Batteries

Reports were issued on the above-mentioned assessments to identify degradation sites within the component and system boundary, aging mechanisms, and aging concerns. The reports, which also made recommendations for maintenance and aging mitigation, were reviewed by the Equipment Qualification Advisory Committee of EPRI and by the various ASME and Institute of Electrical and Electronics Engineers (IEEE) working groups for potential use in revising the corresponding standards.

Intrinsic to the general exploration of reactor aging is the residual life assessment (RLA) of major components and structures. The capability to predict the residual operational lives of major LWR components and structures can be indispensable to resolving technical issues associated with plant aging and license renewal. The objective of the RLA, as an element of the NPAR program, is to develop technical bases and criteria for the NRC to assess methods of mitigating the effects of aging on major components and structures, in considering possible license renewal. The approach is to gauge the degradation of the major LWR components and structures by the synergistic influences of radiation embrittlement, thermal fatigue, corrosion fatigue, environmental attack, metallurgical changes, microbiologically and otherwise induced corrosion, moisture intrusion, erosion, and so forth.

As of fiscal year 1988, the major components important to plant safety have been identified, and research priorities assigned. An initial evaluation has been made of 12 PWR components—including the containment, pressure vessel, primary piping, steam generator, and vessel support—as well as of seven BWR components, including the pressure vessel, recirculation piping, and vessel supports. In this evaluation, the degradation sites, degradation mechanisms, stressors, and failure

modes have been identified. The evaluation also includes a review of the current methods for inspection and surveillance of these components. The results of this effort have been documented in NUREG/CR-4731, Volumes 1 and 2.

Priorities among Safety-Related Components Based on Risk Significance. Time-dependent analyses and calculations that take into account the effects of aging are necessary means to identify and set priorities among risk-significant components, systems, and structures. Then, program development is necessary to better understand and manage aging in those components, systems, and structures. A Risk Significance of Component Aging and Management Practices (RSCAAMP) model allows the assessment of both the risk significance of component aging and the effectiveness of current practices for maintaining an acceptable plant risk level in the presence of component aging. The RSCAAMP model was developed by enhancing the risk significance of component aging (RSCA) methodology, which was developed to evaluate a component's contribution to plant risk because of aging. In the basic RSCA model, the change in a component's contribution to risk from aging is a function of these factors—the component's importance to risk, the frequency at which the component's failure rate is increasing because of aging, and the interval during which the component is aging.

An expert panel workshop was conducted to set research priorities among components. Of some 30 components evaluated, the aging of small safety-related piping (6-to-10 in. diameter) was assigned the top priority overall.

Technical Bases For License Renewal. A rulemaking process was in progress at the close of the report period, leading to a prospective license renewal rule by 1991. In addition to a final rule, more detailed regulatory guidance addressing the technical safety issues related to aging is needed to implement the rule and to advise licensees on license renewal application requirements.

The NPAR program anticipated the need for a timely strategy and guidance in implementing the license renewal rule by initiating, in 1988, a scoping study aimed at developing such regulatory guidance and the review procedures for nuclear power plant license renewal. The overall goal of the effort is to provide the technical basis for detailed guidance and the requirements deriving from the rule to be developed in 1991. This approach will complement the rulemaking process and will allow the NRC to prepare for license renewal review in an orderly and timely way. As the development of the guidance proceeds in parallel with rulemaking, each effort will generate technical information of potential benefit to the other, leading to more useful and timely results from both.

A standardized approach and format for addressing technical safety issues related to the plant aging process over an extended plant life has been developed during the report period; appropriate sections of the standard review plan involving cables and emergency diesel generators have been reviewed.

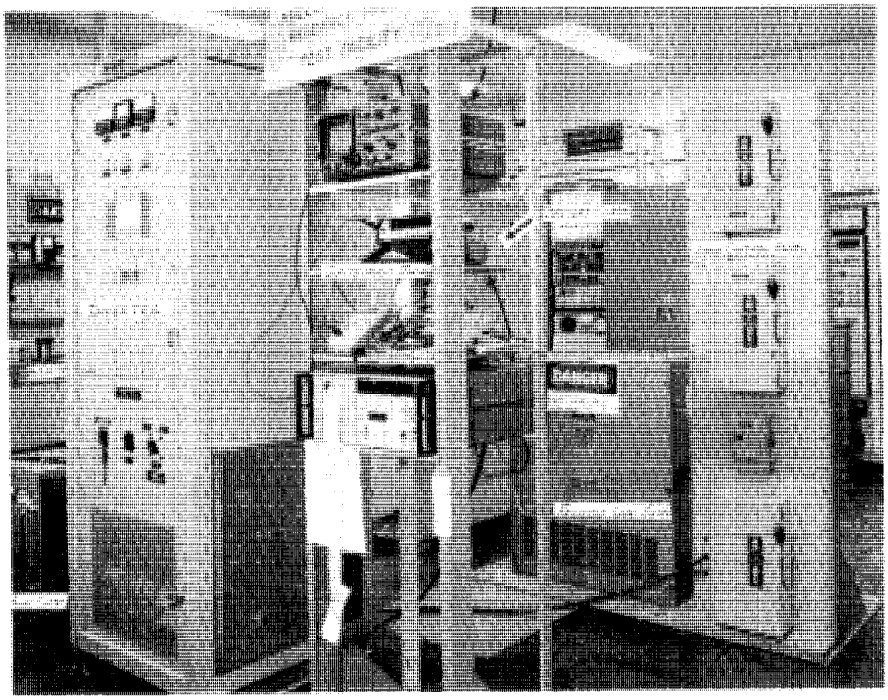
Maintenance to Manage Aging. Maintenance, in its broadest sense, is one of the keys for managing plant aging and will play a pivotal role in life extension/license renewal. The Surry feedwater pipe break and the North Anna steam generator tube rupture are examples of the events that confirm the premise on which the NPAR program is based, with its evaluation of component maintenance effectiveness to alleviate aging concerns. That premise is that component aging, if not adequately managed, will lead to component degradation and often to failure, which will result in (1) reduced component reliability, (2) increased system unavailability, and (3) a concomitant increase in overall plant risk.

To identify the considerations that can contribute to adequate management of component aging, the NPAR program has focused on resolving three major questions with respect to maintenance: (1) what components, systems, and structures to maintain, being susceptible to aging and thus risk-significant; (2) when to maintain them; and (3) how to maintain them.

The NPAR program approach for addressing the following five major maintenance issues has consisted of (1) setting priorities for the selection of risk-significant components, systems, and structures; (2) understanding the aging degradation mechanisms in these selected components, systems, and structures; (3) identifying the degradation sites within the component boundary of interest; (4) evaluating the adequacy of current inspection strategies and detection and mitigation methods for these aging degradation mechanisms; and (5) developing recommendations for improved maintenance practices for these components. Recommendations were made to enhance the maintenance rulemaking process for achieving an effective maintenance capability for managing aging in components and structures.

Components, Systems, and Facilities

Emergency Diesel Generators. Emergency diesel generators (EDGs) used in nuclear power plants are exposed to aging stresses from the environment and from operating and testing practices. Roughly half of the failures appear to be caused by some form of aging degradation. It has been concluded that the basis for the monthly testing of the EDGs should be changed from one of gaining statistical information to developing operational information on key engine performance



The decommissioning of the Shippingport nuclear power plant in Pennsylvania has made available various items of aged equipment—such as the inverter and battery charger shown here—for testing and evaluation.

parameters, in order to understand whether the trends in the engine operation are normal or possibly a sign of aging and wear problems. Since the testing requirements imposed on the EDGs constitute a major service condition and may cause the most severe aging degradation, it was recommended that (1) a more complete inspection and performance monitoring program be considered to help in mitigating certain aging-failure processes; (2) major engine overhauls should not be based entirely on inspection needs; and (3) preventive maintenance programs should be improved to mitigate stresses that result in wear and vibration on such components as the engine governor.

Service Water System. The service water system is important to aging assessments because it is the final link in the transfer chain between the reactor core and the ultimate heat sink. The study indicates that the accumulation of biological and inorganic matter, as well as corrosion, is the primary aging degradation mechanism in this system. However, the current level of surveillance and post-maintenance examination is not sufficient to accurately track and detect the system aging degradation. It was recommended that an improvement in record-keeping of failures and aging degradation be implemented. In addition, a method of analysis for root causes will be developed in 1989 and employed to define the depth of knowledge required to accurately characterize the system's age-related degradation.

Component Cooling Water Systems. Aging assessment of component cooling water systems in PWRs indicated that the component failure rate increases as the plants become older. The components that failed more frequently were valves, pumps, instrumentation and control devices, and heat exchangers. This trend was obvious for systems that are continuously operating and thus expose components to continuous operational stresses.

The implications of component aging for system unavailability was assessed to better understand its impact on plant safety. Using the probabilistic risk assessment (PRA) approach, it was found that, unless these aging rates are properly managed, system unavailability would increase significantly (four-to-five times) after 20 years of plant operation. The study also indicated that maintenance and testing activities should focus more on pumps as plants grow older. It was also observed that heat exchangers and piping have the potential to become very important for system unavailability during later years of plant life.

Shippingport. The Shippingport (Pa.) nuclear power plant, out-of-service after 25 years of operation and undergoing decommissioning, is a valuable source of aged equipment for the nuclear plant aging research (NPAR) program. As the first U.S. large-scale, central-station nuclear plant, the Shippingport reactor is similar to current commercial PWRs in design and operation. Its quarter-century of service exceeds the operating history of most currently active nuclear power plants. Also, because of substantial modifications during the mid-1960s and 1970s, Shippingport offers unique examples of identical or similar equipment used side by side, but representing different vintages and degrees of aging.

The decommissioning of Shippingport has been coordinated with activities of programmatic importance in the NPAR (e.g., data acquisition, including records and operating histories). In an ongoing activity, NRC contractors have conducted *in situ* assessments of Shippingport components. Thus far, more than 140 items of different sizes have been shipped to NRC contractor laboratories. Investigation and evaluation of these components and material specimens will continue.

Electrical and Mechanical Components. In fiscal year 1988, the NRC entered into a six-year international agreement with the French Commissariat a l'Energie Atomique (CEA) for cooperative research on long-term electrical cable aging degradation in nuclear power plants. Under the agreement, the CEA is to irradiate and thermally age both French and U.S. cables in their OSIRIS test reactor at Saclay, at a ten-fold acceleration rate. The French are to irradiate the same cable materials in parallel at the Saclay POSEIDON cobalt-60 gamma irradiation facility. Periodically during the aging, cables and material specimens will be subjected to a LOCA ("loss-of-coolant accident") qualification test in the Saclay CESAR steam chamber. The research results are expected to provide a realistic assessment of electrical cable degradation with age for in-containment safety-related service and to determine the effect of age on cable behavior during a design basis accident.

In addition, the parallel tests in the OSIRIS reactor and the POSEIDON irradiation facility will provide an estimate of the efficacy of procedures used by industry in qualifying electrical cables. The NRC, under the agreement, will test French and U.S. cables in the LICA cobalt irradiation and LOCA steam facilities at Sandia National Laboratories (SNL), in the period from 1989 to 1990.

Cable aging degradation and condition monitoring tests of 12 U.S. cable types, discussed briefly in the *1987 NRC Annual Report*, were continued at SNL.

A summary report on aging assessments and monitoring methods evaluations of motor-operated valves (MOVs) used in engineered safety systems of nuclear power plants was also completed and incorporated in a NUREG report. Methods for inspection, surveillance, and monitoring were reviewed and recommendations made for practices to alleviate aging failures in MOVs.

Battery Chargers and Inverters. A naturally aged inverter and battery charger obtained from the Shippingport facility was tested during the report period. The objectives of the test were to evaluate the naturally aged equipment state, determine the effectiveness of condition monitoring recommendations, and obtain insight into the practicality of preventive maintenance and monitoring methods.

The two primary monitoring techniques employed were temperature measurements and electrical waveform observation. Internal panel temperature, as well as individual component temperatures, was recorded at regular intervals during steady-state and transient operations. Non-intrusive means of monitoring component operation were implemented. Testing of the inverter under degraded conditions proved that the inverter could remain functional despite the removal of one or more input and output filter capacitors.

Monitoring the internal panel temperature—as well as key components such as the transformers, inductors, and filter capacitors—was recommended to detect overheating prior to degradation and failure.

Electric Motors. For smaller motors (under 200 hp), which constitute 90 percent of the motor population in a typical nuclear power plant, the stator insulating system and bearing assemblies were the subcomponents that most frequently failed. They account for almost 70 percent of the reported failures. Large motors, on the other hand, are equipped with devices to monitor the motor insulation and bearing and oil temperatures, and corrective actions can be implemented for those motors immediately on indication of excessive temperatures. The major factors contributing to large-motor failures include voltage surges and mechanical stresses from centrifugal or magnetic forces.

Bearing temperature and bearing vibration measurements are proven indicators of degradation in bearing assemblies. These tests can be performed with portable units, and the results projected to assess future conditions.

Monitoring of insulation conditions can be categorized in two different areas: average and localized. Dissipation factor (or power factor) and capacitance testing provide overall information on the entire insulating system. A.c./d.c.-leakage current testing with step voltage increases also indicate insulation deterioration. These tests can determine if cracks, voids, thinning, or other degradations are present in the insulating system. Defects at their early stage are difficult to detect, and some might remain undetected and can become the source of eventual insulation failure.

Partial discharge tests are also high-voltage tests as used to determine the status of insulation material. However, for low-voltage motors, this test is difficult to perform. On the contrary, for high-voltage motors, this test can yield useful information on the insulation condition.

Decommissioning

The NRC continues to develop an information base for decommissioning LWRs and other nuclear facilities.

Reports on decommissioning cost-estimate updates—and also progress reports on activities and information obtained from actual or related decommissionings of LWR activities—are in preparation. Research on identification of radionuclide source terms that would result from a decommissioned reactor is continuing both experimentally and theoretically.

On June 27, 1988, final rule amendments on decommissioning nuclear facilities were issued (53 FR 24018). Regulatory guidance is in preparation to provide additional information on implementation of the rule in the areas of financial assurance, license termination, content of decommissioning plans, and record-keeping.

Spent Fuel Storage

The final rule amendments on licensing requirements for the independent storage of spent nuclear fuel and high-level radioactive waste were published on August 19, 1988 (53 FR 31651). Regulatory guidance is in preparation on storage of spent fuel. (See the *1987 NRC Annual Report*, p. 119, for background.)

Chemical Decontamination

The NRC continued to develop an information base for reducing occupational doses in nuclear power plants and for assessing the impact of decontaminations on nuclear plant solidification systems. Measurements were made of recontamination rates following chemical decontaminations at operating nuclear power plants. A report analyzing these results was being prepared at the close of the report period.

Shippingport Shield Tank

A program was initiated during the period to determine the effect of low-temperature, low-flux irradiation on the mechanical properties of the neutron shield tank of the Shippingport reactor (see above). With the identification of embrittlement in the pressure vessel, an urgent need was recognized to assess possible embrittlement in present-day reactor supports. (The construction material in the Shippingport neutron shield tank (vessel support structure) is equivalent to that used in present-day support structures.)

A coring tool procedure was developed for extracting six-inch disc samples from the outer and inner wall of the shield tank. The two walls of the neutron shield tank were separated by three feet of concrete, and this made the coring and retrieving the six-inch-diameter samples rather difficult. Twenty-four cores were taken from the tank—12 from the outer wall and 12 from the inner wall. Two of the cores represented material from weldments, while the others were from the base metal. The samples were also taken from locations that would represent different levels of fluence.

Preliminary results in the area of base metal indicated that the low-temperature, low-flux irradiation has significantly lowered the toughness of the shield tank (support) material.

REACTOR EQUIPMENT QUALIFICATION

Electrical Equipment Qualification

An assessment of mechanistic models for estimating source terms, as described in NUREG-0956, was completed. The radiation dose to equipment from beta and gamma radiation (generated by fission product activity and released to containment during accidents) was calculated and presented in NUREG/CR-5175. The integrated radiation dose received by safety-related in-containment equipment from this mechanistic model was shown to be in reasonable agreement with the 200 Mrad integrated dose calculated by the deterministic methods in Regulatory Guide 1.89.

Valve Operability and Survivability

Experiments were conducted during the report period to determine whether valves in high-energy pipes will close as they should to prevent leakage during a pipe break accident outside the containment, when very high velocity flows will develop in the pipe. The leakage, if unchecked—and the valves do not close—can have serious consequences, not only because of steam release outside containment, but also because other emergency equipment may be exposed to the harsh steam environment and fail.

Most valve actuators are sized by analytical methods and provide the force required to close the valves under conditions postulated for analysis. However, since the water in a high-energy pipe is under both high pressure and high temperature, some of the water will rapidly flash to steam at the break. If this rapid change of water into steam propagates inside the valve, the effect of the flashing on valve hardware is very difficult to assess by analytical methods. Therefore, experiments were conducted to directly measure the magnitude of the force required to close valves under pipe-break conditions.

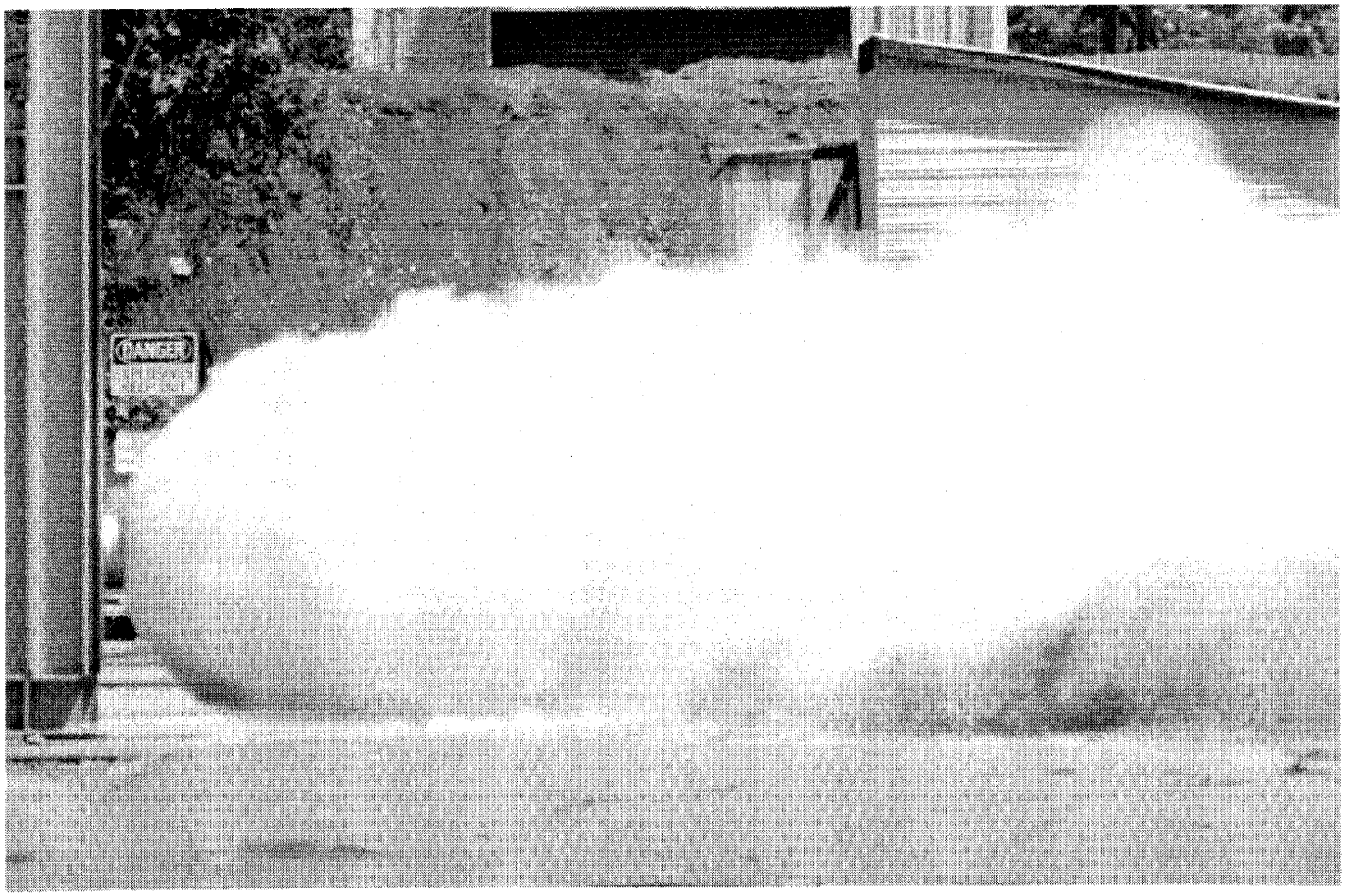
Results of the first series of experiments showed that valve closure was achieved during each blowdown test. However, evidence exists to show that numerical

values used in the analytical methods in the past may not be conservative for all valve applications. Although all tests were successful for the hot water conditions, there is an important need to understand and to validate the existing method for sizing actuators. In addition, it is necessary to develop procedures that can be used to demonstrate and/or assess whether older valves in operating plants will also close under adverse break conditions. Therefore, research effort will continue in 1989 with additional tests involving other fluid environments and with the development of procedures for evaluating installed valves.

The seismic testing program was completed in 1988. A typical U.S. piping system was considered, with a 30-year-old (aged) valve installed. The objective was to excite the piping to increasing levels of earthquake loads (to a maximum of eight times the typical level) in order to determine whether and how valve operability would be affected. There was first the concern that the valve internal parts might bind under such loads, preventing the valve from operating. Another part of the test was aimed at obtaining pipe stress data for validating a pipe-design computer program. The third important goal was to determine the response characteristics of the pipe supports, snubbers, and anchors as a result of these large dynamic loads.

The test data records had not been processed at the close of the report period. Preliminary results indicated that the aged valve operated successfully during and after each test. It is not known whether the valve stroke times changed at the high excitation levels.

The pipe underwent maximum strains in excess of 0.4 percent in one cross section of an elbow; nevertheless, there was no visible physical damage either by deformation or cracking at this location. Although the pipe system has been subjected to many kinds of excitations over the past 15 years while it has been used as a test loop, it remained strong.



A series of experiments was conducted in 1988 to test valve closure under accident conditions. The typical exhaust plume shown above has been emitted from the exhaust pipe during a blowdown experiment. The test valve cannot be seen; it is located approximately 20 feet upstream from the exhaust pipe exit plane. An asphalt service road appearing in the bottom foreground of the photo is about 15 feet wide. During the first blowdown test, the exhaust plume broke up an eight-foot section of the road across its entire width. The chunks of asphalt were projected upward and outward for considerable distances; power lines 30 feet above the road were knocked out; and trees located 60 feet behind the exhaust were stripped of their bark up to a height of 10 feet. The experiments, relevant to exhaust equipment design, were conducted for the NRC by Wyle Laboratory in Huntsville, Ala.

The mechanical snubbers also experienced very large loads during the various excitation levels, and some of them failed. The failures occurred at loads ranging from three-to-seven times their design loads. One snubber that failed prematurely is being investigated. With the exception of that one premature failure, the snubber failures that occurred during the testing were expected.

Typical U.S. concrete anchors were installed at two snubber locations. The large snubber loads were transmitted to the anchors and caused failures; two other anchors broke the concrete around them and became physically loose. The exact margins for these anchors are not yet known but will be determined through subsequent data analysis.

SEISMIC RESEARCH

The primary goal of the NRC seismic research program is to be able to define the potential for earthquakes at nuclear power plant sites and in the regions around the sites, and to determine the possible effects earthquakes would have on the plants and their safety systems. The three main areas of seismic research are earth sciences, component response, and seismic design margins.

Earth Sciences

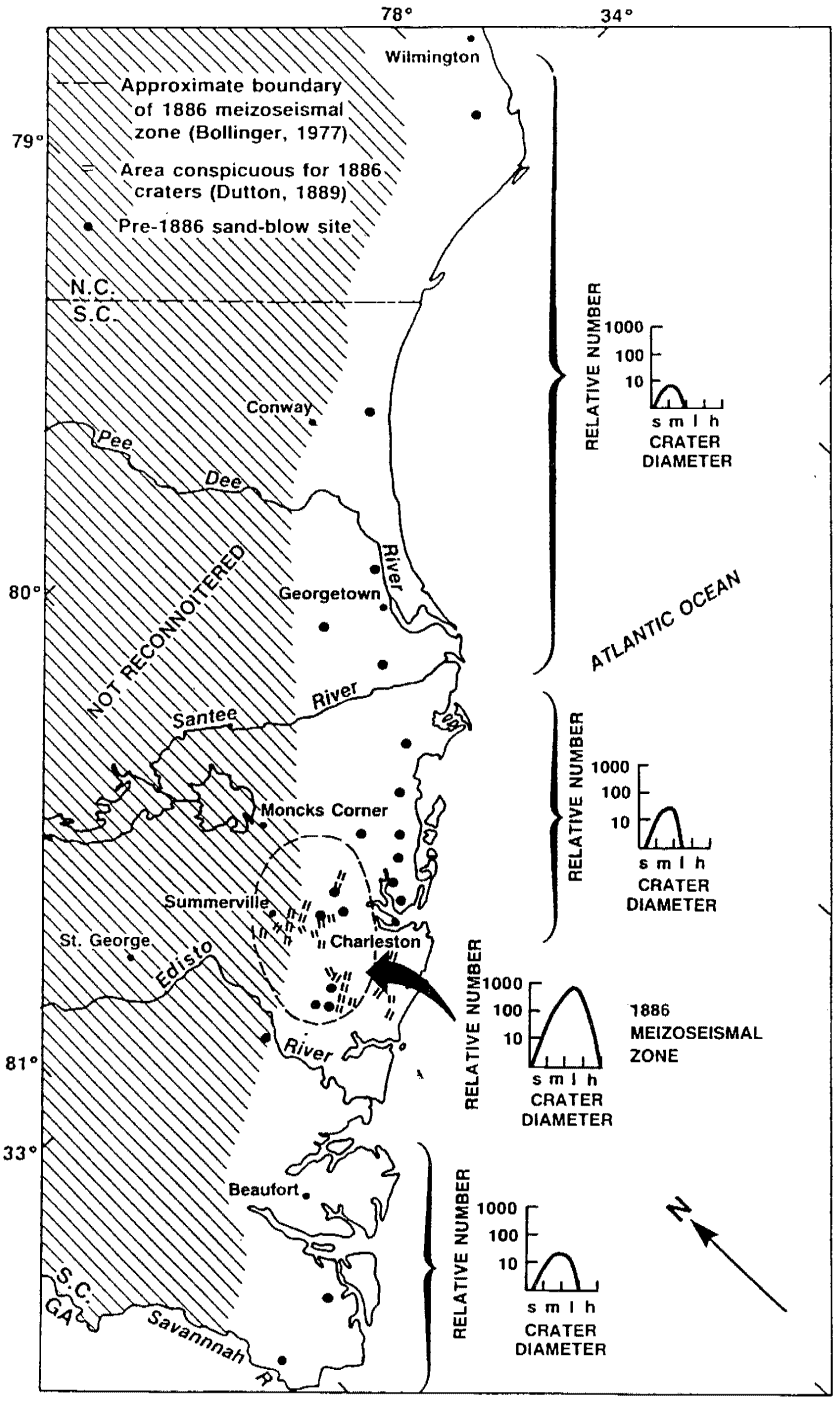
A major focus of the NRC research programs in geology, seismology, and geophysics continues to be identifying and defining potential earthquake sources or source zones in the eastern United States, and then using that information in assessing seismic hazards for nuclear power plants. Many unknowns surround these issues, including the lack of a strong basis for seismic zonation, uncertain source mechanisms, and the difficulty of predicting the characteristics of ground motions, and site-specific response. The NRC is addressing these uncertainties through research that encompasses sustained seismic monitoring, geologic and tectonic studies, neotectonic investigations, exploration of the earth's crust at hypocentral depths, and ground motion studies.

The nerve centers of the NRC program in the eastern United States have been the seismographic networks deployed throughout the eastern and central United States. The NRC is currently funding seismographic networks in the following regions: northeastern United States, Virginia, Charleston, S.C., the Southern Appalachian region, the New Madrid (Mo.) region, Ohio and Indiana, eastern Kansas, and Oklahoma. An agreement was reached in 1986 between the U.S. Geological Survey (USGS) and the NRC to jointly support the establishment of the eastern portion of a national seismographic network. The national network is scheduled to be fully in place by fiscal year 1992. In the meantime, current NRC-funded networks in the eastern and central United States will be gradually phased out.

Northeastern Neotectonics. As part of the seismic research program to improve NRC's ability to estimate seismic hazard in the eastern United States, Columbia University and Pennsylvania State University have, for the past several years, been investigating seismically active regions in the northeast for evidence of Quaternary surface or near-surface tectonic deformation. (The Quaternary is the geologic period variously estimated to have begun from one-to-two million years ago, extending into the present, or Holocene epoch.) Columbia University has concentrated on specific areas where the likelihood of identifying recent surface or near-surface tectonic deformation or paleoseismic features was expected to be high—such as the epicentral area of the 1983 Goodnow earthquake in the Adirondack Mountains, Cape Ann, Mass., the Lancaster, Pa., seismic zone, the Lower Hudson Valley-Eastern Newark Basin seismic zone, and the New Jersey Coastal Plain. Pennsylvania State University has focused its research activities on the Lancaster, Pa., and Moodus, Conn., seismic zones.

The identification of surface or near-surface tectonic structures associated with current seismicity can contribute substantially toward defining earthquake source structures or seismic source zones in the eastern United States. The paleoseismic investigations, by providing isotopic dates of large prehistoric earthquakes, have the potential for providing deterministic guidance for calculating return periods of large earthquakes in the northeastern United States. This would be a major step in assessing seismic hazards in the eastern United States. Field studies associated with these projects were completed during the past year and the final reports are being prepared.

Charleston Studies. Over the past few years, the NRC has funded studies by the USGS and the University of South Carolina of soil deformed by liquefaction during the 1886 earthquake and of similar, but older, features (paleoliquefaction features) that were apparently formed by prehistoric earthquakes of about the same size. The finding of this program—that paleoliquefaction features occur less frequently and become smaller in size the farther away from the Charleston meizoseismal area they are located—indicates that the paleoseismic events occurred in the same vicinity as the 1886 earthquake, but could have been larger. To date no paleoliquefaction features have been identified north of Southport, N.C. Findings



This map shows the distribution of diameters and the relative number of pre-1886 liquefaction craters on the southeastern Atlantic coast. The fact that both the size and abundance of the craters decrease with distance from Charleston, S.C., indicates that the Charleston area has persistently higher seismicity than other areas along the southeastern coast.

coming out of this program thus far support the NRC position taken in past licensing decisions that the Charleston seismic area is unique.

Two and three-dimensional stress models based on seismicity have been constructed by the Law Engineering and Testing Company to clarify causes of seismicity and to attempt to decipher the tectonic stress environment of the Charleston area. The models show that the crust beneath the Blue Ridge mountains of the Appalachians is highly stressed, which is consistent with observed seismicity. The modeling also indicated that the Charleston area was a region of relatively high stress and that the lower seismic areas, such as eastern

North Carolina and southern Georgia, are characterized by low stress. This research suggests that stress modeling can contribute to an understanding of the seismic potential of certain areas. Results of research by the University of South Carolina in the Charleston earthquake epicentral area show that seismicity seems to be concentrated at the intersections of sub-surface faults.

Virginia Piedmont. Research in the central Virginia seismic zone by the Virginia Polytechnic Institute—which consisted of surface geologic mapping, seismic reflection profiling (both within the seismic zone and outside of it), monitoring seismicity and analyzing earthquake data, and reprocessing a USGS-acquired seismic reflection profile along Route I-64—led to a reinterpretation of the basement structure under the Piedmont and Coastal Plain. Among the more important findings of this research are these: (1) the crust that comprises the seismic zone contains a greater number of sub-surface reflectors than the aseismic areas. This finding is interpreted to indicate that the seismic area crust is more highly faulted and sheared than the non-seismic crust; and (2) the seismic zone overlies a section of the crust where the mantle is considerably more shallow than surrounding areas.

Eastern Tennessee. This region is an area in the southeastern United States characterized by relatively high seismicity. The NRC is funding studies in the area by Memphis State University and Georgia Tech. Geophysical and "travel time residual" studies have indicated that the seismicity is correlated with local structure and regional lineaments, such as the New York-Alabama lineament. Stress models have shown this seismic area to be one of locally higher stress.

New Madrid. Considerable research has been conducted by the NRC over the past decade in the New Madrid (Mo.) seismic zone. Based on this work, and on research conducted independently by the USGS, it was concluded that the New Madrid seismic zone follows the trend of the buried Reelfoot Rift that underlies the axis of the south-central Mississippi Valley. Geophysical studies have shown that faults associated with the rift extend into the Wabash Valley between Illinois and Indiana, but that they are apparently cut by the east-west striking Shawneetown-Cottage Grove Fault System near the 38th parallel. Augmenting the ongoing seismic monitoring of this region by NRC-funded networks operated by Memphis State, St. Louis University, and the University of Kentucky, a grant was issued in 1987 for the University of Kentucky to install a seismometer and a three-component downhole accelerometer in a 100-meter-deep hole in western Kentucky, in order to explore the specific characteristics of earthquakes at frequencies greater than those sampled by the conventional installations now in operation.

Anna, Ohio. Data from NRC-funded research conducted by Purdue University, Indiana University, and the University of Michigan have now shown that faults related to the New Madrid and Wabash Valley Fault Systems do not extend into the Anna, Ohio region. A possible explanation for the seismicity of the Anna area is the reactivation by crustal stresses of susceptible zones of structural weakness.

Southern Illinois Earthquake. A discussion of research sponsored by the NRC immediately following the June 10, 1987 southern Illinois earthquake was given in the 1987 NRC Annual Report, p. 123. Additional studies initiated in 1988 include an analysis by the University of Kentucky of more than 50 coalfield blast monitors that were triggered by the earthquake—in order to obtain information on peak particle velocities, frequency content, and response spectra—and a study by the USGS regarding the propagation of audiofrequency (20 Hz) seismic waves from this earthquake sequence over regional distances, and their amplification by site response.

Meers Fault Studies. The initial NRC-funded investigations of the historically aseismic Meers Fault in Oklahoma have been completed. In 1987, a contract was awarded to Geomatrix Consultants to completely characterize the Meers Fault for seismic assessment and to determine if there are other such faults within the Wichita Frontal Fault System that may have been reactivated during the Quaternary. Geomatrix has dated the most recent displacement at 1,300 years ago and also found geologic evidence of at least one earlier event 2,000 years before the present. Geomorphic evidence also indicates faulting events that occurred 100,000 to 200,000 years ago.

Another fault in the Wichita Frontal Fault System, the Washita Valley Fault, east of the Meers Fault, has been investigated during the past two years under an NRC grant to the University of Arkansas. Like the Meers Fault, this fault is not known to be associated with historic seismicity. Although geologic and geomorphic evidence suggest Quaternary displacement along the Washita Valley Fault, trenching at several locations along the fault trace has revealed no positive evidence to date of post-Cretaceous offset (i.e., since about 53 million years ago.)

These studies are extremely important, not only to assess the seismic hazard posed by these faults, but also to test the validity of an assumption used frequently in the licensing process—that the lack of associated seismicity is an important criterion indicating that a fault is not "capable," within the meaning of Appendix A to 10 CFR Part 100.

California. NRC has been funding research projects conducted by the University of California at Santa Bar-

bara and the USGS to determine whether, and to what extent, soil columns over bedrock amplify or attenuate seismic ground motions. An experiment has been under way at McGee Creek, near Mammoth Lakes, Cal. This is an area of high seismicity with a relatively thin soil column consisting of glacial till on top of hornfels bedrock. Seismic recording instruments were placed in core holes at various depths to monitor the propagation of strong ground motions between bedrock and ground surface through the soil column. A significant set of data on the propagation of strong ground motion in a shallow soil column has been obtained. Because the soil column was a specific kind (glacial till), it was decided to perform the same kind of experiment in another high seismic area that is characterized by alluvial soils overlying shallow bedrock. The site selected was near a splay of the San Jacinto Fault near Anza, Cal. Seismographs and accelerometers were being installed in five core borings at various levels, ranging from ground surface, through the soil, and into sound bedrock.

Pacific Northwest. There is a major lack of information in the geology of the Pacific Northwest concerns the nature of the Juan de Fuca subduction zone, off the Pacific coast, and its potential for generating a great earthquake. Evidence from tidal estuaries along the coast, consisting of several buried cyclical layers of marsh and swamp deposits, overlain by shallow marine clays, suggests a sudden subsidence. Based on experience in Alaska and Chile, these subsidences are postulated to have accompanied great subduction zone earthquakes. Dating of organic materials within the marsh deposits indicate five-to-eight subsidence events during the Holocene epoch, the last about 300 years ago.

A second major issue in the Northwest is the nature of ground motion from a subduction zone earthquake. Along with the geologic investigations, the NRC is funding a USGS study in the Santiago, Chile region, the location of a magnitude 7.8-Richter subduction zone earthquake in 1985. The study consists of an analysis of all data from this event and its aftershocks, for the purpose of determining the characteristics of strong subduction zone earthquake ground motion, for use in nuclear licensing activities in the U.S. Pacific Northwest.

Crustal Motion Measurement. In cooperation with the National Geodetic Survey, the NRC is sponsoring a Crustal Motion Network of 45 stations covering the eastern two-thirds of the United States. Highly accurate positions of these stations will be measured with the Global Positioning System, at intervals of about two years. A first set of measurements was performed in fiscal year 1988. Results were very encouraging, in that accuracies of a few parts in 10 were achieved. With this kind of accuracy, errors over a baseline of 2,000 kilometers amount to only a few centimeters. By remeasuring the stations over a period of time, it should be possible to directly determine crustal motion in the eastern and central United States. Such measurements may then provide an indication of belts of larger motion that may exist, and thus help define areas with higher seismic hazards.

Soil Response to Earthquakes. A research program conducted by the Army Corps of Engineers continues to validate dynamic stress models of soil settlement resulting from seismically induced liquefaction. Data from Cambridge University centrifuge tests compared well with the predictions of the two-dimensional effective stress model, TARA, developed during the course of this research program. Research to expand the current research project to consider modeling three-dimensional effects and to update the two-dimensional TARA code was started in fiscal year 1988.

Component Response to Earthquakes

Seismic Category I Structures Program. The last static test in a series of large, reinforced concrete models, representing a portion of a nuclear power plant, was completed during the report period. Results from this test, like those from the two tests in 1987, exhibited excellent agreement with analyses typically performed by design engineers. The findings, however, contradict dynamic test observations made from 1982 to 1986. Investigation into the possible reasons for the differences continues.

A new project, "Assessment of Effects of Structural Response on Plant Risk and Margin," was begun in fiscal year 1988 to determine if the analytical-experimental differences have safety implications on operating power plants. Probabilistic risk assessments (PRAs) and "design type" calculations for three prototypical power plants will be re-evaluated using analytical-experimental differences from past test data. The impact on seismic risk and margin for the first plant, a rock site boiling water reactor, will be available in 1989. Analyses on the other two plants, rock-site and soil-site pressurized water reactors, will be completed in 1990.

Reports published in the report period include NUREG/CR-4998, "Seismic Category I Structures Program: Results for FY 1985," NUREG/CR-5182, "Seismic Category I Structures Program: Results for FY 1986," and NUREG/CR-5154, "Experimental Assessment of Damping in Low Aspect Ratio, Reinforced Concrete Shear Wall Structure."

CARES. Computer Analysis for Rapid Evaluation of Structures (CARES), a personal computer based

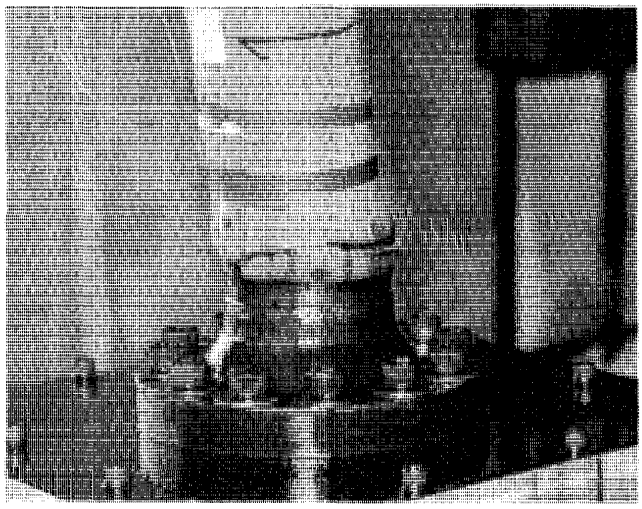
system, has recently been developed by the Brookhaven National Laboratory (BNL) for use in the NRC's evaluations of structural behavior and the capability of nuclear power plant facilities under earthquake loads. Specifically, the CARES system will be used by the NRC staff to assess analysis methods used for structural safety evaluations. In the past year, efforts were concentrated on developing a seismic analysis module for the CARES system that would allow for the definition of the input ground motion in terms of generic or site-specific design spectra and the computation of time histories, and floor response spectra, at a given location in a structure. BNL also initiated the development of a data base to be used with the CARES system. The data base is designed to facilitate the input required by CARES and to permit active storage of structural, geotechnical, and seismic information. Future efforts will be directed toward completing the data base, incorporating a static analysis module, and documenting the CARES system in manuals that cover theoretical and computational aspects of CARES.

Piping and Fitting Dynamic Reliability Program. In recent years, both the U.S. industry and the NRC have been concerned about the appropriateness of piping design rules for seismic and other dynamic loads. The NRC Piping Review Committee recognized the need to obtain failure data for dynamic loads and recommended that the NRC support a test program in this area. The proposal resulted in the NRC's cooperating with the Electric Power Research Institute (EPRI) in the Piping and Fitting Dynamic Reliability Program (PFDRP). The program was initiated in 1985, with three main objectives:

(1) To identify failure mechanism and failure levels of piping components and systems under dynamic loadings.

(2) To provide a data base that will improve predictions of piping system response and failure resulting from high-level dynamic loads.

(3) To develop an improved and defensible set of piping design rules for inclusion into the ASME Code.



The bulging and cracking of this pressurized pipe test specimen is typical of the dynamic failure behavior observed in the EPRI/NRC Piping and Fitting Dynamic Reliability Program, conducted at ETEC in Canoga Park, Cal. While there is concern that current dynamic load design criteria for nuclear plant piping do not directly address the observed cyclic nature of failure, it was reassuring to find that piping could withstand load levels much greater than previously believed.

The first two of these objectives were met in 1988 with the completion of all PFDRP testing, data reduction, and analysis. The test results consistently showed that piping has very high resistance to dynamic inertial loads; typically failure was produced only by dynamic input loads scaled 15-to-30 times higher than design levels. The failure mechanisms were different from what was assumed when the current ASME Code piping design rules were developed, i.e., piping rupture was caused by ratchetting and fatigue effects, and cross-sectional collapse did not occur.

Altogether, 41 piping component failure tests were completed by ANCO Engineers. Two piping systems were ruptured by high seismic-like loads at Energy Technology Engineering Center, and one of these systems was retested. The Materials Characterization Laboratory finished testing over 140 fatigue ratchetting specimens. Also, waterhammer pipe systems tests were performed by ANCO Engineers.

Several steps have been completed toward meeting the last objective listed above. New concepts for piping design rules have been introduced and discussed with the NRC staff. General Electric is now developing a final proposal for revising the piping dynamic load stress criteria given in Section III of the ASME Boiler and Pressure Vessel Code. The proposal is expected to be introduced formally to the ASME in the spring of 1989.

Seismic Component Fragilities. A test program dealing with electrical relays was initiated in which 15 relay models (approximately 43 test specimens) are involved. One objective of the program is to investigate the validity of the concept of qualification by similarity, whereby one relay is seismically qualified based on testing performed on another, similar relay. Because of the importance of electrical relays, both during and after earthquakes, in controlling the reactor, it was decided that the NRC would independently confirm the qualification-by-similarity concept. A second objective of the program is to determine how relay adjustments—such as spring tension, end play, and contact gap—affect the resistance against seismically induced "chatter/change" of state. Additionally, the

impact of both high and low frequency motions, as well as single axis vis-a-vis biaxial and triaxial motions, is to be experimentally investigated for each relay model.

Cooperative International Seismic Programs. The NRC's participation in international seismic test programs is beneficial both in the sharing of research resources and in different perspectives on seismic design issues. The pooling of resources allows the development of bigger, more complex, test articles. These larger scale tests are an important element in the validation of methods to predict the seismic response behavior of nuclear plant systems.

The NRC is cooperating in three such programs:

(1) A soil-structure interaction (SSI) experiment is being conducted at a site in Lotung, Taiwan, in collaboration with EPRI and the Taiwan Power Company. The objective of the experiment is to obtain measured earthquake response data from a soft soil site that will validate the accuracy of analytical predictions of SSI effects. Fourteen earthquakes have been recorded, three of which exceeded Richter magnitude 6.0. A workshop was held in December 1987 at which the results of the experiment were discussed. At the close of fiscal year 1988, a report synthesizing the workshop discussions and evaluating the adequacy of state-of-the-art methods based on recorded data was in preparation.

(2) The Phase II experiments have been performed at the Heissdampfreaktor (HDR) facility in Kahl, Federal Republic of Germany, in collaboration with Kernforschungszentrum Karlsruhe (KfK). The results of the first series of tests are now under evaluation. A second series of tests was run in April-May 1988, in which the piping loop was excited well into the inelastic range. Although failure of piping did not occur, the resistance to high dynamic loads was demonstrated, and valuable dynamic response data were obtained. Results will be available in the spring of 1989.

(3) Seismic tests of a $\frac{1}{2.4}$ scale model of a PWR piping loop were performed on the large shaker table in Tadotsu, Japan, in collaboration with the Japanese Ministry for International Trade and Industry (MITI). The experiment, carried out in April 1988, was successful in exciting the modified piping loop model well into the inelastic range. Both ratchetting and dynamic crack growth occurred. A final report will be available in the fall of 1989.

Seismic Design Margins Methods

Seismic margins review procedures have been found to be an effective and efficient way to assess the capability of nuclear power plants to safely withstand earthquakes larger than their design basis level. The results of seismic margins evaluations can be used to answer questions regarding the effects of higher seismic hazard at a site or to identify what systems and plant functions are most relied upon to lessen the probability of core damage resulting from earthquake events. Current planning for the implementation of the Severe Accident Policy Statement has the use of seismic margins reviews under consideration.

EPRI, Georgia Power, and the NRC began the cooperative seismic margins review of Hatch Unit I (Ga.) in 1988. In addition to review and comment by the NRC staff, the NRC is contributing by sponsoring an independent Hatch Peer Review Group (five expert consultants with expertise in plant systems and seismic evaluation), and a separate fault-tree analysis, to complement the success path analysis sponsored by EPRI. The first major plant walkdown was scheduled for November 1988, and the final evaluations and documentation were expected to be completed in the spring of 1989. Georgia Power is performing its USI A-46 (seismic equipment qualification in operating plants) review of components and tanks in conjunction with the margins review.

Other seismic-margin activities in 1988 include the publication of a BWR systems study (NUREG/CR-5076), updating of the PRA fragility data base (Revision 1 of UCID-20571), and the first phase of a study to compare two methods for predicting component seismic capacities.

Confirming Safety of Nuclear Waste Disposal

The NRC's waste management research seeks to develop and verify methods for predicting and assessing the performance of waste disposal facilities; evaluate and confirm the data bases used in such performance assessments; provide technical support to the licensing staff in their interactions with the Department of Energy (DOE) and the States (see Chapter 7); and develop regulatory standards to support the licensing of facilities and methods for the disposal and management of high-level and low-level radioactive wastes.

High-Level Waste

The NRC maintains active research programs in hydrology, geology, materials science, geochemistry, and several other disciplines related to the management of high-level waste (HLW). The research combines theoretical study with laboratory and field experiments to identify the physical processes that control and determine repository performance in the unsaturated volcanic tuff, the type of geologic medium found at the Yucca Mountain site (Nev.) currently under consideration by DOE as directed by the Congress in December 1987. In 1988, NRC research focused on tuff. The ultimate goal of the NRC's waste management research is to provide the technical bases for the licensing staff to make independent judgments as to the appropriateness and adequacy of DOE's demonstration of compliance with statutory mandates (10 CFR Part 60) and with the Environmental Protection Agency's HLW standard, while DOE goes about the task of providing a permanent high-level waste repository. Key technical issues being addressed are unsaturated flow and transport mechanisms, fault delineation and assessment of seismicity potential, and geochemical assessment (in particular, partially saturated media).

Geohydrology. Since transport by ground water is the most likely path by which radionuclides from disposed waste can reach the environment, the NRC is actively studying the movement of ground water in the unsaturated fractured media being considered by DOE. Experimental sites have been located in fractured rock, both above and below the water table, and field testing is being conducted by the University of Arizona and In Situ, Inc., respectively. The objectives of the field studies are to determine what types of measurements are needed to characterize the hydrology of fractured media and how measurement data should be analyzed to model ground-water flow. The field study in saturated fractured rock was initiated in September 1985 to test the relationship between field measurements of parameters and model data derived from earlier work. The field study in unsaturated fractured rock was begun at an unsaturated tuff site in Arizona in the spring of 1987. This work, being carried out by the University of Arizona, is assessing techniques and methodologies for fracture characterization, infiltration and percolation studies, rock and matrix permeability testing, vapor-phase flow and transport assessment, and numerical simulations of flow and transport in partially saturated media. The importance of large, natural, anomalous hydrologic features, appropriateness of continuum-versus-discrete fracture models, measurements of effective porosity, theories of spatially projecting dispersion measurements, and distinctions between matrix diffusion, dispersion, and sorption are among the subjects addressed in this study.

Cooperative experiments and data analyses being done under a cooperative agreement between NAGRA (Switzerland) and the NRC that was negotiated during fiscal year 1987 will augment the field testing program cited above.

Waste Package Performance. Investigating the performance that can be expected from the waste form and waste package is essential to the NRC's ability to independently evaluate DOE's demonstration that both form and package comply with the containment and controlled release requirements of 10 CFR Part 60. During 1988, NRC sponsored research on the integrated testing of HLW overpack materials in simulated repository environments.

The Japan Atomic Energy Research Institute (JAERI), under a cooperative research agreement with the NRC, continued a series of experiments on the stability of HLW when it is in the form of glass and on the durability of HLW containers in high-radiation environments. This work complements the laboratory research studies being supported by the NRC of radioactive waste containers and of the various forms of radioactive waste.

Geochemistry. The NRC has an active research program in the vital field of geochemistry related to the management of HLW. Work continues at the University of California at Berkeley on the geochemistry of radioactive wastes in repository environments. In 1988, chemical reactions in tuff and ground water in the thermally affected area of a HLW repository were investigated in the laboratory. The NRC is participating in an international field study at an ore body in Australia to examine actual movement of radionuclides. This study will provide a basis for testing performance assessment models to be used in HLW repository licensing. The first year of the study has been completed successfully, with the hydrologic tests well under way. Work was completed at Oak Ridge National Laboratory on the chemistry of technetium in brines that could occur in a salt repository. Chloride ions were not found to affect technetium significantly. Research was initiated at the Center for Nuclear Waste Regulatory Analyses on modeling the chemistry of rock, water, and vapor in a tuff HLW repository.

Rulemaking. In May 1988, the NRC published a notice of proposed rulemaking on required geologic repository disposal of above Class C waste unless an alternative has been approved by the Commission. Comments were under consideration at the close of the report period, with a final rule expected in mid-1989. A final rule on criteria and procedures for evaluating requests for emergency access to low-level waste disposal sites was issued in 1989.

Low-Level Waste

NRC research in support of licensing activities for low-level waste (LLW) disposal facilities centers on (1) the safety and performance of engineered enhancements and alternatives to conventional shallow land burial for LLW disposal, (2) evaluation of the overall performance of disposal systems, (3) water entry into disposal units, (4) performance of waste packages, (5) characterization of the LLW source term, and (6) mechanisms for transport of radionuclides (radioactive nuclei) from the disposal units. This research is useful not only to the NRC licensing staff but also to the States regulating LLW disposal (see Chapter 8). In order to make their research results available to the States during the report period, NRC research contractors, besides publishing their work, made presentations at meetings well attended by State representatives—such as "Waste Management '88," the Oak Ridge Model Conference, and the Annual DOE LLW Management Conference.

Engineered Enhancements and Alternatives to Shallow Burial. There is great interest on the part of States and State compacts in alternatives to shallow land burial for the disposal of low-level nuclear waste. In 1988, Idaho National Engineering Laboratory completed research on the reliability of "engineered components" for alternatives to shallow land burial of LLW. The research indicated that the cover component was most important for the reliability of the engineered alternatives designs. Concrete is expected to play an important role in engineered alternatives to shallow land burial. In 1988, the National Institute of Technology and Standards (formerly the National Bureau of Standards) instituted an investigation for the NRC on the durability of concrete in engineered alternatives to shallow land burial, and Idaho National Engineering Laboratory will conduct further research to develop a mathematical model describing concrete performance.

Contaminant Transport Modeling. An NRC-sponsored cooperative project with Atomic Energy of Canada Ltd. (AECL) and the Battelle Pacific Northwest Laboratories (PNL) used data collected from 40 years of LLW waste disposal at AECL's Chalk River facility in assessing the capability of existing modeling techniques to predict future LLW site performance. The work was done at two Chalk River sites, with well-characterized plumes containing measurable quantities of radionuclides. Modeling was done in two stages. The first stage used a limited data set (20 wells) typical of a site-characterization program. The second stage used the complete data set for each site (over 120 wells-per-site). The results of the site-characterization data set were then compared with the complete data set. Modeling results from the two stages were in reasonably close agreement, thus giving confidence to the use of site-characterization data for predicting future site performance. The greatest uncertainty in this project involved estimating a source term and determining a realistic retardation coefficient for the Chalk River soils.

LLW Waste Forms. Low-level radioactive waste solidified in cement is being tested at the Idaho National Engineering Laboratory to ensure that radionuclide and chemical leaching characteristics, and the compressive strength of the solidified waste, are consistent with NRC technical positions. Under examination is the stability of decontamination waste, obtained from operating nuclear reactors using commercial decontamination processes—such as LOMI, CANDECON, DOW NS-1, and CITROX—and solidified in cement. Field studies are being conducted at the Oak Ridge and Argonne laboratories to determine whether radionuclides are released from solidified waste forms under environmental conditions involving natural precipitation. In 1986, the Brookhaven National Laboratory began an NRC research project to study the use of high-density polyethylene (HDPE) for LLW containers. Representative samples of the material were subjected to the various factors expected in the waste forms and the surroundings—e.g., sulfates, acids, and gamma fields—in order to study their failure and degradation mechanisms and, if possible, to develop methods for predicting the performance of the material over a period of 300-to-500 years. Results thus far indicate that HDPE can be either beneficially or adversely affected by gamma radiation, depending on the dose rate.

Infiltration of Water. The University of California at Berkeley, in cooperation with the University of Maryland, is field testing, at Beltsville, Md., a variety of covers designed to inhibit water percolation into waste disposal units. Covers under investigation include types being considered for future LLW disposal sites and include (1) a compacted clay cover, (2) a compacted clay layer beneath an erosion protection layer (rip-rap), and (3) a compacted clay layer above a conductive layer barrier (flow layer above a capillary break). An additional design under study, "bioengineering management," promises to be highly effective at sites subject to subsidence, or "bath tubbing," because the disposal units have liners or are sited in low permeability sediment. Bioengineering management uses impermeable panels to enhance surface runoff, and vegetation is planted in narrow openings between the panels to remove, by "evapotranspiration," the small amount of water that passes through the panels. Such a system is lowering the water levels in two large lysimeters at Beltsville, while mounded grass-covered lysimeters adjacent to

Part of NRC's research in low-level radioactive waste disposal addresses the problem of water entering disposal units. Shown in the photo is a lysimeter in which the cover consists of impermeable panels and vegetation planted in small openings between the panels. Runoff is enhanced to such a degree that little moisture is able to get through the panel layer. The vegetation seeks the small amount of water available to it and removes the water from the lysimeter by means of "evapotranspiration." This kind of system is lowering the water levels in two lysimeters at Beltsville, Md., while adjacent mounded grass-covered lysimeters are experiencing rising water levels because of water percolation through the vegetative cover.

these are experiencing rising water levels because of water percolation through the vegetative cover. The results of the Beltsville work can be applicable to any disposal scheme employing earthen covers.

Hydrology and Contaminant Transport. The NRC continues to sponsor field tests of flow and transport in unsaturated soils at a New Mexico State University field site near Las Cruces, N.M. The program, which includes NRC-sponsored research by PNL and the Massachusetts Institute of Technology, is intended to provide States and licensees with the ability to realistically model the expected performance of LLW disposal facilities. This work has been formally accepted in the INTRAVAL international study that deals with model validation of ground-water flow and transport models.

Resolving Safety Issues and Developing Regulations

UNRESOLVED SAFETY ISSUES

The Energy Reorganization Act of 1974, as amended, requires that the annual report of the Commission to the President and the Congress include progress reports on those items previously identified as Unresolved Safety Issues (USIs). During fiscal year 1988, five USIs were resolved. Table 1 is a listing of former USIs for which a technical resolution has been achieved, and Table 2 sets forth the schedule for the resolution of USIs currently under review. These current issues are discussed in the summary that follows. With the exception of "PWR Steam Generator Tube Integrity" (USIs A-3, A-4, and A-5), whose resolution has been treated at length in previous NRC annual reports, all USIs resolved during fiscal year 1988 are also discussed below.

SUMMARY OF STATUS

Systems Interactions
(USI A-17)

Adverse systems interactions are events that may jeopardize the independent functioning of nuclear plant systems. Because of the potentially broad bounds of this safety issue, the staff spent considerable effort in defining a safety-significant, and still workable, scope.

The staff has prepared proposed resolution requirements for this issue and these, along with the supporting technical information, were undergoing interoffice review at the close of the report period. The staff expects to issue the proposed resolution for public comment early in fiscal year 1989, with final resolution near the end of fiscal year 1989.

Seismic Design Criteria
(USI A-40)

Rapid advancements in state-of-the-art technology in seismic design over the past decade have made it possible and necessary to update the NRC acceptance criteria for seismic design of structures, systems, and components of nuclear plants. The Lawrence Liver-

Table 1. Unresolved Safety Issues for Which a Final Technical Resolution Has Been Achieved

Number	*Title*	*Report Number*	*Date*
A-1	Water Hammer	NUREG-0927, Rev. 1 NUREG-0933	March 1984
A-2	Asymmetric Blowdown Loads on Reactor Primary Coolant Systems	NUREG-0609	November 1980
A-3	Westinghouse Steam Generator Tube Integrity	NUREG-0844	September 1988
A-4	CE Steam Generator Tube Integrity	NUREG-0844	September 1988
A-5	B&W Steam Generator Tube Integrity	NUREG-0844	September 1988
A-6	Mark I Short-Term Program	NUREG-0408	December 1977
A-7	Mark I Long-Term Program	NUREG-0661 NUREG-0661 Suppl.	July 1980
A-8	Mark II Containment Pool Dynamic Loads	NUREG-0808	August 1981
A-9	Anticipated Transients Without Scram	NUREG-0460, Vol. 4	September 1980
A-10	BWR Feedwater Nozzle Cracking	NUREG-0619	November 1980
A-11	Reactor Vessel Material Toughness	NUREG-0744, Rev. 1	October 1982
A-12	Fracture Toughness of Steam Generator and Reactor Coolant Pump Supports	NUREG-0577, Rev. 1	September 1982
A-24	Qualification of Class 1E Safety-Related Equipment	NUREG-0588, Rev. 1	July 1981
A-26	Reactor Vessel Pressure Transient Protection	NUREG-0224	September 1978
A-31	Residual Heat Removal Shutdown Requirements	SRP 5.4.7	1978
A-36	Control of Heavy Loads Near Spent Fuel	NUREG-0612	July 1980
A-39	Determination of SRV Pool Dynamic Loads and Pressure Transients	NUREG-0802	September 1982
A-42	Pipe Cracks in Boiling Water Reactors	NUREG-0313, Rev. 1	July 1980
A-43	Containment Emergency Sump Performance	NUREG-0897, Rev. 1	October 1985

Table 1. Unresolved Safety Issues for Which a Final Technical Resolution Has Been Achieved
(continued)

Number	*Title*	*Report Number*	*Date*
A-44	Station Blackout	Regulatory Guide 1.155 NUREG-1032 NUREG-1109	August 1988 June 1988 June 1988
A-45	Shutdown Decay Heat Removal Requirements	NUREG-1289 NUREG/CR-5230	September 1988
A-46	Seismic Qualification of Equipment in Operating Plants	NUREG-1030 NUREG-1211	February 1987
A-49	Pressurized Thermal Shock	Regulatory Guide 1.154	February 1987

more National Laboratory compared NRC Seismic Design Criteria with the state-of-the-art knowledge and published the results in its "Recommended Revisions to Nuclear Regulatory Commission Seismic Design Criteria" (NUREG/CR-1161, dated May 1980). Based on these recommendations and results of a staff-sponsored workshop for soil-structure interaction held in June 1986, the staff proposed modifications to related review criteria.

The staff's proposed resolution for this issue has been reviewed by the Committee for Review of Generic Requirements. It was issued for public comment in May 1988. Issuance of the final resolution, including accommodation of public comments, as appropriate, is scheduled for fiscal year 1989.

Station Blackout
(USI-44)

The loss of all alternating current (a.c.) electric power (from both normal off-site and emergency on-site sources) is referred to as station blackout. In the event of a station blackout, the ability to cool the reactor core would be dependent on the availability of systems that do not require these a.c. power sources and on the ability to restore a.c. power in a timely manner.

The Commission amended its regulations on June 21, 1988 (53 FR 23203) to require that light-water nuclear power plants be capable of withstanding a total loss of a.c. power to the essential and non-essential switchgear buses for a specified duration. Regulatory Guide 1.155, "Station Blackout," which gives guidance on how to evaluate plant coping capability for a specified duration, was issued with the station blackout rule (10 CFR *50.63).

The station blackout rule and supporting regulatory guide were developed in response to the staff's study of USI A-44, "Station Blackout." The technical findings are reported in "Evaluation of Station Blackout Accidents at Nuclear Power Plants" (NUREG-1032). A regulatory analysis was prepared and is reported in "Regulatory/Backfit Analysis for the Resolution of Unresolved Safety Issue A-44, Station Blackout" (NUREG-1109). It is estimated that implementation of the rule will limit the contribution to core damage frequency from station blackout-initiated events to approximately one in 100,000 reactor-years. The estimated total cost of industry compliance with the rule is $60 million. These results produce an overall cost/benefit ratio of about one million dollars per 2,400 person-rems dosage prevented. The rule will provide further assurance that a loss of both off-site and emergency on-site electric a.c. power systems will not adversely affect the public health and safety.

The station blackout rule requires that all nuclear plants be capable of coping with a station blackout for some specified period of time beyond which, experience has shown, there is a high probability of off-site power's being restored. The period required for a specific plant will be determined from a comparison of the individual plant's design with factors that have been identified as the main contributors to the risk of core damage resulting from station blackout. These factors vary significantly from plant to plant, because of the considerable differences in design of plant electric power systems, as well as site-specific considerations. The factors include (1) redundancy of on-site

Table 2. Schedule for Resolution of Current Unresolved Safety Issues

Number	*Title*	*Schedule for Issuing Staff Report "For Comment" (as of Sept. 30, 1988)*	*Schedule for Issuing Final Staff Report (as of Sept. 30, 1988)*
A-17	Systems Interactions	November 1988	September 1989
A-40	Seismic Design Criteria	May 1988	June 1989
A-47	Safety Implications of Control Systems	May 1988	June 1989
A-48	Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment	—	December 1988

emergency a.c. power sources (i.e., number of sources minus the number needed for decay heat removal); (2) reliability of on-site emergency a.c. power sources (usually diesel generators); (3) site-specific design provisions for off-site power, including vulnerability of the site to hurricanes, tornados, and ice storms.

Application of the methods in Regulatory Guide 1.155 would determine the station blackout duration (e.g., 2, 4, 8, or 16 hours) for which coping capability must be shown at that plant. However, applicants and licensees could propose alternative methods to that specified in the regulatory guide to justify other durations for station blackout capability. Licensees may also use an alternative a.c. power source to cope with a station blackout if that source meets specific criteria for independence and capacity and can be shown to be available within an hour. The rule calls for submittal of plant-specific station blackout coping evaluations by April 1989. The schedule for implementation of any equipment and associated procedure modifications deemed necessary to meet requirements will be established by the NRC staff in coordination with the licensees; it will generally fall within two years.

Shutdown Decay Heat Removal Requirements
(USI A-45)

The capability to cool a reactor core must be continuously maintained in order to ensure the removal, after reactor shutdown, of decay heat generated by fission products. The staff has resolved this issue by requiring plant-specific analyses under the Individual Plant Evaluation (IPE) program.

Technical findings for this resolution are summarized in NUREG/CR-5230 and include important insights gained from decay heat removal, failure-related, risk assessments for six operating plants. These studies included assessment of the reliability of decay heat removal systems, thermal-hydraulic analyses, emergency operating procedures, system engineering feasibility studies, and evaluation of the vulnerability of these systems to fire, flood, earthquake, and sabotage. A regulatory analysis evaluating six alternative resolutions is reported in NUREG-1289.

These studies, together with the operating history of DHR failures, led to the conclusions that (1) the risk associated with loss of the DHR function could be unduly high for some plants; (2) DHR failure vulnerabilities, and the optimum corrective actions for those vulnerabilities, are strongly plant specific; (3) a new dedicated DHR system is neither cost beneficial nor necessary, and therefore should not be required on a generic (all plants) basis; and (4) detailed plant-specific analyses under the IPE program, as part of the Commission's Severe Accident Policy, will be the most effective means of determining DHR vulnerabilities and the most appropriate corrective actions for each plant.

Table 3. Issues Prioritized in FY 1988

Number	*Title*	*Priority*
43	Reliability of Air Systems	HIGH
55	Failure of Class 1E Safety-Related Switchgear Circuit Breakers to Close on Demand	DROP
57	Effects of Fire Protection System Actuation on Safety-Related Equipment	MEDIUM
62	Reactor Systems Bolting Applications	COVERED IN GSI 29
88	Earthquakes and Emergency Planning	RESOLVED
104	Reduction of Boron Dilution Requirements	DROP
106	Piping and Use of Highly Combustible Gases in Vital Areas	MEDIUM
125.I.3	SPDS Availability	NEARLY RESOLVED
125.I.6	Valve Torque Limit and Bypass Switch Settings	DROP
125.I.7a	Recover Failed Equipment	DROP
125.II.11	Recovery of Main Feedwater as Alternative to AFW	DROP
125.II.13	Operator Job Aids	DROP
126	Reliability of PWR Main Steam Safety Valves	Licensing Issue
136	Storage and Use of Large Quantities of Cryogenic Combustibles on Site	Licensing Issue
C-14	Storm Surge Model for Coastal Sites	DROP
III.D.1.1 (2)	Review Information on Provisions for Leak Detection	DROP
III.D.1.1 (3)	Develop Proposed System Acceptance Criteria	DROP

Safety Implications of Control Systems (USI-A47)

The staff evaluated the control systems of the four U.S. nuclear steam supply vendors that are typically used during normal startup, shutdown, and online power operations of nuclear power plants. The purpose of the studies was to identify those control systems whose failure could cause either transients or accidents to become more severe than those assumed in each plant's licensing basis, adversely affect any assumed or anticipated operator action during the course of an event, cause technical specification limits to be exceeded, or cause transients or accidents to occur at a frequency in excess of those established for abnormal operational transients and design basis accidents. Final reports detailing the staff's review of each of the designs were issued in July 1986.

The studies have identified several control system failures that could cause transients leading to steam generator or reactor vessel overfill, overcooling, overpressure, or overheating events. The final reports assessing the potential risk of these failures have been issued. In addition, various alternatives for reducing the initiating failure frequency, or eliminating the failure mechanism of control systems found to be major contributors to events of concern, have been analyzed.

A proposed staff resolution, which includes recommendations for operating plants and for future plants, was published for public comment in May 1988. Is-

Table 4. Generic Safety Issues Resolved in FY 1988

Number	*Title*
43	Reliability of Air Systems
66	Steam Generator Requirements
86	Long Range Plan for Dealing with Stress Corrosion Cracking in BWR Piping
93	Steam Binding of Auxiliary Feedwater Pumps
102	Human Error in Events Involving Wrong Unit or Wrong Train
125.II.7	Reevaluate Provision to Automatically Isolate Feedwater from Steam Generator During a Line Break
B-5	Ductility of Two-Way Slabs and Shells and Buckling Behavior of Steel Containments
I.A.4.2(4)	Review Simulators for Conformance to Criteria
I.D.4	Control Room Design Standard
II.E.4.3	(Containment) Integrity Check
HF 8	Maintenance and Surveillance Program

suance of the final requirements, including resolution of public comments, was scheduled for fiscal year 1989.

Hydrogen Control Measures (USI A-48)

This issue arose out of Three Mile Island (TMI) Unit 2 (Pa.) accident in 1979. Approximately 1,000 pounds of hydrogen burned up in the TMI containment when it was ignited. Depending on hydrogen concentrations, this combustible gas can deflagrate or detonate. Both of these occurrences can affect containment integrity and/or the operation of safety equipment within the containment. Following the TMI accident, extensive research programs were initiated by both the NRC and the nuclear power industry to control hydrogen produced by metal-water reactions in several types of containments and to study the effects of hydrogen combustion on safety-related equipment.

Based on this research, the Commission published hydrogen control standards in 10 CFR Part 50 addressing four of the five containment types in use. The standards are discussed in the *1987 NRC Annual Report*, pp. 148, 149.

In 1985, the National Research Council was requested to conduct a peer review of the hydrogen research programs as part of the NRC evaluation. Their report, "Technical Aspects of Hydrogen Control and Combustion in Severe Light-Water-Reactor Accidents," was published early in 1987. The nuclear industry research program of the BWR Hydrogen Control Owners Group has been evaluated by the staff. A report was issued in September 1988 on the safety evaluation of the adequacy of this program.

The estimated completion date for resolution of the issue was December 1988. A generic summary report is to be issued based on research results of both the NRC and the nuclear industry. The report will also address conclusions and recommendations of the National Research Council.

GENERIC SAFETY ISSUES

In December 1983, the Commission approved a priority listing, prepared by staff at the behest of the Commission, of all generic safety issues, including TMI-related issues, based on the potential safety significance and cost of implementation of each issue. The information and guidance is reflected in the NRC's Five Year Plan.

Priorities of Generic Safety Issues

The NRC continued to use the methodology, employed at the start and set out in the *1982 NRC Annual Report,* for determining the priority of generic safety issues (GSIs). In December 1983, a comprehensive list of the issues was published in "A Prioritization of Generic Safety Issues" (NUREG-0933), and the list has been updated semi-annually (by supplements in June and December). The list of issues includes TMI Action Plan (NUREG-0660) items and USIs (discussed in detail earlier in this chapter). The results of the NRC's continuing effort to identify significant unresolved GSIs will be set forth in future supplement to NUREG-0933.

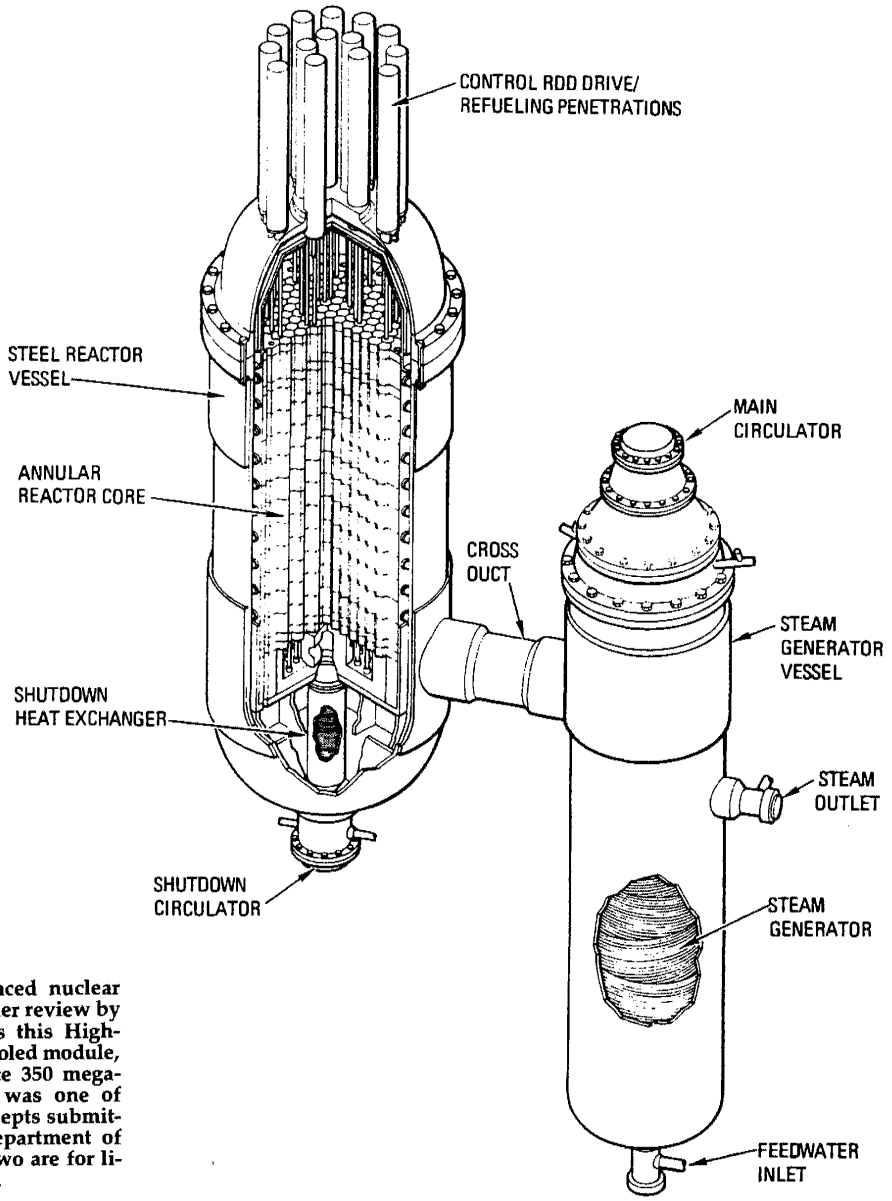
During fiscal year 1988, the NRC identified three new generic issues, established priorities for 17 issues (Table 3), and resolved 11 GSIs (Table 4) other than USIs. In addition, six GSIs scheduled for resolution were integrated into the action plans for the resolution of other unresolved GSIs, or into other ongoing NRC activities. Table 5 contains the schedules for resolution of all unresolved GSIs.

Table 5. Generic Safety Issues Scheduled for Resolution

(as of the close of FY 1988)

Issue Number	*Title*	*Priority*	*Scheduled Resolution Date*
23	Reactor Coolant Pump Seal Failures	HIGH	08/90
29	Bolting Degradation or Failures in Nuclear Power Plants	HIGH	04/90
51	Proposed Requirements for Improving Reliability of Open Cycle Service Water Systems	MEDIUM	07/90
57	Effects of Fire Protection System Actuation on Safety-Related Equipment	MEDIUM	TBD
70	PORV and Block Valve Reliability	MEDIUM	04/89
75	Generic Implications of ATWS Events at the Salem Nuclear Plant	NEARLY RESOLVED	03/90
79	Unanalyzed Reactor Vessel Thermal Stress During Natural Convection Cooldown	MEDIUM	10/88
82	Beyond Design Basis Accidents in Spent Fuel Pools	MEDIUM	05/89
83	Control Room Habitability	NEARLY RESOLVED	04/90
84	CE PORVs	NEARLY RESOLVED	08/89
87	Failure of HPCI Steam Line Without Isolation	HIGH	03/91
94	Additional Low-Temperature Overpressure Protection for Light-Water Reactors	HIGH	04/89
99	RCS/RHR Suction Line Interlocks on PWRs	HIGH	10/88
101	BWR Water Level Redundancy	HIGH	04/90
103	Design for Probable Maximum Precipitation	NEARLY RESOLVED	04/89
105	Interfacing Systems LOCA at BWRs	HIGH	12/89
106	Piping and Use of Highly Combustible Gases in Vital Areas	MEDIUM	03/90

113	Dynamic Qualification Testing of Large Bore Hydraulic Snubbers	HIGH	09/91
115	Enhancement of Reliability of Westinghouse Solid State Protection System	HIGH	05/89
121	Hydrogen Control for Large, Dry PWR Containments	HIGH	10/89
122.2	Initiating Feed and Bleed	HIGH	10/88
124	Auxiliary Feedwater System Reliability	NEARLY RESOLVED	10/88
125.I.3	SPDS Availability	NEARLY RESOLVED	10/88
128	Electrical Power Reliability	HIGH	03/90
130	Essential Service Water Pump Failures at Multiplant Sites	HIGH	06/89
134	Rule on Degree and Experience Requirements for Senior Operators	HIGH	08/89
135	Steam Generator and Steam Line Overfill	MEDIUM	11/90
A-29	Nuclear Power Plant Design for Reduction of Vulnerability to Industrial Sabotage	MEDIUM	02/89
B-17	Criteria for Safety-Related Operator Actions	MEDIUM	TBD
B-55	Improved Reliability of Target Rock Safety Relief Valves	MEDIUM	03/89
B-56	Diesel Reliability	HIGH	04/89
B-61	Allowable ECCS Equipment Outage Periods	MEDIUM	04/90
B-64	Decommissioning of Nuclear Reactors	NEARLY RESOLVED	09/89
C-8	Main Steam Line Isolation Valve Leakage Control Systems	HIGH	04/89
1.D.3	Safety System Status Monitoring	MEDIUM	TBD
1.D.5(5)	Disturbance Analysis Systems	HIGH	03/89
1.F.1	Expand QA List	HIGH	12/88
II.C.4	Reliability Engineering	HIGH	10/88
II.E.6.1	Test Adequacy Study	MEDIUM	12/88
II.H.2	Obtain Technical Data on Conditions Inside TMI-2 Containment Structure	HIGH	12/89
II.J.4.1	Revise Deficiency Report Requirements	NEARLY RESOLVED	02/89
HF 1.1	Shift Staffing	HIGH	12/88
HF 4.1	Inspection Procedures for Upgraded Emergency Operating Procedures	HIGH	10/88
HF 4.4	Guidelines for Upgrading Other Procedures	HIGH	06/89
HF 5.1	Local Control Stations	HIGH	09/90
HF 5.2	Review Criteria for Human Factors Aspects of Advanced Controls and Instrumentation	HIGH	05/91



One of the advanced nuclear reactor concepts under review by the NRC in 1988 is this High-Temperature Gas-Cooled module, designed to generate 350 megawatts (thermal). It was one of three advanced concepts submitted by the U.S. Department of Energy. The other two are for liquid metal reactors.

STANDARDIZED AND ADVANCED REACTORS

Advanced Reactor Concepts

The staff continued to review three advanced reactor concepts that were submitted by the Department of Energy. The purpose of the reviews is to determine the licensability of these unique designs. The conceptual designs consist of two advanced Liquid Metal Reactors and one advanced Modular High-Temperature Gas-Cooled Reactor. Key policy issues associated with these designs will be reviewed by the Commission. The staff plans to issue safety evaluation reports on the three advanced reactors by early fiscal year 1989. In addition, "Development and Utilization of the NRC Policy Statement on the Regulation of Advanced Nuclear Power Plants" (NUREG-1226), was issued in June 1988 to provide further guidance on the staff's advanced reactor review plans.

Standardization

The NRC believes that standardization of nuclear power plant designs is an important initiative that can

significantly enhance the safety, reliability, and availability of nuclear plants. The Commission has moved to improve the licensing process for standardized nuclear power plants and to reduce complexity and uncertainty in the regulatory process. In this regard, the Commission issued a revised Standardization Policy Statement on September 15, 1987, which stated the Commission's intention to develop a rule codifying the process for approving standard plant designs.

Accordingly, in August 1988 the Commission issued for public comment proposed regulations (10 CFR Part 52) to implement the revised standardization policy. The proposed Part 52 will provide a regulatory framework for certification of reference designs by means of rulemaking, in order to obviate the need to reconsider design issues in individual licensing proceedings on future license applications that reference the certified designs. The RES staff will continue to provide technical support in the standardization effort.

Fuel Cycle, Materials Transportation, and Safeguards

In fiscal year 1988, the NRC initiated proposed rulemakings or developed final rules on activities pertaining to the transportation of radioactive materials, the physical protection of special nuclear material, the use or disposal of material containing very small quantities or concentrations of radioactive material, and access authorization at nuclear power plants.

With specific regard to nuclear material transportation, a proposed major revision of NRC's regulations was issued for public comment on June 8, 1988. The proposed revision ensures compatibility between U.S. and international regulations and imposes additional requirements on the transportation of low specific activity (LSA) material—typically material with such a limited concentration of radioactivity that packagings are not required to be accident resistant.

In the safeguards area, a final rule improving physical security at five facilities possessing weapons-grade nuclear material was issued. This regulation, described in proposed form in the *1987 NRC Annual Report*, p. 154, would ensure that the safeguards requirements at licensed facilities are not only adequate but are comparable with requirements at similar facilities operated by the Department of Energy.

Significant developments took place regarding policy and regulations that apply to the use or disposal of radioactive materials containing such small quantities of radionuclides that they do not need to be regulated. On March 14, 1988, a status report on this subject was issued. It was followed by Commission discussions of a proposed policy statement and the decision to release an advanced notice of the statement under consideration, which was done on September 30, 1988, at the close of the report period. (An international workshop was held on the subject on October 17-19, 1988, and a proposed Commission policy is to be developed by early 1989. Related to this broader effort, a proposed rulemaking allowing on-site incineration of waste oil generated at nuclear power plants was issued on August 29, 1988.)

On the subject of unescorted access to nuclear power plants, a proposed Commission policy statement endorsing industry guidelines for an access authorization program was issued on March 9, 1988. Following an evaluation of public comments, the Commission will decide whether the provisions of this policy should be incorporated into NRC regulations.

DEVELOPING AND IMPROVING REGULATIONS

Developments in New or Modified Regulations

In a program initiated in 1985 and continued through 1988, the NRC staff undertook to evaluate existing regulatory requirements in terms of their risk effectiveness and to eliminate or modify requirements with only a marginal safety importance. A three-volume research report (NUREG/CR-4330) provided detailed technical assessments of requirements associated with a number of topics. Based on these and continuing studies, the NRC staff will recommend whether to eliminate or modify related requirements of marginal safety importance.

It is anticipated that there will be a serious need in the near future for added spent fuel storage space at nuclear power reactor sites, to supplement existing spent fuel storage pools. After many years of commercial power operation, these spent fuel storage pools are nearing full capacity. In response to this need, the Nuclear Waste Policy Act of 1982 directed the Secretary of Energy to establish a dry spent fuel storage demonstration program, with the objective of establishing one or more technologies that the NRC may approve for use at civilian nuclear power reactor sites without, to the maximum extent practicable, creating the need for additional site-specific approvals. A proposed rule is being developed that would amend 10 CFR Part 72 to allow dry storage of spent fuel in NRC-approved casks. Holders of nuclear power reactor operating licenses would be allowed to store spent fuel in NRC-approved casks at reactor sites under a general license.

Table 6. Rulemaking Actions Processed During FY 1988

Rulemaking Activities	*Number*
Final Rulemakings Published	29
Rulemakings Terminated/Withdrawn	3
Ongoing Rulemaking Actions	35
Proposed Rulemakings (18)	
Final Rulemakings (11)	
Rulemakings on Hold (6)	
Total Rulemakings	67

In another area, the Commission is considering amending its regulations regarding enhanced professional or educational credentials for senior nuclear power plant operating personnel. The proposed amendments are intended to contribute to the goal of improving the capability of shift operating crews to effectively respond to off-normal situations; higher qualifications could also, over time, add operating experience to plant management, by opening a career path for senior operators into the managerial ranks.

The NRC is proposing to amend its regulations to re-establish its regulatory authority for approving on-site disposal of low-level radioactive waste at NRC-licensed power reactor sites located in Agreement States. Also, for facilities licensed for special nuclear material activities, NRC believes it is prudent to clarify, and to establish in the regulations, that the on-site disposal of small quantities of special nuclear material waste remains an NRC licensing function, in order to retain control over the decommissioning process. The NRC believes that these amendments are necessary in order to avoid unnecessary duplication of effort on the part of both the Agreement States and the Federal Government. Sole NRC jurisdiction would allow for uniform standards of approval and record-keeping for on-site disposal, which would provide greater assurance that the radioactive material is disposed of in a manner that would not present a health hazard at a later date, after the site is decommissioned.

A rulemaking is being developed to amend the 10 CFR Part 35 regulations that apply to the medical uses of byproduct material. The amendments would require medical-use licensees to implement quality assurance (QA) programs and would revise misadministration reporting requirements. Implementation of the new requirements would be supported by issuing a regulatory guide that would include specific criteria for medical QA programs. The feasibility of the proposal will be evaluated during a pilot study involving several medical-use licensees.

In March 1988, the Commission issued a Policy Statement on the Maintenance of Nuclear Power Plants. In the policy statement, the Commission indicated its intention to pursue a rulemaking on maintenance. In developing the proposed rulemaking on maintenance, the staff had extensive interaction with U.S. industry (airline and nuclear), and studied foreign nuclear maintenance programs and practices. In addition, a three-day public workshop was held in July 1988 to solicit feedback on rulemaking options. Information gathered from these efforts and from the workshop was used in the formulation of the proposed rule. The Commission issued the proposed rule for public comment in November 1988.

The NRC, in August 1988, published an active Regulatory Guide 4.19, "Guidance for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste." The purpose of the document is to give guidance on the screening of a potential site or sites for near-surface disposal of low-level radioactive waste. In order to expedite the site screening and selection process, the regulatory guide suggests that the licensee conduct a geographic information system analysis of relevant geophysical and land-use data. An overview of the methodology for conducting the site screening analysis is provided in the regulatory guide.

Regulatory Analysis

The Office of Nuclear Regulatory Research has, as one of its prime tasks, responsibility for the oversight of regulatory impact analyses (RIAs) of rulemakings, backfits, generic safety issues, or regulatory guides. Pursuant to this assignment, the NRC has published operating procedures for agency use in support and/or review of regulatory impact analyses affecting all regulatory actions. Consistent with this goal, the staff is also concerned with the development and implementation of systematic methods for performing

RIAs. For example, two computer-based models for analyzing the cost impacts of nuclear plant physical modifications resulting from a proposed regulatory change were developed. Development of these methodologies, coupled with existing RIA methods, will continue and will facilitate NRC decision-making regarding the need for and the effectiveness of a variety of regulatory actions—including rulemaking, standards development, and backfitting safety improvements on nuclear power plants. During the report period, approximately 15 safety-related regulatory impact analyses (both initiated and completed) have been processed.

Summary

During fiscal year 1988, 67 rulemaking actions were processed. Of these, 29 rules were published final, 3 were terminated/withdrawn, and 35 are ongoing. The detailed status of these reviews, as of September 30, 1988, is provided in Table 6.

NATIONAL STANDARDS PROGRAM

The national standards program is conducted by the American National Standards Institute (ANSI). ANSI acts as a clearinghouse to coordinate the work of standards development in the private sector.

The NRC staff is active in the national standards program, particularly with respect to setting priorities. NRC participation derives from a need for national standards to define acceptable ways of implementing the NRC's basic safety regulations.

Approximately 213 NRC staff members serve on working groups organized by technical and professional societies.

Proceedings and Litigation

Chapter 10

This chapter covers two major spheres of NRC litigatory and judicial engagement during fiscal year 1988: (1) a report—and discussion of select proceedings—of the NRC's Atomic Safety and Licensing Board Panel and of the Atomic Safety and Licensing Appeal Panel (see "The Licensing Process," in Chapter 2); and (2) noteworthy legal actions, including litigation in cases both pending and closed, involving the Commission.

ATOMIC SAFETY AND LICENSING BOARDS

Adjudicatory hearings under the Atomic Energy Act are conducted before a board whose members are drawn from the Atomic Safety and Licensing Board Panel (ASLBP), created by the Commission under authority of Section 191 of the Act. The Commission's nuclear power plant licensing proceedings have been characterized as among the most complex, lengthy, and controversial administrative hearings conducted by the Federal government. In fiscal year 1988, the Atomic Safety and Licensing Board Panel completed 27 proceedings, and docketed 23 new proceedings. At the same time, the Panel accelerated its preparations for the proposed high-level nuclear waste repository proceeding—expected to be the most complex administrative hearing in the history of the Commission.

The Atomic Energy Act of 1954, as amended, requires that a hearing precede every application for a construction permit for a nuclear power plant or related facility. In addition, the Act requires an opportunity for a hearing in connection with any other licensing proceeding under the Act. Other sections of the Act or the Commission's rules provide an opportunity for a hearing on such matters as antitrust issues, enforcement actions, civil penalties, and other actions, as directed by the Commission. These hearings are the Commission's principal public forum, one in which individuals and organizations can voice their interests in a particular licensing, enforcement, or other matter, and have those interests adjudicated by an independent tribunal.

Licensing and construction permit hearings are conducted before Licensing Boards comprised of three administrative judges chosen from the ASLBP. In other matters, hearings may be conducted by a single administrative judge or administrative law judge from the ASLBP. Commission appointment to the ASLBP is based upon recognized experience, achievement, and independence in the appointee's field of expertise. Individual judges are assigned to particular hearings where their professional expertise will assist in resolving the technical and legal matters at issue in a proceeding. As of September 30, 1988, the ASLBP included 37 administrative judges (15 full-time and 22 part-time). By profession, the members of the ASLBP include 13 lawyers, 11 public health and environmental scientists, six engineers, five physicists, one medical doctor, and one economist. (See Appendix 2 for the names of panel members.)

ASLBP Caseload

During the fiscal year ending September 30, 1988, the panel conducted 37 proceedings involving 20 nuclear power plants or related facilities and 13 proceedings involving other Commission licensees. A total of 114 days of hearings (101 trial and 13 pre-hearing conference days) were held. Twenty-seven proceedings were closed and 23 new proceedings were docketed. During this same period, eight of the panel's hearings involved a single Administrative Judge.

In addition to its on-going caseload, the panel looked to the future caseload burden. In connection with the expected construction of a high-level nuclear waste repository, the panel took an active role in the development of the procedural rules to govern the required licensing proceeding and planning for the related Licensing Support System (LSS), a state-of-the-art, full text and image computerized document retrieval system. It is expected that the LSS will be fully compatible with the panel's own pioneering Computer Assistance Project (CAP) system.

Case Management and Litigation Support

Because of restrictions on support personnel and concerns over the costs of delays in the Commission's

licensing process, the panel has moved rapidly towards achieving the goal of an "electronic" office, particularly in the management of its voluminous and complex hearing records. Important administrative tasks (e.g., travel, timekeeping, etc.) have been computerized. All panel members and critical support personnel are provided desktop systems, including an IBM Personal Computer, modem and printer, and a full complement of necessary software, including the LEXIS and WESTLAW automated legal research systems.

During fiscal year 1988, the scope and capabilities of the panel's CAP system were enhanced. The ASLBP developed an "INQUIRE" full text adjudicatory document storage and retrieval system. INQUIRE is a data base management system that stores and retrieves the full text of the panel's adjudicatory hearing transcripts, pre-filed testimony, findings of fact and conclusions of law, and Initial Decisions. The system utilizes the newest IBM search-and-retrieve technology in retrieving information from the data base.

As of the close of the report period, upwards of 18,000 pages of the Seabrook proceedings and 6,500 pages of the Shoreham OL-3 proceeding had been loaded onto the system. The panel is also moving forward to include, on the date of issuance, the decisions of both the Licensing Board Panel and the Atomic Safety and Licensing Appeal Boards (see below). In fiscal year 1989, the panel will begin to load into the system, on the date of receipt, an abstract of every document received in the office.

Hearing Procedure

In addition to its efforts to computerize the licensing process, the panel has moved aggressively to use traditional case management tools, under the Commission's instructions to streamline and focus the licensing process. In many cases, the hearing on a particular application for a nuclear facility license may be divided into several discrete topics—such as on-site versus off-site emergency planning, environmental issues, and reactor health and safety considerations. In such complex cases, the panel creates separate, parallel licensing boards assigned to each topic. Besides the time saved through parallel adjudication, each board can be assigned panel members whose expertise matches the issues to be resolved. Even single boards frequently structure their hearing schedule into distinct phases, each dealing with related groups of issues. This allows the parties to sharpen their hearing preparation and focus their discovery efforts.

Licensing Boards have also taken an active role in shaping the issues before them through an active involvement in the most time-consuming segment of the Commission's licensing process, which is the pre-hearing discovery phase. Pre-hearing conferences are routinely employed to review and define proposed contentions, to clarify the scope and timing of discovery, to develop realistic hearing schedules, and to resolve potentially time-consuming procedural disputes among the parties. The discovery process is continuously monitored in an effort to identify and resolve as early as possible any unnecessary, excessive, or duplicitous discovery requests. In this manner, the vast majority of proposed contentions in operating license proceedings are resolved prior to hearing. Equally important, the resolution of issues has occurred through a process which involves direct and timely interaction between the Licensing Board and the parties, anchored in the fundamental fairness to all parties mandated by law.

Significant Decisions—Shoreham

In the sphere of nuclear power reactor operating licenses, cases dealing with the adequacy of emergency planning at the Shoreham (N.Y.) nuclear power plant and the Seabrook (N.H.) nulcear power plant dominated significant decisions for fiscal year 1988.

State Emergency Plan Non-existent. Setting the stage for invocation of the Commission's "realism" rule, the Licensing Board concluded, in a November 6, 1987 decision, that New York State had no radiological emergency plan for the Shoreham nuclear plant. That being the case, the board averred that it could properly turn its attention to the utility-developed emergency response plan for the facility. The board found, however, that the applicants' own emergency response plan failed to provide for coordination with the State, assuming such a response would occur. (26 NRC 45 (LBP-87-30, 1988).)

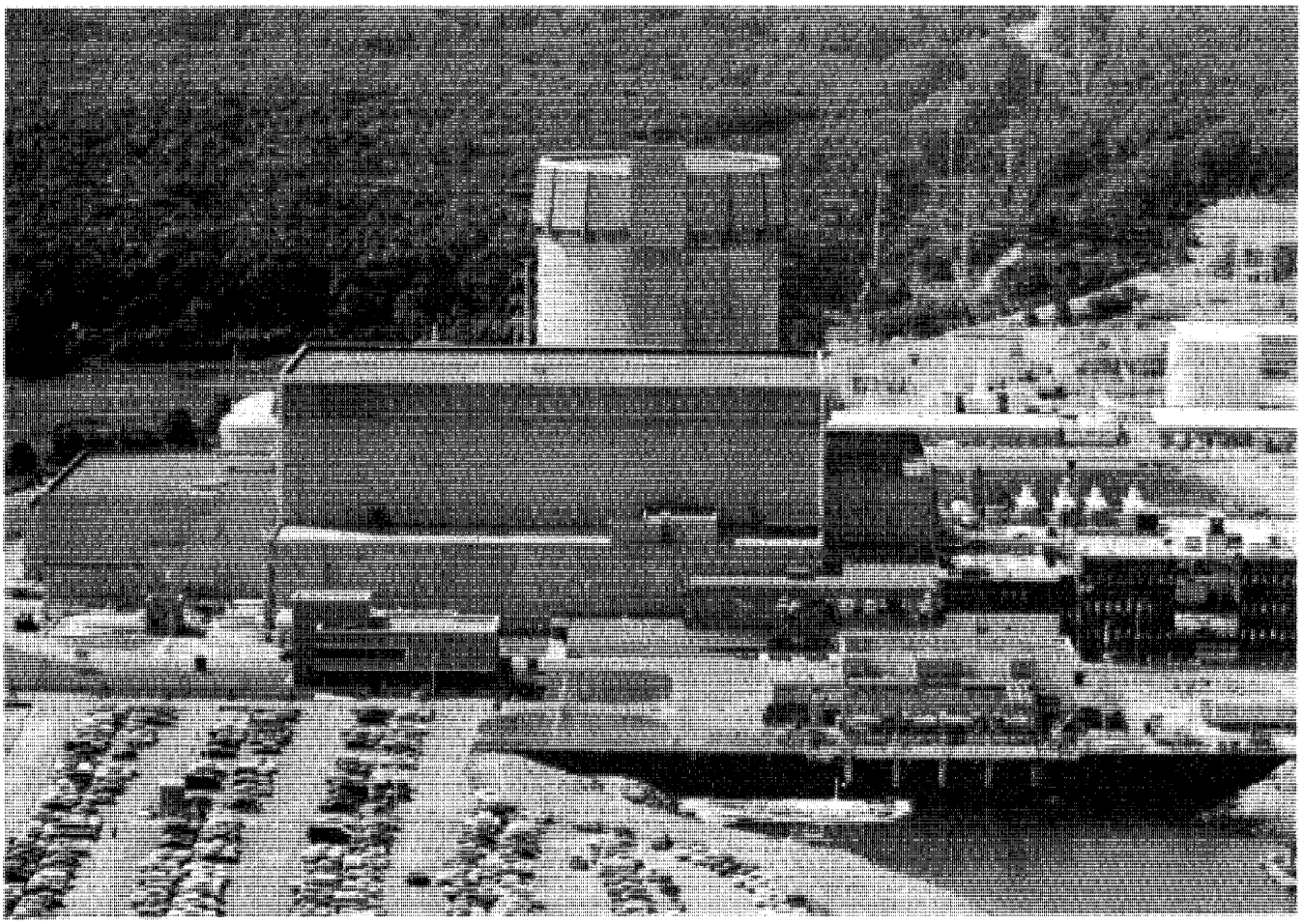
Request For Twenty-five Percent Low-Power License Proper. In a January 7, 1988 decision, the board ruled that the applicants' request for authority to increase operation of the Shoreham facility to 25 percent of rated power was proper under existing Commission regulations. Moreover, the board noted that such a low-power license could be granted, notwithstanding the pending of emergency planning contentions, if it were shown that all remaining contentions are not relevant to the operation of the facility at the requested power level. However, the board also concluded that the parties had a right to be heard prior to a grant of the request on the relevancy of their existing contentions to the facility's operation at 25 percent power. (27 NRC 7 (LBP-88-1, 1988).)

Guidance on "Realism" Rule Provided. On April 8, 1988, the board issued a decision providing guidance on the Commission's emergency planning "realism"

rule. The board concluded that the rule reinforced its responsibility to ensure that a utility's emergency plan, in conjunction with an assumed "best efforts" response by State and local governments, satisfied the Commission's regulatory standards. The board noted that, absent the development of an adequate and feasible alternative emergency response plan by State and local governments, it will be assumed that the governments will in fact utilize the utility's plan should an emergency arise. (27 NRC 355 (LBP-88-9, 1988).)

Evacuee Monitoring and Decontamination Services Found Adequate. In a May 9, 1988 decision, the board found that a radiation monitoring capacity of 20 percent of all evacuees from the emergency planning zone (EPZ) surrounding a nuclear facility—the figure recommended by the Federal Emergency Management Agency (FEMA)—satisfied the Commission's regulatory standards regarding provision of adequate monitoring services to EPZ evacuees. In a related matter, the board held that prior police training on a plan's traffic control procedures was not required. Finally, the board noted that the Commission's public health protection standards with respect to emergency plans would be met by a practical demonstration of existing capability if the underlying analysis is reasonable and is not dependent upon flawed or distorted data or assumption. (27 NRC 509 (LBP-88-13, 1988).)

Intervenors Dismissed and Operating License Authorized. In a September 23, 1988 decision, the Licensing Board resolved all issues remaining before it related to the Shoreham Emergency Plan. First, the board found the applicant's emergency plan adequate in the areas of emergency broadcast system, school bus drivers, and hospital evacuation. Second, the board found the intervenors in willful default of prior board discovery orders concerning the intervenors' own "realism" contentions on the likely State/local government ad hoc response to an emergency. As a sanction, the board dismissed the intervening governments from the entire proceeding; the board then authorized the issuance of a full-power operating license for the Shoreham nuclear power plant. (28 NRC 311 (LBP-88-24, 1988).)



The Shoreham nuclear power plant Unit 1, located near Brookhaven on Long Island, N.Y., is shown above. The facility was again the subject of Licensing Board, Appeal Board, and Commission review in 1988. The extent and boundaries of an Emergency Planning zone dominated the continuing and strongly contested operating license hearings.

Exercise Requirements Clarified. In connection with the February 1986 exercise of the applicant's emergency plan for the Shoreham nuclear power plant, a December 7, 1987 decision by the Licensing Board construed the Commission's regulatory standards to require an initial full-participation exercise that tests as much of the plan as is reasonably achievable. The board also held that the exercise must include participation by all response organizations within both the plume and ingestion exposure EPZs. However, where local government action or the lack of Federal standards prevented the testing or evaluation of portions of an emergency plan, the board held that testing of those portions are not "reasonably achievable." Thus, they would not be considered in determining whether the exercise met the requirements of the Commission's criteria. Of those portions of the plan which were "reasonably achievable," the board concluded that four portions—EBS messages, school and ingestion exposure pathways emergency plans, and coordination and communication between the local emergency response organization and special facilities—had not been adequately tested. (27 NRC 479 (LBP-87-32, 1987).)

Exercise Demonstrated Fundamental Flaws in Plan. In a February 1, 1988 decision, the Licensing Board defined a "fundamental flaw" as a pervasive problem in an emergency plan or its implementation which, if uncorrected, would substantially affect the health and safety of the public. The board then equated that definition with the standard used by FEMA to identify a deficiency in an emergency plan. The board went on to conclude that the February 1986 Shoreham exercise had demonstrated numerous fundamental flaws in the emergency plan. (27 NRC 85 (LBP-88-2, 1988).)

Significant Decisions—Seabrook

Remanded Contentions No Bar to Low-Power Operation. In two decisions issued February 17 and August 8, 1988, the Licensing Board renewed its March 25, 1987 authorization of a low-power operating license for the Seabrook (N.H.) nuclear power plant. The board found that three contentions remanded by the Appeal Board for further litigation did not raise safety concerns relevant to low-power operation of the Seabrook nuclear power plant. The board also rejected arguments that the Atomic Energy Act required all issues relevant to a full-power license must be resolved before a low-power license was authorized. However, the board declined to authorize the issuance of a low-power license pending, *inter alia*, completion of the Commission's rulemaking on proposed modifications to its regulations on off-site public notification requirements. (27 NRC 245 (LBP-88-6, 1988); 28 NRC 161 (LBP-88-20, 1988).)

License Amendment Proceedings

During fiscal year 1988, a number of hearings challenging license amendments authorizing an increase in the storage capacity of on-site spent fuel pools continued to make significant demands on the panel's resources.

Turkey Point. In an April 19, 1988 decision, the Licensing Board affirmed the grant of a November 1984 license amendment more than doubling the authorized storage capacity of the spent fuel pools at the Turkey Point (Fla.) nuclear power plant. The board found that the proposed high-density racks satisfied the Commission's structural criteria with respect to seismic events. The board also concluded that the staff had adequately considered the effects of long term storage in a high-density configuration on the rate of deterioration and integrity of the materials used in the racks. (27 NRC 387 (LBP-99-9A, 1988).)

St. Lucie. In an April 20, 1988 decision, the Licensing Board framed the issues that it will consider in connection with a challenge to a St. Lucie (Fla.) license amendment. That amendment authorized an increase in the spent fuel storage capacity at the plant from 728 to 1,706 fuel assemblies. In addition, the board noted that the Commission had under its regulations reserved to itself review of staff determinations of "no significant hazards consideration." Because of this, the board concluded that it was without authority to review the propriety of that determination in the context of a post-amendment hearing. Rather, the board's authority extended only to determining whether any threat to the public health or safety disclosed at any subsequent hearing required corrective action. The board also concluded that low probability severe accidents (i.e., beyond design basis accidents) were outside the ambit of the National Environmental Policy Act (NEPA) and need not be considered in connection with Commission licensing actions. (27 NRC 452 (LBP-88-10A, 1988).)

Reactor Operator License Proceedings

Fiscal year 1988 witnessed an increase in the panel's involvement in the adjudication of disputes between the staff and applicants for reactor operator licenses.

In one proceeding, an applicant challenged the staff's determination that he had failed the simulator portion of the Commission's reactor operator license examination. A single member Licensing Board concluded that under the applicable facts, the applicant could not utilize more than one license at a time. Since the applicant already possessed a license to operate the facil-

ity's companion reactor, review of the staff's determination was a moot question. However, the Presiding Officer retained jurisdiction over the matter for two years, given the possibility that the utility-employer could seek to license its operators for both reactors. In that event, the board concluded that the challenged staff action would have some real impact on the applicant. (27 NRC 29 (LBP-88-1B, 1988); see also 27 NRC 233 (LBP-88-3A, 1988).) On remand from the Commission, and after the staff withdrew its objection to the applicant's challenge, the Presiding Officer determined that the applicant had passed the simulator examination and thus was entitled to the license sought. (28 NRC 176 (LBP-88-22, 1988).)

In another proceeding involving a single member Licensing Board, an applicant for a senior reactor operator license successfully challenged a staff finding that he had failed both the written and simulator portions of the Commission's examination. While subsequently awarding a passing score on the written examination, the staff had reaffirmed the applicants' unsatisfactory grades on four of the eight competencies tested in the simulator examination. The Presiding Officer performed a detailed and exhaustive review of the factual basis for and legal sufficiency of the staff's ratings. Based on his analysis, the Presiding Officer sustained only one of the staff's unsatisfactory scores, and upgraded the applicant's performance on three of the competencies to a passing level. The Presiding Officer then concluded that the applicant's overall performance on the test, when viewed against the insignificance of the deficiencies in his test performance, warranted a passing score on the simulator examination. (27 NRC 417 (LBP-88-10, 1988).)

Enforcement

In two decisions arriving at different results, single member Licensing Boards highlighted the impact of on-going Department of Justice (DOJ) criminal inquiries on parallel Commission enforcement proceedings based on the same licensee conduct.

In a decision issued January 27, 1988, the Presiding Officer denied a staff motion to stay a show-cause proceeding pending completion of DOJ inquiry into the matter. The proceeding involved a challenge to an immediately effective order suspending a materials license. The Presiding Officer held that where a stay would devastate a licensee's business and deny it its due-process rights, the staff had a heavy burden to demonstrate that a stay was warranted. Because the stay sought was of an unlimited duration and because no significant adverse impact on the parallel DOJ inquiry was clearly established, the Presiding Officer concluded that a stay was not justified, particularly where the licensee was unable to conduct any business pending completion of the administrative hearing. (27 NRC 19 (LBP-88-1A, 1988).) Subsequently, the Presiding Officer approved settlement of this enforcement matter as in the public interest. (27 NRC 586 (LBP-88-17, 1988).)

In a decision issued April 29, 1988, the Presiding Officer granted a staff motion for a stay pending completion of a parallel Department of Justice criminal inquiry. In this case, the Presiding Officer concluded that no significant harm to the respondent would result from a grant of a short stay, since he was still employed. In contrast, the staff established the possibility of some harm to the on-going Grand Jury investigation in the absence of a stay. Based on these considerations, the Presiding Officer found that the equities favored the grant of a stay. (27 NRC 475 (ALJ-88-1, 1988).)

ATOMIC SAFETY AND LICENSING APPEAL BOARDS

Atomic Safety and Licensing Appeal Boards, each consisting of three members, review, on behalf of the Commission, decisions rendered by Atomic Safety and Licensing Boards in a wide range of formal adjudicatory proceedings. These include proceedings for the licensing of nuclear power plants and other nuclear facilities. The decision of the Appeal Board in these proceedings becomes the final agency order unless the Commission, in its discretion, decides to review it. In the absence of such Commission action, the Appeal Board decision is subject only to judicial review in a Federal court of appeals. The more significant decisions are published in the permanent collection of NRC licensing and other decisions, entitled *Nuclear Regulatory Commission Issuances.* (See Appendix 2 for membership of the Atomic Safety and Licensing Appeal Panel (ASLAP), from which Appeal Board members for a particular proceeding are selected by the panel Chairman.)

Once again this year, the protracted proceedings on the operating license applications for the Seabrook Units 1 & 2 (N.H.), and the Shoreham (N.Y.) nuclear power plant absorbed the greater part of the Appeal Boards' attention. Because of the numerous appeals from Licensing Board decisions and other requests for Appeal Board action, the *Seabrook* proceeding alone required 13 published decisions, while the *Shoreham* proceeding produced three.

Seabrook Nuclear Power Plant

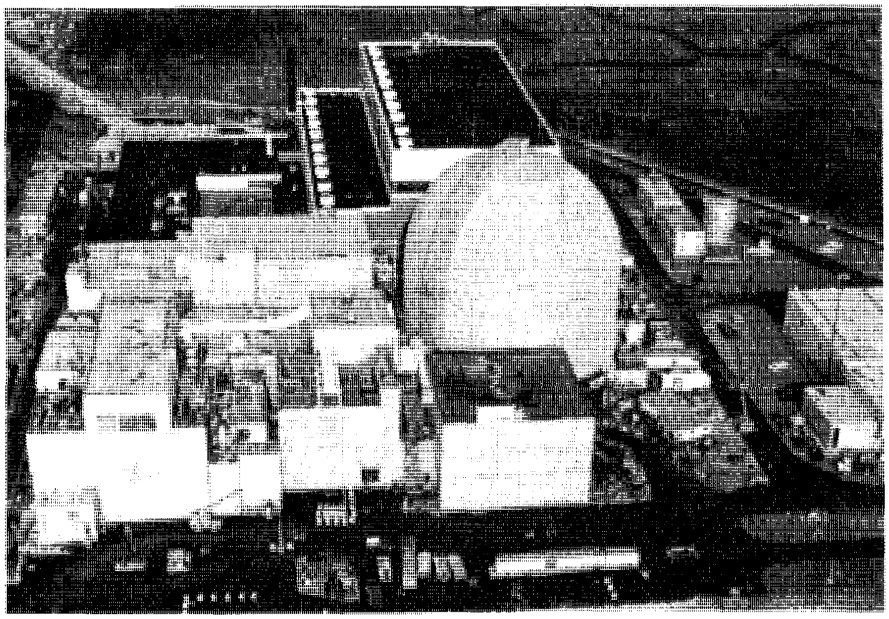
Before a plant can be licensed for full-power operation, it must meet the Commission's on-site health and safety requirements, as well as provide for the protection off-site of persons within a 10-mile area surrounding the plant (the area called the plume exposure pathway Emergency Planning Zone (EPZ)). For low-power operation (up to 5 percent of rated power), however, a plant can be licensed without regard to off-site emergency planning requirements, if all on-site safety and emergency planning requirements have been met.

In March 1987, following a hearing on certain on-site safety and emergency planning issues raised by the intervenors—the Attorney General of Massachusetts (in whose state a portion of the EPZ is located), the New England Coalition on Nuclear Pollution, the Seacoast Anti-Pollution League, and the Town of Hampton, N.H.—the Licensing Board authorized the issuance of a low-power license for Unit 1 of the Seabrook facility. (See *1987 NRC Annual Report,* pp. 161 and 162, for background on this proceeding.)

The low-power authorization was challenged on appeal. An issue concerned the Licensing Board's rejection at the outset of several contentions. The Appeal Board agreed with the intervenors that two of those contentions, both sponsored by the Coalition, were improperly rejected. (One of the contentions concerned the requirement for inservice inspection of the plant's steam generator tubes to assure their integrity, and the other related to the accumulation of aquatic organisms and other foreign matter in the plant's cooling systems that might prevent their proper operation.) Accordingly, the Appeal Board returned these contentions to the Licensing Board for further consideration. Subsequently, the Coalition elected not to pursue either contention. With respect to the cooling system contention, however, the Coalition claimed its decision came only after the Licensing Board had erroneously precluded it from trying to show that cooling system blockage could result from *microbiologically induced* corrosion. The Licensing Board had construed the Coalition's contention as encompassing only blockage from the accumulation of organisms, not failure in the cooling systems from microbiologically induced corrosion. On appeal from that ruling, the Appeal Board agreed with the Licensing Board's reading of the Coalition's contention.

Another issue on appeal concerned a question as to whether the Licensing Board had correctly ruled that certain coaxial cables used for data transmission in the facility's computer system were environmentally qualified—i.e., would not break down in an accident and thus prevent other safety-related equipment from performing its function. The Appeal Board found an insufficient basis for the Licensing Board's ruling and sent the matter back to that board. The Licensing Board made the same ruling twice more, each time reaching the same conclusion as before, but on a different basis. And in each instance, the Appeal Board disagreed. At the end of the fiscal year, the matter remained pending before the Licensing Board.

Another appellate issue dealt with the need to litigate the adequacy of the public warning system, in the event of a plant emergency. In one decision, the Appeal Board upheld the Licensing Board's rejection of the intervenors' attempt to raise, after the evidentiary



The protracted proceeding on the application of the Public Service Company of New Hampshire for license to operate the Seabrook nuclear power plant Units 1 and 2 continued in 1988, taking up a substantial share of time and attention of NRC Licensing and Appeal Boards. The plant, for which a construction permit was granted in 1976 and which, with construction completed, was licensed in 1986 to load fuel, is shown at left.

record had closed, two contentions concerned with the sound levels of the sirens installed in East Kingston, N.H., and Merrimac, Mass. In another decision, the Appeal Board allowed the record to be reopened to consider a new contention that challenged the adequacy of the public notification system in the absence of any fixed-position emergency notification sirens in the Massachusetts portion of the EPZ. That contention was founded on the fact that the City of Newburyport, Mass., had dismantled and removed all of the emergency sirens, poles, and related equipment located within the city that were to be used for that purpose. In sending the matter back to the Licensing Board, the Appeal Board ruled that low-power operation could not be authorized pending the outcome of the issue. However, as a result of a subsequent Commission rule change, the pendency of that issue no longer constituted a bar to low-power operation.

Another matter before the Appeal Board was the question whether the Seabrook applicants should be required to demonstrate prior to low-power operation that they are financially qualified to operate and decommission the facility. Commission regulations require such demonstration for construction permit applications but not for operating license applications. The intervenors sought to obtain a waiver from this rule to the extent necessary to require such showing, i.e., of financial qualification, with respect to the low-power operation and decommissioning of Seabrook. The Appeal Board upheld the Licensing Board's denial of the waiver request of three of the intervenors. The board went on to determine, however, that the waiver petition of the Attorney General of Massachusetts (submitted in the wake of a Chapter XI bankruptcy petition filed by the lead applicant, Public Service Company of New Hampshire) stated a *prima facie* case for the granting of such relief. On the strength of that determination, and in accordance with prescribed procedure, the board referred that petition to the Commission for ultimate action.

Shoreham Nuclear Power Plant

The Shoreham (Unit 1) facility has been authorized for low-power operation since July 1985. Hearings on the request for a full-power license for the plant, however, continue. The State of New York, Suffolk County (in which the plant is located), and the neighboring Town of Southampton (collectively referred to as "the Governments") oppose issuance of a full-power license for the asserted lack of an adequate plan to evacuate the public from the area in the event of a radiological emergency at the plant. (The Governments have refused to participate in emergency planning for the Shoreham facility. Consequently, the applicant Long Island Lighting Company (LILCO) has developed its own plan, which relies on LILCO employees and support organizations in its emergency planning. See *1987 NRC Annual Report*, pp. 163, 164, for a discussion of earlier litigation on the emergency plan.)

A further requirement for a full-power operating license is a pre-license exercise of the plan, conducted within two years of license issuance. Such an exercise was conducted in early 1986. The Governments contested the adequacy of the exercise, both as to its scope and results. The two-year period, however, expired soon after the so-called "OL-5" Licensing Board rendered its two decisions on the 1986 exercise and before appeals from them could even be briefed. (For case management purposes, the *Shoreham* proceeding has been divided among several boards. The exercise hearing was held before the board designated OL-5.) Notwithstanding its conclusion that the appeal was technically moot, the Appeal Board issued a decision, in the nature of an advisory opinion, in which it affirmed the OL-5 Board's conclusion that the scope of the 1986 exercise was too limited to meet regulatory requirements. (The Appeal Board also heard argument on the separate appeal pertaining to the results of the exercise but, by the end of the report period, had not issued a decision on it.)

In June 1988, a new emergency exercise was held. This raised the question of which one of two boards should conduct any potential hearing on the results of that exercise—the same OL-5 Licensing Board that had conducted the 1986 exercise hearing, or the OL-3 Board that had heard challenges to the emergency plan itself. The Appeal Board decided that because the 1986 and 1988 exercises were both intended to satisfy the same regulatory requirement, the OL-5 Board should be the one to preside over any new hearing.

Soon after that Appeal Board decision, in September 1988, the OL-3 Licensing Board issued its decision on the matters remaining before it. Among other things, it found the Governments in default for failure to comply with certain of its discovery orders, dismissed them from the entire operating license proceeding, and authorized the issuance of a full-power license. The Governments appealed and asked that the appeal be bifurcated, with the question whether their dismissal extended to the portion of the hearing before the other Licensing Board (OL-5) to be considered immediately. The Appeal Board agreed to do so. Then, addressing the question on the merits, it ruled that the OL-3 Board lacked the authority to dismiss the parties from the part of the proceeding not before it and vacated the full-power license authorization because other emergency planning issues remained before the other board.

As of the end of October 1988, all three Appeal Board decisions were before the Commission on petitions for review. The remainder of the bifurcated appeal and a portion of yet another appeal from an earlier decision

of the OL-3 Board (related to the suitability of three reception centers for monitoring evacuees) were pending before the Appeal Board.

Other Noteworthy Proceedings

Other proceedings giving rise to significant Appeal Board action included those involving the following power plants: Diablo Canyon Units 1 & 2 (Cal.); St. Lucie Unit 1 and Turkey Point Units 3 & 4 (Fla.); Braidwood Units 1 & 2 (Ill.); and the Vermont Yankee facility.

The *Diablo Canyon, St. Lucie, Turkey Point,* and *Vermont Yankee* proceedings all involved expansion of the capacity of spent fuel pools at those plants. *Braidwood* involved allegations of harassment of quality assurance inspectors during plant construction, sufficient to render the plant unsafe for operation. On appeal by the intervenors from a Licensing Board decision rejecting their claim, the Appeal Board agreed with the Licensing Board that while the record in the proceeding established harassment, such action did not prevent the inspectors from discharging their responsibilities or establish that the plant was improperly built.

One significant proceeding involved a facility other than a nuclear power plant. In *Kress Creek* , the NRC staff had issued a show-cause order against the Kerr-McGee Chemical Corporation, directing it to prepare and implement a cleanup plan for a contaminated area near the company's West Chicago, Ill., Rare Earths facility. The area, which included parts of Kress Creek and the West Branch of the DuPage River, was contaminated from the indirect discharge of radioactive wastes from the plant (which ceased operations in 1973) over a number of years. The NRC staff claimed that the contamination exceeded Environmental Protection Agency (EPA) standards and thus had to be cleaned up. The company disputed the charge and, following a hearing, the Licensing Board dismissed the show-cause order on the ground, among others, that the EPA standards did not apply to the situation at Kress Creek. On appeal by the staff, the Appeal Board agreed with the Licensing Board's holding and affirmed the dismissal of the show-cause order.

New Chairman for the Appeal Panel

On July 30, 1988, Alan S. Rosenthal, the Chairman of the Appeal Panel since October 1972, retired from full-time Federal service. He is continuing as a part-time member of the panel. The Commission appointed Christine N. Kohl, a panel member since 1980, as the new chairman. In addition to board activities, Judge Kohl, together with the panel's technical advisor, has been actively involved with agency personnel and others in the development of special rules and procedures (including the use of a computerized Licensing Support System) to govern the eventual hearing on the Department of Energy's application for a license to construct and operate a geologic repository for high-level radioactive waste.

COMMISSION DECISIONS

Some of the Commission's more significant decisions during fiscal year 1988 are discussed below. The Commission's actions on export licensing are discussed in Chapter 8.

Seabrook Nuclear Power Plant

In fiscal year 1988, the Commission issued two significant decisions concerning the Seabrook (N.H.) nuclear power plant. The first found that applicant's utility plan appeared to be a good faith submittal which demonstrated that adequate emergency planning was not foreclosed. Therefore, the Commission lifted its stay on the issuance of a low-power operating license. It also held that an evidentiary hearing was not available on summary review of the utility emergency plan. The second decision required the utility, before issuance of a low-power licence, to provide reasonable assurance that adequate funds would be available to decommission the plant safely in the event that low-power operation should take place and a full-power license not subsequently be granted.

In *Public Service Company of New Hampshire* (Seabrook Units 1 and 2, CLI-87-13, 26 NRC 400 [1987]), the Commission held that the applicant's proposed utility plan constituted a *bona fide* plan for that portion of the emergency planning zone located in Massachusetts. The Commission held that the plan addressed the 16 planning standards by which emergency plans are judged, under 10 CFR 50.47(b), contained compensating measures for the lack of State and local government participation, had been submitted to FEMA and NRC for review, and appeared to be intended for implementation. Thus, adequate emergency planning for the Massachusetts zone was held to be " 'in the realm of the possible' or stated conversely... not 'categorically unresolvable.' " Noting that the applicant had deleted individual names and phone numbers in the proposed plan, the Commission stated that, while such deletions and other issues were legitimate questions for full-power hearings, the proposal as submitted satisfied the policy concerns which had led to the imposition of the stay. Therefore, the stay was lifted. However, the Commission did impose two conditions on a future grant of a low-power license: (1) the appli-

cant must have provided to FEMA and NRC staff any of the deleted information they needed for a detailed full-power review of the emergency plan, and (2) the applicant must state clearly for the record its willingness to provide the detailed information to the other parties.

Also, the Commission stated that all it had intended need occur with respect to the utility's plan submittal before low-power operations was summary review. The Commission's policy decision to require submittal of a *bona fide* utility plan before low-power was not intended to effect an exception to the Commission's rules which provide for a full evidentiary hearing on off-site emergency plans before full-power operations, but not before low-power. Therefore, the Commission denied the motion for a hearing.

In the second decision (CLI-88-07 [September 22, 1988]), the Commission noted that its decommissioning rule became effective after the intervenors requested waiver of certain aspects of its financial qualifications rules, which eliminated financial reviews for public utilities. Given that the new rule was promulgated to protect public health and safety by assuring that funds were available so that decommissioning could be carried out in a safe and timely manner, and given the unique and unusual circumstances of this case, the Commission required the applicant to provide assurance, before low-power authorization, that adequate funds would be available for safe decommissioning in the event that low-power operation had occurred and that a full-power license was not granted for Seabrook Unit 1. The Commission requested that the applicant provide, as a basis on which the reasonable assurance finding could be made, adequate documentation of their decommissioning plan and the appropriate commitments under the plan.

Shoreham Nuclear Power Plant

In *Long Island Lighting Company* (Shoreham Unit 1), CLI-87-12, 26 NRC 383 [1987]), the Commission reversed the Appeal Board's decision to admit contentions that the Emergency Planning Zone (EPZ) should be expanded a "few miles" in order to provide an adequate base for *ad hoc* emergency response efforts beyond the EPZ and to minimize the occurrences and effects of spontaneous evacuation from outside the EPZ. The Commission upheld the Appeal Board's decision to remand the proceeding to the Licensing Board for further consideration of the emergency evacuation plans for hospitals in the EPZ.

The Commission, in carefully examining the history of the EPZ concept, noted that the regulations derived from an NRC/EPA task force report, NUREG-0396, which concluded that, even in a Class 9 accident (core melt and containment failure), EPA radiation exposure guidelines would not be exceeded beyond 10 miles from the plant, even using conservative assumptions and analyses. The Commission also noted that nothing in the report or any other material in the emergency planning rulemaking record compelled a finding that EPZ adequacy was especially sensitive to where exactly the boundary fell, and that any such conclusion would be at odds with the overall thrust of the report. However, the rule clearly intended to set limits and concluded that a 10-mile radius provided adequate protection. Therefore the Commission held that the proper interpretation of the rule called for an adjustment of the EPZ only on the basis of such straightforward administrative considerations as avoiding boundaries that run through the middle of schools, and that intervenors' contentions, as admitted by the Appeal Board, were impermissible challenges to the rules.

In regard to the proposed plan for hospital evacuation, the Commission noted that the hospitals within the EPZ had not obtained letters of agreement with hospitals outside the EPZ concerning the transfer of patients in response to an emergency, had not provided the transportation for evacuation of those patients until other special facilities were evacuated, had not calculated the evacuation times for all of the EPZ hospitals, and had not predetermined the circumstances under which hospital evacuation would take place. Noting that 10 CFR Part 50 requires evacuation time estimates without exception for hospitals, the Commission upheld the Appeal Board's decision to remand the proceeding to the Licensing Board for further consideration of hospital evacuation plans within the EPZ.

West Chicago Rare Earths Facility

The Commission's decision *In the Matter of the State of Illinois* (Section 274 Agreement, CLI-88-06 [August 5, 1988]) considered factual and legal issues concerning the distribution of regulatory jurisdiction over radiologically contaminated materials at or near the Kerr-McGee Chemical Corporation's West Chicago Rare Earths Facility. Under the 1987 Section 274 Agreement between Illinois and the Commission, Illinois regulates "source material," as defined in §11z of the Atomic Energy Act, but the Commission retains jurisdiction over "byproduct material," as defined in §11e(2) of the Act. A dispute arose over whether certain materials at or near the West Chicago Facility, including materials in Kress Creek and the West Branch of the DuPage River, were source material or more properly called §11e(2) byproduct material. Material is

§11e(2) byproduct material if consists of "wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content."

The Commission found that the materials in Kress Creek and the West Branch of the DuPage River were best described as byproduct material under §11e(2) of the Atomic Energy Act and were therefore under Commission jurisdiction. It held that the other materials were best described as source material, and were therefore under the jurisdiction of the State of Illinois.

In holding that the Commission retained jurisdiction over the source materials in Kress Creek, the Commission found that, for the whole period during which the contaminated material in Kress Creek originated, namely after 1954, the facility processed ore primarily for its thorium content. More than twice as many tons were processed for thorium sales to the government as were processed for commercial rare earth sales. The thorium content, therefore, appeared to have been both a necessary and sufficient reason for the processing to have taken place. Thus the ore was processed "primarily for its source material content" in the words of §11e(2), and was therefore "byproduct material" under that section.

The Commission held that the pre-1954 processing of the other materials in dispute was driven by the demands for rare earths. Initially, all of the pre-1954 ore had been processed for its rare earths contents, while only a part of it had been processed for thorium. Later, the remainder was processed for thorium. The Commission held that, because the demand for rare earths had apparently been sufficient to cause the processing of the entire tonnage, the wastes from that processing were not §11e(2) byproduct materials, but were source materials under §11z.

Rejecting arguments that the State had prejudged the issues and therefore could not assume jurisdiction, the Commission held that it does not have the authority to disqualify an officer of another government, let alone an entire agency because of allegations that the State has prejudged the issues. The Commission held that recourse against State prejudgment lay in State law, and that the Commission's authority was limited to determining that such recourse existed.

The Commission also held that §151(c) of the Nuclear Waste Policy Act does not prohibit Illinois from regulating the source material.

JUDICIAL REVIEW

The more significant litigation involving the Commission during fiscal year 1988 is summarized below.

Pending Cases

American Mining Congress v. NRC, No. 88-1040 (10th Cir.).

Quivira Mining Company, et al. v. NRC, No. 88-1041 (10th Cir.).

Environmental Defense Fund, et al. v. NRC, No. 88-1001 (10th Cir.).

The above actions challenge the Commission's amendments to its uranium mill tailings regulations conforming NRC's requirements to groundwater standards set by the Environmental Protection Agency (EPA). The industry petitioners argue that the NRC's conforming amendments improperly rely on EPA's cost-benefit analysis of its standards and on EPA's determination that its standards are comparable to similar EPA requirements under the Solid Waste Disposal Act, as required by the Uranium Mill Tailings Radiation Control Act. The environmental petitioners assert that NRC's amended regulations do not fully conform to EPA's standards and that the NRC has failed to conduct a rulemaking allegedly required by §84a(3) of the Atomic Energy Act. Briefing was complete in these cases at the close of the report period, but the court has not yet set a date for oral argument.

Dellums v. United States, No. 87-1531 (D.C. Cir.). This action was filed by several Congressmen, individuals, and public interest groups challenging the NRC's decision to permit the importation of South African uranium hexafloride into the United States. Petitioners claim the NRC's order violates the terms of the Comprehensive Anti-Apartheid Act. The NRC filed a motion to dismiss on standing grounds; the motion was referred to the merits panel by the court. The NRC's brief on the merits was filed on July 29, 1988.

Martin v. NRC, Nos. 85-3444 and 87-3190 (3d Cir.).

Limerick Ecology Action, Inc. v. NRC, Nos. 85-3431 and 86-3314 (3d Cir.).

Anthony v. NRC, No. 85-3606 (3d Cir.).

Limerick Ecology Action, Inc. v. NRC, No. 87-3508 (3d Cir.).

Martin v. NRC, No. 87-3565 (3d Cir.).

These seven consolidated cases challenge various orders issued by the NRC in the completed *Limerick* (Pa.) operating license proceeding. Petitioner Limerick

Ecology Action has asserted that the agency failed to comply with the National Environmental Policy Act by failing to discuss accident mitigation design alternatives in the Limerick Environmental Impact Statement (''EIS''), by not fully analyzing the consequences of facility sabotage, and by limiting its EIS analysis to the potential economic effects of a severe accident to a period of one year following the accident. Petitioner Martin has raised various claims of substantive and procedural irregularities, with respect to his challenge to the Limerick emergency plan as it affects the inmates of the Waterford Correctional Institution, where he is incarcerated. Oral argument was held on February 23, 1988. At the close of the report period, the court had yet to render a decision.

NRC v. Federal Labor Relations Authority, No. 87-3182.

The NRC filed an appeal in the Fourth Circuit challenging an order by the Federal Labor Relations Authority (FLRA) which requires the agency to bargain with the union over certain wage matters. In particular, the FLRA held that the NRC must bargain over a union proposal that the agency grant NRC employees annual pay comparability increases equal to those recommended by the President's Pay Advisory Council, notwithstanding Presidential or Congressional action on those recommendations. The case presents at least two issues of importance in Federal labor relations law.

First, the NRC argues that the union's appeal to the FLRA, in which the union contested the agency's refusal to bargain, was untimely. Second, the NRC argues that the FLRA was incorrect in determining that *161 (d) of the Atomic Energy Act left room for labor negotiations on the extent to which the NRC could deviate from civil service salaries. The case was argued in May 1988 and was under advisement by the Fourth Circuit at the close of the report period.

Quivira Mining Company, et al. v. NRC, No. 85-2853 (10TH Cir.).

Environmental Defense Fund, et al. v. NRC, No. 86-1235 (10th Cir.).

These actions challenged the Commission's amendments to its uranium mill tailings regulations conforming NRC's requirements to standards set by the Environmental Protection Agency (EPA), 50 FR 41852 (October 16, 1985). The industry petitioners asserted, *inter alia,* that the amended regulations fail to undertake a sufficient cost-benefit analysis and fail to supply sufficient flexibility. They argued that the mill tailings regulations (10 CFR Part 40, Appendix A) as a whole exhibit these defects and therefore requested that the court vacate the regulations *in toto.* The environmental petitioners asserted that the NRC had failed to fully conform its regulations to EPA's standards, and had misconstrued the scope of its authority under §84(c) of the Atomic Energy Act. Oral argument was held November 17, 1987; at the close of the report period, the court had yet to render a decision.

Sierra Club v. NRC, No. 87-7481 (9th Cir.).

This case represents the second round in the Sierra Club's attack on the re-racking of the Diablo Canyon (Cal.) spent fuel storage pools. On October 30, 1987, the Sierra Club filed a petition for review, and emergency request to stay pending appeal immediately, effective license amendments which permitted a re-racking of the storage pools at the facility. At the same time, the Sierra Club pursued an administrative appeal of the same issues before the Appeal Board.

The central issue in the Sierra Club's challenge is whether the agency violated the National Environmental Policy Act or the Atomic Energy Act when it issued the amendments without first considering the environmental and public health and safety consequences of a zircaloy-cladding fire after a total loss of pool water caused by, *inter alia,* a seismic event or a dropped cask. As factual support for the challenge, the Sierra Club pointed to a July, 1987 Brookhaven National Laboratory Report concluding that the likelihood of a cladding fire after a total loss of pool water in a high-density rack configuration approached 100 percent, with significant adverse consequences. The Sierra Club also challenged the license amendments as being inconsistent with the Nuclear Waste Policy Act.

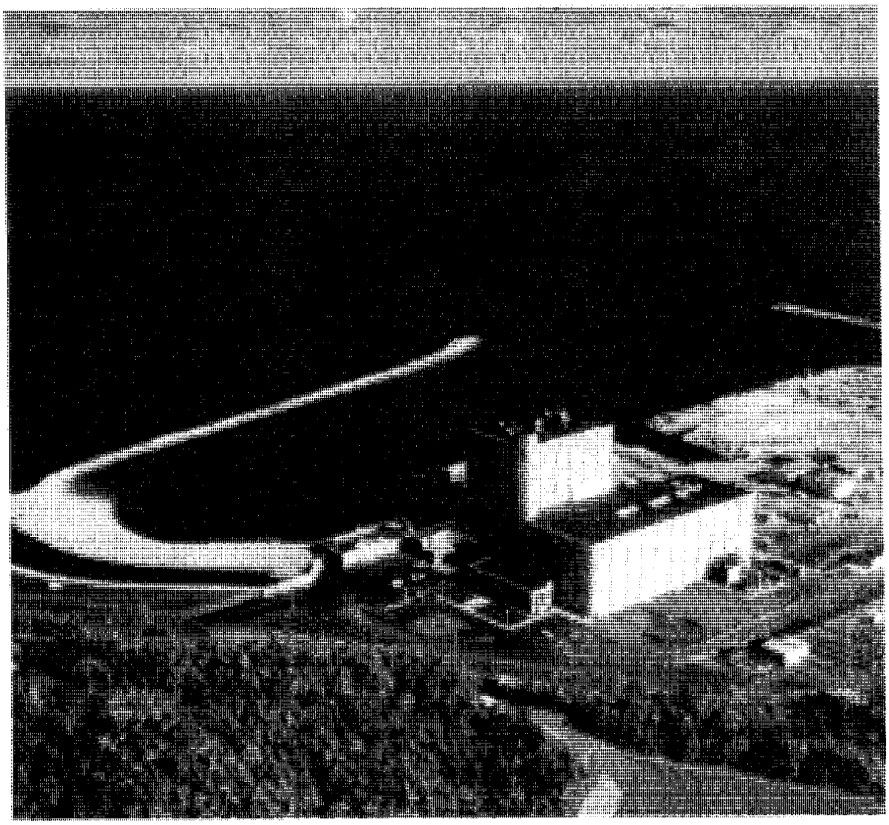
On June 17, 1988, oral arguments were heard by the Ninth Circuit Court of Appeals. A decision was pending at the close of the report period.

Significant Judicial Decisions

Commonwealth of Massachusetts v. NRC, F.2d (1st Cir. 1988). On September 6, 1988 the First Circuit Court of Appeals unanimously affirmed the NRC's emergency planning rule change which allowed the agency to consider a utility emergency plan in the absence of plans offered by State and local governments.

The court rejected petitioners' claim that the NRC is an agency without expertise in emergency planning and is not entitled to deference on emergency planning issues. An agency's area of expertise, said the court, is a question of statute, and the statute has authorized and directed the NRC to make decisions in this area.

The court also dismissed the claim that it was unreasonable for the NRC to presume that the State and local governments would follow a utility plan in an actual accident if no other plan existed. ''This prediction is supported by common sense,'' the court said, as well as by the rulemaking record, which



Boston Edison company's Pilgrim nuclear power plant Unit 1, located near Plymouth, Mass., has been in operation since 1972. The boiling water reactor was shut down in 1986 to permit correction of certain design deficiencies in the emergency core cooling system; the plant has remained in that status while NRC reviews an intervenor group's petition opposing restart.

showed the preference of State and local governments for a planned response, rather than an *ad hoc* response. The court added that the rule's use of presumption was not objectionable, so long as the presumption is rational, as it was in this case. The court added that the presumption here was expressly made rebuttable, and that nothing in the rule declared that the only way to rebut the presumption was with an adequate State or local plan.

Noting that petitioners charged the NRC with having deviated from the position it took in 1980, the court observed that even if that were true (an issue which it did not decide), it would not be irrational for NRC to find that changed circumstances made a rule change necessary in order to better effectuate the intent of Congress.

The court also addressed the claim that the NRC violated notice requirements when it incorporated the realism presumptions in its final rule. Taking note of language in the proposed rule which set forth the realism doctrine, the court declared this argument to be without merit.

In addition, the court rejected the claim that the rule permitted the NRC to consider economic costs in determining the adequacy of an emergency plan. The NRC's notice specifically denied any such intent, the court observed. Nor did the rule imply a consideration of economic costs in making allowance for the possibility that the State and/or local non-participation in emergency planning might make compliance with planning standards "infeasible," the court said. In context, the court said, this refers to the fact that some of the planning standards contemplate utility-government cooperation.

Finally, the court rejected petitioners' remaining arguments as failing either to acknowledge the discretion vested in the NRC, or to recognize that the application of the rule in specific future cases is a matter for future litigation.

Massachusetts Public Interest Research Group, Inc. v. NRC, 852 F.2d 9 (1st Cir. 1988).

The First Circuit held that the NRC's refusals to take enforcement action requested under 10 CFR §2.206 may not be judicially reviewed, because such requests are committed to agency discretion by law.

The case involved a §2.206 request by MassPIRG, a public interest group, to suspend the license of the Pilgrim (Mass.) nuclear power plant because of emergency planning deficiencies, "Mark I" containment design defects, and management problems. In the Interim Decision, the Director denied the request to institute a show cause hearing to address MassPIRG's emergency planning and containment

concerns, and he deferred ruling on the management concerns raised by MassPIRG. He also noted, however, that to the extent MassPIRG was requesting that Pilgrim not be restarted until emergency planning deficiencies were corrected, the petition was granted.

Although MassPIRG filed the petition which sought judicial review of this Director's Denial, the case was, in fact, briefed and argued by the Massachusetts Attorney General's Office.

In its analysis of whether the judiciary could review a final agency decision not to institute formal enforcement action, the court reviewed *Heckler v. Chaney*, 470 U.S. 821 (1985), which establishes a presumption that agency refusals to take enforcement actions are not reviewable. The court then canvassed the Atomic Energy Act and concluded that nothing in the statute rebutted the presumption of non-reviewability. Next the court considered whether any NRC regulations could rebut that presumption. While the court concluded that agency regulations could rebut the presumption of non-reviewability, it also concluded that nothing in the NRC's regulations did so. The court then reviewed the agency's policy statement on enforcement and concluded that it did not rebut the non-reviewability presumption. Finally, the court reviewed internal Commission guidance which sets forth the standard of review which the Commission would apply in considering the Director's Denial of a §2.206 petition. The court concluded that that decision was not intended to limit NRC discretion to deny a §2.206 request.

In a final note, the court found that its decision to decline to review the Director's §2.206 denial was "bolstered" by the fact that the NRC took some enforcement action against the licensee. In particular, the court noted the NRC's decision to keep Pilgrim shut down until management and emergency planning problems were dealt with to the Commission's satisfaction. While the agency's enforcement action was not the formal agency action requested by MassPIRG, the court viewed the NRC's selection from among various enforcement alternatives as precisely the kind of policy choice which *Heckler* reserved for the agency.

Florida Power & Light CO. v. United States, 846 F.2d 765 (D.C. Cir. 1988; petition for *certiorari* filed, No. 88-234 (October 11, 1988)).

The United States Court of Appeals for the District of Columbia affirmed the Commission's 1986 rule which charged nuclear power facilities approximately $1 million per year as a "user fee" under the Consolidated Omnibus Budget Reconciliation Act ("COBRA").

The majority accepted every argument the NRC raised in defense of the rule. It deferred to the NRC interpretation of COBRA; it found compliance with the APA's notice-of-comment requirements; and it upheld the constitutionality of the Act as being lawful delegation of authority from Congress to the Commission.

Public Citizen v. NRC, 845 F.2d 1105 (D.C. Cir. 1988). This case presented a challenge to the NRC's implementation of §306 of the Nuclear Waste Policy Act of 1982, 42 USC §10226. The NRC responded to that statute by promulgating a policy statement governing training and qualifications of nuclear power plant personnel. Petitioners asserted that the agency was required by the statute to promulgate regulations. In addition to defending the NRC's decision to implement §306 through regulatory guidance in the form of a policy statement, NRC argued that the court lacked jurisdiction over the case. On this issue, NRC argued that regardless of whether the suit was viewed as a challenge to the NRC's policy statement or to its denial of petitioner's request for rulemaking, petitioners failed to file their action in a timely manner.

In its opinion, the court dismissed the case for lack of jurisdiction without deciding either the legality of the NRC's policy statement or NRC's refusal to promulgate regulations. The court completely adopted NRC's arguments and ruled that "[p]etitioners' suit was too late to challenge the Policy Statement and too early to challenge NRC's denial of their request for rulemaking."

Management and Administrative Services

Chapter 11

This chapter covers such internal NRC matters as changes in the Commission membership, consolidation of the agency's offices, major aspects of personnel management, NRC's information resources, license fees levied and collected, activities of the Office of Inspector and Auditor, and activities of the Office of Small and Disadvantaged Business Utilization and Civil Rights.

Changes Within the Commission

Two changes occurred in Commission membership during the report period. In June, Commissioner Frederick M. Bernthal completed his five-year term. In October, Commissioner James R. Curtiss was appointed to fill the vacancy. Other appointments at the senior staff level are reported in Chapter 1.

Consolidation

The NRC achieved a major milestone in its goal of consolidating Headquarters offices at a single location with the completion, in April 1988, of full occupancy of the One White Flint North building. The newly constructed building—located at 11555 Rockville Pike in Rockville, Md., across the street from the White Flint Metro Station—houses 62 percent of the Headquarters total staff of 2,250. With the interim consolidation of the Office of Research at a nearby Nicholson Lane site late last year, 73 percent of the Headquarters staff is now consolidated in the White Flint area of Rockville.

Construction of a second building, Two White Flint North, is planned to complete NRC Headquarters consolidation in 1991. Two White Flint North will house the Office of Research, currently situated close by the White Flint site in two leased buildings, and the Offices of Inspector and Auditor, Analysis and Evaluation of Operational Data, Personnel, Administration and Resources Management, Small and Disadvantaged Business Utilization/Civil Rights, and the professional staffs and facilities of the Advisory Committee on Reactor Safeguards, Advisory Committee on Nuclear Waste, Atomic Safety and Licensing Board Panel, and Atomic Safety and Licensing Appeal Panel. These offices are currently located in the Bethesda, Md., central business district. The NRC Operations Center and various administrative support facilities will also be moved into the second building.

Significant progress was made during the year toward securing Montgomery County (Md.) approval of the second building. In April 1988, a hearing before the Montgomery County Planning Board resulted in a recommendation to the County Council for approval of a change in the original zoning of the property to allow construction of Two White Flint North. Opposition from a local businessman and a local civic association required referral of the case to a Hearing Examiner, who ruled in favor of the requested zoning change. A month later, in July, the County Council voted to approve the amended development plan, thus opening the way for final Site Plan and Subdivision review by the Montgomery County Planning Board and, if all required conditions are met by the developer, issuance of a building permit.

PERSONNEL MANAGEMENT

NRC Staff Ceilings

During fiscal year 1988, the NRC expended a total of 3,267 staff-years in carrying out its mission, a figure 0.5 percent above the budget ceiling of 3.250 staff-years. Major categories of employees included in the total staff-years expenditure are: permanent full-time staff, part-time and temporary workers, and consultants.

In fiscal year 1989, the NRC ceiling is 3,180 staff-years. This figure reflects a continuing reduction in the personnel ceiling and will require stringent limitations in hiring during the fiscal year. The Office of Personnel has developed a staffing strategy for the agency overall, as well as for each Headquarters office and Region, in order to effect the reduction.

Recruitment

In fiscal year 1988, the NRC hired 164 and lost 234 permanent full-time employees, representing an attrition rate of 7.5 percent per year. The agency's recruitment program included visits to numerous college

James R. Curtiss, who had served as Associate Counsel for the Senate Committee on Environment and Public Works since 1981, was sworn in as a member of the U.S. Nuclear Regulatory Commission on October 20, 1988, to serve until June 30, 1993. Commissioner Curtiss had previously served with the NRC, in 1979-1981, first as an attorney in the Office of the Executive Legal Director and later as a member of the staff of Commissioner Richard T. Kennedy. Mr. Curtiss was graduated from the University of Nebraska in 1976 and received his law degree there in 1979, shortly before joining the staff of the NRC.

campuses (including campus "job fairs") and participation in approximately 15 other kinds of job fairs during the report period.

Performance and Incentive Awards

NRC managers recognized high-quality work by staff members in fiscal year 1988 with five Distinguished Service Awards, 37 Meritorious Service Awards, 442 Special Achievement Awards, 313 High-quality Performance Salary Increases, 138 Certificates of Appreciation, one Presidential Distinguished Executive Rank Award, 11 Presidential Meritorious Executive Rank Awards,and 82 Senior Executive Service (SES) bonuses.

Labor Relations

NRC management and the National Treasury Employees Union (NTEU) implemented an interim Collective Bargaining Agreement in fiscal year 1987 covering all Articles except "Performance Appraisal," "Reduction-in-Force," and "Salary." Those articles were referred to the Federal Labor Relations Authority (FLRA) for a determination as to negotiability. The FLRA determined that some aspects of each of these articles are negotiable; the agency is appealing that determination with respect to "Salary." Negotiations began in September 1988 on "Performance Appraisal" and "Reduction-in-Force," along with two other articles—"Merit Selection" and "Reorganizations and Moves"—presented by the NTEU for negotiation under the "limited reopener" provision of the Interim Agreement. In addition, NTEU proposed negotiations on six new articles; those matters were under discussion at the close of the report period.

Drug Testing

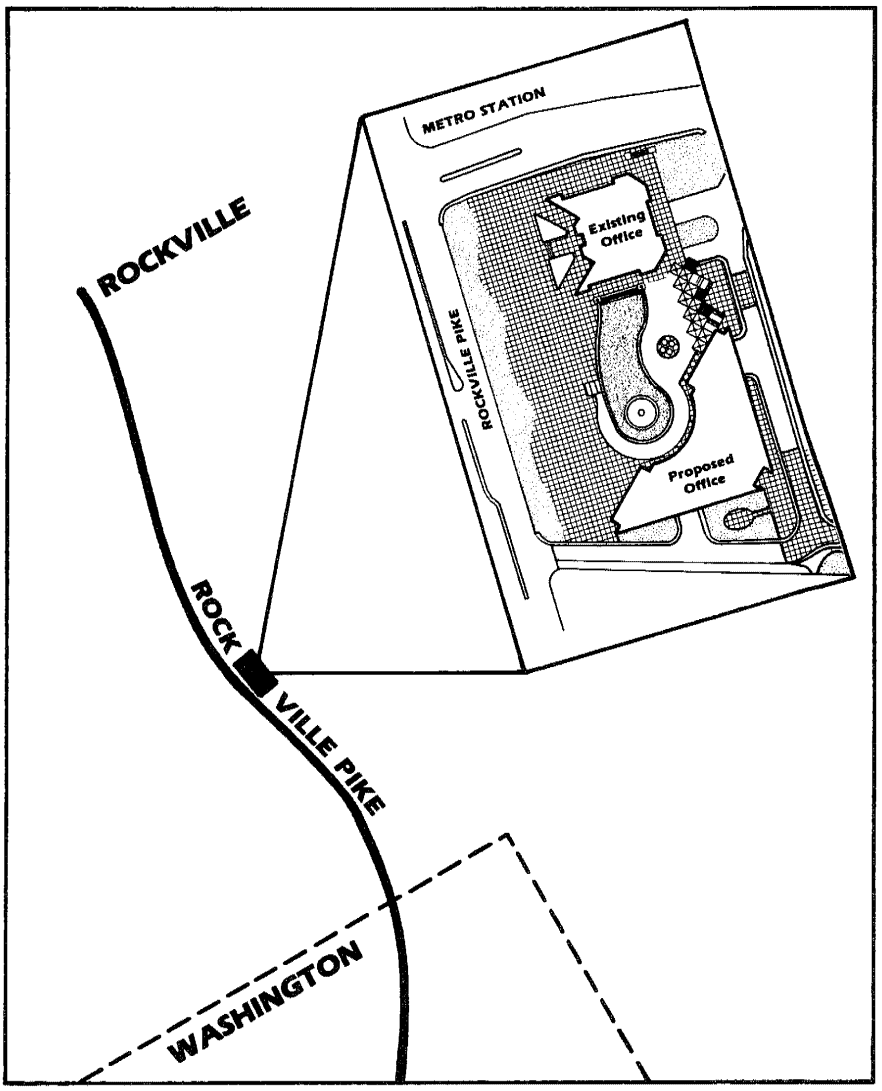
On July 9, 1987, the Commission communicated its drug testing Policy Statement to all NRC employees. The statement emphasized that the use of illegal drugs by NRC employees is unacceptable and that the NRC has a "zero tolerance" policy with regard to such use.

The NRC Drug Testing Plan was certified to Congress by the Department of Health and Human Services on August 16, 1988. The plan calls for random testing of (1) Regional and Headquarters employees who have unescorted access to vital areas of nuclear plants (to include "Category 1" fuel facilities), (2) employees who have assigned responsibilities or are on call for Regional or Headquarters incident response centers, and (3) employees with access to Sensitive Compartmented Information (SCI) and/or Foreign Intelligence Information (FII). The plan also includes testing based on reasonable suspicion, testing in connection with accidents or unsafe practices, testing of applicants for testing-designated positions, voluntary testing, and follow-up testing.

By announcement dated August 22, 1988, all NRC employees received the required 60-day general notice of the NRC drug testing program. Employees in testing-designated positions began receiving their specific 30-day notice of drug testing on September 20, 1988. Drug testing for non-bargaining unit employees in testing-designated positions began in November 1988. Testing of bargaining unit employees will begin after appropriate negotiations have been conducted with the NTEU

Training and Development

The NRC provides over 60 different technical courses in reactor and reactor-related technology, end-user computer applications, and probabilistic risk assessment for its technical and administrative person-



A milestone was attained for the new (and projected) NRC Headquarters office complex in 1988 with full occupancy of the first of two buildings in Rockville, Md., about five miles north of the District of Columbia. The second building is scheduled for completion in 1991.

nel. Twenty-nine on-site courses are also provided to improve executive, management, supervisory, and administrative skills. NRC employees also participate in a wide range of private sector, college and university, and government-wide educational and development programs directed at improving performance and maintaining up-to-date technical proficiency.

In fiscal year 1988, the NRC continued its emphasis on upward mobility programs and the use of Individual Development Plans to help all employees clarify their career goals and improve their job skills and performance. A Certified Professional Secretary Program, an Administrative Skills Enhancement Program, and a Computer Science Development Program were available as vehicles by which secretarial/clerical/administrative personnel might expand their sphere of training and advancement opportunities. NRC employees also participated in two formal development programs sponsored by the Office of Personnel: the Women's Executive Leadership Program and the Interagency Executive Potential Program for Mid-Level Employees. These one-year, part-time programs are designed to help program participants to acquire or enhance their supervisory and managerial competences. They provided NRC employees with opportunities to complete individual and group activities and developmental work assignments.

The NRC offers extensive supervisory and management development programs for current staff members. A pre-supervisory orientation program is offered to assist employees in the pursuit of career goals leading to supervisory positions. Supervisory develop-

ment training is mandatory for new supervisors. A course in supervising human resources covers all aspects of supervision, and an NRC Management Workshop enables managers to evaluate and analyze their current managerial effectiveness.

In fiscal year 1988, the NRC expanded its use of rotational assignments for the career development of employees and for satisfying organizational and staffing needs. Employees can be selected for a position at the same grade, with no change in promotion potential, and be trained for positions in different NRC offices and occupations. Employees may serve on a temporary assignment for periods ranging from one month to two years, returning to their previous office, or be permanently reassigned to a different office. Managers and supervisors have been encouraged to become actively involved in identifying employees to meet the objectives of this program. In July 1988, the Office of Personnel distributed an information pamphlet to all non-SES employees giving guidance on the development and use of rotational assignments and providing a method for employees to indicate their interest in and to apply for rotational assignments.

Executive Leadership Development

The implementation of the Executive Leadership Program continued during the report period. Members of the Senior Executive Service completed career planning questionnaires and discussed their responses with members of senior management, resulting in a number of rotational assignments intended both to broaden the experience of current executives and to ensure continuity of executive expertise for the future.

Employee Assistance Program

During fiscal year 1988, the NRC Employee Assistance Program (EAP), which already included employee benefits and the Alcohol and Drug Abuse Program, was expanded to provide assistance to employees dealing with issues such as job stress, chronic illness, and family or relationship problems. Fifty-three employees and supervisors were counseled during the fiscal year. EAP staff participated in the Drug Testing Program information sessions for Headquarters and Regional Office personnel. The EAP was given responsibility for implementing the "NRC Guidelines on Acquired Immune Deficiency Syndrome (AIDS) in the Workplace."

NRC INFORMATION RESOURCES

The Office of Administration and Information Resources Management (ARM) seeks to provide NRC management with state-of-the-art tools and methods for gathering, storing, and retrieving the information needed to carry out agency programs and fulfill the agency mission. In doing so, ARM sets out to ensure that all data gathered by and contained in automated systems is consistent, timely, and accurate; to provide the capability to process and report information efficiently; and to furnish the strategic approaches—equipment and software, as well as the organizational structures—to facilitate achievement of these information goals.

Safety Information Network (SINET)

The NRC's information resource planning is based on the principle that comprehensive, reliable, and accessible information is crucial to carrying out the agency's mission. Under the NRC's approach, responsibility for both the availability and integrity of data rests with the NRC organizational units responsible for the collection and validation of the data. It is intended that data-users shall have ready access to the data they need with a minimum of technical knowledge or required training. Data are to be managed in a network of subject-oriented data bases in an integrated hardware/software environment, linked by the most current telecommunications technology. This network was named the Safety Information Network (SINET) in fiscal year 1987, in order to stress primary application in the area of safety-related data bases.

The purpose behind the SINET initiative is to collect health and safety information related to NRC licensees and their operations into a centralized data base, and to provide the tools that the NRC staff will need to obtain instant access to the data, as well as to analyze and display the information in the most relevant, usable mode. The ultimate objective is to assure that the NRC performs its basic mission—protecting public health and safety by assuring adequate protections are provided in civilian nuclear operations—in the most informed, coordinated, efficient, and effective way.

Early development of the SINET information network is described in the *1987 NRC Annual Report*, pp. 172-175. When complete, the SINET centralized data base will contain information about data entities concerning safety, operational and technical data that have been identified as having agency-wide usefulness or interest. Each of these entities is a person, place, thing, concept, or event about which the NRC wishes to store data.

During the report period, use of SINET has continued to increase, with ever wider acceptance. Several general user-oriented information tools have been developed and made available to the technical staff. Two of these tools—the Online SINET Query System and the SINET Nuclear Power Reactor Book—are being employed daily by the technical staff as reference, preparation, and analytic materials.

New systems under development are a Master Inspection Planning System (MIPS), for use by Headquarters and the Regions in planning, tracking, and reporting the status of the reactor inspection program and a Probabilistic Risk Assessment Status Information System (PRASIS), intended to track the status of PRA studies in progress and to summarize currently available information on important accident initiators and threats to core damage.

Future work is planned for data reported in Preliminary Notifications, data on events found in Daily Reports from the Regions and Headquarters, data associated with system/component failures or actuations which contributed to an event, data from "10 CFR Part 21" and Construction Deficiency Reports, and data associated with enforcement activities.

Nuclear Documents System (NUDOCS)

The Nuclear Documents System (NUDOCS) is the product of major improvements in the former Document Control System (DCS), especially by incorporation of a full text search-and-retrieval capability for selected documents. Full text display is currently available for Title 10 of the Code of Federal Regulations, Licensee Event Reports (LERs) from January 1988 to the present, and abstracts of NUREG and NUREG/CR reports from 1984 to the present. In the future, the collection of abstracts and full text records will include a still greater portion of NRC documents. An on-line thesaurus is available to help the user search the data base by supplying narrower, broader, and related terms.

In an effort to reduce operational costs in the areas of data acceptance and preparation, NUDOCS has incorporated the capabilities of electronic transmittal and capture of selected documents. Electronic dissemination of NUDOCS data has also been initiated in support of the NRC's SINET data base (see above) and the Sequence Coding and Search System (SCSS) operated by Oak Ridge National Laboratory (ORNL) for the Office for Analysis and Evaluation of Operational Data (AEOD). Additional benefits deriving from these capabilities include enhanced operational performance, and improved data integrity and reliability.

The Waste Management Transitional Licensing Support System (TLSS), the Congressional Correspondence Retrieval System (CCS), and the Atomic Safety and Licensing Board Panel Proceedings System are three additional full text search-and-retrieval systems which have become operational this year. These on-line, interactive query systems are examples of applications which support objectives of the Paperwork Reduction Act of 1980. Efforts are progressing toward combining all full text capabilities into one umbrella system, which would streamline operations while reducing maintenance costs.

The NRC's Safety Information Network (SINET) provides headquarters personnel with instant access to operational data on licensees and their facilities. In the photo, NRC Chairman Lando W. Zech, Jr., gets some pointers on using SINET from Project Director Francine Goldberg.

New technologies have been tested in the areas of text processing and records management. Two optical disk demonstration projects were implemented: one of them—involving the participation of Toledo Edison, licensee for the Davis-Besse (Ohio) facility—successfully produced a mastered CD-ROM disk containing documents germane to the licensing process. Three work stations (one at the site, one with the licensee, and one with the NRC-NRR Project Manager) have been installed for purposes of evaluation. A second project—involving the participation of Florida Power & Light, the Turkey Point licensee—was ongoing at the close of the report period.

NRC FIVE YEAR PLAN PUBLISHED

In March 1988, the NRC published its first comprehensive Five Year Plan. The document is the latest step in the evolution of the agency's planning, programming, and budgeting process. Its purpose is to provide the basis for long-range planning, for future budget submissions to the Office of Management and Budget (OMB) and the Congress, and for assessments of the agency's progress in achieving its goals. The plan includes a discussion of the assumptions that underlie agency planning, the strategic goals and objectives that the agency intends to achieve, program guidance that has been approved by senior management to guide the development of agency programs, and descriptions of the programs and resources that are planned for the realization of agency goals and objectives. The plan will be updated annually and will be published for public distribution some time after the President's budget is submitted to the Congress.

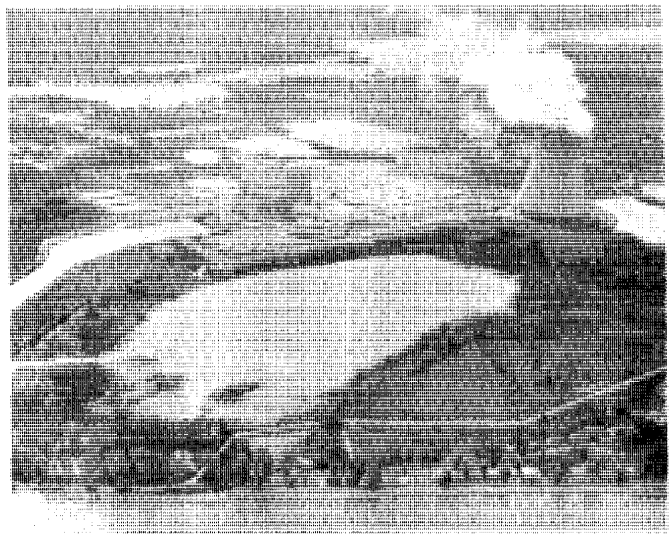
OFFICE OF INSPECTOR AND AUDITOR

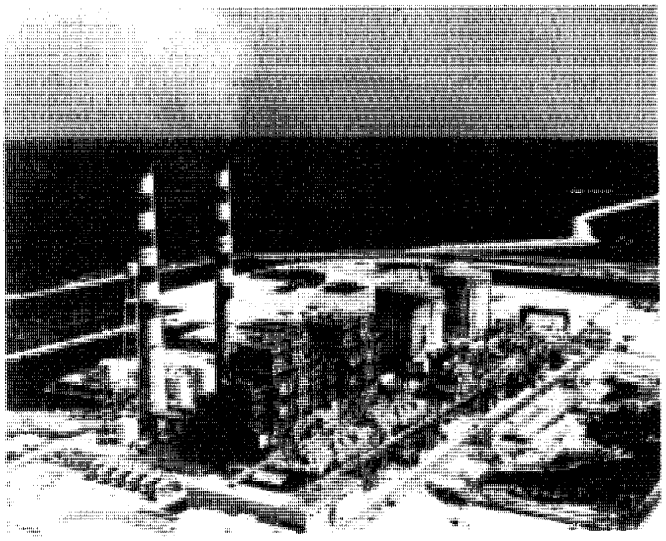
The mission of the NRC Office of Inspector and Auditor (OIA) is to assure effectiveness, efficiency, and integrity in all NRC operations. In fiscal year 1988, OIA issued 23 audit reports, containing 120 recommendations, and 20 follow-up audit reports intended to improve the operations of various NRC programs and activities. OIA also issued 29 investigative reports in response to allegations concerning the integrity of NRC operations and employees. Of the investigative matters addressed by OIA during the fiscal year, seven were referred to the Department of Justice for consideration and possible prosecution. Some of the notable OIA audit reports issued during fiscal year 1988 are summarized below:

NRC's Relationship with TVA

This review was conducted in response to a letter dated March 19, 1986, from Congressman John Dingell to the Chairman, NRC, which questioned NRC's relationship with the Tennessee Valley Authority's Nuclear Safety Review Staff (NSRS).

OIA found there were no formal or informal arrangements between NRC and TVA through which NSRS reports were routinely provided to NRC prior to January 1, 1985. The review indicated, however, that NRC's senior Regional management was aware of the existence of the NSRS and its general activity since its inception. Both Region II (Atlanta) and NSRS understood that the NSRS organization and its activities were not a regulatory requirement. However, NSRS did cooperate with Region II in providing NSRS re-





Computerized text processing and records management techniques, using new technologies, were implemented by the NRC in two optical disk demonstration projects during 1988. One involved the Toledo Edison Company's Davis-Besse nuclear power plant, shown above left, and produced a CD-ROM disk of documents used in the licensing process still under way at the end of the report period. The other demonstration project pertains to the Florida Power and Light Company's Turkey Point facility, shown above right.

ports when requested by Region II senior management, or by Region II inspectors when visiting a TVA site. OIA's report, issued in December 1987, identified 29 NSRS reports that the NRC Headquarters and Region II staffs had access to or had received. OIA's report was provided to Congressman Dingell by the Chairman on February 2, 1988.

Implementation of the Backfit Procedures

In September 1985, the NRC revised its regulations to establish standards for future management of backfitting for power reactors. In February 1986, the Commission approved Manual Chapter (MC) 0514, entitled, "NRC Program for the Management of Plant-Specific Backfitting of Nuclear Power Plants." In this audit, OIA reviewed the effectiveness of the staff's implementation of the Backfit Rule.

OIA identified a need for the Executive Director for Operations (EDO) to increase and improve his management oversight of the plant-specific backfit process, in order to assure that backfits are being identified and handled in accordance with 10 CFR 50.109 and MC 0514. OIA concluded that MC 0514 needed to be clarified as to when backfits are to be recorded in the Plant-Specific Backfit System, and office procedures needed to be revised reflecting that clarification. MC 0514 also needed to be revised to include guidance on considering plant-specific issues for their generic implications; and the quality of and control over data in the Plant-Specific Backfit System needed to be improved. And it was concluded that MC 0514 needed to be issued in final form.

The OIA report was issued in June 1988 and contained eight recommendations for the improvement of the plant-specific backfit process in the NRC.

Cable Installation at Watts Bar

As part of an overall review of NRC's activities related to nuclear projects of the Tennessee Valley Authority (TVA), OIA reviewed NRC's oversight of electrical construction at TVA's Watts Bar (Tenn.) site. The objectives of the review were to determine whether NRC had implemented the inspection program in the electrical construction area at Watts Bar and whether the electrical inspection program, as it existed at the height of Watts Bar's construction, could have been expected to disclose the types of problems later to be addressed at TVA—such as problems with cable bending radii, excessive sidewall pressure, and improper "pullby's."

OIA concluded that, while it could not be established whether the electrical inspection program had been fully implemented at Watts Bar, simply fulfilling the inspection requirements would not necessarily have led the inspector to the identification of those cable issues that were being addressed at TVA at the time of the audit.

OIA also concluded that NRR did not adequately coordinate its efforts with Region II regarding the consultant activities related to cable installation concerns at Watts Bar and the Sequoyah (Tenn.) plant. However, with NRC's creation of the Office of Special Projects (OSP), the programmatic controls had been strengthened sufficiently to assure the appropriate use of consultant information and of knowledgeable NRC staff.

OIA's report was issued in May 1988 and contained two recommendations to address cable installation issues at TVA facilities.

Use of NRC's Telephone System

NRC spends approximately $3 million each year on general purpose/data telecommunications lines and equipment. OIA's February 1988 audit report identified improvements which could be made in NRC's management of its telephone system to improve service and reduce costs. Specifically, improvements could be made in (1) the authorization for and verification of receipt of telephone services, (2) the verification of the accuracy of the telephone bill before it is paid, (3) the system used to track changes in and account for NRC's telephone lines and features, and (4) NRC employees' awareness of their telephone's capabilities. Based on its statistical sample of NRC's telephone services, OIA estimated that NRC could save between $198,000 and $358,000 each year by eliminating telephone lines not being used and assuring that services for which it is paying are actually being received. OIA's report contained 15 recommendations to improve NRC's management of its telephone system.

Regional Administrative Activities

Beginning in about 1982, NRC assigned many of the administrative responsibilities for operating NRC's five Regional Offices to those offices. As a result, the Regional Offices became responsible for certain administrative matters related to personnel administration, payroll, procurement, inventory management and travel. OIA reviewed the Regions' performance of their administrative responsibilities and, during fiscal year 1988, issued a report to each Regional Administrator assessing that Region's administrative activities. Each report contained recommendations to improve the Region's administrative activities where necessary.

Table 1. License Fee Collections—FY 1988

Fees	*Facilities Program*	*Materials Program*	*Total*
10 CFR 171	$136.6 million	—	$136.6 million
10 CFR 170	39.6 million	$2.3 million	41.9 million
TOTAL FEES	$176.2 million	$2.3 million	$178.5 million

Controls Over Travel Funds

This January 1988 OIA audit report evaluated the adequacy and implementation of NRC's controls over all aspects of the travel process. The audit found that, while certain controls which had been implemented by NRC over the use of and accounting for travel funds were adequate, other controls had not been fully implemented. That fact meant that certain aspects of the administration of travel funds were exposed to potential waste and abuse. Specifically, the audit identified a need to improve the separation of functions in the operation of the automated travel data system, improve the training of the Travel Unit staff in the operation of the automated system, and document and consistently apply internal controls. The report contained 15 recommendations to improve the controls over the administration of travel funds.

Controls Over Imprest Funds

Because of the large amount of funds NRC has in its imprest fund locations in the Regional Offices and at NRC Headquarters, and because of the loss of funds in several locations, OIA has placed increased emphasis on assessing the adequacy of controls and on management's involvement in the imprest fund operations. During the course of the fiscal year, OIA issued three reports with recommendations for tighter controls over imprest fund operations.

CONTRACTING

Contracts with commercial firms for technical assistance, research work, and general purchases totaled approximately $62,200,000 in fiscal year 1988. Contracts under the Small Business Innovative Research Program totaled $500,000, and grants under cooperative agreements with education and nonprofit institutions totaled $2,600,000.

NRC LICENSE FEES

In fiscal year 1988, the Commission collected $178.5 million in fees. Section 5601 of the Omnibus Budget Reconciliation Act of 1987 (OBRA, Public Law 100-203) required the Commission to assess and collect fees of not less than $177 million, or 45 percent of the Commission's budget for fiscal year 1988 of $392.8 million. Two different approaches were used by the NRC in collecting these fees. First, the NRC acted under its authorization to collect fees for processing applications, permits, licenses, and approvals, and for routine and non-routine safety inspections, under Title V of the Independent Offices Appropriation Act of 1952 (IOAA). The IOAA fees are established under 10 CFR 170 of the Commission's regulations. Second, the NRC assesses annual fees under Public Law 100-203 from utilities licensed to operate nuclear power plants. These annual fees are established under 10 CFR 171 of the Commission's regulations. The annual fee assessed in fiscal year 1988 for each plant with an operating license was $1,286,000.

All license, inspection, and annual fees collected are sent to the Department of Treasury for deposit as miscellaneous receipts. Table 1 shows the total amount collected in the two categories.

Litigation Concerning Fees

The Commission published a Final Notice of Rulemaking in the *Federal Register* on September 18, 1986, establishing annual fees for power reactors with operating licenses (10 CFR 171), which became effective on October 20, 1986. That rule was challenged and later upheld in its entirety in *Florida Power and Light Co., et al. v. United States*, 846 F.2d 765 (D.C. Circuit, March 13, 1988). A petition for writ of certiorari challenging that decision is pending in the Supreme Court (*Florida Power and Light Co. v. United States*, No. 88-234).

OFFICE OF SMALL AND DISADVANTAGED BUSINESS UTILIZATION AND CIVIL RIGHTS

Small and Disadvantaged Business Utilization Program

In accord with Public Law 95-507, amending the Small Business Investment Act of 1957, the Small and Disadvantaged Business Utilization Program annually establishes certain procurement preference goals. Actual total prime contract dollars awarded during fiscal year 1988 came to $56,372,691, of which the actual award of small business prime contract dollars was $22,188,362, or 39.36 percent of the total.

Awards to "8(a) firms" were actually $8,122,100, or 14.41 percent of the total dollar amount of all prime contracts regardless of dollar value.

Achievement for prime contracts awarded to small disadvantaged business firms other than 8(a) firms was $211,000, or 0.37 percent of the dollars reported above.

Prime contract awards to small business concerns owned and controlled by women was $2,106,670, or 3.74 percent of the total dollar amount of all prime contracts regardless of dollar value.

Subcontract awards to small business was $1,930,395, or 72.71 percent of total subcontracts awarded. The NRC's total subcontract dollar awards in fiscal year 1988 was $2,654,842.

Subcontract awards to small disadvantaged businesses was $286,936, or 10.81 percent of total subcontract dollars awarded.

During calendar year 1988, 110 interviews were conducted with firms wanting to do business with the NRC, and 55 follow-up meetings, were arranged with NRC technical personnel. The Office of Small and Disadvantaged Business Utilization and Civil Rights (OSDBU/CR) staff also participated in five major small business conferences. Most noteworthy among these were the Small Business Week observance in May 1988, and the annual Minority Enterprise Development Week in October 1988.

Civil Rights Program

During the report period, the NRC Multi-year Affirmative Employment Plan was approved by Chairman Zech and forwarded to the Equal Employment Opportunity Commission (EEOC). The Commission was briefed in November 1987 and in July 1988 concerning NRC's EEO and Affirmative Employment programs, goals and accomplishments.

An analysis of the EEO accomplishment report, submitted annually by Office Directors and Regional Administrators to the Director, OSDBU/CR, was provided to the NRC Executive Director for Operations to apprise him of the performance of managers in achieving assigned goals. The Director, OSDBU/CR, continues to function as a non-voting, *ex-officio* member of the SES Performance Review Board.

Five new EEO Counselors were appointed during the fiscal year, bringing the total to 29 EEO Counselors at NRC Headquarters. The Headquarters and Regional counselors met at Headquarters in April 1988 for the annual training provided by OSDBU/CR, EEOC, and Office of Personnel Management staffs.

In June and July 1988, three EEO training sessions were conducted for senior staff to address various issues associated with the implementation of the agency EEO program.

Federal Women's Program

Continuing emphasis on the advancement of women through program initiatives, special awareness efforts, and affirmative recruitment and selection characterized the fiscal year 1988 Federal Women's Program (FWP). Highlights of the program included the following:

- The FWP and Civil Rights Program (CRP) Managers began the fiscal year with a series of compliance monitoring conferences, working with office directors to review past and current EEO initiatives and provide additional advice and assistance.
- National Women's History Month was observed in March with a special program and exhibit highlighting the contribution of women at all levels of work at NRC.
- The Federal Women's Program Advisory Committee (FWPAC) Leadership Award was presented to the former Committee Chairperson.
- National Secretaries Day was celebrated, with managers and secretaries attending a luncheon.
- Women's Equality Day was observed with an All Employee Announcement from Chairman Zech acclaiming women for the contributions that they have made to the agency and the nation.

The Annual FWP Working Conference was held July 25-27, 1988, in Baltimore, Md. Participants included representatives from the Offices of the Executive Director for Operations, Personnel, Small and Disadvantaged Business Utilization and Civil Rights, Nuclear Regulatory Research, Analysis and Evaluation of Op-

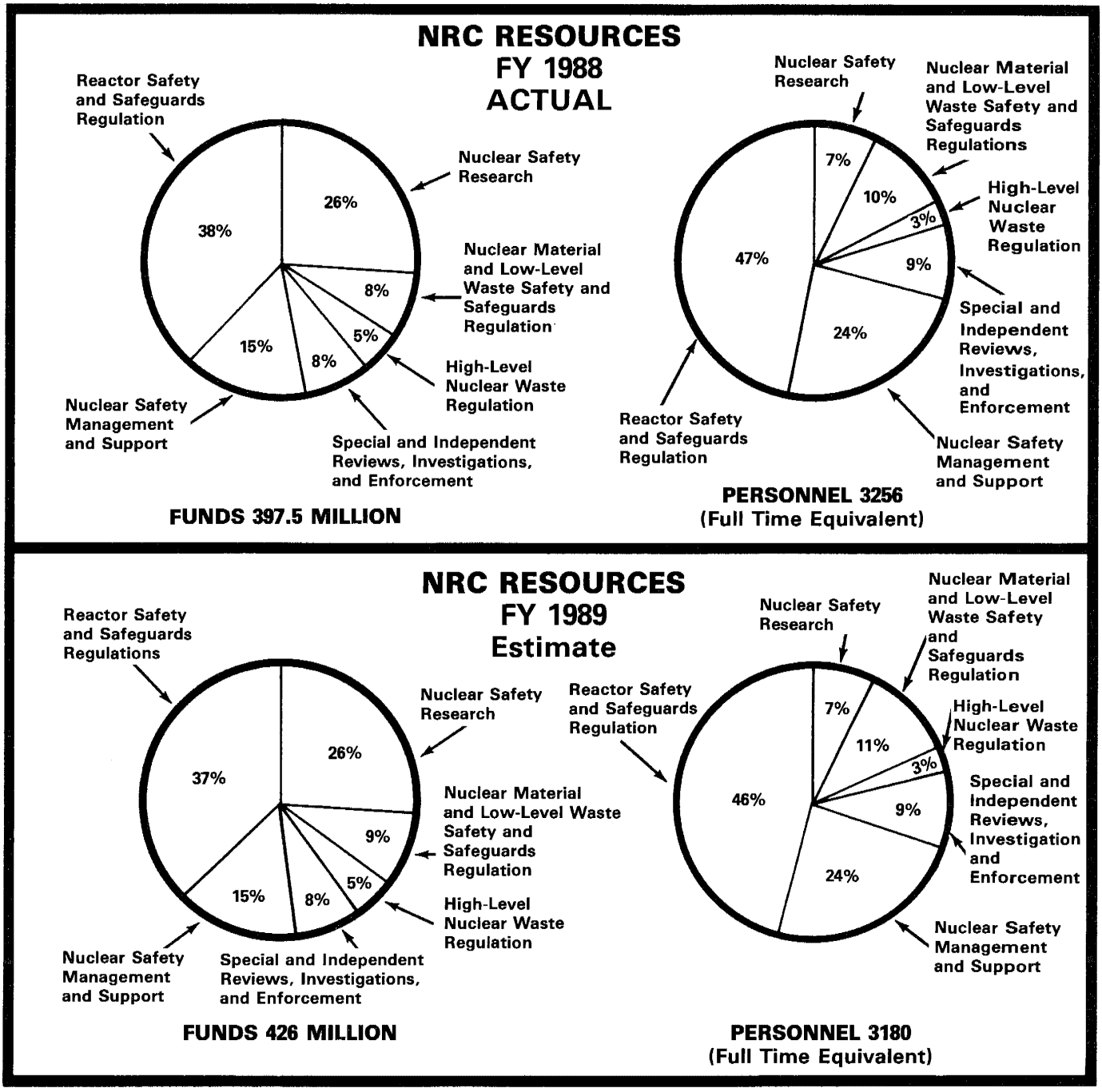
One of three main events in the NRC's observance of Women's History Month was a meeting on March 10, 1988, featuring addresses by Chairman Lando W. Zech, Jr., and Ms. Susan King, a news anchor for the ABC television station in the Washington, D.C. area, WJLA. More than 400 NRC employees attended. Ms King (l.) is shown here with Era Marshall, Director of the Federal Women's Program at the NRC.

erational Data, Investigations, Nuclear Material Safety and Safeguards, and Nuclear Reactor Regulation, as well as members of the FWPAC, Regional FWP coordinators, and Regional personnel officers. The Federally Employed Women's National Training Conference was held in Baltimore during that same week and many NRC women attended.

A number of women on the NRC staff were cited in the NRC newsletter, "News, Reviews and Comment"—in the FWP Manager's feature, "Women on the Move"—for demonstrated excellence and initiative.

Women continue to move forward in the NRC, both in terms of preparation for and selection to higher level positions. Three out of the four "upward mobility" positions went to women during the fiscal year, 18 of the 55 rotational assignments went to women, and seven of the 18 participants in the 1988 Federal Executive Institute were women or minority employees. Two NRC women were among the 12 Federal Executive Fellows selected for the 1988-89 Congressional Fellowship Program. Three women were selected to participate in the Executive Potential Program for Mid-Level Employees, and four women were selected to participate in the Women's Executive Leadership Program, sponsored by the Office of Personnel Management.

During the report period, 14 women were hired by the agency, over 100 women were promoted, 67 received managerial and executive preparatory training, and two entered the Senior Executive Service.



Source: **USNRC Budget Estimates, Fiscal Years 1990-1991,** "Summary of Headquarters and Regional Resources by Mission Area," pg. 152, January 1989.

FY 1987/1988 NRC Financial Statements

Balance Sheet (in thousands)

Assets	*September 30, 1988*	*September 30, 1987*
Cash:		
Appropriated Funds in U.S. Treasury	$ 119,472	$ 137,431
Other—Notes 1 & 3	91,565	91,163
Imprest Fund Balance	346	250
	211,383	228,844
Accounts Receivable:		
Federal Agencies	—0—	—0—
Miscellaneous Receipts—Note 2	7,510	18,943
Other	9,073	1,713
Less: Allowance For Uncollectibles	(307)	(307)
	16,276	20,349
Plant:		
Completed Plant and Equipment	33,562	32,171
Less: Accumulated Depreciation	(12,488)	(17,361)
	21,074	14,810
Advances and Prepayments:		
Federal Agencies	—0—	—0—
Other	4,901	3,962
	4,901	3,962
Total Assets	$ 253,634	$ 267,965

Liabilities and NRC Equity	*September 30, 1988*	*September 30, 1987*
Liabilities:		
Funds Held for Others—Notes 1 & 3	$ 91,565	$ 91,163
Accounts Payable and Accrued Expenses:		
Federal Agencies	7,000	31,882
Other	7,275	7,460
Accrued Annual Leave of NRC Employees	15,345	14,334
Deferred Revenue—Note 3	—0—	—0—
Total Liabilities	$ 121,185	$ 144,839
NRC Equity: Balance at October 1	123,126	106,634
Additions:		
Funds Appropriated—Net	392,800	401,000
Non-Reimbursable Transfers from Other Gov't Agencies	—0—	—0—
	515,926	506,634
Deductions:		
Net Cost of Operations	378,146	333,706
Funds Returned to U.S. Treasury—Note 2	5,331	50,802
	383,477	384,508
Total NRC Equity	132,449	123,126
Total Liabilities and NRC Equity	$ 253,634	$ 267,965

Note 1. As of September 30, 1988, includes $4,146,679.54 of funds received under cooperative research agreements involving NRC, DOE, Euratom, France, Federal Republic of Germany, Japan, Austria, the Netherlands, Belgium, and the United Kingdom. Also included is $86,391,906.00 of funds received from deferred revenue billings. These funds will be refunded and/or recorded as earned revenue after the cost of processing the applications has been finalized and, accordingly, are not available for NRC use.

Note 2. These funds are not available for NRC use.

Note 3. On March 24, 1978, 10 CFR 1 was revised. Contained therein by category of license are maximum fee amounts to be paid by applicants at the time a facility or material license is issued. Also, after the review of the license application is complete, the expenditures for professional manpower and appropriate support services are to be determined and the resultant fee assessed. In no event will the fee exceed the maximum fee for that license category, which generally has been paid. This could involve the refunding of a significant portion of the initial amount paid. Therefore, the revenue is recorded in a Deferred revenue account at the time of billing and is removed from this account and recorded in Funds Held for Others when the bill is paid. The balance in the Deferred revenue account consists of deferred revenue on billings issued but not collected. See Note 1.

Note 4. Represents current year cost of plant and equipment acquisition for use at DOE facilities.

Statement of Operations (in thousands)

	Fiscal Year, 1988 (October 1, 1987, thru September 30, 1988)	*Fiscal Year, 1987 (October 1, 1986, thru September 30, 1987)*
Personnel Compensation	$ 158,028	$ 157,138
Personnel Benefits	23,009	18,899
Program Support	142,321	120,227
Administrative Support	72,110	79,380
Travel of Persons	18,743	11,162
Equipment (Technical)—Note 4	1	10
Construction—Note 4	—0—	—0—
Taxes and Indeminities	167	22
Refunds to Licensees	—0—	—0—
Representational Funds	16	6
Reimbursable Work	491	703
Increase in Annual Leave Accrual	1,011	—0—
Depreciation Expense	3,736	3
Equipment Write-Offs and Adjustments	—0—	1
Allowance for Uncollectibles	—0—	—0—
Total Cost of Operations	$ 419,633	$ 387,551
Less Revenues:		
Reimbursable Work for Other Federal Agencies	(491)	(703)
Fees (Deposited in U.S. Treasury as Miscellaneous Receipts—Note 2)		
Material Licenses	—0—	(3,333)
Facility Licenses	(35,007)	(43,943)
Other	(5,989)	(5,866)
Total Revenue	(41,487)	(53,845)
Net Cost of Operations Before Prior Year Adjustments	378,146	333,706
Prior Year Adjustment	—0—	—0—
Net Cost of Operations	$ 378,146	$ 333,706

Government Investment in the Nuclear Regulatory Commision (in thousands)

Appropriation Expenditures:	
Fiscal Year 1975 (January 19, 1975 through June 30, 1975)	$ 52,792
Fiscal Year 1976 (July 1, 1975 through September 30, 1976)	208,403
Fiscal Year 1977 (October 1, 1976 through September 30, 1977)	230,559
Fiscal Year 1978 (October 1, 1977 through September 30, 1978)	270,877
Fiscal Year 1979 (October 1, 1978 through September 30, 1979)	309,493
Fiscal Year 1980 (October 1, 1979 through September 30, 1980)	377,889
Fiscal Year 1981 (October 1, 1980 through September 30, 1981)	416,867
Fiscal Year 1982 (October 1, 1981 through September 30, 1982)	441,902
Fiscal Year 1983 (October 1, 1982 through September 30, 1983)	514,613
Fiscal Year 1984 (October 1, 1983 through September 30, 1984)	462,084
Fiscal Year 1985 (October 1, 1984 through September 30, 1985)	467,902
Fiscal Year 1986 (October 1, 1985 through September 30, 1986)	420,946
Fiscal Year 1987 (October 1, 1986 thorugh September 30, 1987)	392,624
Fiscal Year 1988 (October 1, 1987 through September 30, 1988)	410,663
	$4,977,614
Unexpended Balance of Appropriated Funds in U.S. Treasury September 30, 1988	137,413
Transfer of Refunds Receivable from Atomic Energy Commission, January 19, 1975	429
Funds Appropriated—Net	5,115,456
Less:	
Funds Returned to U.S. Treasury—Note 2	330,363
Assets and Liabilities Transferred from Other Federal Agencies Without Reimbursement	1,673
Net Cost of Operations from January 19, 1975 through September 30, 1988	4,650,971
Total Deductions	4,983,007
NRC Equity at September 30, 1988 as Shown on Balance Sheet	$ 132,449

Appendix 1

NRC Organization

(As of December 31, 1988)

COMMISSIONERS

Lando W. Zech, Jr., Chairman
Thomas M. Roberts
Kenneth M. Carr
Kenneth C. Rogers
James R. Curtiss

The Commission Staff

General Counsel, William C. Parler
Office of Governmental and Public Affairs, Harold R. Denton, Director
Office of Inspector and Auditor, Sharon R. Connelly, Director
Secretary of the Commission, Samuel J. Chilk

Other Offices

Advisory Committee on Reactor Safeguards, William Kerr, Chairman
Atomic Safety & Licensing Board Panel, B. Paul Cotter, Jr., Chairman
Atomic Safety & Licensing Appeal Panel, Christine N. Kohl, Chairman
Advisory Committee on Nuclear Waste, Dade W. Moeller, Chairman

EXECUTIVE DIRECTOR FOR OPERATIONS

Executive Director for Operations, Victor Stello, Jr.
Deputy Executive Director for Operations (Acting), James M. Taylor
Deputy Executive Director for Regional Operations, James M. Taylor
Assistant for Operations, James L. Blaha

Program Offices

Office of Nuclear Reactor Regulation, Thomas E. Murley, Director
Office of Nuclear Material Safety and Safeguards, Hugh L. Thompson, Director
Office of Nuclear Regulatory Research, Eric S. Beckjord, Director
Office of Enforcement, James Lieberman, Director
Office of Special Projects, James G. Partlow, Director

Staff Offices

Office of Administration and Resources Management,
William G. McDonald, Director
Office for Analysis and Evaluation of Operational Data,
Edward Jordan, Director
Office of Investigations, Ben B. Hayes, Director
Office of Personnel, Paul E. Bird, Director
Office of Small and Disadvantaged Business Utilization/Civil Rights,
William B. Kerr, Director
Office of Consolidation, Michael L. Springer, Director

Regional Offices

Region I—Philadelphia, Pa., William T. Russell, Regional Administrator
Region II—Atlanta, Ga., Malcolm L. Ernst, Acting Regional Administrator
Region III—Chicago, Ill., A. Bert Davis, Regional Administrator
Region IV—Dallas, Tex., Robert D. Martin, Regional Administrator
Region V—San Francisco, Cal., John B. Martin, Regional Administrator

The NRC is responsible for licensing and regulating nuclear facilities and materials and for conducting research in support of the licensing and regulatory process, as mandated by the Atomic Energy Act of 1954, as amended; the Energy Reorganization Act of 1974, as amended; the Nuclear Nonproliferation Act of 1978; and in accordance with the National Environmental Policy Act of 1969, as amended, and other applicable statutes. These responsibilities include protecting public health and safety, protecting the environment, protecting and safeguarding materials and plants in the interest of national security, and assuring conformity with antitrust laws. Agency functions are performed through: standards-setting and rulemaking; technical reviews and studies; conduct of public hearings; issuance of authorizations, permits and licenses; inspection, investigation and enforcement; evaluation of operating experience; and regulatory research. The Commission itself is composed of five members, appointed by the President and confirmed by the Senate, one of whom is designated by the President as Chairman. The Chairman is the principal executive officer and the official spokesman of the Commission.

The Executive Director for Operations directs and coordinates the Commission's operational and administrative activities among the program and support staff offices described below and also coordinates the development of policy options for Commission consideration. The EDO reports directly to the Chairman.

The Office of Nuclear Reactor Regulation carries out the licensing and inspection of nuclear power reactors, test reactors, and research reactors. Reactor licensing is a two-phase process. A construction permit is granted before facility construction can begin and an operating license is issued before fuel can be loaded. NRR reviews license applications to assure that each proposed facility can be built and operated without undue risk to the health and safety of the public an with minimal impact on the environment. NRR monitors operating reactor facilities during their lifetime through decomissioning.

The Office of Nuclear Material Safety and Safeguards is responsible for the licensing, inspection, and regulation of facilities and materials associated with the processing, transport and handling of nuclear materials, and with the disposal of nuclear waste; the office also regulates uranium recovery facilities. NMSS reviews and assesses safeguards against potential threats, thefts and sabotage for licensed facilities, including reactors, working closely with other NRC offices in coordinating safety and safeguards programs and in recommending research, standards and policy options necessary for their successful operation.

The Office of Nuclear Regulatory Research plans and conducts the comprehensive research and standards program that is deemed necessary for the performance of the Commission's licensing and regulatory functions and that is responsive to current and future NRC needs. The program covers such areas as facility operation, engineering technology, accident evaluation, probabilistic risk analysis, siting, health, and waste management.

The Office of Enforcement develops policies and programs for the enforcement of NRC requirements, manages major enforcement actions, and assesses the effectiveness and uniformity of regional enforcement actions.

The Office of Special Projects exists to ensure that licensed facilities with particularly complex regulatory problems are given comprehensive and timely attention and appropriately high-level direction by NRC. The mission of the Office is short-term.

The Regional Offices are under the supervision and direction of the Executive Director for Operations and carry out NRC regulatory programs originating in the various Headquarters Offices.

THE COMMISSION STAFF

The Office of the Secretary provides general management services to support the Commission and to implement Commission decisions, advises and assists the Commission and staff on the planning, scheduling and conduct of Commission business; prepares for and records Commission meetings; manages the Commission staff paper system and monitors the status of all items requiring action; integrates automated data processing and office automation initiatives into the Commission's administrative system, maintains a forecast of matters for future Commission consideration; processes and controls Commission correspondence; maintains the Commission's official records; maintains the official Commission adjudicatory and rulemaking dockets and serves Commission issuances in all adjudicatory matters and public proceedings; administers the NRC Historical Program; and directs and administers the NRC Public Document Room.

The Office of the General Counsel directs matters of law and legal policy, providing opinions, advice, and assistance to the Commission and staff with respect to all activities of the agency.

The Office of Governmental and Public Affairs maintains communications between the NRC and governmental entities at all levels within the United States, and with the nations and organizations that make up the international nuclear community; in the latter area, GPA coordinates and licenses export-import activity. The Office also administers the agency's program of public information.

The Office of Inspector and Auditor investigates to ascertain the integrity of all NRC operations; investigates allegations of NRC employee misconduct, equal employment and civil rights complaints, and claims for personal property loss or damage; conducts the NRC's internal audit activities; and hears individual employee concerns regarding Commission activities, under the agency's "open door" policy. The Office develops policies governing the Commission's financial and management audit program and is the agency contact with the General Accounting Office on this function. The Office refers criminal matters to the Department of Justice and maintains liaison with law enforcement agencies.

SUPPORT STAFF

The Office of Administration and Resources Management directs the agency's programs for preparation of the budget; the accounting and financial systems management, such as payroll and travel expenses; central administrative services, such as rules and records management, facilities and operations support and publications services; and management of centralized information resources, including computer and

telecommunications services, document control systems, records management, and library facilities.

The Office for Analysis and Evaluation of Operational Data provides agency coordination for the collection, storage, and retrieval of operational data associated with licensed activities, analyzes and evaluates such operational experience and feeds back the lessons of that experience to NRC licensing, standards and inspections activities. The Office is also responsible for the NRC incident response program and the technical training center, as well as the tracking of licensee performance indicators.

The Office of Investigations conducts, supervises and assures quality control of investigations of licensees, applicants, contractors or vendors, including the investigation of all allegations of wrongdoing by other than NRC employees and contractors. The Office develops policy, procedures, and standards for these activities.

The Office of Personnel plans and implements NRC policies, programs, and services to provide for the effective organization, staffing, utilization, and development of the agency's human resources.

The Office of Small and Disadvantaged Business Utilization/Civil Rights develops and implements the NRC's program in accordance with the Small Business Act, as amended, insuring that appropriate consideration is given to labor surplus area firms and women-owned businesses. The Office develops and recommends NRC policy providing for equal employment opportunity and develops, monitors, and evaluates the affirmative action program to assure compliance with the policy. The Office also serves as contact with local and national public and private organizations with related interests.

The Office of Consolidation was created to oversee realization of the agency's long-term objective of consolidating all of the NRC's Headquarters operations at a single location; consolidation has begun and is expected to require several years to reach completion.

OTHER ORGANIZATIONAL ELEMENTS

The Advisory Committee on Reactor Safeguards is a statutory committee of 15 scientists and engineers advising the Commission on safety aspects of proposed and existing nuclear facilities and on the adequacy of proposed reactor safety standards and performing such other duties as the Commission may request. The Committee conducts a continuing study of reactor safety research and submits an annual report to the Congress. The Committee also administers the ACRS Fellowship Program.

The Atomic Safety and Licensing Board Panel is a panel of lawyers and others with expertise in various technical fields from which three-member Licensing Boards are drawn to conduct public hearings and make such intermediate or final decisions as the Commission may authorize in proceedings to grant, amend, suspend or revoke NRC licenses.

The Atomic Safety and Licensing Appeal Panel is a panel from which three-member Appeal Boards are selected to exercise the authority and perform the review functions which would otherwise be carried out by the Commission in certain licensing proceedings. Licensing Board decisions are reviewable by an Appeal Board, either in response to an appeal or on its own initiative. The Appeal Board's decision is also subject to review by the Commission in response to an appeal for discretionary review or on its own initiative.

The Advisory Committee on Nuclear Waste was established by the Nuclear Regulatory Commission in 1988 to advise the Commission on all aspects of nuclear waste management within the purview of NRC responsibility.

Appendix 2

NRC Committees and Boards

Advisory Committee on Reactor Safeguards

The Advisory Committee on Reactor Safeguards is a statutory committee established to advise the Commission on the safety aspects of proposed and existing nuclear facilities and the adequacy of proposed reactor safety standards, and to perform such other duties as the Commission may request. As of September 30, 1988, the members were:

CHAIRMAN: DR. WILLIAM KERR, Professor of Nuclear Engineering and Director of the Office of Energy Research, University of Michigan, Ann Arbor, Mich.

VICE-CHAIRMAN: DR. FORREST J. REMICK, Associate Vice-President for Research and Professor of Nuclear Engineering, The Pennsylvania State University, University Park, Pa.

MR. JAMES C. CARROLL, retired Manager, Nuclear Operations Support Department, Pacific Gas & Electric Company, San Francisco, Cal.DR. HAROLD W. LEWIS, Professor of Physics, Department of Physics, University of California, Santa Barbara, Cal.

MR. CARLYLE MICHELSON, retired Principal Nuclear Engineer, Tennessee Valley Authority, Knoxville, Tennessee, and retired Director, Office for Analysis and Evaluation of Operational Data, U.S. Nuclear Regulatory Commission, Washington, D.C.

DR. PAUL G. SHEWMON, Professor, Metallurgical Engineering Department, Ohio State University, Columbus, Ohio.

DR. CHESTER P. SIESS, Professor Emeritis of Civil Engineering, University of Illinois, Urbana, Ill.MR. DAVID A. WARD, Research Manager on Special Assignment, E.I. du Pont de Nemours & Company, Savannah River Laboratory, Aiken, S.C.

MR. CHARLES J. WYLIE, retired Chief Engineer, Electrical Division, Duke Power Company, Charlotte, N.C.

Atomic Safety and Licensing Board Panel

PANEL MEMBERS:

CHIEF ADMINISTRATIVE JUDGE B. PAUL COTTER, JR., ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

DEPUTY CHIEF ADMINISTRATIVE JUDGE—(Executive) ROBERT M. LAZO, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

DEPUTY CHIEF ADMINISTRATIVE JUDGE—(Technical) FREDERICK J. SHON, ASLBP Physicist, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE GEORGE C. ANDERSON, Marine Biologist, University of Washington, Seattle, Wash.

JUDGE CHARLES BECHHOEFER, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE PETER B. BLOCH, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE GLENN O. BRIGHT, ASLBP Engineer, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE A. DIXON CALLIHAN, Physicist (retired), Union Carbide Corporation, Oak Ridge, Tenn.

JUDGE JAMES H. CARPENTER, ASLBP Environmental Scientist, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE RICHARD F. COLE, ASLBP Environmental Scientist, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE GEORGE A. FERGUSON, Physicist, Howard University, Washington, D.C.

JUDGE HARRY FOREMAN, Medical Doctor (retired), University of Minnesota, Minneapolis, Minn.

JUDGE RICHARD F. FOSTER, Environmental Scientist, Sunriver, Ore.

JUDGE JOHN H. FRYE, III, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE JAMES P. GLEASON, Attorney, Silver Spring, Md.

JUDGE CADET H. HAND, JR., Marine Biologist, University of California, Bodega Bay, Cal.

JUDGE JERRY HARBOUR, ASLBP Environmental Scientist, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JUDGE DAVID L. HETRICK, Nuclear Engineer, University of Arizona, Tucson, Ariz.
JUDGE ERNEST E. HILL, Nuclear Engineer, Hill Associates, Livermore, Cal.
JUDGE FRANK F. HOOPER, Marine Biologist (retired), University of Michigan, Ann Arbor, Mich.
JUDGE HELEN F. HOYT, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE ELIZABETH B. JOHNSON, Nuclear Engineer, Oak Ridge National Laboratory, Oak Ridge, Tenn.
JUDGE WALTER H. JORDAN, Physicist (retired), Oak Ridge Laboratories, Oak Ridge, Tenn.
JUDGE MICHAEL A. KIRK-DUGGAN, Economist, University of Texas, Austin, Tex.
JUDGE JERRY R. KLINE, ASLBP Environmental Scientist, U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE JAMES C. LAMB, III, Sanitary Engineer, University of North Carolina, Chapel Hill, N.C.
JUDGE GUSTAVE A. LINENBERGER, ASLBP Physicist, U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE EMMETH A. LUEBKE, ASLBP Physicist (retired), U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE MORTON B. MARGULIES, ASLBP Administrative Law Judge, U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE KENNETH A McCOLLOM, Electrical Engineer (retired), Oklahoma State University, Stillwater, Okla.
JUDGE GARY L. MILHOLLIN, Attorney, Catholic University of America, Washington, D.C.
JUDGE MARSHALL E. MILLER, Attorney (retired), Summerland, Fla.
JUDGE OSCAR H. PARIS, ASLBP Environmental Scientist, U.S. Nuclear Regulatory Commission Bethesda, Md.
JUDGE DAVID R. SCHINK, Oceanographer, Texas A&M University College Station, Tex.
JUDGE IVAN W. SMITH, ASLBP Administrative Law Judge, U.S. Nuclear Regulatory Commission, Bethesda, Md.
JUDGE MARTIN J. STEINDLER, Chemist, Argonne National Laboratory, Argonne, Ill.
JUDGE SEYMOUR WENNER, Administrative Law Judge (retired), Postal Rate Commission, Chevy Chase, Md.
JUDGE SHELDON J. WOLFE, ASLBP Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.

PROFESSIONAL STAFF:

C. SEBASTIAN ALOOT, Chief Counsel and Director, Technical and Legal Support Staff, U. S. Nuclear Regulatory Commission, Bethesda, Md.
CHARLES J. FITTI, Director, Program Support and Analysis Staff, U. S. Nuclear Regulatory Commission, Bethesda, Md.
CHARLES N. KELBER, Senior ASLBP Technical Advisor, U. S. Nuclear Regulatory Commission, Bethesda, Md.
ELVA W. LEINS, Assistant Director, Program Support and Analysis Staff, U. S. Nuclear Regulatory Commission, Bethesda, Md.
JACK G. WHETSTINE, Hearing Support Supervisor, U. S. Nuclear Regulatory Commission, Bethesda, Md.

Atomic Safety and Licensing Appeal Panel

An Atomic Safety and Licensing Appeal Board, established September 18, 1969, was delegated the authority to perform the review function that would otherwise be performed by the Atomic Energy Commission in proceedings on applications for licenses or authorizations in which the Commission had a direct financial interest, and in such other licensing proceedings as the Commission might specify.

As a result of the increase in the number of proceedings subject to administrative appellate review, that Commission, on October 25, 1972, established the Atomic Safety and Licensing Appeal Panel, from whose membership three-member Appeal Boards could be designated. At the same time, that Commission modified its rules to delegate authority to Appeal Boards in all proceedings involving the licensing of production and utilization facilities (for example, power reactors).

Pursuant to subsection 201(g)(1) of the Energy Reorganization Act of 1974, the functions performed by Appeal Boards were specifically transferred to the Nuclear Regulatory Commission. The Commission appoints members to the Appeal Panel, and the Chairman of the panel designates a three-member Appeal Board for each proceeding. In January 1987, the Commission expanded the Appeal Board's review authority to cover, as well, a variety of other formal adjudicatory proceedings including those resulting from orders to show cause and assessing civil penalties. The Commission retains review authority over decisions and actions of Appeal Boards.

The Appeal Panel, on September 30, 1988, was composed of the following persons:

FULL-TIME MEMBERS:

CHRISTINE N. KOHL, Appeal Panel Chairman, U.S. Nuclear Regulatory Commission, Bethesda, Md.
THOMAS S. MOORE, Appeal Panel Member, U.S. Nuclear Regulatory Commission, Bethesda, Md.
HOWARD A. WILBER, Appeal Panel Member, U.S. Nuclear Regulatory Commission, Bethesda, Md.

PART-TIME MEMBERS:

ALAN S. ROSENTHAL, Attorney, Kensington, Md. (retired as ASLAP Chairman on July 30, 1988).
DR. W. REED JOHNSON, Professor of Nuclear Engineering, University of Virginia, Charlottesville, Va.

PROFESSIONAL STAFF:

JOHN CHO, Counsel, U.S. Nuclear Regulatory Commission, Bethesda, Md.
THOMAS G. SCARBROUGH, Technical Advisor, U.S. Nuclear Regulatory Commission, Bethesda, Md.

Advisory Committee on Nuclear Waste

The Advisory Committee on Nuclear Waste was established by the Commission to provide advice on all aspects of nuclear waste management within the preview of NRC responsibility. As of September 30, 1988, the members were:

CHAIRMAN: DR. DADE W. MOELLER, Professor of Engineering in Environmental Health and Associate Dean for Continuing Education, School of Public Health, Harvard University, Boston, Mass.
DR. CLIFFORD V. SMITH, Jr., Chancellor, University of Wisconsin, Milwaukee, Wis.
DR. MARTIN J. STEINDLER, Director, Chemical Technology Division, Argonne National Laboratory, Argonne, Ill.

Advisory Committee on Medical Uses of Isotopes

The Advisory Committee on Medical Uses of Isotopes (ACMUI) was established in July 1958. The ACMUI, composed of qualified physicians and scientists, considers medical questions referred to it by the NRC staff and renders expert opinions regarding the medical uses of radioisotopes. The ACMUI also advises the NRC staff, as required, on matters of policy. Members are employed under yearly personal services contracts. As of September 30, 1988, the members were:

RICHARD E. CUNNINGHAM, Chairman, ACMUI, and Director, Division of Fuel Cycle and Material Safety, U.S. Nuclear Regulatory Commission, Rockville, Md.
DR. VINCENT P. COLLINS, Medical Director, Houston Institute for Cancer Research, Diagnosis and Treatment, Houston, Tex.
DR. SALLY J. DE NARDO, Director, Nuclear Hematology-Oncology, Department of Nuclear Medicine, University of California Davis Medical Center, Sacramento, Cal.
DR. JACK K. GOODRICH, Radiology Associates of Erie, Erie, Pa.
DR. MELVIN L. GRIEM, Professor and Director, Chicago Tumor Institute, University of Chicago, Chicago, Ill.
DR. NILO E. HERRERA, Director, Department of Laboratory Medicine, Danbury Hospital, Danbury, Conn.
DR. GERALD M. POHOST, Director, Division of Cardiovascular Disease, University of Alabama at Birmingham, Birmingham, Ala.
DR. EDWARD W. WEBSTER, Director, Department of Radiation Physics, Massachusetts General Hospital, Boston, Mass.
DR. DAVID H. WOODBURY, Director, Nuclear Medicine Section, Wayne County General Hospital, Westland, Mich.

Advisory Panel for the Decontamination of Three Mile Island Unit 2

The Advisory Panel for the Decontamination of Three Mile Island Unit 2 was established in October 1980. Its purpose is to obtain the views and perspectives of residents of the Three Mile Island area near Harrisburg, Pa., and afford State officials the opportunity to participate in the Commission's decision-making process regarding cleanup of the damaged nuclear facility. The panel consists of the following members representing agencies of the Commonwealth of Pennsylvania, local government officials, the scientific community, and persons having their principal place of residence in the vicinity of the Three Mile Island nuclear power plant.

ARTHUR E. MORRIS, Panel Chairman, Mayor of Lancaster, Pa.
THOMAS GERUSKY, Director of the Pennsylvania Bureau of Radiation Protection, Department of Environmental Resources, Harrisburg, Pa.
JOHN LUETZELSCHWAB, Professor of Physics, Dickinson College, Carlisle, Pa.
ELIZABETH MARSHALL, resident of York, Pa.
KENNETH L. MILLER, Director of the Division of Health Physics and Associate Professor of Radiology, Milton S. Hershey Medical Center, Hershey, Pa.
FREDERICK S. RICE, Chairman, Dauphin County Board of Commissioners, Harrisburg, Pa.
GORDON ROBINSON, Associate Professor of Nuclear Engineering, Pennsylvania State University, University Park, Pa.
JOEL ROTH, resident of Elizabethville, Pa.
THOMAS SMITHGALL, resident of Lancaster, Pa.
ANN TRUNK, resident of Middletown, Pa.
NEIL WALD, Professor of Radiation Health, Department of Radiology, University of Pittsburgh, Pittsburgh, Pa.

Appendix 3

Local Public Document Rooms

Copies of most documents originating in the NRC or submitted to it for review are placed in the Commission's Public Document Room (PDR) in the Gelman Building, 2120 L Street, N.W., Washington, D.C., for public inspection. Other PDRs are maintained in the five Regional Offices (for documents related to nuclear material licenses, i.e., most byproduct and source material licenses). In addition, documents related to licensing proceedings or licensed operation of specific facilities are made available in local PDRs established in the vicinity of each proposed or existing nuclear facility. The locations of the local PDRs, the names of the persons to contact, and the names of the facilities for which documents are retained are listed below. (N.B. Updated listings of local PDRs may be obtained by writing to: Freedom of Information Act/Local Public Document Room Branch, Division of Freedom of Information and Publications Services, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.)

ALABAMA

- Mrs. Maude S. Miller,
  Head Librarian
  Athens Public Library
  South Street
  Athens, Ala. 35611
  Browns Ferry Nuclear Power Station
  Browns Ferry Low-Level Waste Storage
- Ms. Yvonne Cooper,
  Reference Librarian
  Houston-Love Memorial Library
  212 W. Burdeshaw Street
  P.O. Box 1369
  Dothan, Ala. 36302
  Joseph M. Farley Nuclear Plant
- Ms. Nancy Stover
  Scottsboro Public Library
  1002 South Broad Street
  Scottsboro, Ala. 35768
  Bellefonte Nuclear Plant

ARIZONA

- Ms. Stefanie Moritz, Librarian II
  Business and Science Division
  Phoenix Public Library
  12 East McDowell Road
  Phoenix, Ariz. 85004
  Palo Verde Nuclear Station

ARKANSAS

- Mrs. Delores Pollard,
  Serials Librarian
  Tomlinson Library
  Arkansas Tech. University
  Russellville, Ark. 72801
  Arkansas Nuclear One

CALIFORNIA

- Ms. Margaret J. Nystrom
  Documents Librarian
  Eureka-Humboldt County Library
  421 I Street
  Eureka, Cal. 95501
  Humboldt Bay Power Plant
- Mr. Richard Kraus
  West Los Angeles Regional Library
  11360 Santa Monica Boulevard
  Los Angeles, Cal. 90025
  UCLA Training Reactor
- Ms. Bess Chen, Librarian
  Martin Luther King Regional Library
  7340 24th Street Bypass (temporary)
  Sacramento, Cal. 95822
  Rancho Seco Nuclear Generating Plant
- Ms. Judy Horn, Department Head
  University of California
  Main Library
  P.O. Box 19557
  Irvine, Cal. 92713
  San Onofre Nuclear Station
- Mr. Chi Su Kim, Head
  Government Documents and Maps Dept.
  Robert E. Kennedy Library
  California Polytechnic State University
  San Luis Obispo, Cal. 93407
  Diablo Canyon Nuclear Power Plant

COLORADO

- Miss Shirley Soenksen
  Greeley Public Library
  City Complex Building
  919 7th Street
  Greeley, Colo. 80631
  Fort St. Vrain Nuclear Generating Station

CONNECTICUT

- Ms. Marcella Kenney,
  Reference Librarian
  Russell Library
  123 Broad Street
  Middletown, Conn. 06457
  Haddam Neck Plant
- Ms. Carolyn Greene
  Waterford Public Library
  49 Rope Ferry Road (temporary)
  Waterford, Conn. 06385
  Millstone Nuclear Power Station

FLORIDA

- Ms. Julie DeBusk
  Coastal Region Library
  8619 W. Crystal Street
  Crystal River, Fla. 32629
  Crystal River Nuclear Plant
- Ms. Jimmie Anne DeRoss, Librarian
  Charles S. Miley Learning Resources Ctr.
  Indian River Community College
  3209 Virginia Avenue
  Ft. Pierce, Fla. 33450
  St. Lucie Plant
- Ms. Karlinne Wulf, Librarian
  Miami-Dade Public Library
  Homestead Branch
  700 North Homestead Blvd.
  Homestead, Fla. 33030
  Turkey Point Plant
- Ms. Esther B. Gonzalez, Librarian
  Urban and Regional Documents Collection Library
  Florida International University
  University Park
  Miami, Fla. 33199
  Turkey Point Plant

GEORGIA

- Mrs. Wynell Bush, Librarian
  Appling County Public Library
  301 City Hall Drive
  Baxley, Ga. 31513
  Edwin I. Hatch Nuclear Plant
- Mrs. Gwen Jackson, Librarian
  Burke County Library
  412 4th Street
  Waynesboro, Ga. 30830
  Alvin W. Vogtle Nuclear Plant

ILLINOIS

- Mrs. Yvonne Jaycox,
  Assistant Librarian
  Byron Public Library District
  109 N. Franklin Street
  Byron, Ill. 61010
  Byron Station
- Ms. Cheryle Rae Nyberg
  Assistant Law Librarian
  University of Illinois Law Library
  504 East Pennsylvania Avenue
  Champaign, Ill. 61820
  Clinton Power Station
- Mrs. Betsy Taubert
  Vespasian Warner Public Library
  120 West Johnson Street
  Clinton, Ill. 61727
  Clinton Power Station
- Mr. Earl R. Shumaker, Head
  Government Publications
  Department
  Founder's Memorial Library
  Northern Illinois University
  DeKalb, Ill. 60115
  Byron Station
- Mrs. Nancy Gillfillian
  Library Director
  Dixon Public Library
  221 Hennepin Avenue
  Dixon, Ill. 61021
  Quad Cities Station
  Sheffield Low-level Waste
  Burial Site
- Ms. Deborah Trotter
  Reference Assistant
  Morris Area Public Library District
  604 Liberty Street
  Morris, Ill. 60450
  Dresden Nuclear Power Station
  Morris Spent Fuel Storage Facility
- Ms. Evelyn Moyle,
  Documents Librarian
  Jacobs Memorial Library
  Illinois Valley Community College
  Rural Route 1
  Oglesby, Ill. 61348
  LaSalle County Station
- Ms. Jean Beeman
  Business, Science and
  Technology Dept.
  Rockford Public Library
  215 North Wyman Street
  Rockford, Ill. 61101
  Byron Station
- Ms. Nancy Barbour, Librarian
  Government Documents Collection
  Wilmington Public Library
  201 South Kankakee Street
  Wilmington, Ill. 60481
  Braidwood Station
- Mrs. Gail Dever
  Reference Librarian
  Waukegan Public Library
  128 N. County Street
  Waukegan, Ill. 60085
  Zion Nuclear Power Station
- Ms. Ann Bergstrom,
  Library Assistant
  West Chicago Public Library
  332. E. Washington Street
  West Chicago, Ill. 60185
  Kerr-McGee West Chicago

IOWA

- Mr. Roger Rayborn,
  Reference Librarian
  Cedar Rapids Public Library
  500 1st Street, S.E.
  Cedar Rapids, Ia. 52401
  Duane Arnold Energy Center

KANSAS

- Ms. Nannette Martin,
  Documents Librarian
  Government Documents Division
  William Allen White Library
  Emporia State University
  1200 Commercial Street
  Emporia, Kans. 66801
  Wolf Creek Generating Station
- Mr. David Ensign,
  Assistant Director
  NRC-LPDR Documents Collection
  Washburn University School of Law
  Topeka, Kans. 66621
  Wolf Creek Generating Station

LOUISIANA

- Mrs. Smittie Bolner, Head
  Government Documents
  Department
  Troy H. Middleton Library
  Louisiana State University
  Baton Rouge, La. 70803
  River Bend Station
- Mr. Kenneth E. Owen, Head
  Louisiana Collection
  Earl K. Long Library
  University of New Orleans
  Lakefront Drive
  New Orleans, La. 70148
  Waterford Generating Station

MAINE

- Ms. Sue Cereste,
  Assistant Librarian
  Wiscasset Public Library
  High Street
  P.O. Box 367
  Wiscasset, Me. 04578
  Maine Yankee Atomic Power Plant

MARYLAND

- Ms. Mildred Ward,
  Library Assistant
  Calvert County Public Library
  Fourth Street
  P.O. Box 405
  Prince Frederick, Md. 20678
  Calvert Cliffs Nuclear Power Plant

MASSACHUSETTS

- Mrs. Margaret E. Howland, Director
  Library/Learning Resource Center
  Greenfield Community College
  One College Drive
  Greenfield, Mass. 01301
  Yankee Rowe Nuclear Power
  Station
- Ms. Grace E. Karbott,
  Reference Librarian
  Plymouth Public Library
  11 North Street
  Plymouth, Mass. 02360
  Pilgrim Nuclear Power Station

MICHIGAN

- Dr. Carol Juth, Reference Librarian
  Van Wylen Library
  Hope College
  Holland, Mich. 49423
  Palisades Nuclear Plant

- Mr. Eric Grandstaff, Library Director
  North Central Michigan College
  1515 Howard Street
  Petoskey, Mich. 49770
  Big Rock Point Nuclear Plant
- Mr. Carl Katafiasz
  Government Documents Librarian
  Monroe County Library System
  Monroe, Mich. 48161
  Enrico Fermi Atomic Power Plant
- Ms. Bea Rodgers, Library Assistant
  Maude Preston Palenske Memorial Library
  500 Market Street
  St. Joseph, Mich. 49085
  Donald C. Cook Nuclear Power Plant

MINNESOTA

- Mr. William L. Johnston, Librarian
  Technology and Science Department
  Minneapolis Public Library
  300 Nicollet Mall
  Minneapolis, Minn. 55401
  Monticello Nuclear Generating Plant

MISSISSIPPI

- Mrs. Gayle Keefe
  Library Technical Assistant
  George M. McLendon Library
  Hinds Community College
  Main Street
  Raymond, Miss. 39154
  Grand Gulf Nuclear Station

MISSOURI

- Mrs. Evelyn Hillard
  Public Services Librarian
  Callaway County Public Library
  710 Court Street
  Fulton, Mo. 65251
  Callaway Plant
- Mr. Bill Olbrich
  Government Publications Librarian
  John M. Olin Library
  Washington University
  Skinker and Lindell Boulevards
  St. Louis, Mo. 63130
  Callaway Plant

NEBRASKA

- Mrs. Trudy Peaslee
  Auburn Public Library
  1118 15th Street
  P.O. Box 324
  Auburn, Neb. 68305
  Cooper Nuclear Station
- Mr. Patrick R. Esser, Librarian
  Business, Science and Technology Dept.
  W. Dale Clark Library
  215 S. 15th Street
  Omaha, Neb. 68102
  Fort Calhoun Station

NEVADA

- Ms. Susan Jarvis, Head
  Special Collections Librarian
  James R. Dickinson Library
  University of Nevada-Las Vegas
  4505 Maryland Parkway
  Las Vegas, Nev. 89154
  Yucca Mountain High-Level Waste Geologic Repository Site

NEW HAMPSHIRE

- Ms. Pamela Gjettum, Director
  Exeter Public Library
  46 Pleasant St.
  Exeter, N.H. 03833
  Seabrook Nuclear Station

NEW JERSEY

- Mrs. Amy Allen, Librarian
  Pennsville Public Library
  190 S. Broadway
  Pennsville, N.J. 08070
  Hope Creek Nuclear Station
- Ms. Elizabeth C. Fogg, Director
  Salem Free Public Library
  112 West Broadway
  Salem, N.J. 08079
  Salem Nuclear Generating Station
- Mr. Sherman Howard, Reference Librarian
  Reference Department
  Ocean County Library
  101 Washington Street
  Toms River, N.J. 08753
  Oyster Creek Nuclear Power Plant

NEW YORK

- Mr. Thomas Larson
  Reference and Documents Department
  Penfield Library
  State University of New York
  Oswego, N.Y. 13126
  James A. Fitzpatrick Nuclear Power Plant
  Nine Mile Point Nuclear Station
- Ms. Carolyn Johnson, Head
  Business and Social Science Division
  Rochester Public Library
  115 South Avenue
  Rochester, N.Y. 14610
  Robert Emmet Ginna Nuclear Plant
- Mr. Erick Mayer, Assistant Librarian
  Buffalo and Erie County Public Library
  Lafayette Square
  Buffalo, N.Y. 14203
  West Valley Demonstration Project
- Ms. Laura Given
  Shoreham-Wading River Public Library
  Route 25 A
  Shoreham, N.Y. 11786
  Shoreham Nuclear Power Station
- Mr. Oliver F. Swift
  Municipal Reference Librarian
  White Plains Public Library
  100 Martine Avenue
  White Plains, N.Y. 10601
  Indian Point Station

NORTH CAROLINA

- Ms. Dawn Hubbs,
  Documents Librarian
  J. Murrey Atkins Library
  University of North Carolina at Charlotte—UNCC Station
  Charlotte, N.C. 28223
  William B. McGuire Nuclear Station
- Ms. Janet Vimenson, Head,
  Adult Services
  Cameron Village Regional Library
  1930 Clark Avenue (temporary)
  Raleigh, N.C. 27605
  Shearon Harris Nuclear Power Plant
- Mrs. Arlene Hanerfeld
  Reference/Documents Librarian
  William Madison Randall Library
  University of North Carolina at Wilmington
  601 S. College Road
  Wilmington, N.C. 28403-3297
  Brunswick Steam Electric Plant

OHIO

- Ms. Ann Freed, Reference Librarian
  Perry Public Library
  3753 Main Street
  Perry, Ohio 44081
  Perry Nuclear Power Plant

- Mrs. Julia Baldwin,
  Documents Librarian
  Government Documents Collection
  William Carlson Library
  University of Toledo
  2801 West Bancroft Avenue
  Toledo, Ohio 43606
  Davis-Besse Nuclear Power Station

OKLAHOMA

- Ms. Valerie Rogers,
  Library Assistant
  Sallisaw City Library
  101 E. Cherokee St.
  Sallisaw, Okla. 74955
  Kerr-McGee Sequoyah

OREGON

- Mr. Robert Lockerby
  Engineering Librarian
  Branford P. Millar Library
  Portland State University
  P.O. Box 1151
  10th and Harrison
  Portland, Ore. 97207
  Trojan Nuclear Plant

PENNSYLVANIA

- Ms. Mary Ann Paulin,
  Reference Librarian
  B.F. Jones Memorial Library
  663 Franklin Avenue
  Aliquippa, Pa. 15001
  Beaver Valley Power Station

- Mr. John E. Geschwindt, Head
  Government Publications Section
  State Library of Pennsylvania
  Walnut Street and
  Commonwealth Avenue
  Box 1601
  Harrisburg, Pa. 17105
  Three Mile Island Nuclear Station
  Peach Bottom Atomic Power Station

- Ms. Sharon Reilly
  Apollo Memorial Library
  219 N. Pennsylvania Avenue
  Apollo, Pa. 15613
  Babcock & Wilcox Parks Township and B&W Apollo

- Mr. Janette Neal
  Assistant Department Head
  Government Publications Department
  Free Library of Philadelphia
  19th and Vine Streets
  Philadelphia, Pa. 18103
  Limerick Generating Station

- Mrs. Julia Albright
  Interlibrary Loan Librarian
  Pottstown Public Library
  500 High Street
  Pottstown, Pa. 19464
  Limerick Generating Station

- Mr. Ernest Fuller
  NRC Materials Aide
  Saxton Community Library
  911 Church Street
  Saxton, Pa. 16678
  Saxton Nuclear Experimental Facility

- Ms. Diane H. Smith, Head
  Government Documents
  Pattee Library
  Room C 207
  Pennsylvania State University
  University Park, Pa. 16802
  Beaver Valley Power Station
  Susquehanna Steam Electric Station

- Ms. Sandra Schimmel
  Reference Librarian
  Reference Department
  Osterhout Free Library
  71 South Franklin Street
  Wilkes-Barre, Pa. 18701
  Susquehanna Steam Electric Station
  Susquehanna Low-Level Waste Storage

RHODE ISLAND

- Ms. Ann Crawford, Director
  Cross Mill Public Library
  4417 Old Post Road
  Charlestown, R.I. 02813
  Wood River Junction

SOUTH CAROLINA

- Mrs. Margaret Cannon, Director
  Barnwell County Public Library
  Hagood Avenue
  Barnwell, S.C. 29812
  Barnwell Reprocessing Plant
  Barnwell Low-Level Waste Burial Site

- Ms. Mary Toll, Reference Librarian
  Technical Services Department
  South Carolina State Library
  1500 Senate Street
  Columbia, S.C. 29201
  Catawba Nuclear Station

- Ms. Virginia Warr, Librarian
  Nuclear Information Depository
  Hartsville Memorial Library
  220 N. Fifth Street
  Hartsville, S.C. 29550
  H.B. Robinson Plant
  Robinson Independent Spent Fuel Storage

- Mrs. Mary Mallaney
  Assistant Reference Librarian
  York County Library
  138 East Black Street
  P.O. Box 10032
  Rock Hill, S.C. 29730
  Catawba Nuclear Station

- Ms. Joyce McCall, Librarian
  Oconee County Library
  501 W. South Broad Street
  Walhalla, S.C. 29691
  Oconee Nuclear Plant

- Ms. Sarah D. McMaster, Director
  Fairfield County Library
  Garden and Washington Streets
  Winnsboro, S.C. 29180
  Virgil C. Summer Nuclear Station

TENNESSEE

- Ms. Patricia Maroney, Head
  Business, Science and Technology Dept.
  Chattanooga-Hamilton County Library
  1001 Broad Street
  Chattanooga, Tenn. 37402
  Sequoyah Nuclear Plant
  Watts Bar Nuclear Plant
  TVA Sequoyah Low-Level Waste Storage

TEXAS

- Mrs. Pamela A. Morris, Head
  Library—Documents
  University of Texas at Arlington
  701 South Cooper
  P.O. Box 19497
  Arlington, Tex. 76019
  Comanche Peak Steam Electric Station

- Mr. Tim Wilder, Library Aide
  Austin History Center
  Austin Public Library
  810 Guadalupe Street
  P.O. Box 2287
  Austin, Tex. 78701
  South Texas Project

- Ms. Peggy Oldham
  Librarian
  Glen Rose-Somervell Library
  Barnard and Highway 144
  P.O. Box 417
  Glen Rose, Tex. 76043
  Comanche Peak Steam Electric Station

- Mr. John R. Deosdade
  Documents Librarian
  Business and Science Dept.
  San Antonio Public Library
  203 S. St. Mary's Street
  San Antonio, Tex. 78205
  South Texas Project

- Ms. Patsy G. Norton, Director
  Wharton County Junior College
  J.M. Hodges Learning Center
  911 Boling Highway
  Wharton, Tex. 77488
  South Texas Project

VERMONT

- Mr. Jerry Carbone
  Assistant Librarian
  Brooks Memorial Library
  224 Main Street
  Brattleboro, Vt. 05301
  Vermont Yankee Nuclear Power Station

VIRGINIA

- Mr. Gregory A. Johnson
  Senior Public Services Assistant
  Manuscripts Dept.
  Alderman Library
  University of Virginia
  Charlottesville, Va. 22901
  North Anna Power Station

- Mr. Alan Zoellner
  Documents Librarian
  Swem Library
  College of William and Mary
  Williamsburg, Va. 23185
  Surry Power Station
  Surry Independent Spent Fuel Storage

WASHINGTON

- Mrs. Lois McCleary
  Library Assistant
  W.H. Abel Memorial Library
  125 Main Street, South
  Montesano, Wash. 98563
  WPPSS Nuclear Projects 3 & 5

- Ms. Judy Truhler
  Reference Librarian
  Richland Public Library
  Swift and Northgate Streets
  Richland, Wash. 99352
  WPPSS Nuclear Projects 1, 2, & 4
  Basalt Waste Isolation Project, Richland Low-level Waste Burial Site

WISCONSIN

- Mrs. Kathy Pletcher, Head
  Government Documents Section
  Library Learning Center
  University of Wisconsin
  2420 Nicolet Drive
  Green Bay, Wis. 54301
  Kewaunee Nuclear Power Plant

- Ms. Elizabeth J. Helfrich
  Reference Librarian
  LaCrosse Public Library
  800 Main Street
  LaCrosse, Wis. 54601
  LaCrosse Nuclear Power Plant

- Ms. Linda Tebo
  Adult Services Assistant
  Joseph Mann Library
  1516 16th Street
  Two Rivers, Wis. 54241
  Point Beach Nuclear Plant

Appendix 4

Regulations and Amendments—Fiscal Year 1988

REGULATIONS AND AMENDMENTS PUT INTO EFFECT

Regional Nuclear Materials Licensing for the United States Navy—Parts 30, 40, and 70

On October 16, 1987 (52 FR 38391), the NRC published an amendment to its regulations concerning the domestic licensing of source, byproduct, and special nuclear material. The amendment, effective December 1, 1987, transfers the authority for administering the United States Navy license from Headquarters to NRC Region II.

Modification of General Design Criterion 4 Requirements for Protection Against Dynamic Effects of Postulated Pipe Ruptures—Part 50

On October 27, 1987 (52 FR 41288), the NRC published an amendment to its regulations to broaden the scope of a recent modification to General Design Criterion 4. The amendment, effective November 27, 1987, allows the removal of numerous pipe whip restraints and jet impingement barriers, as well as other related changes, in all reactor types.

Minor Nomenclature Amendment; Statement of Organization and General Information—Part 150

On October 30, 1987 (52 FR 41699), the NRC published an amendment to its regulations, effective immediately, that corrects references in its regulations to a now defunct unit of the agency. Evaluation of the Adequacy of Off-Site Emergency Planning for Nuclear Power

Plants at the Operating License Review Stage Where State and/or Local Governments Decline To Participate in Off-Site Emergency Planning—Part 50

On November 3, 1987 (52 FR 42078), the NRC published an amendment to its regulations to provide criteria for the evaluation at the operating license review stage of utility-prepared emergency plans in situations in which state and/or local governments decline to participate further in emergency planning. The rule, effective December 3, 1987, recognizes that Congress did not intend that the absence of state or local government participation in off-site emergency planning should preclude licensing of a substantially completed nuclear power plant where there is a utility-prepared emergency plan that provides reasonable assurance of adequate protection to the public.

Uranium Mill Tailings Regulations; Ground-Water Protection and Other Issues—Part 40

On November 13, 1987 (52 FR 43553), the NRC published an amendment to its regulations governing the disposal of uranium mill tailings. The amendment, effective December 14, 1987, incorporates into existing NRC regulations the ground-water protection regulations published by the Environmental Protection Agency for these wastes.

Access Authorization Fee Schedule for Licensee Personnel—Parts 11 and 25

On November 20, 1987 (52 FR 44593), the NRC published an amendment to its regulations, effective immediately, that revised the fee schedule charged for background investigations of licensee personnel who require access to National Security Information and/or Restricted Data and access to or control over Special Nuclear Material.

Domestic Licensing of Byproduct, Source, and Special Nuclear Material; Revision of List of Non-Agreement States in Region III—Parts 30, 40, and 70

On December 18, 1987 (52 FR 48092), the NRC published an amendment to its regulations, effective immediately, that reflects the status of Illinois and Iowa as Agreement States.

Revision of Freedom of Information Act Regulations; Conforming Amendments—Parts 2 and 9

On December 31, 1987 (52 FR 49350), the NRC published an amendment to its Freedom of Information Act (FOIA) regulations necessary to conform these provisions to the requirements of the Freedom of Information Reform Act of 1986. The final rule, effective February 1, 1988, reduces the repetition of statutory requirements and informs the public of procedural changes to the FOIA regulations.

Completeness and Accuracy of Information—Parts 2, 30, 40, 50, 55, 60, 61, 70 71, 72, 110, and 150

On December 31, 1987 (52 FR 49362), the NRC published an amendment to its regulations that codifies the obligations of licensees and applicants for licenses to provide the Commission with complete and accurate information, to maintain accurate records, and to provide for disclosure of information identified by licensees as significant for licensed activities. This action, effective February 1, 1988, reflects the need for NRC to receive complete, accurate, and timely communications from its licensees and license applicants.

General Criteria for Security Personnel—Part 73

On January 7, 1988 (53 FR 403), the NRC published an amendment to its regulations concerning physical fitness qualifications for security personnel. The amendment, effective February 8, 1988, deletes the scheduling requirement that the medical examination be conducted within the 30 days preceeding the physical fitness test.

Revision of Headquarters Office Locations—Part 1

On January 22, 1988 (53 FR 1744), the NRC published an amendment to its regulations, effective immediately, announcing the revised location of some of the NRC's Headquarters Offices.

Change of Region I Address—Parts 1, 20, 30, 40, 55, 70, and 73

On February 10, 1988 (53 FR 3861), the NRC published an amendment to its regulations, effective immediately, announcing the new address of its Region I Office in King of Prussia, Pennsylvania.

Relocation of NRC Offices—NMSS, OI, and GPA—Parts 30, 40, 60, 61, 70, 71, 72, 73, 74, and 110

On February 12, 1988 (53 FR 4109), the NRC published an amendment to its regulations, effective immediately, to indicate that the Office of Nuclear Material Safety and Safeguards, the Office of Investigations, and portions of the Office of Governmental and Public Affairs have relocated at One White Flint North in Rockville, Maryland.

Relocation of Office of Nuclear Reactor Regulation—Parts 4, 15, 19, 20, 21, 50, 53, 55, 73, 75, 81, 140, 150, and 170

On March 1, 1988 (53 FR 6137), the NRC published an amendment to its Regulations, effective immediately, announcing the relocation of the Office of Nuclear Reactor Regulation.

Reconsideration of Enforcement Policy Revision Involving Reopening Closed Cases—Part 2

On March 23, 1988 (53 FR 9429), the NRC published an amendment to its regulations that clarified its policy on reopening closed enforcement actions. The amendment, effective immediately, emphasized that the decision to reopen a case is to be made on a case-by-case basis.

Revision to Ex Parte and Separation of Functions Rules Applicable to Formal Adjudicatory Proceedings—Parts 0 and 2

On March 31, 1988 (53 FR 10360), the NRC published an amendment to its rules of practice concerning ex parte communications and separation of functions in formal adjudicatory proceedings. The amendment, effective April 29, 1988, incorporates requirements imposed by the Government in the Sunshine Act on ex parte communications into existing regulations. The amendment also allows members of the NRC staff to serve as confidential advisors to the Commission with respect to a contested proceeding so long as the staff members do not serve as investigators or litigators in the proceeding.

Revision of Telephone Numbers for Environmental Inquiries—Part 51

On April 25, 1988 (53 FR 13399), the NRC published an amendment to its regulations pertaining to environmental matters. The amendment, effective immediately, indicates the revised telephone numbers that enable prospective applicants or petitioners to consult with members of the NRC staff.

Codes and Standards for Nuclear Power Plants—Part 50

On May 5, 1988 (53 FR 16051), the NRC published an amendment to its regulations, effective immediately, to incorporate by reference the most recent addenda to pertinent portions of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). These provisions specify rules for the construction of light-water-cooled nuclear power plant components and requirements for the inservice inspection of these components.

Addresses for Personal Delivery of Communications—Parts 1, 110, and 171

On May 19, 1988 (53 FR 17915), the NRC published an amendment to its regulations, effective immediately, that indicates an additional address for the personal delivery of communications.

Retention Periods for Records—Parts 4, 11, 25 30, 31, 32, 34, 35, 40, 50, 60, 61, 70, 71, 73, 74, 75, 95, and 110

On May 27, 1988 (53 FR 19240), the NRC published an amendment to its regulations that establishes a definite retention period for each record that an applicant or licensee is required to maintain. The amendment, effective July 26, 1988, also establishes a uniform standard acceptable to the NRC for the condition of a record throughout each specified retention period.

Revision of Backfitting Process for Power Reactors—Part 50

On June 6, 1988 (53 FR 20603), the NRC published an amendment to its regulations which governs the backfitting of nuclear power plants. The amendment, effective July 6, 1988, is intended to clarify when economic costs may be considered in backfitting nuclear power plants.

Diagnostic Misadministration Report Form—Part 35

On June 9, 1988 (53 FR 21627), the NRC published an amendment to its regulations for the medical use of byproduct material to indicate the form to be used for reporting diagnostic misadministrations. This amendment, effective immediately, is intended to inform the public of the development and availability of the form that medical licensees must use to meet the reporting requirements.

Access Authorization Fee Schedule for Licensee Personnel—Parts 11 and 25

On June 13, 1988 (53 FR 21979) the NRC published an amendment to its regulations to revise the fee schedule charges for background investigations of licensee personnel who require access to National Security Information and/or Restricted Data and access to or control over Special Nuclear Material. The amendment, effective immediately, complies with current regulations in Parts 11 and 25 which provide that NRC will publish fee adjustments, concurrent with notification of any changes in the rate charged the NRC by the Office of Personnel Management (OPM), for conducting the investigations.

Station Blackout—Part 50

On June 21, 1988 (53 FR 23203), the NRC published an amendment to its regulations to require that light-water-cooled nuclear power plants be capable of withstanding a total loss of alternating current (ac) electric power for a specified duration and maintaining reactor core cooling during that period. The amendment, effective July 21, 1988, is intended to provide further assurance that a loss of both off-

site power and onsite emergency ac power systems will not adversely affect the public health and safety.

General Requirements for Decommissioning Nuclear Facilities—Parts 30, 40, 50, 51, 70, and 72

On June 27, 1988 (53 FR 24018), the NRC published an amendment to its regulations to set forth technical and financial criteria for decommissioning licensed nuclear facilities. The amended regulations address decommissioning planning needs, timing, funding methods, and environmental review requirements. The amendment, effective July 27, 1988, also contains a response to a petition for rulemaking (PRM-50-22), concerning decommissioning financial assurance, initially filed by the Public Interest Research Group (PIRG), et al. on July 5, 1977.

Control of Aerosols and Gases—Part 35

On July 22, 1988 (53 FR 27665), the NRC published an amendment to its regulations governing the medical uses of byproduct material that removed the requirement that radioactive aerosols be administered to patients only in rooms that are at negative pressure relative to surrounding rooms. The amendment, effective August 22, 1988, developed in response to PRM-35-6, allows the use of radioactive aerosols in locations such as intensive care units, critical care units, and patients' rooms.

Revision of Fee Schedule—Part 171

On August 12, 1988 (53 FR 30423), the NRC published an amendment to its regulations, on an interim basis, to revise the annual charges for licensed power reactors for Fiscal Year 1988. This action, effective September 12, 1988, is necessary to provide for the timely collection of fees as required by recently enacted legislation.

Implementation of the Use of SF-86, "Questionnaire for Sensitive Positions"—Parts 11 and 25

On August 16, 1988 (53 FR 30829), the NRC published an amendment to its regulations, effective September 15, 1988, to change the forms required to request an NRC personnel security clearance or material access authorization for NRC licensee personnel, licensee contractors, and other persons when an Office of Personnel Management (OPM) background investigation is necessary. The OPM has stipulated the use of the SF-86, "Questionnaire for Sensitive Positions" as the basis for their background investigations.

Facility Form Nuclear Liability Insurance Policy; Miscellaneous Amendments—Part 140

On August 18, 1988 (53 FR 31282), the NRC published an amendment to its regulations, effective September 19, 1988, making several minor changes in the Facility Form nuclear liability insurance policy furnished as evidence of financial protection.

Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste—Parts 2, 19, 20, 21, 51, 70, 72, 73, 75 and 150

On August 19, 1988 (53 FR 31651), the NRC published an amendment to its regulations, effective September 19, 1988, to provide for licensing the storage of spent nuclear fuel and high-level radioactive waste in a monitored retrievable storage facility. The Nuclear Waste Policy Act of 1982, as amended, requires that monitored retrievable storage facilities for spent nuclear fuel and high-level radioactive waste be subject to licensing by the Nuclear Regulatory Commission.

Restrictions Against Ownership of Certain Security Interests by Members of Advisory Committee on Nuclear Waste; Gifts, Entertainment, and Favors—Part 0

On September 13, 1988 (53 FR 35301), the NRC published an amendment to its regulations governing the ownership by NRC employees of stocks, bonds, and other security interests in companies that fall within any one of five reactor-related or fuel cycle-licensed categories. The amendment, effective immediately, will add to the group of affected employees those special Government employees who serve as members of the Advisory Committee on Nuclear Waste. The NRC is also amending its regulations on acceptance of gifts, entertainment, and favors to permit acceptance of travel expenses from an otherwise prohibited source when proffered in connection with a job interview and to permit acceptance of food and refreshments at widely attended events sponsored by certain groups whose membership is composed of prohibited sources.

Emergency Core Cooling Systems; Revisions to Acceptance Criteria—Part 50

On September 16, 1988 (53 FR 35996), the NRC published an amendment to its regulations, effective October 17, 1988, to allow the use of alternative methods to demonstrate that the emergency core cooling system would protect the nuclear reactor core during a postulated design basis loss-of-coolant accident.

Emergency Planning and Preparedness Requirements for Nuclear Power Plant Fuel Loading and Low-Power Testing—Part 50

On September 23, 1988 (53 FR 36955), the NRC published an amendment to its regulations, effective October 24, 1988, to establish more clearly what emergency planning and preparedness requirements are needed for fuel loading and low power testing of nuclear power plants.

REGULATIONS AND AMENDMENTS PROPOSED

Basic Quality Assurance in Radiation Therapy—Part 35

On October 2, 1987 (52 FR 36942), the NRC published a notice of proposed rulemaking that would amend its regulations concerning the medical use of byproduct material. The proposed rule would require medical licensees to implement certain quality assurance steps so that the chance of a therapy misadministration is reduced. The proposed rule would provide better patient safety and form the basis for enforcement action in case of a therapy misadministration.

Retention Periods for Records—Parts 4, 11, 25, 30, 31, 32, 34, 35, 40, 50, 60, 61, 70, 71, 73, 74, 75, 95, and 110

On October 28, 1987 (52 FR 41442), the NRC published a notice of proposed rulemaking that would establish a definite retention period for each record that an NRC applicant or licensee for a materials or facility license is required to maintain. The proposed rule is expected to reduce the overall recordkeeping burden for NRC applicants and licensees.

Criteria and Procedures for Emergency Access to Non-Federal and Regional Low-Level Waste Disposal Facilities—Part 62

On December 15, 1987 (52 FR 47578), the NRC published a notice of proposed rulemaking that would establish procedures and criteria for fulfilling its responsibilities concerning responding to requests for emergency access to operating, non-Federal or regional, low-level radioactive waste disposal facilities. The proposed rule is intended to address situations where a grant of emergency access may be necessary if a generator of low-level radioactive waste is denied access to operating disposal facilities and the lack of access could result in a serious and immediate threat to public health and safety.

Control of Aerosols and Gases—Part 35

On December 16, 1987 (52 FR 47726), the NRC published a notice of proposed rulemaking that would amend its regulations governing the medical uses of byproduct material. The proposed rule would remove the requirement that radioactive aerosols be administered to patients only in rooms that are at negative pressure relative to surrounding rooms. The proposed rule would allow physicians greater latitude in administering necessary clinical procedures to their patients.

Safeguards Requirement for Fuel Facilities Possessing Formula Quantities of Strategic Special Nuclear Material—Part 73

On December 31, 1987 (52 FR 49418), the NRC published a notice of proposed rulemaking that would amend its physical protection and security personnel performance regulations for fuel facilities possessing formula quantities of strategic special nuclear material to a level equivalent to the protection in place at comparable Department of Energy facilities. The proposed rule would provide greater assurance that physical protection measures at these fuel facilities can provide the capability to protect against the design basis threat.

Alternative Method for Leakage Rate Testing—Part 50

On February 29, 1988 (53 FR 5985), the NRC published a notice of proposed rulemaking that would clarify the requirements of its regulations applicable to the leakage testing of containments of light-water-cooled nuclear power plants. The proposed rule would explicitly permit the use of a statistical data analysis technique that the NRC considers to be an acceptable method of calculating containment leakage rates.

Safety Requirements for Industrial Radiographic Equipment—Part 34

On March 15, 1988 (53 FR 8460), the NRC published a notice of proposed rulemaking that would amend regulations applicable to industrial radiography. Licensees would be required to use radiographic exposure devices and associated equipment that provide additional safety features and radiographers would be required to wear pocket alarm dosimeters. The proposed requirements are intended to reduce radiation exposures to radiographic personnel and the general public that may result from the use of radiographic equipment.

Licensee Announcements of Inspectors—Part 50

On March 18, 1988 (53 FR 8924), the NRC published a notice of proposed rulemaking that would ensure that the presence of NRC inspectors on power reactor sites is not communicated to license and contractor personnel without the expressed permission of the inspector. The proposed rule would allow NRC inspectors to observe ongoing activities as they are being performed without advanced notification to affected personnel.

Facility Form Nuclear Liability Insurance Policy; Miscellaneous Amendments—Part 140

On April 27, 1988 (53 FR 15049), the NRC published a notice of proposed rulemaking that would make several minor changes in the Facility Form nuclear liability insurance policy furnished as evidence of financial protection. The proposed rule would conform NRC's regulations to endorsements to the Facility Form policy submitted by the two nuclear insurance pools that make available a single insurance policy to cover onsite worker claims.

NEPA Review Procedures for Geologic Repositories for High-Level Waste—Parts 2, 51, and 60

On May 5, 1988 (53 FR 16131), the NRC published a notice of proposed rulemaking that would revise its procedures for implementing the National Environmental Policy Act (NEPA). The proposed rule would address the Commission's rule under NEPA in connection with a license submitted by the Department of Energy (DOE) with respect to a geologic repository for high-level radioactive waste. The proposed rule reflects provisions of the Nuclear Waste Policy Act of 1982 requiring the Commission to adopt the DOE's environmental impact statement to the extent practicable.

Emergency Planning and Preparedness Requirements for Nuclear Power Plant Fuel Loading and Initial Low-Power Operations—Part 50

On May 9, 1988 (53 FR 16435), the NRC published a notice of proposed rulemaking that would establish more clearly the emergency planning and preparedness requirements that are needed for fuel loading and lower power operation of nuclear power plants. The proposed rule would require NRC findings on an applicant's onsite plan and only those offsite elements of the plan which would reasonably be expected to be needed in the event of a radiological emergency at low power.

Disposal of Radioactive Wastes—Part 61

On May 18, 1988 (53 FR 17709), the NRC published a notice of proposed rulemaking that would require disposal of "greater-than-Class C" low-level radioactive wastes in a deep geologic repository unless disposal elsewhere has been approved by the Commission. The proposed amendments would obviate the need for altering classifications of radioactive wastes as high-level or low-level.

Transportation Regulations; Compatibility With the International Atomic Energy Agency (IAEA)—Part 71

On June 8, 1988 (53 FR 21550), the NRC published a notice of proposed rulemaking that would amend its regula-

tions for the safe transportation of radioactive material to make them compatible with those of the International Atomic Energy Agency (IAEA) and thus with those of most major nuclear nations. These regulations would apply to all NRC specific licensees who place byproduct, source, or special nuclear material in transit.

Revision of Fee Schedules—Parts 170 and 171

On June 27, 1988 (53 FR 24077), the NRC published a notice of proposed rulemaking that would amend its regulations by revising its fee schedules in 10 CFR Parts 170 and 171. This revision is necessary both to update the current fees and to implement the most recent fee legislation enacted by the Congress.

Licensee Action During National Security Emergency—Part 50

On July 19, 1988 (53 FR 27174), the NRC published a notice of proposed rulemaking that would amend its regulations to allow a licensee to take action that departs from approved technical specifications in a national security emergency. The amendment is necessary to specify in the regulations that in a national security emergency a licensee is permitted to take a needed action although it may deviate from technical specifications.

Reasserting NRC's Authority for Approving Onsite Low-Level Waste Disposal in Agreement States—Part 150

On August 22, 1988 (53 FR 31880), the NRC published a notice of proposed rulemaking that would amend its regulations to reassert NRC's jurisdiction for onsite low-level waste disposal for waste generated onsite at all reactors licensed by NRC in Agreement States. The proposed rule is necessary to (1) provide a more centralized and consistent regulatory review of all onsite waste management activities and (2) avoid duplication of regulatory effort by the NRC and Agreement States. The uniform review procedures which will accrue from the proposed rule are intended to provide greater assurance that onsite radioactive material will not present a health hazard at a later date after the site is decommissioned.

Early Site permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Reactors—Part 52

On August 23, 1988 (53 FR 32060), the NRC published a notice of proposed rulemaking that would add a new part to its regulations which would provide for issuance of early site permits, standard design certifications, and combined construction permits and conditional operating licenses for nuclear power reactors. The proposed rule sets out the review procedures and licensing requirements that would apply to applications for these new licenses and certifications. The proposed action is intended to achieve the early resolution of licensing issues. This would enhance the safety and reliability of nuclear power plants and reduce the complexity and uncertainty of the licensing process.

Disposal of Waste Oil by Incineration—Part 20

On August 29, 1988 (53 FR 32914), the NRC published a notice of proposed rulemaking that would permit the onsite incineration of slightly contaminated waste oils generated at licensed nuclear power plants without the need to specifically amend existing Part 50 operating licenses. This proposed action would help ensure that the limited capacity of licensed regional low-level waste burial grounds is used more efficiently while maintaining releases from operating nuclear power plants at levels which are "as low as is reasonably achievable" as required by 10 CFR part 50, Appendix I. This proposed rule, if promulgated, would constitute a partial granting of a petition for rulemaking (PRM-20-5) submitted by Edison Electric Institute and Utility Nuclear Waste Management Group.

Extension of Time for the Implementation of the Decontamination Priority and Trusteeship Provisions of Property Insurance Requirements—Part 50

On September 19, 1988 (53 FR 36338), the NRC published a notice of proposed rulemaking that would amend the implementation schedule for the stabilization and decontamination priority and trusteeship provisions of its property insurance regulations contained in 10 CFR 50.54(w)(5)(i) by changing the effective date from October 4, 1988 to April 4, 1990.

Fitness-for-Duty Program—Part 26

On September 22, 1988 (53 FR 36795), the NRC published a notice of proposed rulemaking that would create a new part in its regulations requiring licensees authorized to operate nuclear power reactors to implement a fitness-for-duty program. The general objective is to provide reasonable assurance that nuclear power plant personnel are not under the influence of any substance, legal or illegal, or mentally or physically impaired from any cause which in any way adversely affects their ability to safely and competently perform their duties.

ADVANCE NOTICES OF PROPOSED RULEMAKING

Comprehensive Quality Assurance in Medical Use and a Standard of Care—Part 35

On October 2, 1987 (52 FR 36949), the NRC published an advance notice of proposed rulemaking on a contemplated amendment that would require licensees offering teletherapy or brachytherapy services to implement a comprehensive quality assurance program to reduce the chance of misadministrations. The advance notice of proposed rulemaking requests public comment on the extent to which additional radiopharmaceutical quality assurance requirements are needed.

Regulation of Uranium Enrichment Facilities—Part 76

On April 22, 1988 (53 FR 13276), the NRC published an advance notice of proposed rulemaking on a contemplated amendment that would add new regulations for uranium enrichment facilities. The advance notice of proposed rulemaking requests public comment on whether a separate set of regulations is desirable for uranium enrichment licensing.

Medical Use of Byproduct Material; Training and Experience Criteria—Part 35

On May 25, 1988 (53 FR 18845), the NRC published an advance notice of proposed rulemaking that requests comments on the training and experience criteria for all individuals who use byproduct material for clinical procedures in the practice of medicine. Comments submitted on the advance notice of proposed rulemaking will help the NRC en-

sure that its training and experience criteria reflect the evolution of medical practice without compromising public health and safety.

Custody and Long-Term Care of Uranium Mill Tailings Sites—Part 40

On August 25, 1988 (53 FR 32396), the NRC published an advance notice of proposed rulemaking considering general licenses that would permit NRC to license the custody and long-term care of decommissioned uranium or thorium mill tailings sites after remedial actions under the Uranium Mill Tailings Radiation Control Act have been completed. Although the notice was published as an advance notice of proposed rulemaking, the full text of a proposed rule was included and a proposed rule may not be necessary.

Nuclear Plant License Renewal—Part 50

On August 29, 1988 (53 FR 32919), the NRC published an advance notice of proposed rulemaking to develop regulations for extending nuclear power plant licenses beyond 40 years. In order to inform the public, industry, and other government agencies of its activities and to solicit comments on various regulatory options and issues developed thus far, the Commission is promulgating this notice and requesting comments on NUREG-1317 "Regulatory Options for Nuclear Plant License Renewal."

Appendix 5

Regulatory Guides—Fiscal Year 1988

NRC regulatory guides describe methods acceptable to the NRC staff of implementing specific parts of the Commission's regulations and, in some cases, describe techniques used by the staff in evaluating specific problems or postulated accidents. Guides also may advise applicants regarding information the NRC staff needs in reviewing applications for permits and licenses.

Comments on the guides are encouraged, and the guides are revised whenever appropriate to reflect new information or experience. NRC issues the guides for public comment in draft form before they have received complete staff review and an official staff position has been established.

Once issued, regulatory guides may be withdrawn when superseded by Commission regulations, when equivalent recommendations have been incorporated in applicable approved codes and standards, or when changes make them obsolete.

When guides are issued, reviewed, or withdrawn, notices are placed in the Federal Register.

To reduce the burden on the taxpayer, the NRC has made arrangements for the sale of active regulatory guides by both the U.S. Government Printing Office (on an individual guide basis) and the National Technical Information Service (on a standing order basis). Draft guides issued for public comment receive free distribution. NRC licensees receive, at no cost, pertinent draft and active regulatory guides as they are issued.

The following guides were issued, revised, or withdrawn during the period October 1, 1987 to September 30, 1988.

Division 1—Power Reactor Guides

1.84 Design and Fabrication Code Case Acceptability—ASME Section III, Division 1 (Revision 25)

1.85 Materials Code Case Acceptability—ASME Section III, Division 1 (Revision 25)

1.99 Radiation Embrittlement of Reactor Vessel Materials (Revision 2)

1.100 Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants (Revision 2)

1.147 Inservice Inspection Code Case Acceptability—ASME Section XI, Division 1 (Revision 6)

1.155 Station Blackout

1.156 Environmental Qualification of Connection Assemblies for Nuclear Power Plants

Division 2—Research and Test Reactor Guides

NONE

Division 3—Fuels and Materials Facilities Guides

3.63 Onsite Meteorological Measurement Program for Uranium Recovery Facilities—Data Acquisition and Reporting

Division 4—Environmental and Siting Guides

4.19 Guidance for Selecting Sites for Near-Surface Disposal of Low-Level Radioactive Waste

Division 5—Materials and Plant Protection Guides

5.62 Reporting of Safeguards Events (Revision 1)

Division 6—Product Guides

NONE

Division 7—Transportation Guides

NONE

Division 8—Occupational Health Guides

8.13 Instruction Concerning Prenatal Radiation Exposure (Revision 2)

8.22 Bioassay at Uranium Mills (Revision 1)

8.32 Criteria for Establishing a Tritium Bioassay Program

Division 9—Antitrust and Financial Review Guides

NONE

Division 10—General Guides

10.4 Guide for the Preparation of Applications for Licenses to Process Source Material (Revision 2)

DRAFT GUIDES

Division 3

CE 802-5 Proposed Revision 1 to Regulatory Guide 3.45, Nuclear Criticality Safety for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials

Division 7

MS 804-4 Proposed Revision 1 to Regulatory Guide 7.8, Load Combinations for the Structural Analysis of Shipping Casks for Radioactive Material

Division 8

CE 801-5 Proposed Revision 2 to Regulatory Guide 8.12, Criticality Accident Alarm Systems

Appendix 6

Civil Penalties and Orders—Fiscal Year 1988

CIVIL PENALTY ACTIONS DURING FY 1988*

Licensee	*Amount*	*Reason*
Wisconsin Electric Power Company (Point Beach) (EA 86-148)	$50,000 proposed in FY 87; imposed and paid in FY 88	Violations involving degraded vital area barriers.
Dairyland Power Cooperative (Lacrosse) (EA 87-002)	$25,000 proposed and imposed in FY 87; paid in FY 88	Violations involving licensee's Safeguards Information protection program.
Duke Power Company (Oconee) (EA 87-014)	$25,000 proposed in FY 87; withdrawn in FY 88	Violation involving failure to provide adequate design control to assure that the emergency feedwater pumps would remain operable under design basis transients.
Halliburton Company Duncan, OK (EA 87-035)	$1,000 proposed in FY 87; paid in FY 88	Violations involving unauthorized use of byproduct material, calibration of survey instruments, training, materials accountability records, and posting of documents.
Arkansas Power & Light (ANO) (EA 87-062)	$25,000 proposed in FY 87; imposed and paid in FY 88	Violation in which one pressurizer code safety valve was found inoperable.
Wheeling Hospital, Inc. Wheeling, WV (EA 87-074)	$2,500 proposed in FY 87; $1,429 imposed and paid in FY 88	Violations involving inadequate management oversight and control of the radiological safety program.
Eastern Testing & Inspection Pennsauken, NJ (EA 87-079)	$6,500 proposed in FY 87; $3,250 imposed in FY 88; pending	Violations involving maintenance of a warning signal, use of dosimeters, audit of radiographic personnel, and transportation of a radiographic source.
Florida Power & Light (Turkey Point) 87-085)	$225,000 proposed and paid in FY 88	Violations involving the loss of boration flow paths for both units, isolation of the backup nitrogen system, and operation of intake cooling water system outside design basis.
Arkansas Power & Light (ANO) (EA 87-090)	$75,000 proposed in FY 87; imposed and paid in FY 88	Violations involving seven examples of breaches in vital area barriers and two examples of sleeping security guards.
Norwalk Hospital Norwalk, CT (EA 87-093)	$2,500 proposed and imposed in FY 87; paid in FY 88	Violations involving the disposal of licensed material; posting of a radiographic area; the wearing of protective clothing; storage of food in an area where radioactive material was used and stored, and failure to meet several specific additional requirements.

*Cases are presented in the order of EA number. Indicated status reflects the situation as of the end of the fiscal year, September 30, 1988. Some pending cases may have been settled by the time of publication.

Licensee	*Amount*	*Reason*
Kermit Butcher Elkins, WV (EA 87-096)	$500 proposed and imposed in FY 87; paid in FY 88	Multiple health physics violations demonstrating a breakdown in the management oversight and control of the licensee's radiation safety program.
Florida Power & Light Company (Turkey Point) (EA 87-098)	$75,000 proposed in FY 87; imposed and paid in FY 88	Violations involving personnel access control and vehicle search.
Georgia Power Company (Vogtle) (EA 87-100)	$200,000 proposed in FY 87; paid in FY 1988	Violations involving security compensatory measures, procedures, and access control.
Commonwealth Edison Company (Zion) (EA 87-105)	$50,000 proposed and paid in FY 88	Violations involving installation of control room ventilation system, resulting in several significant air inleakage paths.
Sequoyah Fuels Corp. Oklahoma City, OK (EA 87-108)	$8,000 proposed in FY 87; pending	Violation involving a material false statement in a letter to the NRC.
Carolina Power & Light (H. B. Robinson) (EA 87-112)	$50,000 proposed in FY 87; paid in FY 88	Violations involving the failure to control valve lineup activities.
Georgia Power Company (Vogtle) (EA 87-115)	$50,000 proposed in FY 87; paid in FY 88	Violations involving the improper evaluation of component and system operability and the failure to take prompt corrective action.
Consolidated NDE, Inc. Woodbridge, NJ (EA 87-121)	$5,000 proposed in FY 87; imposed and paid in FY 88	Violations involving failure to maintain direct surveillance of the high radiation area resulting in individuals gaining access to the area while a radiographic source was exposed.
Carolina Power & Light (H. B. Robinson) (EA 87-124)	$50,000 proposed, imposed, and paid in FY 88	Violations involving the failure to properly establish and implement procedures for the conduct of the safe shutdown evolutions following a fire.
Veterans Administration Wichita, KA (EA 87-125)	$2,500 proposed, imposed, and paid in FY 88	Violations involving absence of authorized physician to use and supervise licensed material and use of unqualified physician.
Tidewater Memorial Hosp. Tappahannock, VA (EA 87-127)	$2,500 proposed in FY 87; $2,416 imposed and paid in FY 88	Violations involving program and records review, calibration of survey meters, and testing of the dose calibrator for accuracy and linearity.
Froehling & Robertson Richmond, VA (EA 87-128)	$5,000 proposed in FY 88; $4,200 imposed and paid in FY 88	Violations involving training and testing, operations of the Radiation Safety responsibilities, the use shipping labels and film badges.
Detroit Edison Company (Fermi) (EA 87-133)	$75,000 proposed in FY 87; paid in FY 88	Violations involving an uncontrolled heatup of the reactor in violation of technical specifications.
Northern States Power (Prairie Island) (EA 87-138)	$25,000 proposed in FY 87; paid in FY 88	Violations involving a failure to verify that the power supply breaker for a safety injection pump was in the full racked in position, resulting in the inoperability of the pump during startup and power operation.
Wego Perforaters, Inc. Ada, OK (EA 87-140)	$500 proposed and paid in in FY 88	Violations involving unauthorized location, unauthorized users, and failure to mark and label transportation containers.

Licensee	*Amount*	*Reason*
Alabama Power Company (Farley) (EA 87-142)	$50,000 proposed, imposed, and paid in FY 88	Violations in the area of procurement and vendor interface.
H & G Inspection Company Houston, TX (EA 87-145)	$7,500 proposed and imposed in FY 87; pending	Violations involving a overexposure to a radiographer.
Northern States Power (Monticello) (EA 87-147)	$50,000 proposed, imposed, and paid in FY 88	Violations involving the failure to establish and implement a procedure to evaluate the effects of electrical design changes on other portions of the system in the area of electrical coordination.
University of Virginia Charlottesville, VA (EA 87-155)	$2,500 proposed in FY 88; $1,250 imposed and paid in FY 88	Violations involving surveying of a high radiation area, posting and control of access to high radiation area, and written procedures for the installation, operation, modification, and surveillance of experimental facilities.
Beckley Appalachian Regional Hospital Beckley, WV (EA 87-157)	$5,000 proposed in FY 88; $1,000 imposed and paid in FY 88	Violations involving numerous radiation protection program violations.
Babcock & Wilcox Company Lynchburg, VA (EA 87-160)	$12,500 proposed and paid in FY 88	Violations involving failures to do adequate bioassay evaluations, wear appropriate protective clothing, and do adequate surveys.
Duke Power Company (McGuire) (EA 87-163)	$100,000 proposed, imposed, and paid in FY 88	Violations involving an event in which one of two required emergency diesel generators was rendered inoperable for approximately 90.5 hours.
Carolina Power & Light (Brunswick) (EA 87-165)	$50,000 proposed in FY 88; pending	Violations involving equipment qualification requirements.
Carolina Power & Light (H. B. Robinson) (EA 87-166)	$450,000 proposed in FY 88; pending	Violations involving equipment qualification requirements.
Professional Service Industries, Inc. Oakbrook, IL (EA 87-170)	$2,250 proposed and paid in FY 88	Violations involving the failure to secure a moisture density gauge containing licensed material.
BP Oil, Inc. Marcus Hook, PA (EA 87-175)	$2,000 proposed, imposed, and paid in FY 88	Violations involving excessive radiation levels, maintenance, improper removal of nuclear gauges, and a gauge not in a shielded storage container.
Osage Wireline Corporation Cleveland, OK (EA 87-178)	$1,500 proposed in FY 88; $1,450 imposed and paid in FY 88	Violations involving handling of radioactive sources, radiation surveys, records of inventories, unsecured radioactive sources, and records of personnel monitoring results.
Florida Power & Light Co. (Turkey Point) (EA 87-179)	$150,000 proposed and paid in FY 88	Violations involving failure to maintain access control and failure to properly store Safeguards Information.
University of Missouri Columbia, Missouri (EA 87-180)	$5,000 proposed and paid in FY 88	Violations involving an extremity overexposure and failure to adequately train an individual and adequately evaluate his qualifications.
Wisconsin Electric Power Company (Point Beach) (EA 87-182)	$25,000 proposed and paid in FY 88	Violations involving an event in which both main steam isolation valves were rendered inoperable for approximately four hours with the reactor critical, failure to make a prompt notification to plant management, and failure to promptly notify NRC.

Licensee	*Amount*	*Reason*
Precision Logging and Perforating Company Cleveland, Oklahoma (EA 87-184)	$1,000 proposed in FY 88; pending	Violations involving surveys, unsecured material, posting records, shipping labels and papers, and storage of licensed material.
Milford Memorial Hospital Milford, Delaware (EA 87-189)	$27,500 proposed and paid in FY 88	Violations involving falsification of records, denial of that falsification, falsification of meeting minutes, and submittal of falsified Radiation Safety Committee meeting minutes to the NRC.
Duke Power Company (McGuire) (EA 87-192)	$25,000 proposed and paid in FY 88	Violations involving an event in which the containment shield/divider barrier was found to be inoperable.
Union Electric Company (Callaway) (EA 87-194)	$50,000 proposed and paid in FY 88	Violations involving the inoperability of the Control Room Emergency Ventilation System and the failure to take prompt corrective actions after a partially closed valve in the Essential Service Water System was identified.
Combustion Engineering, Inc. Windsor, Connecticut (EA 87-195)	$12,500 proposed and paid in FY 88	Violations involving excessive contamination levels, surveys, bioassays of individuals, and failure to maintain certain records.
Northeast Nuclear Energy Company (Millstone) (EA 87-198)	$25,000 proposed and paid in FY 88	Violations involving the failure to maintain the integrity of vital and protected area barriers and failure to ensure that visitors are properly escorted while within the protected area of the plant.
Omaha Public Power District (Ft. Calhoun) (EA 87-200)	$75,000 proposed and paid in FY 88	Violations involving the health physics procedures and technical specifications when entering a very high radiation area, an unlocked very high radiation area door, and the failure to issue a Licensee Event Report.
Consumers Power Company (Big Rock Point) (EA 88-202)	$25,000 proposed and paid in FY 88	Violations involving failure to maintain positive access control to a vital area.
Payne & Payne, Inc. Shawnee, OK (EA 87-205)	$1,600 proposed in FY 88; pending	Violations involving failure to calibrate survey instruments, failure to use personnel dosimetry, failure to perform leak tests, and failure to follow transportation requirements indicating breakdown of management control.
Cleveland Electric Illuminating Company (Perry) (EA 87-206)	$25,000 proposed and paid in FY 88	Violations involving failure to ensure that some electrical equipment important to safety was properly environmentally qualified by test and/or analysis, installed in the configuration qualified by test and/or analysis, and maintained to preserve its qualification.
Commonealth Edison Company (Dresden) (EA 87-207)	$50,000 proposed and paid in FY 88	Violations involving an event in which the licensee exceeded the specified time limits for two Technical Specifications associated with containment deinerting.
Omaha Public Power District (Ft. Calhoun) (EA 87-210)	$175,000 proposed and paid in FY 88	Violations involving two events in which water from the Fire Protection System entered the Instrument Air System, rendering one Emergency Diesel Generator inoperable with the potential for disabling the second.

Licensee	*Amount*	*Reason*
Commonwealth Edison Company (Zion) (EA 87-211)	$100,000 proposed, imposed, and paid in FY 88	Violations involving inadequacies in the licensee's quality assurance program and management controls to ensure adequate testing of pressure isolation valves.
Kansas Gas & Electric Company (Wolf Creek) (EA 87-213)	$100,000 proposed, imposed, and paid in FY 88	Violations involving significant procedural control weaknesses during the performance of outage activities.
United Hospital Center Clarksburg, WV (EA 87-214)	$1,250 proposed and paid in FY 88	Violations involving meetings of the Radiation Safety Committee, daily and weekly radiationsurveys, the geometric variation test of the dose calibrator, posting a radiation area, conducting training of ancillary personnel, conducting an annual review of the Radiation Safety Program, and storing radioactive material.
Toledo Edison Company (Davis Besse) (EA 87-219)	$25,000 proposed and paid in FY 88	Violations involving failure to maintain the integrity of a vital area barrier in that maintenance work performed without coordination with the security organization resulted in four openings being created in a vital area barrier.
Niagara Mohawk Power Corporation (Nine Mile Point) (EA 87-224)	$100,000 proposed and paid in FY 88	Violations involving operation of the plant without dispositioning certain weld flaw indications which were identified by inservice inspections.
Case Western Reserve University Cleveland, OH (EA 87-226)	$10,000 proposed and paid in FY 88	Violations involving failure to adequately correct past violations and numerous other violations, resulting in a significant breakdown in the licensee's radiation safety program.
Arkansas Power & Light (ANO) (EA 87-227)	$100,000 proposed and paid in FY 88	Violations involving failure to take corrective action for a longstanding problem of containment building temperatures in excess of those assumed in the plant design basis.
Detroit Edison Company (Fermi) (EA 87-232)	$25,000 proposed and paid in FY 88	Violations involving design error discovered in the circuitry of the swing electrical bus which would have resulted in the loss of both divisions of low pressure coolant injection during an accident condition.
St. Louis University St. Louis, MO (EA 87-234)	$6,000 proposed, imposed, and paid in FY 88	Violations involving permitting an individual to receive a whole body dose of at least 7.5 rems during one calendar quarter, failing to assess the radiation hazards or observe three separate warning lights, and the failure to report to the NRC within 24 hours that an overexposure event had occurred.
Houston Light & Power Company (South Texas Project) (EA 87-236)	$50,000 proposed and paid in FY 88	Violations involving access control, training and qualification of security force members, improper marking of Safeguards Information, and testing and maintenance of security equipment.
Nebraska Public Power District (Cooper) (EA 87-237)	$25,000 proposed and paid in FY 88	Violations involving inadequate search of a contractor's vehicle that resulted in the introduction of ammunition to the protected area.

Licensee	*Amount*	*Reason*
Micromedic Systems, Inc. Horsham, PA (EA 87-241)	$500 proposed and paid in FY 88	Violations involving improper disposal of radioactive waste materials and failure to perform adequate surveys as required at the facility.
Gamma Diagnostic Laboratories Attleboro Falls, Mass.	$5,000 proposed in FY 88; $2,500 imposed in FY 88; pending	Violations involving an overexposure to the left hand of a laboratory supervisor.
Virginia Electric & Power Company (North Anna) (EA 87-246)	$100,000 proposed and paid in FY 88	Violations involving failure to place inoperable steam flow channels in trip in required by the Technical Specifications.
Philadelphia Electric Company (Peach Bottom) (EA 88-004)	$1,250,000 proposed and paid in FY 88 Order.	Violations involving widespread inattentiveness in the control room that resulted in a Shutdown
Licensed Operators at Peach Bottom (EAs 88-205 through 88-031, 88-075 through 88-081, 88-105, and 88-124)	$21,900 (cumulative) proposed and paid in FY 88	Violations involving widespread inattentiveness in the control room that resulted in a Shutdown Order. (Proposed along with the $1,250,000 civil penalty proposed for Philadelphia Electric)
Florida Power Corporation (Crystal River) (EA 88-034)	$50,000 proposed in FY 88; pending	Violations involving failure to take appropriate corrective action to resolve a deficiency regarding the electrical loads placed on one of two plant emergency diesel generators.
Alabama Power Company (Farley) (EA 88-040)	$450,000 proposed in FY 88; pending	Violations involving equipment qualification requirements of 10 CFR 50.49.
Public Service Electric and Gas Company (Salem) (EA 88-044)	$50,000 proposed and paid in FY 88	Violations involving failure to satisfy fire protection requirements, including the separation of redundant trains of equipment, cabling, and associated circuits necessary to achieve and maintain hot shutdown in the event of a fire.
Joslin Diabeties Center Boston, Mass. (EA 88-054)	$2,500 proposed in FY 88; $625 imposed and paid in FY 88	Violations involving an overexposure of 35.13 rem to the right hand of a research investigator.
Northeast Nuclear Energy Company (Millstone) (EA 88-061)	$50,000 proposed and paid in FY 88	Violations involving failure to have the required cold overpressure protection systems operable prior to and during a pressure transient in which such systems could have actuated.
Arizona Public Power Project (Palo Verde) (EA 88-062)	$100,000 proposed and paid in FY 88	Violations involving improper engineering and review resulting in an inoperable turbine driven Auxiliary Feedwater Pump on each unit and operational problems including failure to follow procedures and inadequate verification resulting in inoperable Auxiliary Feedwater Pump, an inoperable High Pressure Injection Pump, and an inadvertent safety injection.
Hospital Metropolitano San Juan, Puerto Rico (EA 88-063)	$2,500 proposed and paid in FY 88	Numerous violations indicating a breakdown in management oversight of the radiation safety program for the nuclear medicine department.
Omaha Public Power District (Ft. Calhoun) (EA 88-072)	$112,500 proposed and paid in FY 88	Numerous violations involving radiation protection including the failure to control a very high radiation area.

Licensee	*Amount*	*Reason*
Virginia Electric and Power Company (Surry) (EA 88-074)	$50,000 proposed and paid in FY 88	Violations involving the failure to verify operability of required boric acid piping heat tracing circuits on a monthly basis as required by the Technical Specifications.
TVA (Sequoyah) (EA 88-086)	$50,000 proposed and paid in FY 88	Violations involving failure to maintain the required number of centrifugal charging pumps oberable in an operational mode and failure to promptly report this condition to the NRC.
U.S. Air Force Wright Patterson AFB (EA 88-087)	$102,500 proposed in FY 88; pending	Violations involving a willful failure to report a significant spill of americium-241 and an internal exposure of americium-241 to an individual in excess of NRC quarterly limits.
Carolina Power & Light (H. B. Robinson) (EA 88-088)	$50,000 proposed in FY 88; pending	Violations involving failure of the required emergency core cooling system evaluation model used to reflect the most damaging single failure relative to the ECCS safety injection subsystem.
Illinois Power Company (Clinton) (EA 88-090)	$75,000 proposed in FY 88; pending	Violations involving failure to assure that electrical equipment important to safety were environmentally qualified, resulting in a significant deficiency which could have led to equipment failures during postulated accident conditions in multiple safety systems.
Commonwealth Edison Company (Braidwood) (EA 88-091)	$50,000 proposed in FY 88; pending	Violations involving design control deficiencies which resulted in the Control Room Ventilation System being in a degraded condition.
Texas A & M University College Station, Texas (EA 88-092)	$5,000 proposed and paid in FY 88	Violations involving failure to provide appropriate personnel dosimetry, proper placement of personnel dosimetry, failure to establish proper control for high radiation areas, and failure to provide radiological instructions to personnel working in a restricted area.
Professional Service Industries, Inc. Lombard, Illinois (EA 88-093)	$500 proposed and paid in FY 88	Violations involving failure to secure a moisture density gauge during transport which resulted in the temporary loss of the gauge after it fell onto a public road from the back of the licensee's vehicle.
United Nuclear Corporation Uncasville, CT (EA 88-094)	$12,500 proposed and paid in FY 88	Violations involving measurements of airborne radioactivity, surveys of radiological conditions, ventilation flow, procedures for implementing the radiation safety program, and audits of the radiation safety program.
Bridgeton Hospital Bridgeton, NJ (EA 88-097)	$1,250 proposed, imposed, and paid in FY 88	Violations involving a shipment of improperly labeled packages of radioactive materials with external radiation levels in excess of NRC requirements, failure to survey waste for radiation levels, failure to properly follow assay procedures for molybdenum-99 on eluates from Mo99-technetium 99m generators, failure to check survey meters, and failure to train.
Southern California Edison Company (San Onofre) (EA 88-099)	$150,000 proposed and paid in FY 88	Violations involving equipment qualification requirements of 10 CFR 50.49.

Licensee	*Amount*	*Reason*
Detroit Edison Company (Fermi) (EA 88-104)	$200,000 proposed in FY 88; pending	Violations involving containment isolation provisions, and use of Noninterruptable Air System in a degraded mode which led to the violation of two Technical Specifications.
Riverton Hospital Riverton, WY (EA 88-107)	$5,000 proposed and paid in FY 88	Violations involving unauthorized use of licensed material, failure to instruct individuals.
Alabama Power Company (Farley) (EA 88-113)	$100,000 proposed in FY 88; pending	Violations involving inadequate engineering analysis of the potential impact of substantial amounts of hydrogen gas accumulating in the crossover piping from the RHR pumps to the charging pump suctions.
Virginia Electric and Power Company (Surry) (EA 88-114)	$100,000 proposed and paid in FY 88	Violations involving radiation hazards during work on an incore detector, inadequate procedures for freeing the incore detector, and failure to follow approved procedures.
Southern Ohio Coal Company Athens, Ohio (EA 88-118)	$750 proposed, imposed, and paid in FY 88	Violations involving inadequate control over a device containing a 35 millicurie cesium-137 radioactive source and the failure to conduct a physical inventory every six months.
Veterans Adminstration Medical Center Northport, NY (EA 88-123)	$2,500 proposed and paid in FY 88	Violations involving failure to perform output spot checks on the teletherapy unit or maintain records of these checks, failure to notify NRC of Radiation Safety Officer's employment termination, failure to monitor for hand contamination, and other violations.
Commonwealth Edison Company (Braidwood) (EA 88-125)	$50,000 proposed in FY 88; pending	Violations involving the failure to maintain control of access to a vital area of the plant.
Carolina Power & Light (Brunswick) (EA 88-131)	$75,000 proposed in FY 88; $50,000 paid in FY 88; $25,000 pending	Violations involving leaving a control rod fully withdrawn with the reactor protection system shorting links installed and the failure to have required system alignments completed prior to a change in Operational Condition as required by the Technical Specifications.
Louisiana Power & Light (Waterford) (EA 88-144)	$50,000 proposed in FY 88; pending	Violations involving an event in which inaccurate reactor vessel water level indication twice resulted in cavitation of and subsequent loss of the operating shutdown cooling pump.
Brigham & Women's Hospital Boston, Mass. (EA 88-147)	$5,000 proposed and paid in FY 88	Violations involving an individual researcher receiving a thyroid uptake in an amount approximately twice the regulatory limit, inadequate evaluation of the uptake after initial indications that it occurred, excessive radiation levels in an unrestricted area, use of phosphorus-32 by individual not specifically authorized by the Radiation Safety Committee, and failure to maintain records of certain surveys.
Rochester Gas & Electric Corporation (Ginna) (EA 88-154)	$50,000 proposed and paid in FY 88	Violations involving failure to test various safety related check valves as required by the approved inservice testing program and 10 CFR 50.55a(g).

Licensee	*Amount*	*Reason*
Virginia Electric and Power Company (Surry) (EA 88-158)	$100,000 proposed and paid in FY 88	Health physics violations occurring during a refueling outage and an overexposure to an individual.
Commonwealth Edison Company (Quad Cities) (EA 88-161)	$125,000 proposed in FY 88; pending	Violations involving the shared diesel being unable to respond for approximately six months due to a wiring error, and the ungrounded battery system for one unit being operated in a grounded condition for approximately six months.
University of Medicine and Dentistry of New Jersey Newark, NJ (EA 88-163)	$5,000 proposed and paid in FY 88	Violations involving failure to conduct appropriate surveys, train individuals, perform dose calibrator testing, and leak test irradiators nad sealed sources.
Computalog, Inc. Drumright, OK (EA 88-169)	$1,000 proposed in FY 88; pending	Violations including a breakdown in management oversight and control over licensed activities.
Department of the Army Albuquerque, NM (EA 88-172)	$1,000 proposed in FY 88; pending	Violations involving securing a gauge against unauthorized removal, utilizing an untrained radiation protection officer, inventories of licensed material, receipt records of licensed material, leak tests of sealed sources, and posting of copies of required documents.

ORDERS ISSUED DURING FY 88

Licensee	*Date*	*Reason*
Florida Power & Light Company (Turkey Point) (EA 87-085)	October, 19, 1987	Order (Effective Immediately) Reason: To direct the licensee to put in place a corporate operations audit program.
GPU (Three Mile Island) (EA 87-102)	April 28, 1988	Order Reason: To modify restart conditions to allow persons addressed other than the Supervisor of Operations to be employed in management and operational positions.
GPU (Oyster Creek) (EA 87-185)	November 5, 1988	Confirmatory Order (Effective Immediately) Reason: Confirms the licensee's commitment to remove the personnel of the operating shift on duty at the time of the safety limit violation from licensed duties and to provide the NRC staff with a copy of the licensee's investigation into the subsequent apparent willful destruction of a portion of the documentation of the event.
Tracer Profiles, Inc. Oklahoma City, OK (EA 87-204)	October 30, 1987	Order to Show Cause and Order Suspending License (Effective Immediately) Reason: Failure to respond to a Notice of Violation and three Confirmation of Action Letters. (The license expired on February 28, 1988.)
Advanced Medical Systems, Inc. Geneva, Ohio (EA 87-212)	October 30, 1987	Confirmatory Order Modifying License (Effective Immediately) Reason: To incorporate revised decontamination plans for the licensee's London Road Facility due to circumstances beyond the licensee's control.
Wrangler Laboratories, Larsen Laboratories, Orion Chemical Company, John P. Larsen Provo, Utah (EA 87-223)	February 25, 1988	Order Suspending Licenses (Effective Immediately) Reason: Failure to fulfill commitments made to the the NRC, contradictory statements made to the NRC and State authorities, and processing of uranium in an unsafe manner with inadequate controls. (This action was followed by an Order Revoking Licensee on August 15, 1988.)
Philadelpha Electric Co. (Peach Bottom) (EA 88-004)	August 10, 1988	Order Modifying License Reason: Prohibiting certain individuals from being employed in site supervisory positions.
Georgia Institute of Technology (Atlanta, Georgia) (EA 88-032)	January 20, 1988	Order Modifying License (Effective Immediately) Reason: To require the licensee to immediately suspend certain activities under its NRC license until requirements of the Order are satisfied. (This Order was subsequently followed up by a Confirmatory Order Modifying License (Effective Immediately) to confirm licensee's commitment to continue suspension of all reactor operations until the licensee resolved all safety questions.)
Veterans Administration Edward Hines, Jr. Medical Center Hines, Illinois (EA 88-042)	February 25, 1988	Order to Show Cause Why License Should Not Be Modified (Effective Immediately) Reason: To impose verification requirements before a technologist administers any licensed material.

Licensee	*Date*	*Reason*
Hospital Metropolitano San Juan, Puerto Rico (EA 88-063)	June 7, 1988	Order Modifying License Reason: To require the licensee the employ an independent consultant to assess the radiation safety program's organization staffing, audits, and training and to develop a Performance Improvement Plan.
University of Utah Salt Lake City, Utah (EA 88-064)	July 8, 1988	Order Modifying Licenses Reason: To confirm the licensee's commitment to retain an additional professor who will perform the duties of the facility's reactor supervisor.
Finlay Testing Laboratories Aiea, Hawaii (EA 88-069)	April 11, 1988	Order Continuing Suspension of License and Order to Show Cause Why License Should Not Be Revoked Reason: To continue suspension ordered on September 21, 1987 due to transportation findings identified during an inspection and investigation.
Radiology and Nuclear Medicine, Inc. Tulsa, Oklahoma (EA 88-103)	May 10, 1988	Order Suspending License and Order to Show Cause Why License Should Not Be Revoked (Effective Immediately) Reason: To order the suspension of activities, the storage only or transfer to an authorized user of all licensed materials, the notification of the NRC of the disposition of all licensed materials, and a response why the license should not be revoked.
Riverton Memorial Hospital Riverton, Wyoming (EA 88-107)	June 3, 1988	Order Modifying License Reason: To require notifications to the NRC of personnel terminations, obtaining an independent consultant to assess the program and perform audits.
Maurice P. Acosta (EA 88-164)	June 15, 1988	Order Suspending License (Effective Immediately) and Notice of Denial of Application for Renewal of License Reason: To suspend operator's license due to a pattern of behavior that questions the licensee's willingness to carry out his duties with sufficient alertness and ability.
Midwest Wireline Logging and Perforating, Inc. Seminole, Oklahoma (EA 88-166)	August 29, 1988	Order Suspending License (Effective Immediately) and Order to Show Cause Reason: To suspend the licensee's byproduct material license, directing the transfer of all licensed material to an authorized recipient, and providing an opportunity to show cause why the license should not be revoked.

Appendix 7

Nuclear Electric Generating Units in Operation Or Under Construction

(As of December 31, 1988)

The following is a listing of the 123 nuclear power reactor electrical generating units which were in operation or under construction in the United States as of December 31, 1988, representing a total capacity of approximately 113,000 MWe, of which about 16,000 MWe was not licensed for operation. Reactor types are indicated as follows: PWR—pressurized water reactor, BWR—boiling water reactor, HTGR—high temperature gas-cooled reactor. Of the 123 reactor units listed, 82 are PWRs, 40 are BWRs, and 1 is an HTGR (Fort St. Vrain in Colorado, which was shut down as of the date above. Plant status is indicated as follows: OL—has operating license (not necessarily for full-power operation), CP—has construction permit. The dates for operation are either actual (in the case of operating licenses) or as scheduled by the utilities (for plants not yet licensed for operation), as of December 31, 1988. At that time, there were 110 commercial nuclear reactors in the United States with operating licenses (including one, the Seabrook (N.H.) nuclear power plant, licensed to load fuel only, and one, the Shoreham (N.Y.) plant, licensed for low-power only) and 13 units for which construction permits were in effect (although construction of some of these has been postponed indefinitely).

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
ALABAMA						
Decatur	Browns Ferry Nuclear Power Plant Unit 1	1,065	BWR	OL 1973	Tennessee Valley Authority	1974
Decatur	Browns Ferry Nuclear Power Plant Unit 2	1,065	BWR	OL 1974	Tennessee Valley Authority	1975
Decatur	Browns Ferry Nuclear Power Plant Unit 3	1,065	BWR	OL 1976	Tennessee Valley Authority	1977
Dothan	Joseph M. Farley Nuclear Plant Unit 1	804	PWR	OL 1977	Alabama Power Co.	1977
Dothan	Joseph M. Farley Nuclear Plant Unit 2	814	PWR	OL 1981	Alabama Power Co.	1981
Scottsboro	Bellefonte Nuclear Plant Unit 1	1,235	PWR	CP 1974	Tennessee Valley Authority	1993
Scottsboro	Bellefonte Nuclear Plant Unit 2	1,235	PWR	CP 1974	Tennessee Valley Authority	1995
ARIZONA						
Wintersburg	Palo Verde Nuclear Generating Station Unit 1	1,304	PWR	OL 1984	Arizona Public Service Co.	1986
Wintersburg	Palo Verde Nuclear Generating Station Unit 2	1,304	PWR	OL 1985	Arizona Public Service Co.	1986
Wintersburg	Palo Verde Nuclear Generating Station Unit 3	1,304	PWR	OL 1987	Arizona Public Service Co.	1988
ARKANSAS						
Russelville	Arkansas Nuclear One Unit 1	836	PWR	OL 1974	Arkansas Power & Light Co.	1974
Russelville	Arkansas Nuclear One Unit 2	858	PWR	OL 1978	Arkansas Power & Light Co.	1980

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
CALIFORNIA						
San Clemente	San Onofre Nuclear Generating Station Unit 1	436	PWR	OL 1967	So. Calif. Ed. & San Diego Gas & Electric Co.	1968
San Clemente	San Onofre Nuclear Generating Station Unit 2	1,100	PWR	OL 1982	So. Calif. Ed. & San Diego Gas & Electric Co.	1983
San Clemente	San Onofre Nuclear Generating Station Unit 3	1,100	PWR	OL 1983	So. Calif. Ed. & San Diego Gas & Electric Co.	1984
Diablo Canyon	Diablo Canyon Nuclear Power Plant Unit 1	1,084	PWR	OL 1984	Pacific Gas & Electric Co.	1985
Diablo Canyon	Diablo Canyon Nuclear Power Plant Unit 2	1,106	PWR	OL 1985	Pacific Gas & Electric Co.	1986
Clay Station	Rancho Seco Nuclear Generating Station Unit 1	873	PWR	OL 1974	Sacramento Municipal Utility District	1975
COLORADO						
Platteville	Fort St. Vrain Nuclear Generating Station	330	HTGR	OL 1973	Public Service Co. of Colorado	1979
CONNECTICUT						
Haddam Neck	Haddam Neck Generating Station	555	PWR	OL 1967	Conn. Yankee Atomic Power Co.	1968
Waterford	Millstone Nuclear Power Station Unit 1	654	BWR	OL 1970	Northeast Nuclear Energy Co.	1971
Waterford	Millstone Nuclear Power Station Unit 2	864	PWR	OL 1975	Northeast Nuclear Energy Co.	1975
Waterford	Millstone Nuclear Power Station Unit 3	1,156	PWR	OL 1985	Northeast Nuclear Energy Co.	1986
FLORIDA						
Florida City	Turkey Point Station Unit 3	646	PWR	OL 1972	Florida Power & Light Co.	1972
Florida City	Turkey Point Station Unit 4	646	PWR	OL 1973	Florida Power & Light Co.	1973
Red Level	Crystal River Plant Unit 3	806	PWR	OL 1977	Florida Power Corp.	1977
Ft. Pierce	St. Lucie Plant Unit 1	817	PWR	OL 1976	Florida Power & Light Co.	1976
Ft. Pierce	St. Lucie Plant Unit 2	842	PWR	OL 1983	Florida Power & Light Co.	1983
GEORGIA						
Baxley	Edwin I. Hatch Plant Unit 1	757	BWR	OL 1974	Georgia Power Co.	1975
Baxley	Edwin I. Hatch Plant Unit 2	771	BWR	OL 1978	Georgia Power Co.	1979
Waynesboro	Alvin W. Vogtle, Jr. Plant Unit 1	1,100	PWR	OL 1987	Georgia Power Co.	1987
Waynesboro Unit 2	Alvin W. Vogtle, Jr. Plant	1,100	PWR	CP 1974	Georgia Power Co.	1989

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
ILLINOIS						
Morris	Dresden Nuclear Power Station Unit 2	772	BWR	OL 1969	Commonwealth Edison Co.	1970
Morris	Dresden Nuclear Power Station Unit 3	773	BWR	OL 1971	Commonwealth Edison Co.	1971
Zion	Zion Nuclear Plant Unit 1	1,040	PWR	OL 1973	Commonwealth Edison Co.	1973
Zion	Zion Nuclear Plant Unit 2	1,040	PWR	OL 1973	Commonwealth Edison Co.	1974
Cordova	Quad-Cities Station Unit 1	769	BWR	OL 1972	Comm. Ed. Co.-Iowa-Ill Gas & Elec. Co.	1973
Cordova	Quad-Cities Station Unit 2	769	BWR	OL 1972	Comm. Ed. Co.-Iowa-Ill Gas & Elec. Co.	1973
Seneca	LaSalle County Nuclear Station Unit 1	1,078	BWR	OL 1982	Commonwealth Edison Co.	1984
Seneca	LaSalle County Nuclear Station Unit 2	1,078	BWR	OL 1983	Commonwealth Edison Co.	1984
Bryon	Byron Station Unit 1	1,120	PWR	OL 1984	Commonwealth Edison Co.	1985
Byron	Byron Station Unit 2	1,120	PWR	OL 1986	Commonwealth Edison Co.	1987
Braidwood	Braidwood Unit 1	1,120	PWR	OL 1986	Commonwealth Edison Co.	1988
Braidwood	Braidwood Unit 2	1,120	PWR	OL 1987	Commonwealth Edison Co.	1988
Clinton	Clinton Nuclear Power Plant Unit 1	950	BWR	OL 1986	Illinois Power Co.	1987
IOWA						
Pala	Duane Arnold Energy Center Unit 1	515	BWR	OL 1974	Iowa Elec. Power & Light Co.	1975
KANSAS						
Burlington	Wolf Creek	1,150	PWR	OL 1985	Kansas Gas & Elec. Co.	1985
LOUISIANA						
Taft	Waterford Steam Electric Station	1,151	PWR	OL 1984	Louisiana Power & Light Co.	1985
St. Francisville	River Bend Station Unit 1	934	BWR	OL 1985	Gulf States Utilities Co.	1986
MAINE						
Wiscasset	Maine Yankee Atomic Power	810	PWR	OL 1972	Maine Yankee Atomic Power Co.	1972
MARYLAND						
Lusby	Calvert Cliffs Nuclear Power Plant Unit 1	825	PWR	OL 1974	Baltimore Gas & Elec. Co.	1975
Lusby	Calvert Cliffs Nuclear Power Plant Unit 2	825	PWR	OL 1976	Baltimore Gas & Elec. Co.	1977

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
MASSACHUSETTS						
Rowe	Yankee Nuclear Power Station	175	PWR	OL 1960	Yankee Atomic Elec. Co.	1961
Plymouth	Pilgrim Station Unit 1	670	BWR	OL 1972	Boston Edison Co.	1972
MICHIGAN						
Big Rock Point	Big Rock Point Nuclear Plant	64	BWR	OL 1962	Consumers Power Co.	1963
South Haven	Palisades Nuclear Power Station	635	PWR	OL 1971	Consumers Power Co.	1971
Laguna Beach	Enrico Fermi Atomic Power Plant Unit 2	1,093	BWR	OL 1985	Detroit Edison Co.	1988
Bridgman	Donald C. Cook Plant Unit 1	1,044	PWR	OL 1974	Indiana & Michigan Elec. Co.	1975
Bridgman	Donald C. Cook Plant Unit 2	1,082	PWR	OL 1977	Indiana & Michigan Elec. Co.	1978
MINNESOTA						
Monticello	Monticello Nuclear Generating Plant	525	BWR	OL 1970	Northern States Power Co.	1971
Red Wing	Prairie Island Nuclear Generating Plant Unit 1	503	PWR	OL 1973	Northern States Power Co.	1973
Red Wing	Prairie Island Nuclear Generating Plant Unit 2	500	PWR	OL 1974	Northern States Power Co.	1974
MISSISSIPPI						
Port Gibson	Grand Gulf Nuclear Station Unit 1	1,250	BWR	OL 1982	Mississippi Power & Light Co.	1985
Port Gibson	Grand Gulf Nuclear Station Unit 2	1,250	BWR	CP 1974	Mississippi Power & Light Co.	Indef.
MISSOURI						
Fulton	Callaway Plant Unit 1	1,188	PWR	OL 1984	Union Electric Co.	1985
NEBRASKA						
Fort Calhoun	Fort Calhoun Station Unit 1	478	PWR	OL 1973	Omaha Public Power District	1973
Brownville	Cooper Nuclear Station District	764	BWR	OL 1974	Nebraska Public Power	1974
NEW HAMPSHIRE						
Seabrook	Seabrook Nuclear Station Unit 1	1,198	PWR	OL 1986	Public Service of N.H.	Indef.

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
NEW JERSEY						
Toms River	Oyster Creek Nuclear Power Plant Unit 1	620	BWR	OL 1969	GPU Nuclear Corp.	1969
Salem	Salem Nuclear Generating Station Unit 1	1,079	PWR	OL 1976	Public Service Elec. & Gas Co.	1977
Salem	Salem Nuclear Generating Station Unit 2	1,106	PWR	OL 1980	Public Service Elec. & Gas Co.	1981
Salem	Hope Creek Generating Station Unit 1	1,067	BWR	OL 1986	Public Service Elec. & Gas Co.	1986
NEW YORK						
Indian Point	Indian Point Station Unit 2	864	PWR	OL 1973	Consolidated Edison Co.	1974
Indian Point	Indian Point Station Unit 3	891	PWR	OL 1975	Power Authority of the State of New York	1976
Scriba	Nine Mile Point Nuclear Unit 1	610	BWR	OL 1969	Niagara Mohawk Power Co.	1969
Scriba	Nine Mile Point Nuclear Unit 2	1,080	BWR	OL 1986	Niagara Mohawk Power Co.	1988
Ontario	R. E. Ginna Nuclear Power Plant Unit 1	470	PWR	OL 1969	Rochester Gas & Elec. Co.	1970
Brookhaven	Shoreham Nuclear Power Station	820	BWR	OL 1984	Long Island Lighting Co.	Indef.
Scriba	James A. FitzPatrick Nuclear Power Plant	810	BWR	OL 1974	Power Authority of the State of New York	1975
NORTH CAROLINA						
Southport	Brunswick Steam Electric Plant Unit 2	790	BWR	OL 1974	Carolina Power & Light Co.	1975
Southport	Brunswick Steam Electric Plant Unit 1	790	BWR	OL 1976	Carolina Power & Light Co.	1977
Cowans Ford Dam	Wm. B. McGuire Nuclear Station Unit 1	1,180	PWR	OL 1981	Duke Power Co.	1981
Cowans Ford Dam	Wm. B. McGuire Nuclear Station Unit 2	1,180	PWR	OL 1983	Duke Power Co.	1984
Bonsal	Shearon Harris Plant Unit 1	915	PWR	OL 1986	Carolina Power & Light Co.	1987
OHIO						
Oak Harbor	Davis-Besse Nuclear Power Station Unit 1	874	PWR	OL 1977	Toledo Edison-Cleveland Electric Illum. Co.	1977
Perry	Perry Nuclear Power Plant Unit 1	1,205	BWR	OL 1986	Toledo Edison-Cleveland Elec. Illum. Co.	1987
Perry	Perry Nuclear Power Plant Unit 2	1,205	BWR	CP 1977	Toledo Edison-Cleveland Elec. Illum. Co.	Indef.

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
OREGON						
Prescott	Trojan Nuclear Plant Unit 1	1,080	PWR	OL 1975	Portland General Elec. Co.	1976
PENNSYLVANIA						
Peach Bottom	Peach Bottom Atomic Power Station Unit 2	1,051	BWR	OL 1973	Philadelphia Elec. Co.	1974
Peach Bottom	Peach Bottom Atomic Power Station Unit 3	1,035	BWR	OL 1974	Philadelphia Elec. Co.	1974
Pottstown	Limerick Generating Station Unit 1	1,065	BWR	OL 1984	Philadelphia Elec. Co.	1986
Pottstown	Limerick Generating Station Unit 2	1,065	BWR	CP 1974	Philadelphia Elec. Co.	1990
Shippingport	Beaver Valley Power Station Unit 1	810	PWR	OL 1976	Duquesne Light Co. Ohio Edison Co.	1976
Shippingport	Beaver Valley Power Station Unit 2	852	PWR	OL 1987	Duquesne Light Co. Ohio Edison Co.	1987
Goldsboro	Three Mile Island Nuclear Station, Unit 1	776	PWR	OL 1974	GPU Nuclear Corp.	1974
Berwick	Susquehanna Steam Electric Station Unit 1	1,052	BWR	OL 1982	Pennsylvania Power & Light Co.	1983
Berwick	Susquehanna Steam Electric Station Unit 2	1,052	BWR	OL 1984	Pennsylvania Power & Light Co.	1985
SOUTH CAROLINA						
Hartsville	H. B. Robinson S.E. Plant Unit 2	665	PWR	OL 1970	Carolina Power & Light Co.	1971
Seneca	Oconee Nuclear Station Unit 1	860	PWR	OL 1973	Duke Power Co.	1973
Seneca	Oconee Nuclear Station Unit 2	860	PWR	OL 1973	Duke Power Co.	1974
Seneca	Oconee Nuclear Station Unit 3	860	PWR	OL 1974	Duke Power Co.	1974
Broad River	Virgil C. Summer Nuclear Station Unit 1	900	PWR	OL 1982	So. Carolina Elec. & Gas CO.	1984
Lake Wylie	Catawba Nuclear Station Unit 1	1,145	PWR	OL 1984	Duke Power Co.	1985
Lake Wylie	Catawba Nuclear Station Unit 2	1,145	PWR	OL 1986	Duke Power Co.	1986
TENNESSEE						
Daisy	Sequoyah Nuclear Power Plant Unit 1	1,128	PWR	OL 1980	Tennessee Valley Authority	1981
Daisy	Sequoyah Nuclear Power Plant Unit 2	1,148	PWR	OL 1981	Tennessee Valley Authority	1982
Spring City	Watts Bar Nuclear Plant Unit 1	1,165	PWR	CP 1973	Tennessee Valley Authority	1988
Spring City	Watts Bar Nuclear Plant Unit 2	1,165	PWR	CP 1973	Tennessee Valley Authority	1989

Site	Plant	Capacity (Net MWe)	Type	Status	Utility	Commercial Operation
TEXAS						
Glen Rose	Comanche Peak Steam Electric Station Unit 1	1,150	PWR	CP 1974	Texas Utilities	1988
Glen Rose	Comanche Peak Steam Electric Station Unit 2	1,150	PWR	CP 1974	Texas Utilities	1989
Bay City	South Texas Nuclear Project Unit 1	1,250	PWR	OL 1987	Houston Lighting & Power Co.	1988
Bay City	South Texas Nuclear Project Unit 2	1,250	PWR	CP 1975	Houston Lighting & Power Co.	1989
VERMONT						
Vernon	Vermont Yankee Generating Station	504	BWR	OL 1972	Vermont Yankee Nuclear Power Corp.	1972
VIRGINIA						
Gravel Neck	Surry Power Station Unit 1	775	PWR	OL 1972	Va. Electric & Power Co.	1972
Gravel Neck	Surry Power Station Unit 2	775	PWR	OL 1973	Va. Electric & Power Co.	1973
Mineral	North Anna Power Station Unit 1	865	PWR	OL 1976	Va. Electric & Power Co.	1978
Mineral	North Anna Power Station Unit 2	890	PWR	OL 1980	Va. Electric & Power Co.	1980
WASHINGTON						
Richland	WPPSS No. 1 (Hanford)	1,266	PWR	CP 1975	Wash. Public Power Supply System	Indef.
Richland	WPPSS No. 2 (Hanford)	1,103	BWR	OL 1983	Wash. Public Power Supply System	1984
Satsop	WPPSS No. 3	1,242	PWR	CP 1978	Wash. Public Power Supply System	Indef.
WISCONSIN						
Two Creeks	Point Beach Nuclear Plant Unit 1	495	PWR	OL 1970	Wisconsin Electric Power Co.	1970
Two Creeks	Point Beach Nuclear Plant Unit 2	495	PWR	OL 1971	Wisconsin Electric Power Co.	1972
Kewaunee	Kewaunee Nuclear Power Plant	515	PWR	OL 1973	Wisconsin Public Svc. Corp.	1974

U.S. Nuclear Power Plants with Operating Licenses

(Plant—type—MWe—cp—ol)*

Arkansas 1 = pwr, 836, 12/68, 5/74.
Arkansas 2 = pwr, 858, 12/72, 12/78.
Beaver Valley 1 (Pa.) = pwr, 810, 6/70, 7/76.
Beaver Valley 2 = pwr, 833, 5/74, 8/87.
Big Rock Point (Mich.) = bwr, 69, 5/60, 5/64.
Braidwood 1 (Ill.) = pwr, 1120, 12/75, 7/87.
Braidwood 2 = pwr, 1120, 12/75, 5/88.
Browns Ferry 1 (Ala.) = bwr, 1065, 5/67, 12/73.
Browns Ferry 2 = bwr, 1065, 5/67, 8/74.
Browns Ferry 3 = bwr, 1065, 5/67, 8/76.
Brunswick 1 (N.C.) = bwr, 790, 2/70, 11/76.
Brunswick 2 = bwr, 790, 2/70, 12/74.
Byron 1 (Ill.) = pwr, 1105, 12/75, 2/85.
Byron 2 = pwr, 1105, 12/75, 1/87.
Callaway (Mo.) = pwr, 1145, 4/76, 10/84.
Calvert Cliffs 1 (Md.) = pwr, 825, 7/69, 7/74.
Calvert Cliffs 2 = pwr, 825, 7/69, 11/76.
Catawba 1 (S.C.) = pwr, 1129, 8/75, 1/85.
Catawba 2 = pwr, 1129, 8/75, 5/86.
Clinton (Ill.) = bwr, 930, 2/76, 4/86.
Cook 1 (Mich.) = pwr, 1020, 3/69, 10/74.
Cook 2 = pwr, 1060, 3/69, 12/77.
Cooper (Neb.) = bwr, 764, 6/68, 1/74.
Crystal River 3 (Fla.) = pwr, 821, 9/68, 1/77.
Davis-Besse ((Ohio) = pwr, 860, 3/71, 4/77.
Diablo Canyon 1 (Cal.) = pwr, 1073, 4/68, 11/84.
Diablo Canyon 2 = pwr, 1087, 12/70, 8/85.
Dresden 2 (Ill.) = bwr, 772, 1/66, 12/69
Dresden 3 = bwr, 773, 10/66, 3/71.
Duane Arnold (Iowa) = bwr, 515, 6/70, 2/74.
Farley 1 (Ala.) = pwr, 813, 8/72, 6/77.
Farley 2 = pwr, 823, 8/72, 3/81.
Fermi 2 (Mich.) = bwr, 1093, 9/72, 7/85.
Fitzpatrick (N.Y.) = bwr 778, 5/70, 10/74.
Fort Calhoun 1 (Neb.) = pwr, 478, 6/68, 8/73.
Fort St. Vrain (Colo.) = htgr, 330, 9/68, 12/73.
Ginna (N.Y.) = pwr, 470, 4/66, 12/84.
Grand Gulf 1 (Miss.) = bwr, 1142, 9/74, 11/84.
Haddam Neck (Conn.) = pwr, 569, 5/64, 12/74.
Harris 1 (N.C.) = pwr, 860, 1/78, 1/87.
Hatch 1 (Ga.) = bwr, 860, 9/69, 10/74.
Hatch 2 = bwr, 768, 12/72, 6/78.
Hope Creek 1 (N.J.) = bwr, 1067, 11/74, 7/86.
Indian Point 2 (N.Y.) = pwr, 849, 10/66, 9/73.
Indian Point 3 = pwr, 965, 8/69, 4/76.
Kewaunee (Wis.) = pwr, 503, 8/68, 12/73.
LaSalle 1 (Ill.) = bwr, 1036, 9/73, 8/82.
LaSalle 2 = bwr, 1036, 9/73, 3/84.
Limerick 1 (Pa.) = bwr, 1055, 6/74, 8/85.
Maine Yankee = pwr, 810, 10/68, 6/73.
McGuire 1 (N.C.) = pwr, 1129, 2/73, 7/81.
McGuire 2 = pwr, 1129, 2/73, 5/83.
Millstone 1 (Conn.) = bwr, 654, 5/66, 10/86.
Millstone 2 = pwr, 863, 12/70, 9/75.
Millstone 3 = pwr, 1142, 8/74, 1/86.
Monticello (Minn.) = bwr, 536, 6/67, 1/81.
Nine Mile Point 1 (N.Y.) = bwr, 610, 4/65, 12/74.
Nine Mile Point 2 = bwr, 1080, 6/74, 7/87.
North Anna 1 (Va.) = pwr, 915, 2/71, 4/78.
North Anna 2 = pwr, 915, 2/71, 8/80.
Oconee 1 (S.C.) = pwr, 846, 11/67, 2/73.
Oconee 2 = pwr, 846, 11/67, 10/73.
Oconee 3 = pwr, 846, 11/67, 6/74.
Oyster Creek (N.J.) = bwr, 620, 12/64, 8/69.
Palisades (Mich.) = pwr, 730, 3/67, 10/72.
Palo Verde 1 (Ariz.) = pwr, 1221, 5/76, 6/85.
Palo Verde 2 = pwr, 1221, 5/76, 4/86.
Palo Verde 3 = pwr, 1221, 5/76, 11/87.
Peach Bottom 2 (Pa.) = bwr, 1051, 1/68, 12/73.
Peach Bottom 3 = bwr, 1035, 1/68, 7/74.
Perry 1 (Ohio) = bwr, 1205, 5/77, 11/86.
Pilgrim 1 (Mass.) = bwr, 670, 8/68, 9/72.
Point Beach 1 (Wis.) = pwr, 485, 7/67, 10/70.
Point Beach 2 = pwr, 485, 7/68, 3/73.
Prairie Island 1 (Minn.) = pwr, 503, 6/68, 4/74.
Prairie Island 2 = pwr, 503, 6/68, 10/74.
Quad Cities 1 (Ill.) = bwr, 769, 2/67, 12/72.
Quad Cities 2 = bwr, 769, 2/67, 12/72.
Rancho Seco (Cal.) = pwr, 873, 10/68, 8/74.
River Bend 1 (La.) = bwr, 936, 3/77, 11/85.
Robinson 2 (S.C.) = pwr, 665, 4/67, 9/70.
Salem 1 (N.J.) = pwr, 1106, 9/68, 12/76.
Salem 2 = pwr, 1106, 9/68, 5/81.
San Onofre 1 (Cal.) = pwr, 436, 3/64, 3/67.
San Onofre 2 = pwr, 1070, 10/73, 9/82.
San Onofre 3 = pwr, 1080, 10/73, 9/83.
Seabrook 1 (N.H.) = pwr, 1198, 7/76, 10/86 (fuel load only).
Sequoyah 1 (Tenn.) = pwr, 1148, 5/70, 9/80.
Sequoyah 2 = pwr, 1148, 5/70, 9/81.
Shoreham (N.Y.) = bwr, 820, 4/73, 7/85 (low power only).
South Texas 1 = pwr, 1250, 12/75, 3/88.
St. Lucie 1 (Fla.) = pwr, 839, 7/70, 3/76.
St. Lucie 2 = pwr, 839, 5/77, 6/83.
Summer (S.C.) = pwr, 885, 3/73, 11/82.
Surry 1 (Va.) = pwr, 781, 6/68, 5/72.
Surry 2 = pwr, 781, 6/68, 1/73.
Susquehanna 1 (Pa.) = bwr, 1032, 11/73, 11/82.
Susquehanna 2 = bwr, 1032, 11/73, 6/84.
Three Mile Island 1 (Pa.) = pwr, 776, 5/68, 4/74.
Trojan (Ore.) = pwr, 1095, 2/71, 11/75.
Turkey Point 3 Fla.) = pwr, 666, 4/67, 7/72.
Turkey Point 4 = pwr, 666, 4/67, 4/73.
Vermont Yankee = bwr, 504, 12/67, 2/73.
Vogtle 1 (Ga.) = pwr, 1079, 6/74, 3/87.
Washington Nuclear 2 = bwr, 1095, 3/73, 4/84.
Waterford 3 (La.) = pwr, 1075, 11/74, 3/85.
Wolf Creek 1 (Kans.) = pwr, 1128, 5/77, 6/85.
Yankee-Rowe (Mass.) = pwr, 167, 11/57, 12/63.
Zion 1 (Ill.) = pwr, 1040, 12/68, 10/73.
Zion 2 = pwr, 1040, 12/68, 11/73.

Total as of 12/31/88 = 110.

Reactor projects for which construction permits were in effect† as of 12/31/88 (cp date shown):

Bellefonte 1 (Ala.) = pwr, 1235, 12/74.
Bellefonte 2 = pwr, 1235, 12/74.
Comanche Peak 1 (Tex.) = pwr, 1150, 12/74.
Comanche Peak 2 = pwr, 1150, 12/74.
Grand Gulf 2 (Miss.) = bwr, 1250, 9/74.
Limerick 2 (Pa.) = bwr, 1065, 6/74.
Perry 2 (Ohio) = bwr, 1205, 5/3/77.
South Texas 2 = pwr 1250, 12/75.
Vogtle 2 (Ga.) = pwr, 1165, 6/74.
Washington Nuclear 1 = pwr, 1266, 12/75.
Washington Nuclear 3 = pwr, 1242, 4/78.
Watts Bar 1 (Tenn.) = pwr, 1165, 1/73.
Watts Bar 2 = pwr, 1165, 1/73.
Total as of 12/31/88 = 13

* Name of plant; pressurized water reactor = pwr, boiling water reactor = bwr, and high-temperature gas reactor = htgr; MWe = megawattage (power output); cp = construction permit issuance; ol = operating license issuance.

†Construction has been halted on a number of these projects.

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