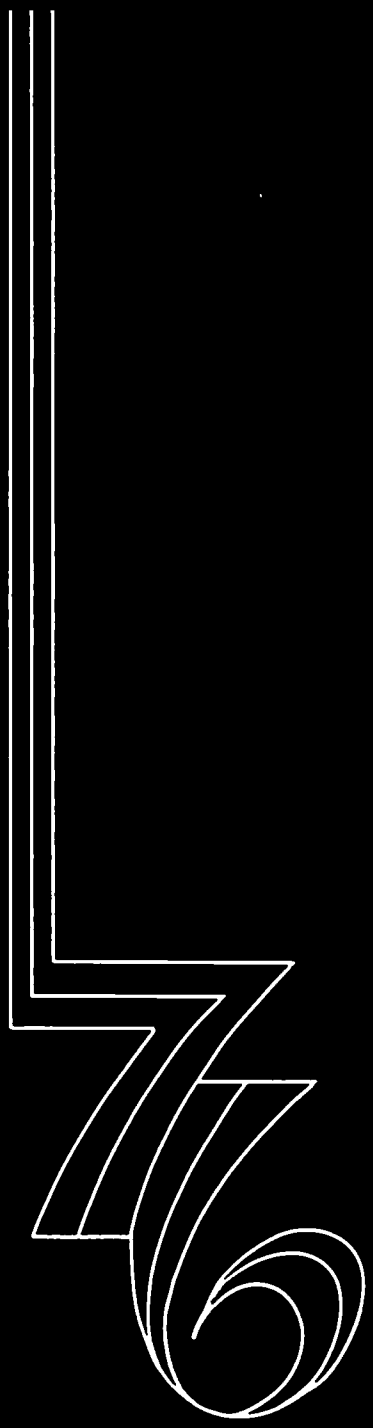
U. S. Nuclear Regulatory Commission

Annual Report 1976



June 28, 1977

The President
The White House
Washington, D. C. 20500

Dear Mr. President:

We have the honor to submit herewith the second Annual Report of the United States Nuclear Regulatory Commission for your transmittal to the Congress, as required by Section 307(c) of the Energy Reorganization Act of 1974. This report covers the major activities of the NRC from July 1, 1975, through September 30, 1976.

Respectfully,

Marcus A. Rowden

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Chairman

U. S. Nuclear Regulatory Commission

Annual Report 1976

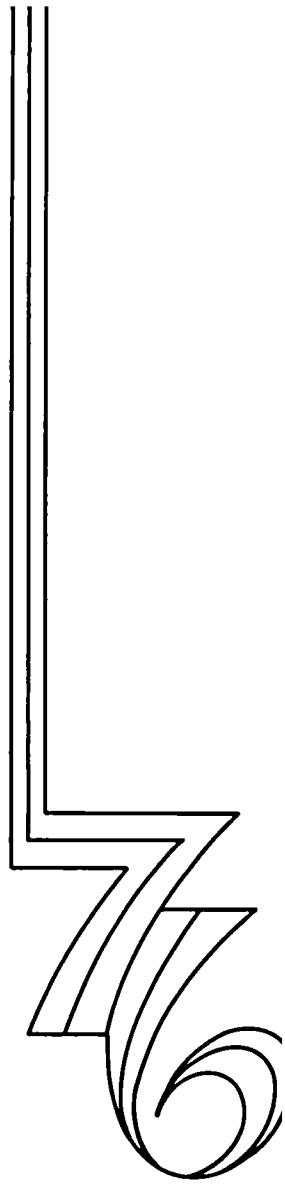

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Table of Contents

Chapter 1—OVERVIEW AND SUMMARY

Chapter 2—LICENSING POWER REACTORS

Chapter 3—REGULATING NUCLEAR MATERIALS

Chapter 4—PRESERVING ENVIRONMENTAL QUALITY

Chapter 5—MANAGING NUCLEAR WASTES

Chapter 6—DOMESTIC NUCLEAR SAFEGUARDS

Chapter 7—INSPECTION AND ENFORCEMENT

Chapter 8—NUCLEAR OPERATIONAL EVENTS

Chapter 9—COOPERATING WITH THE STATES

Chapter 10—INTERNATIONAL COOPERATION

Chapter 11—EXPORT-IMPORT AND INTERNATIONAL SAFEGUARDS

Chapter 12—DEVELOPING REGULATORY STANDARDS

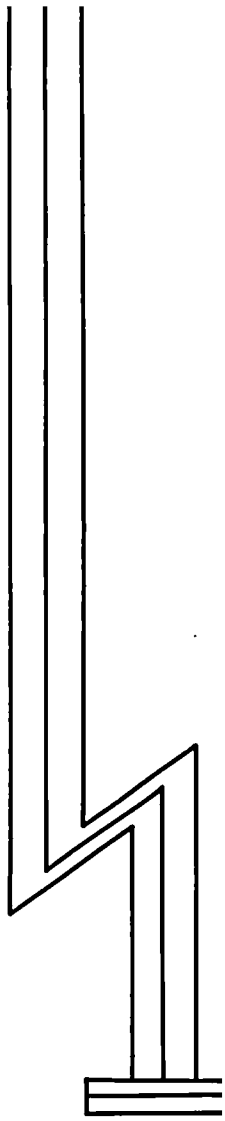
Chapter 13—CONFIRMATORY RESEARCH

Chapter 14—ADDRESSING PUBLIC CONCERNS

Chapter 15—MANAGEMENT AND ADMINISTRATIVE MATTERS

Appendices

Overview and Summary



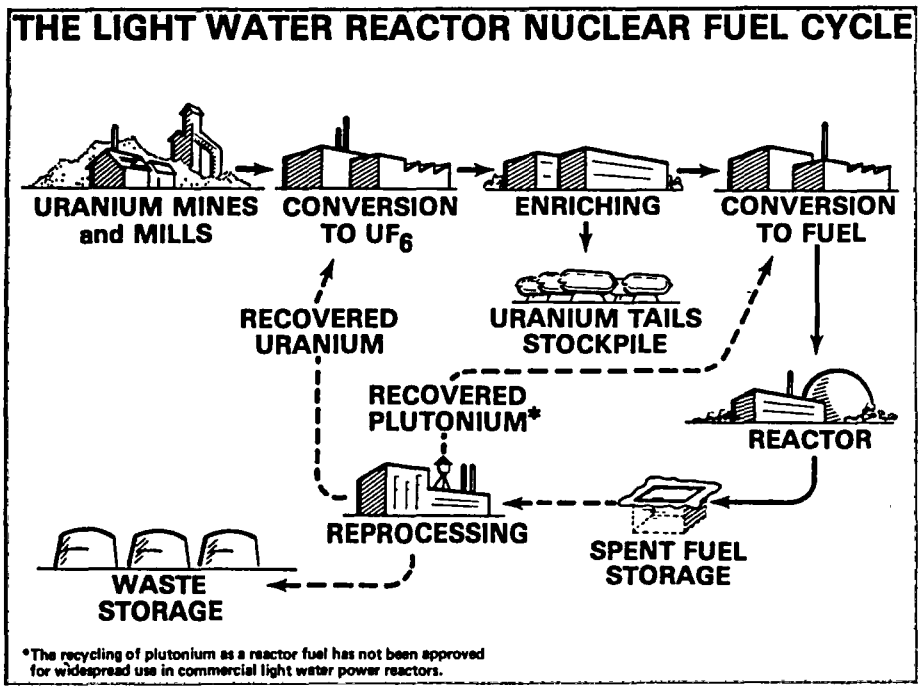
Nuclear Regulation in 1976: Introduction

During 1976 the Nuclear Regulatory Commission broadened the scope and accelerated the pace of actions required to carry out its responsibility for assuring that civilian nuclear activities are performed in a manner consistent with public health and safety, national security, environmental quality, and the antitrust laws.

Fundamental issues concerning the nuclear fuel cycle for power reactors tended to predominate during the Commission's second year of regulatory operations. The social and political ramifications of utilizing nuclear energy assumed even greater importance in the public mind and in Commission decision-making than the purely technological problems involved. Because of continuing public concern over the potential hazards of nuclear facilities and radioactive wastes and the safeguarding of nuclear materials, the Commission intensified its efforts to increase the public's access to, and participation in, the nuclear regulatory process.

The Fuel Cycle

Salient developments in the nuclear fuel cycle area during the past several months included (1) a major NRC reanalysis of the environmental impacts of waste management attributable to operation of individual nuclear power plants, in response to court decisions which resulted in a temporary halt in reactor licensing; (2) a coordinated movement by several Federal agencies to establish a firm basis for early resolution of the problem of permanently managing high-level radioactive wastes, with NRC assuming a progressively more active role; (3) a greater involvement of the Commission in the foreign policy considerations required to carry out its export licensing responsibilities; and, (4) after the end of the fiscal year, a Presidential statement of nuclear policy announcing, among other things, that spent nuclear fuel reprocessing and the recycle of plutonium in new



fuel for recators should not proceed unless there is sound reason to conclude that the world community can effectively overcome the associated risks of proliferation of nuclear explosives capability.

President Ford's nuclear policy statement of October 28, 1976 brought sharply into focus the intersection of foreign policy interests with domestic fuel cycle decisions. He stated that the avoidance of nuclear proliferation in the world must take precedence over economic interests, but that the United States and other nations should increase the peaceful use of nuclear power to meet energy needs even if reprocessing and recycle of plutonium are not found to be acceptable. He directed the Energy Research and Development Administration to explore the feasibility of recovering energy values from used nuclear fuel without separating the plutonium; to define a reprocessing and recycle evaluation program that is consistent with the Nation's international energy cooperation and nonproliferation objectives, and that complements the NRC's ongoing consideration of the recycle question; to demonstrate, by 1985, the operation of a high-level waste repository, and to submit plans for the repository to the NRC for licensing review in order to assure its safety and acceptability to the public.

During 1976 the NRC made progress in developing licensing procedures for the independent evaluation of high-level waste facilities that will be proposed by ERDA, began preparation of criteria to be met by solidified high-level wastes, and, by year-end was completing the scheduling of standards required to regulate all categories of radioactive wastes.

Several steps were taken in the Commission's proceeding toward a decision on the plutonium recycle question, including the issuance, in August 1976, of the health, safety, and environmental portion of the final generic environmental impact statement on reprocessing spent fuel and wide-scale use of mixed plutonium-uranium oxide as fuel in current light-water power reactors. The public hearing on this phase of the rulemaking proceeding began in November, and supplements to the statement covering safeguards and an overall cost-benefit analysis are scheduled to be published and taken up in the hearing in 1977.

Because no reprocessing is available, many utilities have requested authorization to expand capacity of storage pools at nuclear power plant sites to accommodate the growing inventory of spent fuel. The NRC issued several approvals and began an evaluation of the environmental impact of handling, shipping and storing opera-

tions over the approximate 10-year period in which interim storage of spent fuel will be required, regardless of the outcome of other NRC fuel cycle decisions. During 1977 the environmental statement on spent fuel storage is expected to be issued and any subsequent rulemaking completed.

In other fuel cycle areas, the NRC undertook a reassessment of commercial shallow land burial grounds for low-level radioactive wastes, began preparation of a generic environmental impact statement on uranium milling operations with emphasis on management of mill tailings, and issued a draft environmental statement, as part of a public rulemaking proceeding, on the air transport of all nuclear materials, including plutonium and enriched uranium.

International Activities

When the NRC was formed in January 1975, it was not possible to foresee the degree to which international currents would affect domestic regulatory policy nor to anticipate the increasing complexity of the Commission's involvement in export licensing matters. In the absence of clear statutory guidance, the NRC developed export license review procedures to ensure that the views of Executive Branch agencies having foreign affairs and national security responsibilities are received and weighed in the Commission's independent decision process. Innovative measures were employed by the Commission including, for the first time, a public hearing on a proposed export license. A Commissioner dissent was noted in two licensing actions. A number of bills on export licensing were introduced in the 94th Congress, and the Commission supported constructive legislative action, but the Congress adjourned without agreeing on new legislation in this area.

The Commission continued to expand its international activities, signing several additional bilateral arrangements for the exchange of regulatory information and cooperation in reactor safety research with other countries. An agreement was also consummated between the United States and the International Atomic Energy Agency providing for application of IAEA safeguards inspections to U.S. civil nuclear activities.

Domestic Safeguards

The assessment and upgrading of measures to prevent theft or diversion of nuclear materials or sabotage of U.S. nuclear facilities required a high level of activity on many fronts throughout the year. The NRC modified licenses to reflect new requirements in material control plans; evaluated capabilities against specified threat levels at major fuel cycle facilities and monitored the correction of deficiencies; reviewed physical protection provisions at all nuclear power plants; and conducted special onsite surveys in developing new safeguard requirements. Contingency planning brought NRC in contact with all Federal agencies having functions that would be needed in responding to safeguards contingencies, and with local law enforcement agencies and citizens' groups. Prototype contingency plans for a plutonium facility and for highway transportation were prepared to demonstrate NRC methodology. NRC also upgraded the measures required to protect special nuclear material during transport after conducting extensive field tests of road transport vulnerability, and a mobile NRC training team conducted seminars for licensees' drivers and guards. The NRC completed the Federal security agency study mandated by Section 204(b)(2) of the Energy Reorganization Act, concluding that there is no present need to create a Federal force to safeguard commercial nuclear operations. Finally, an NRC-ERDA working agreement was adopted to maintain compatibility and cooperation in the two agencies' safeguards programs.

Safety

NRC licensees, as a whole, continued to compile a good radiation safety record during fiscal year 1976. Of 10 abnormal occurrences in licensed operations occurring from July 1, 1975 through June 1976, only one had any direct consequence to public health and safety. This occurrence, involving exposure of about 400

hospital patients to radiation exceeding the doses prescribed by their physicians, was caused by the erroneous calibration of a cobalt-60 teletherapy unit. The NRC conducted an extensive investigation and took action to prevent a recurrence of this kind, including consultation with the 25 NRC Agreement States which also administer licenses for teletherapy units.

Through September 30, 1976, licensed nuclear power plants in the United States had logged more than 300 reactor-years of operation without any nuclear accident affecting the general public. A total of 62 nuclear units were licensed to operate, representing a generating capacity of more than 45,000 electrical megawatts—about 7.7 percent of total U.S. electric generating capacity. The NRC continued close scrutiny of reactor operating problems in order to apply the lessons of experience. As a result of the Browns Ferry plant fire in Alabama in 1975, for example, fire prevention and control were emphasized in licensing reviews, requirements and standards were upgraded, and relevant research efforts were intensified.

A report summarizing the more than 400,000 occupational radiation exposure records for personnel working under NRC or AEC licenses in the period 1968-1975 was issued during the year. About 95 percent of these records indicated an annual exposure of less than 2 rems per person. Of the 78,713 individuals monitored in 1975, more than half received exposures that were too small to be detected by personnel monitoring devices, more than 99 percent received less than 5 rems, and the average exposure was only 0.36 rem per person.

NRC's program of water reactor safety research began to yield significant data during fiscal year 1976. Data from the major testing facilities, when added to previously available information, confirmed NRC's expectations that the emergency systems of licensed reactors are able to cool the nuclear core of a power reactor if required by a loss of the normal coolant. Four nonnuclear tests were completed in the Loss-of-Fluid Test facility, the largest facility, located at ERDA's Idaho National Engineering Laboratory (INEL), and other tests were performed by the Semiscale test loop and the Power Burst Facility, also located at INEL. A number of tests also were completed at the Thermal Hydraulic Test Facility at the Oak Ridge National Laboratory in Tennessee, and at two industrial nonnuclear test loops. The large quantity of data generated during the year enabled the development of various computer codes for reactor safety analysis to proceed expeditiously. The Plenum Fill Experiment, which has been the major program concerning emergency core cooling bypass and steam-water mixing phenomena, was cancelled after it had been determined that the existing program would not yield the desired results. NRC undertook study of the pros and cons of a different facility that could be built by 1981.

NRC RESPONSIBILITIES — NUCLEAR FACILITIES AND MATERIALS

- PROTECTING PUBLIC HEALTH AND SAFETY
  - Consequences of accidents
  - Routine releases of radioactivity
- PROTECTING THE ENVIRONMENT
  - Total impact on environment
  - Balance between economic and environmental values
- MATERIALS AND PLANT PROTECTION (SAFEGUARDS)
  - Theft or diversion of materials to unauthorized uses
  - Sabotage of plants
- ASSURING CONFORMITY WITH ANTITRUST LAWS

Public Participation

The Commission continued to take steps to assure an open regulatory process, including new initiatives to afford opportunity and support for public participation. In the export licensing area, for example, the Commission, as a matter of discretion, conducted a public hearing on an export licensing application. In the hearing, which concerned the export of low-enriched uranium to India, testimony was presented by a member of Congress, several former and current government officials, and representatives of the academic community and three petitioners. The Commission also announced it would ask Congress to fund intervenors in the mixed-oxide fuel proceedings, and would relieve qualified participants of some procedural cost burdens.

Special facilities were provided in NRC's public document room in Washington to make documets more readily available in connection with this proceeding.

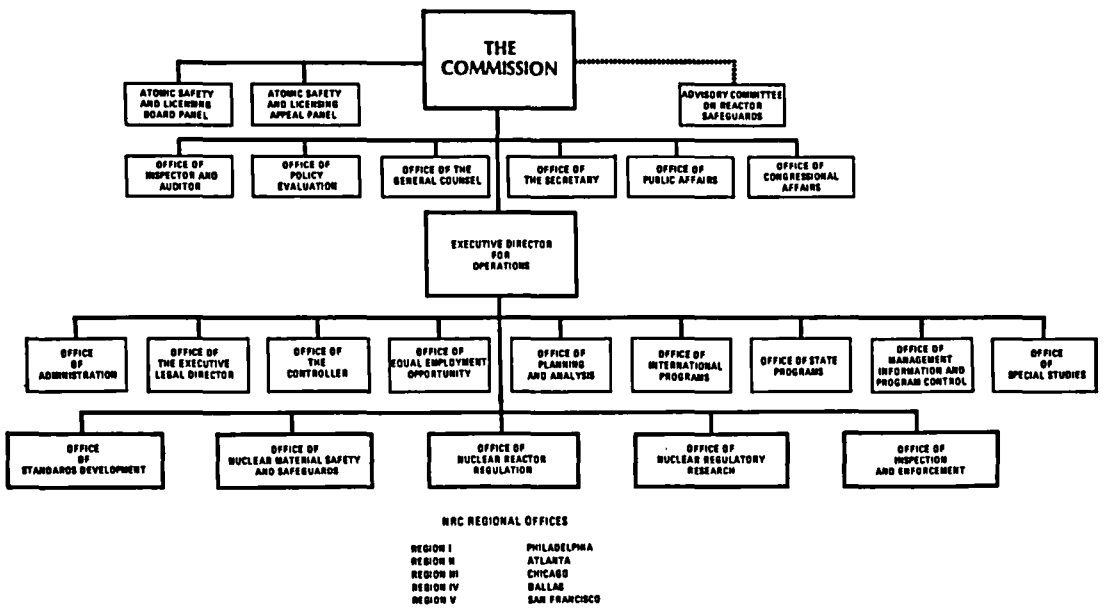
In addition to conducting public rulemaking proceedings during the year, the NRC staff held several public meetings relating to the development of regulatory guides, the management of nuclear wastes, and other matters.

During the year, the Commission addressed several matters that had created public concern, including the widely publicized resignations of three persons from nuclear industry positions and of two NRC employees. Their allegations of unsafe conditions or practices regarding nuclear power reactors and regulation were viewed with the utmost seriousness by the NRC, the public, industry and the Congress. The NRC sought to assure a full and impartial evaluation of their views and to determine whether or not the allegations on safety offered grounds for immediate corrective action at any licensed facility. Such grounds were not identified, but, since safety issues of continuing importance and interest were involved, the matters were examined at length by the NRC, the Advisory Committee on Reactor Safeguards, the Joint Committee on Atomic Energy, and the Senate Government Operations Committee.

To accomplish its mission, the NRC maintains broad programs of standards-setting and rulemaking, technical reviews and studies, licensing actions, inspection and enforcement, evaluation of operating experience, safeguards measures, and regulatory research. The NRC currently administers about 11,000 licenses authorizing nuclear activities involving electric power generation, the fuel cycle for reactors, and a wide variety of radioactive material uses in industry, commerce, medicine, education and research. The nuclear regulatory function includes development of effective working relationships with the 50 States and with foreign governments concerning nuclear regulation, safety research and safeguards measures.

The routine day-to-day nuclear regulatory actions required to carry out the mission of ensuring protection of the public health and safety, national security, and the environment add up to thousands of NRC actions over a year's period. Highlights of NRC activities during the 15-month fiscal year 1976, including the

NUCLEAR REGULATORY COMMISSION



transitional quarter, are briefly described in the following summary of the remaining chapters of this Annual Report.

SUMMARY OF 1976 ACTIVITIES

Licensing Power Reactors (Chapter 2)

• In August 1976 the NRC suspended nuclear power plant licensing activity following two July court decisions holding that the rule governing the consideration of environmental impacts of waste management and fuel reprocessing should be more fully documented and explained. In October the NRC completed a new, extensively documented evaluation and announced a proposed interim rule dealing with these impacts in licensing. On November 5, the NRC resumed licensing of nuclear plants on a conditional basis in accord with a court order, pending a final decision on adopting an interim rule.

• The NRC licensed the operation of nine nuclear electric generating units and authorized construction to proceed on 26 others during fiscal year 1976. As of September 30 there were 62 units licensed to operate, with a total capacity of 45,000 electrical megawatts (MWe); 72 with construction permits, representing 76,000 MWe capacity; and 68 under review for construction permits, representing 75,000 MWe capacity.

• The NRC continued close surveillance of operating problems encountered at nuclear power plants in order to apply lessons of experience. Fire prevention and control were emphasized in review procedures, upgraded requirements and research. Other problems receiving priority attention included steam generator tube degradation, structural strength of boiling water reactor containments and pressurized water reactor vessel supports, fuel channel box wear, pipe cracks, the "water hammer" phenomenon, and the reliability of reactor shutdown systems.

• In the licensing review of the proposed Clinch River Breeder Reactor, a joint government-industry liquid metal fast breeder reactor project in Tennessee, the NRC issued a draft environmental statement in February 1976. The Atomic Safety and Licensing Board was expected to begin environmental hearings in early 1977. The NRC staff issued guidance and comments in May on how plant design should proceed in order to achieve desired safety objectives, and the Advisory Committee on Reactor Safeguards in August reported that the postu-

STATUS OF NUCLEAR POWER PLANTS — SEPT. 30, 1976

Number Of Units		Rated Capacity (MWe)
* 62	LICENSED TO OPERATE	45,000
* * 72	CONSTRUCTION PERMIT GRANTED	76,000
20	Under Operating License Review	20,000
52	Operating License Not Yet Applied For	56,000
68	UNDER CONSTRUCTION PERMIT REVIEW	75,000
* * 21	Site Work Authorized, Safety Review in Process	22,000
47	Other Units Under CP Review	53,000
16	ORDERED	18,000
19	PUBLICLY ANNOUNCED	23,000
237	TOTAL	237,000

*Includes 3 plants with fuel loading and low-power testing licenses only. Not included are two operable ERDA-owned reactors with a combined capacity of 940 MWe.

**Total of units authorized construction (Construction Permit Granted plus Site Work Authorized): 93 units, 98,000 MWe.

lated core-disruptive accident should be included as part of the safety evaluation of an LMFBR.

- A "Liquid Pathway Study" by the NRC staff concluded that the consequences of postulated accidents in floating nuclear plants were comparable with results of the same accidents in land-based plants. Public hearings on certain safety issues associated with the proposed manufacture of floating plants commenced in June and were in progress at year-end.
- Extensive geologic and seismic investigations were initiated or carried out in the areas of several power plant sites to resolve faulting questions.
- Improvements in the reactor licensing process undertaken during the year included implementation of standard plans for safety reviews and development of standard plans for environmental reviews; application of standard technical specifications for each of the nuclear steam supply system vendors and associated balance-of-plant equipment; documentation of acceptance criteria for plant design; continued development of the plant standardization program; and work toward a policy of early site review, designed to separate that process from the review and action on the facility proposed to be constructed on the site.
- As of September 30, 1976, all five reactor vendors had submitted at least one standard reactor design, four architect-engineering firms had submitted balance-of-plant designs, and 20 different utilities had applied for permits to build 42 "standard" units. During the fiscal year the NRC issued several Preliminary Design Approvals for standardized designs.
- During the year, 14 antitrust reviews were concluded or undertaken; the Department of Justice recommended that no hearing be held in 10 of the cases, two of which will result in antitrust conditions in the licenses by agreement with the applicants.
- In September 1976, the NRC published proposed regulations to implement legislation which provides for the phasing out of Government indemnity that would pay public liability claims for injury and property damage in the event of a major nuclear accident. Utility industry licensees would collectively share in the risk of a nuclear incident through payment of retrospective premiums to insurance pools.
- The independent Advisory Committee on Reactor Safeguards held 15 full committee meetings and 121 subcommittee and working group sessions during the fiscal year, providing to the Commission advisory reports on 14 nuclear power plant construction applications and special reports on numerous nuclear facilities and a wide variety of safety topics.
- The NRC completed and transmitted to Congress a national survey to locate and identify potential sites for nuclear energy centers, and to assess the technical feasibility and social practicality of locating multiple and various nuclear facilities at a single site. NRC concluded that such centers can be feasible and practical in certain locations, but that dispersed siting of nuclear power facilities also remains a feasible, practical, and even desirable, option for many locations.

Regulating Nuclear Materials (Chapter 3)

- The Commission announced in November 1975 the steps it would follow in deciding whether plutonium should be separated from spent nuclear fuel and permitted to be recycled with uranium in new mixed oxide fuel for current light-water-cooled power reactors. In August 1976 the NRC staff issued the health, safety and environmental portion of the final environmental statement (GESMO) on this matter, and public hearings by a special five-member board began on November 30.
- Construction was virtually completed on the separations plant of Allied-General Nuclear Services' spent fuel reprocessing facility at Barnwell, S.C. A public hearing on the operating license application, involving a wide range of contentions, continued at year-end. NRC safety and environmental reviews of proposed modifications of the closed-down Nuclear Fuel Services reprocessing plant at West Valley, N.Y., were suspended in September 1976 when NFS announced its decision to withdraw from the nuclear fuel reprocessing field. Meanwhile, Exxon Nuclear Co. applied for a license to construct a reprocessing plant at Oak Ridge, Tenn.

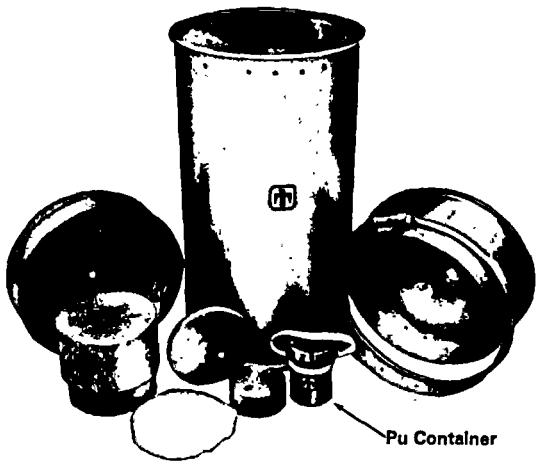
• In June 1976 the NRC undertook preparation of a generic environmental impact statement on uranium milling operations, with emphasis on the problem of managing uranium ore tailings.

• A final generic environmental statement published in July 1976 concluded that plutonium-powered cardiac pacemakers can be licensed for routine use. They presently are being licensed on a limited, investigational basis.

• Impacts associated with transportation of radioactive materials, including relative costs and benefits of alternative modes of shipping, are defined in a draft generic environmental statement issued for public comment in March 1976.

• Progress was made in designing and testing packages for air transport of plutonium which can withstand virtually any type of aircraft accident, in response to 1975 legislation that banned most air transport of plutonium until a safe container was developed and certified to the Joint Committee on Atomic Energy.

• A survey indicates that about 2.5 million packages of radioactive material—most of which contain radioisotopes for medical uses—are transported each year in the United States.



This package developed by Sandia Laboratories for air transport of plutonium is being extensively tested to a sequence of extremely severe accident conditions—impact, crush, puncture, fire, and deep water immersion—in order to verify its crashworthiness. The package is four feet high, two feet in diameter, and is constructed primarily of stainless steel and redwood.

Preserving Environmental Quality (Chapter 4)

• NRC prepared and issued 20 draft environmental impact statements and 17 final statements concerning nuclear power plants during the period July 1, 1975 through September 30, 1976.

• Archaeological investigations at the construction site of the Seabrook Station in Rockingham County, N.H., have unearthed evidence of prehistoric Indian sites dating back to 1000 A.D. The utility will fund recovery and packaging of artifacts from the area.

• A large-scale field study on effects of heated effluents on the distribution and abundance of marine borers in the estuary adjacent to the Oyster Creek nuclear power plant near Toms River, N.J., has been started by Jersey Central Power and Light Co. in response to studies and recommendations by the NRC staff. NRC also has contracted with a university to conduct confirmatory and complementary research on the problem.

• NRC staff undertook improvement of several areas of cost-benefit and impact analysis used in environmental reviews. Projects include (1) revised techniques to compare the relative economics of generating electricity with coal-fired and nuclear-fueled plants, (2) health and safety impacts of coal-fired plants as alternatives to nuclear, (3) evaluations of cooling tower impacts, (4) impacts of offshore or coastal plants on tourism, and (5) independent capability to forecast electric power demand by State.

• In implementing the Commission's guidelines for controlling levels of radioactive material in effluents from light-water nuclear power reactors, the NRC staff issued for comment several guides and technical reports to improve evaluation models used by the staff and to help licensees comply with the cost-benefit analysis requirements of the new regulation (Appendix I to 10 CFR Part 50).

• At the end of fiscal year 1976, agencies of 19 States were assisting in long-term, repetitive sampling of radioactivity around nuclear plants to evaluate licensees' environmental programs. Most arrangements with States provide for

NRC funding, technical support and training assistance.

• A second NRC-Environmental Protection Agency memorandum of understanding was executed to make the analysis of the water quality impact of nuclear power plants more effective and meaningful, and to reduce the demands for data being placed upon applicants for licenses.

Managing Nuclear Wastes (Chapter 5)

• Throughout 1976, the NRC assumed an increasingly active role in seeking an early resolution of the issues involved in managing nuclear wastes in a safe, workable and environmentally sound manner. A staff task force worked throughout the year to define objective performance goals, submitting its recommendations to the Commission in early 1977.

• Liquid high-level wastes in interim storage at the end of 1976 included 600,000 gallons of commercial waste containing 400 million curies of radioactivity and 80 million gallons of military waste containing from 400 million to 700 million curies. There were also 6,000 spent nuclear reactor fuel assemblies in fuel storage pools, and power reactors were using fuel at a rate of about 3,200 assemblies per year.

• An interagency task force program was initiated by the Office of Management and Budget to help structure an integrated Federal effort concerning high-level waste management. Key issues being addressed are the Energy Research and Development Administration's proposed schedule for constructing a waste repository and NRC's role in licensing the repositories planned by ERDA.

• Development work supporting NRC's formulation of performance criteria for high-level waste solid matrices was completed and NRC by year-end was completing identification and scheduling of the standards required to regulate all categories of wastes.

• Licensing procedures for high-level waste being developed by NRC will provide for an independent assessment of proposed ERDA waste management facilities. Studies are underway at NRC contract laboratories. Panel studies by the National Academy of Sciences will also support development and implementation of NRC licensing procedures.

• An ongoing reassessment of commercial shallow burial grounds for disposal of "other than high-level" radioactive wastes involves interrelated activities by NRC, other Federal agencies and the States. A philosophy is emerging among the concerned Federal agencies that consignment of radioactive wastes to shallow burial should be decided on the basis of the longevity of the hazard more than on its magnitude.

• Independent hearings and reports included a JCAE hearing on nuclear waste management, a recommendation by the ACRS that NRC assume an aggressive role in developing and implementing a comprehensive long-term waste management program, and a General Accounting Office report recommending several actions for improvements in land disposal of radioactive wastes. NRC instigated establishment of an informal working group representing NRC, ERDA, EPA, the U.S. Geological Survey and the States to deal with shallow-land burial and the GAO recommendations.

• An NRC staff analysis of the environmental impacts of waste management and fuel reprocessing related to individual uranium-fueled nuclear power plants was issued in October 1976 as a supplement to an environmental survey on the subject published by the Atomic Energy Commission in 1974. The new study will be the basis for new rulemaking proceedings on such impacts in the licensing of nuclear power plants.

Domestic Nuclear Safeguards (Chapter 6)

• NRC's continuing assessment of safeguards for licensed activities concentrated on whether current measures are satisfactory in terms of present needs, and what augmented measures may be necessary to protect public health and safety and national security in the future.

• The staff completed review of licensees' fundamental nuclear material control plans which represent an upgrading in requirements, and modified individual licenses accordingly.

Affected licensees were found to have adopted acceptable implementation plans.

- In preparing contingency plans, the NRC worked toward development of a methodology for determining when a given threat or situation should be perceived as serious, and began constructing a base for assessment of information from other Federal agencies. Contacts were established with 60 organizational elements of 23 Federal agencies.
- NRC formed an Information Assessment Team which rapidly reviews the authenticity of sources and data on each reported threat to licensed nuclear facilities and materials, and recommends a course of action.
- Occasions arose during the year when NRC or its licensees deemed it advisable to intensify the state of readiness at certain nuclear facilities to deal with threats of varying severity.
- Prototype safeguards contingency plans were prepared by NRC for a plutonium facility and for highway transportation of special nuclear material in order to verify and demonstrate the NRC methodology in actual application. NRC staff conducted an industry-wide meeting with fuel cycle licensees to discuss contingency planning.
- In a study of the need and feasibility of a Federal security agency to safeguard commercial nuclear operations, which was mandated by the Energy Reorganization Act of 1974, the NRC concluded that: (1) there is no present need to create such an agency, (2) a special Federal security force would not result in a higher degree of guard force effectiveness than can be achieved through private guards trained and certified by NRC, and (3) there is no difference in potential impact on civil liberties between use of Federal and use of private guard forces.
- NRC staff reviewed safeguards at 15 fuel cycle facilities possessing strategic quantities of high-enriched uranium or plutonium to assess ability to meet current regulations and capabilities against specified threat levels. Correction of safeguards deficiencies was monitored by NRC staff.
- Physical protection provisions in force at all nuclear power plants were reviewed, special inspections were made at each plant, and onsite surveys of six representative reactor sites were conducted to evaluate the effectiveness of safeguards requirements proposed to be incorporated in a new regulation.
- NRC conducted field tests of road transportation vulnerability with assistance of the U.S. Army Special Forces. New license conditions were imposed to rectify weaknesses, including addition of an armed vehicle escort for all shipments, upgrading of communication equipment and a requirement for supplementary training of security personnel. An NRC mobile training team conducted seminars at four locations in the U.S., certifying participating drivers and guards as having received the supplementary training prescribed.
- NRC emphasized close cooperation with local law enforcement agencies in dealing with attempted nuclear thefts, sabotage or threats, and established a working relationship with citizens' groups around the country which use Citizens Band (CB) Radio to report or relay reports of events to local authorities. All vehicles transporting strategic quantities of special nuclear material were equipped with CB transceivers.
- At year-end, the NRC staff was nearing completion of a draft safeguards supplement to the Atomic Energy Commission's "Generic Environmental Statement on the Use of Recycle

NRC SAFEGUARDS PROGRAM

PRINCIPAL CONCERNS

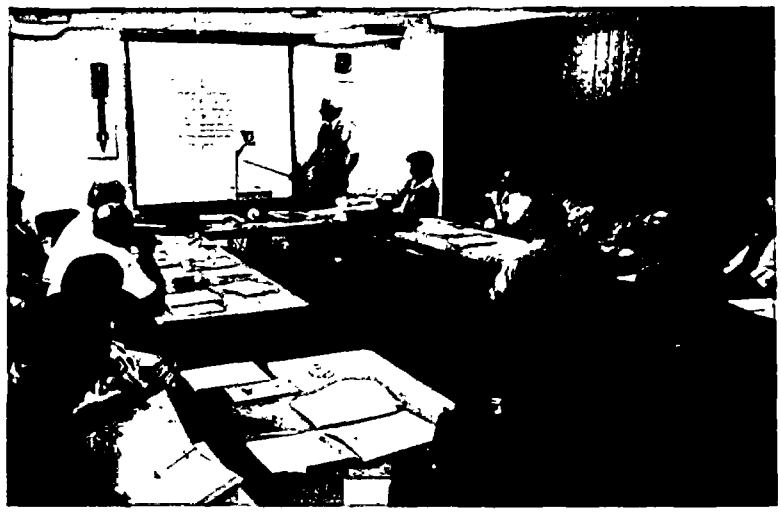
- **Theft or Diversion of Nuclear Materials**
- **Sabotage of Nuclear Facilities**

PRINCIPAL GOALS

- **Prevention**
- **Early Detection**
- **Timely Response**

PRINCIPAL METHODS

- **Intelligence to Provide Early Warning**
- **Physical Protection Systems**
- **Materials Control and Accounting**
- **Coordination with Law Enforcement Authorities**



The NRC conducted a training session in May 1976 on Land Transportation Vulnerability Analysis. Attending the meeting in Bethesda, Md., were transportation guards employed by commercial carriers who transport special nuclear material under NRC regulations.

Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors" (GESMO), which will assist the Commission in reaching a decision on whether wide-scale use of mixed oxide fuel should be permitted.

• An NRC-ERDA working agreement was adopted to maintain compatibility and encourage mutual reinforcement in the two agencies' safeguards programs.

• NRC began development of a comprehensive information system to collect, process and disseminate safeguards-related information. The question of what kinds of sensitive data should be protected from public disclosure for security reasons is being explored jointly by NRC, ERDA and the National Security Council.

Inspection and Enforcement (Chapter 7)

• During the 15-month period ending September 30, 1976, NRC inspectors, deployed in five regional offices, conducted 2,420 inspections of nuclear reactors in the design, construction and preoperational testing stages, finding noncompliance items in 34 percent of the inspections. An additional 184 vendor inspections were made involving 100 shops of nuclear steam system suppliers, architect-engineers and suppliers of mechanical components.

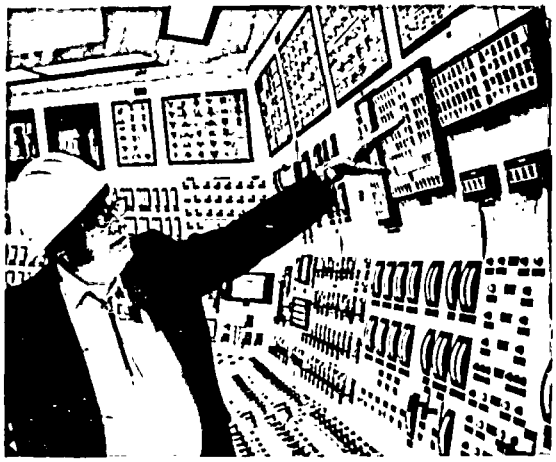
• Fuel facility and materials health and safety inspections totaled 152 and 2,278, respectively, during the same period, with items of noncompliance found in nearly half of these inspections.

• Inspections of licensees' safeguard programs totaled 482, with noncompliance items revealed in 44 of the inspections. In its independent verification program, involving actual measurements of special nuclear material, NRC increased use of mobile laboratory vans for sampling and measurement at nuclear facility sites. In addition, NRC contract laboratories analyzed 706 inspection samples of uranium and plutonium.

• NRC is exploring means of reducing duplication of inspection effort by using existing "third-party" inspection programs—those inspections being done by a party with no financial interest in a vendor-supplied product or service, as do the customer and the seller. Among such systems is the American Society of Mechanical Engineers' "N" stamp program for nuclear components.

• NRC's Office of Inspection and Enforcement conducted 57 special investigations during the fiscal year, two of which involved radiation exposures of licensee personnel, and 32 dealt with allegations of improper or unsafe working conditions. Licensees were cited for failure to meet NRC requirements in 25 of the investigations.

• NRC informed owners of operating reactors and major fuel facilities of several incidents and threats against nuclear plants during the weeks preceding Memorial Day and requested that they confirm that security plans, personnel and equipment were fully operational during the



Periodic unannounced inspections assure that required safety systems in a nuclear power plant are operable. Here, an inspector from NRC's San Francisco regional office checks the safety system status boards in the control room of the Trojan Nuclear Power Station.

period May 28 through June 8, 1976. No unusual incidents occurred.

- An interim Incident Response Center was established at NRC headquarters in Bethesda, Md., as the precursor of a permanent, specially-equipped center, with on-call duty officers available to respond to events arising after normal working hours.

- NRC imposed 15 civil monetary penalties, ranging up to $25,000, during fiscal year 1976 as a means of enforcing compliance of licensees with rules and regulations. In addition, six orders were issued, five of which suspended or revoked licenses or ordered licensees to cease and desist from unauthorized activities.

Nuclear Operational Events (Chapter 8)

- Through September 30, 1976, licensed nuclear power plants in the United States had produced more than 300 reactor-years of operation without any nuclear accident resulting in a death among plant personnel or the general public. A total of 62 nuclear units were licensed to operate with an aggregate generating capacity of over 45,000 MWe—about 7.7 percent of total U.S. generating capacity.

- A summary of more than 400,000 occupational radiation exposure records for personnel working under NRC or AEC licenses in the period 1968-1975, showed that 95 percent of the annual exposures were less than 2 rems per person. More than half the 78,713 individuals monitored in 1975 received exposures that were too small to be detected by personnel radiation monitoring devices, and more than 99 percent received less than 5 rems. The average exposure for 1975 was 0.36 rem per person.

- Tennessee Valley Authority's Browns Ferry Units 1 and 2 in Alabama, which were shut down after an electrical cable fire in March 1975, were authorized to resume full power operation in August 1976 after restoration, a public hearing by an Atomic Safety and Licensing Board, and an NRC determination of satisfactory completion of a detailed fire protection training program.

- NRC reported to the Congress 10 "abnormal occurrences"—events in licensed operations involving an actual loss of, or major reduction in, protection provided for the health or safety of the public—for the period July 1, 1975 through June 1976. Only one, involving exposure of hospital patients to radiation exceeding the amounts prescribed, had any direct consequence to public health and safety.

- Approximately 400 patients received overdoses of radiation treatment during an 11-month period at the Riverside Methodist Hospital, Columbus, Ohio, due to erroneous calibration of a cobalt-60 teletherapy unit. The patients—primarily those taking radiation treatment for cancer—received doses ranging from 10 percent to 40 percent in excess of amounts prescribed by their physicians from March 1, 1975 through January 1976. A coroner's preliminary findings in reviewing 30 autopsies were that radiation exposure was a contributor to death in two instances. NRC conducted an extensive investigation, modified the hospital licenses to assure correct procedures and effective controls, directed all licensees using teletherapy units to perform appropriate tests, and took other actions to prevent a recurrence of this kind.

- A significant anomaly in the inventory of nuclear material on hand at the Nuclear Fuel Services' Erwin, Tennessee, facility, reported in December 1975, prompted an intensive NRC

investigation. While there were no indications of any material actually missing or of any attempt to breach security, NRC imposed an immediate requirement for upgrading of the licensee's material accounting and physical protection program.

- Three of the abnormal occurrences involved overexposures of two radiographers and two radiographers' assistants employed by three different firms. Causes included personnel error and deficiencies in company radiation safety programs and administrative controls. NRC took various enforcement actions, including imposition of a civil penalty on one licensee.
- The potential for hydrodynamic load stresses that would be imposed by a highly unlikely accident brought into question the structural adequacy of the designs of the General Electric Co.'s Mark I and Mark II containments for boiling water reactors. Licensees with affected plants were required to alter their mode of operation to increase the structural safety margin in effect.
- A small quantity of cesium-137 used as a medical radiation source was lost temporarily in transit between the Holy Cross Hospital in Chicago and its destination in Houston, Texas. Investigators determined that no significant exposures of people resulted.
- In each of two separate incidents, a utility employee was overexposed to radiation while performing inspection or maintenance duties during reactor refueling operations—one at the Commonwealth Edison Co.'s Zion Unit 1 in Illinois, and the other at the Consolidated Edison Co.'s Indian Point Unit 2 in New York. NRC monitored corrective actions and imposed a civil penalty on each licensee.
- Discovery of the unauthorized removal of items contaminated with radioactivity from a waste disposal facility near Beatty, Nevada prompted intensive investigations by NRC, ERDA, EPA and the State of Nevada. It was determined that a large amount of materials and equipment had been removed over a period of years from the burial site, licensed by both NRC and the State of Nevada. Nevada and NRC suspended the facility's licenses in March 1976, and the State authorized resumption of operations under new controls in May. NRC conveyed results of its investigations to the Department of Justice for consideration of possible violation of Federal criminal statutes, and was continuing its review of the matter at year-end.

Cooperating with the States (Chapter 9)

- In June 1976 the Commission established a separate Office of State Programs which centralized NRC efforts to give fullest possible assistance to States engaged in nuclear regulation, promote cooperation in this area, and address State concerns.
- The 25 States exercising regulatory authority over certain nuclear materials by agreement with NRC were administering 10,700 radioactive material licenses at the end of the fiscal year, compared to about 8,500 such licenses under direct NRC jurisdiction. Negotiations preparatory to entering into regulatory agreements were in progress with Illinois and Michigan.
- NRC's annual formal review of each Agreement State's radiation control program determined that all 25 programs were adequate and compatible with NRC's regulatory program. NRC-sponsored training programs provided 383 man-weeks of training to 134 State regulatory staff personnel.
- As the "lead" Federal agency assisting State and local governments in developing plans for responding to radiological emergencies, NRC concentrated on planning guidance, training courses, field assistance to States and review of their plans, and requirements for radiological measurement instruments.
- Eight Federal agencies and the Conference of (State) Radiation Control Program Directors undertook review of NRC's basic guide for State emergency plans to rate items in the document according to whether they are essential or merely desirable for inclusion in such plans. At the end of 1976, NRC had not concurred in any State plan since none submitted had met all criteria in the "Guide and Checklist."
- NRC and other involved Federal agencies continued to develop and offer formal training courses in radiological emergency response planning and operations to State and local govern-

ment personnel. By the end of the fiscal year, 360 persons had taken one such course.

- NRC published a handbook setting forth guidelines for the Federal agencies involved in State emergency response planning, including activities of 10 regional advisory committees, each of which is headed by an NRC representative. These committees undertook field reviews of 12 State plans in fiscal year 1976.

- During the fiscal year, State and local governments initiated or participated in 20 radiological emergency response exercises, 12 of which were observed by Federal field assistance cadres.

- A General Accounting Office report issued in March 1976 indicated stronger Federal assistance to States was needed in their emergency response planning, and recommended regionalization of NRC activities in this area. An NRC study on implementing the recommendation was near completion at year-end.

- NRC provided guidance and assistance to States on proposed legislation when requested, and presented testimony before several legislative committees.

- A second State-Federal conference on power plant siting, sponsored jointly by NRC and the Energy Program of the National Governors' Conference, was attended by representatives of 40 States. NRC designated liaison officers to coordinate licensing and siting activities with the States, and 12 States have appointed liaison officer counterparts.

- The first joint NRC-State public hearing on a proposed nuclear power plant was held with Maryland concerning the Douglas Point facility application. A similar protocol was adopted by NRC and New York for a hearing to be scheduled in 1977.

- NRC initiated a long-term program for surveillance of radioactive materials in transport by States under contractual arrangements.

International Cooperation (Chapter 10)

- The increasing importance of its international activities prompted the Commission to establish a separate Office of International Programs, incorporating the export-import licensing function and international safeguards policy development and coordination.

- Four new bilateral arrangements for exchange of regulatory information and cooperation in standards development were signed with foreign nuclear regulatory authorities in the 15-month period ending September 30, 1976. This brought the number of such arrangements with the NRC to 11, and four others were being negotiated.

- NRC also has bilateral reactor safety research exchange agreements with eight countries, whereby exchanges are made of reports, computer codes, research results on specific programs and, in certain cases, personnel. Additional agreements have been made under auspices of the International Energy Agency for participation by several IEA countries in certain NRC reactor safety research programs.

- NRC is participating in the multinationally-supported Halden nuclear fuel performance project in Norway and in the Marviken containment response project in Sweden. Selected NRC-sponsored specialists have been assigned to laboratories in foreign countries to follow various safety research programs.

- NRC received 510 visitors from 32 countries and three international organizations from July 1, 1975 through September 1976—a 27 percent increase over the number of foreign visitors during the previous 15-month period. NRC's Fourth Annual Water Reactor Safety Research Meeting, held in September 1976, was attended by 126 foreign technical experts.

- The International Atomic Energy Agency, with which the NRC cooperates extensively, partially completed a major task of developing codes of practice and safety guides for nuclear power plants. NRC staff coordinated reviews within the U.S. NRC experts also advised the IAEA on U.S. safeguards standards, technology and systems.

- A safeguards agreement between the U.S. and the IAEA, approved by the IAEA Board of Governors in September 1976, provides that U.S. nuclear facilities, except those with national security significance, will be subject to IAEA safeguards inspections.

• The U.S. acceded to full membership in the OECD's Nuclear Energy Agency, which will involve NRC and other interested U.S. agencies more closely in planning and management of the NEA programs.

Export-Import and International Safeguards (Chapter 11)

• NRC's responsibility for determining whether or not a proposed export-import action would be inimical to the common defense and security of the United States and the need to ensure that this function is conducted in a manner that will contribute to U.S. efforts to inhibit nuclear proliferation demanded substantial time and personal attention of the Commission during fiscal year 1976.

• To ensure consideration of all relevant information in licensing actions, NRC developed export and import review procedures in consultation with the Department of State, the Arms Control and Disarmament Agency, the Energy Research and Development Administration and other interested agencies of the Executive Branch.

• During the fiscal year, NRC issued 338 nuclear export licenses and received 431 new export license applications.

• Two applications for export of low-enriched uranium to India to fuel the Tarapur Atomic Power Station brought the first request for intervention and a hearing on an export licensing application ever received by the NRC or its predecessor, the Atomic Energy Commission. Although concluding that the petitioners had not demonstrated a legal interest entitling them to intervention as a matter of right, the Commission, as a matter of discretion, held a legislative-type public hearing.

• The Commission, with one member dissenting, issued one license (based on an amended application) for export of material to India, without prejudice to the broader question of continued supply and the remaining pending license application. The dissenting opinion expressed lack of confidence that truly effective safeguards would be applied.

• Consideration of an application to export a nuclear power reactor to Spain resulted in the first Commissioner dissent on a nuclear export license decision. The majority decision favored issuance of the license as being consistent with national security requirements, while the dissenting opinion held that, for safeguards purposes, the license should be conditioned to require that only U.S. fuel be used in the reactor.

• License applications for export of two power reactors and nuclear fuel to South Africa were filed in May 1976, and withdrawn in June after another supplier had been awarded the orders. In July, a petition was filed with NRC to intervene against a pending license application for the export of highly enriched uranium to fuel a U.S.-supplied research reactor in South Africa.

• Several bilateral discussions were held with representatives of foreign nations concerning safeguards activities. NRC participated with other concerned agencies in developing a five-year program designed to strengthen IAEA safeguards, and in development and approval of the U.S.-IAEA agreement concerning application of IAEA safeguards to U.S. facilities.

• An October 1976 statement on nuclear policy by President Ford announced several specific actions concerning control of U.S. nuclear exports, and asked all nations to join with the United States in exercising maximum restraint in the transfer of reprocessing and enrichment technology and facilities by avoiding such sensitive exports or commitments for a period of at least three years.

Developing Regulatory Standards (Chapter 12)

• During 1976, public response to NRC solicitation of ideas and inputs to the standards development process increased substantially.

• Current issues of high priority in standards development include (1) safe transportation of radioactive materials, (2) assuring integrity of steam generator tubes in nuclear power plants, (3) fire protection at nuclear plants, (4) management of radioactive waste, (5) qualification testing of components, (6) cost/benefit of reducing radiation exposures to populations from nuclear facility effluents, (7) treatment of siting

issues on a regional basis, (8) methods to ensure that occupational exposures at nuclear facilities other than reactors are also kept as low as is reasonably achievable, (9) testing and accuracy of personnel dosimeters, (10) possible need for reactor design guidance to increase protection against sabotage, and (11) the need to upgrade training and qualifications of licensees' guards for protecting nuclear material and facilities.

- Guides were issued on protection of nuclear power plants against fire, missiles generated by turbine failure, and earthquake motion. NRC staff also worked with the American National Standards Institute in its broadened program of developing fire protection standards and initiated a national laboratory study to help identify priorities for additional standards in this area. Wind tunnel tests were conducted in a program to develop guidance for protection against possible tornado-generated missiles.

- Guidance was issued concerning reactor containment, including regulatory guides on design of main steam isolation valve leakage control systems for boiling water reactors, criteria for air filtration and adsorption units of atmosphere cleanup systems, and construction and inspection of prestressed concrete containments. A proposed regulation was published on the control of hydrogen gas that might be generated in the event of a severe accident in a boiling water reactor.

- Guidance on specific aspects of the design, construction, and operation of nuclear power plants was issued—for example, in regulatory guides on tornado design classification, overhead crane handling systems, coolant pump flywheel integrity, preoperational and initial startup testing programs, and electrical systems and components important to safety.

- Site standards effort focused on providing guidance for protecting nuclear power plants against flooding, implementing NRC's "as low as reasonably achievable" rule on radioactive effluents from facilities, and implementing NRC's early site review concept.

- NRC staff worked with EPA staff toward assuring that EPA's emerging environmental radiation standards for the uranium fuel cycle and light-water reactors will achieve the desired level of environmental protection with efficient use of NRC staff resources in regulation.

- NRC issued the first two draft environmental impact statements for consumer products. The first one concerned a proposed rule to exempt spark-gap irradiators containing cobalt-60 for use in spark-ignited fuel oil burners, and the second concerned a proposed rule to exempt from licensing the use of thorium in personnel neutron dosimeters worn on the human body.

- NRC published, in response to a petition, an analysis of "hot particles" of plutonium which concluded that radionuclides in the form of particles are not more hazardous, and may be less hazardous, than the same quantity of radionuclides distributed uniformly in the lung.

- NRC asked all licensees to submit a one-time voluntary report of their personnel monitoring data for 1975 for use in evaluating proposed requirements to file annual statistical summary reports in a proposed amendment made public in May 1975.

- A rule change adopted in August 1976 is expected to strengthen workers' respiratory safety requirements and at the same time result in savings by eliminating unnecessary licensee reporting.

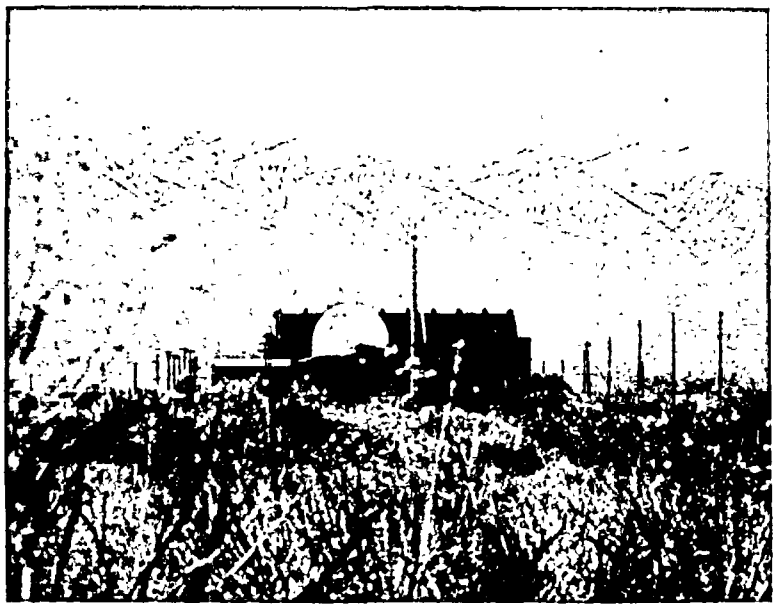
- Regulations were amended to improve monitoring of radiographers and to enable rapid screening of personnel who might have been exposed to radiation during a criticality (nuclear chain reaction) accident.

Confirmatory Research (Chapter 13)

- During 1976, NRC's major testing facilities began to generate significant data which, combined with previous test data, confirmed NRC's expectations concerning the ability of emergency systems to cool the nuclear core of a light-water power reactor if required by loss of the normal coolant.

- The Loss-of-Fluid Test Facility (LOFT) at ERDA's Idaho National Engineering Laboratory performed well in an initial series of four nonnuclear tests.

- Four series of tests involving 26 test runs in the Semiscale Loop, a model of the LOFT reactor system, improved understanding of loop blowdown behavior.



LOFT, the largest experimental facility in the NRC's safety research program, is dwarfed by towering mountains on the 892 square mile Idaho National Engineering Laboratory site.

- Five tests were completed at the Thermal Hydraulic Test Facility at the Oak Ridge National Laboratory, and testing continued at two industrial nonnuclear test loops.
- Results of fuel safety research indicate the conservatism that exists in assumptions used in current safety assessments.
- The large quantity of data generated during the year enabled the development and improvement of various computer codes for water reactor safety analysis to proceed at top speed.
- Experimental tests were conducted and computer code development continued related to postulated accidents in liquid metal cooled fast breeder reactors.
- A coordinated fuel cycle, health and environmental confirmatory research plan was developed, and progress was made on several research projects.
- Safeguards research was conducted on the evaluation and design of physical protection, material control and transport protection subsystems, and several additional projects in this area were initiated.

Addressing Public Concerns (Chapter 14)

- Requests for documents under provisions of the Freedom of Information Act totaled 370 in the first nine months of calendar year 1976, compared to only 49 during the same period in 1975. NRC folowed a liberal disclosure policy, making available thousands of pages of documentation which could have been withheld under exemption provisons of the Act.
- More than 130 NRC public document rooms are located throughout the nation near proposed or existing nuclear plant sites to afford easy public access to information pertaining to NRC responsibilites. Special facilities were set up at the main public document room in Washington for all NRC documents pertinent to the ongoing public hearing on the question of using mixed oxide fuel in light-water power reactors.
- The widely publicized resignations of three persons from nuclear industry positions and of two NRC employees and their allegations of unsafe conditions or practices were viewed with the utmost seriousness by the NRC, the public, industry and the Congress. NRC sought to assure full and impartial consideration of the allegations and to determine as quickly as possible whether or not they offered grounds for immediate corrective action at any licensed facility.
- During the 15-month period ending September 30, 1976, NRC representatives testified in hearings conducted by 11 Congressional committees and subcommittees, covering a total of

31 hearing days. One or more Commissioners appeared on 24 days, and NRC staff on 25 days.

- In November 1976, the Commission announced that it would ask Congress for funds to provide direct financial assistance to intervenors in the mixed-oxide fuel proceedings; that it would relieve qualified participants of certain procedural cost burdens and study measures that might be considered for other proceedings, but that it would not initiate a general program to provide funds for participants in regulatory proceedings. Commissioner Gilinsky disagreed in part with the decision, concluding that funding should be more generally provided.

- Over the 15-month report period, Atomic Safety and Licensing Boards issued 25 decisions approving limited work authorizations, 7 decisions authorizing construction permits and two decisions approving operating licenses for nuclear plants.

- Atomic Safety and Licensing Appeal Boards completed or undertook review of 289 matters. Opinions rendered during the report period reflected the growing complexity of nuclear reactor licensing proceedings.

- The Commission rendered nine significant adjudicatory decisions, seven in the context of authorizing construction, operation or other aspects of domestic commercial reactors, and two in the context of nuclear export.

- Judicial decisions involving the NRC were issued during fiscal year 1976 in five significant cases; 13 cases were concluded, 13 were initiated, and five others remained pending at year-end.

Management and Administrative Matters (Chapter 15)

- NRC staff has increased by 28.5 percent in total personnel from its inception to the close of fiscal year 1976, when total staff numbered 2,289 full-time members.
- Funds appropriated to NRC for the 15-month fiscal year 1976 totaled $289.2 million; for the subsequent 12 months of fiscal year 1977 the appropriation is $256.4 million.
- Since NRC (and AEC) first began collecting fees for its licensing services in 1968, it has collected a total of $66.4 million, $15.4 million of that total in fiscal year 1976.
- The Office of Inspector and Auditor performed special investigations during fiscal year 1976 of charges and complaints of certain NRC employees, two of whom had resigned from the agency; the conduct of NRC inspections at a waste burial facility, a proposed power plant site, and an operating plant; the NRC material licensing program and materials inspection program; the NRC export licensing program; and NRC-ERDA joint research activities.
- NRC's Office of Equal Employment Opportunity has adopted the goal of increasing minority employment from 10.8 percent of total NRC staff in June of 1976 to 12 percent in fiscal year 1977, and to 16 percent in the period 1978-1982.

Licensing Power Reactors

Safety Is First

The primary goal of the NRC in its regulation of the nuclear power industry is to assure the preservation of the health and safety of the public and the protection of the environment. These assurances are maintained through NRC's comprehensive licensing process for nuclear reactors which encompasses safety and environmental factors, safeguarding of nuclear material and facilities from theft or sabotage, antitrust reviews and indemnification.

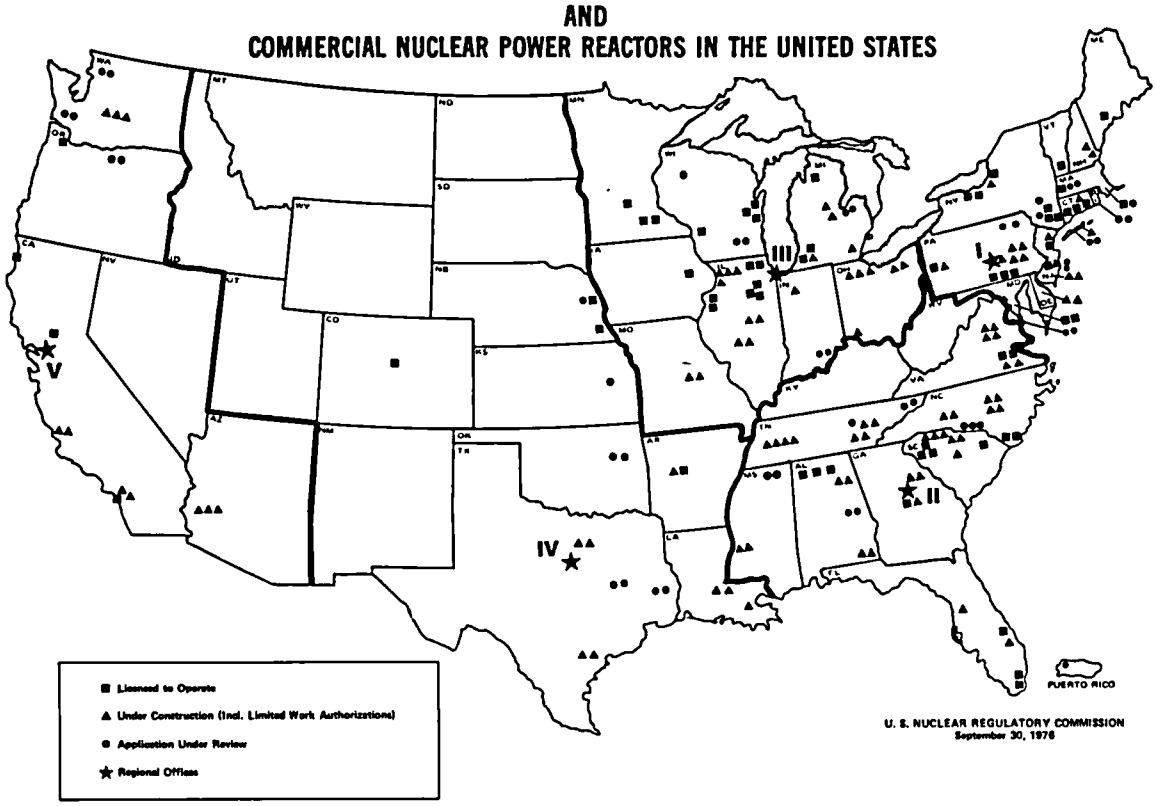
The licensing process is centered in the NRC's Office of Nuclear Reactor Regulation, whose evaluations are conducted by a staff drawn from across the spectrum of technical disciplines and organized into 37 functional branches in four divisions, plus an antitrust and indemnification group. The four-division structure was adopted in January 1976 to more clearly delineate regulatory responsibilities within the Office; they are the Division of Project Management, the Division of Operating Reactors, the Division of Systems Safety, and the Division of Site Safety and Environmental Analysis.

This chapter discusses all major aspects of the reactor licensing process and develops the relationship between licensing actions and concepts and the primary objective: the safe operation of nuclear power plants. The chapter covers specific licensing actions during fiscal year 1976; steps to ensure safe design under the "defense-in-depth" concept; highlights of special technical reviews; action to improve the licensing process through standardization and early site review; antitrust reviews; indemnity and insurance matters; Commission actions for the reporting period; and other subjects related to licensing for safety in reactor operation.

STATUS OF NUCLEAR POWER

As of September 30, 1976, there were 237 nuclear power units either in operation, being built or planned, representing a

NRC REGIONAL OFFICES
AND
COMMERCIAL NUCLEAR POWER REACTORS IN THE UNITED STATES



total capacity of 237,000 net megawatts electric (MWe). Of these 237 units, 202 had entered the NRC licensing process, as follows:

- 62 licensed to operate, with a total capacity of 45,000 MWe;
- 72 with construction permits, representing 76,000 MWe capacity;
- 68 under review for construction permits, representing 75,000 MWe capacity.

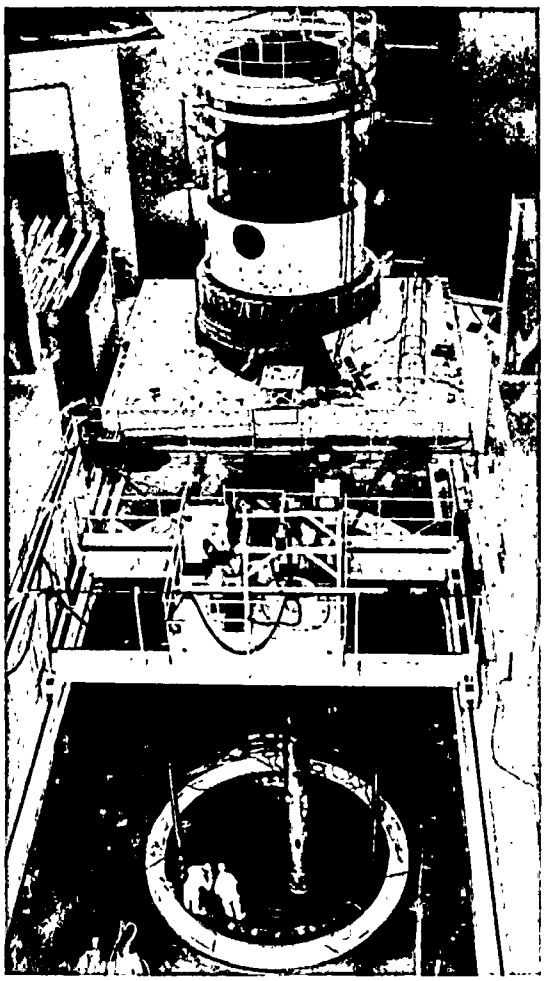
(Initial construction work was proceeding on 21 of these under limited work authorizations.)

Of the remaining 35 units, 16 had been ordered and 19 publicly announced.

COURT RULING IMPACTS LICENSING

Two decisions handed down on July 21, 1976 by the United States Court of Appeals for the District of Columbia Circuit resulted in a temporary suspension of licensing by NRC. The two cases—discussed under "Judicial Review" in Chapter 14—related to the manner and degree to which the NRC considers the environmental impact of reprocessing and waste disposal in its reactor licensing process. The court held that the rule governing such consideration (10 CFR 51.20(e)) must be more fully explained and documented than it was under then current practice. In August 1976, the Commission directed that a new and thorough staff analysis of the environmental impact of fuel reprocessing and waste mangement associated with individual nuclear power plant licensing be undertaken.

Pending completion of the staff analysis, the Commission suspended issuance of new full-power operating licenses, construction permits and limited work authorizations. However, some types of licensing action—such as fuel loading, limited power testing, and construction permit amendments—were not affected by the Commission's decision. On October 8, the Court of Appeals stayed its mandate of July 21 and indicated that the Commission could continue licensing activites on condition that the Com-



The loading of nuclear fuel into the St. Lucie Unit 1 plant began soon after NRC issued an operating license for the Unit to Florida Power & Light in 1976. During the 10-day procedure, 217 fuel assemblies were lowered into exact placement in the reactor vessel (lower center). The reactor closure head sits in the background ready for final positioning when the vessel is fully loaded.

mission "shall make any licenses granted between July 21, 1976, and such time as the mandate has issued subject to the outcome of the proceeding herein." On October 13, the Commission announced a proposed interim rule —based on the newly completed staff analysis— dealing with environmental impacts of fuel reprocessing and waste management in licensing nuclear power plants. The interim rule was to be used for licensing only during the period required for completion of a public hearing process and publication of a final rule. In publishing the interim rule to gain public comment on it, Chairman Rowden stated: "The Commission's review of the staff analysis indicates that it provides a sound basis for consideration of an interim rule which could be in place within three months. The staff analysis has taken into account the most current information available. It quantifies impacts where the information warrants, identifies areas where quantification is not feasible at present, and discusses research programs designed to resolve uncertainties, and the timing of those programs."

The staff report concluded that environmental impacts of fuel reprocessing and waste management as they relate to individual nuclear plants continue to be small, even when impacts which were not completely accounted for in the past were considered. (See also Chapter 5.)

On November 5, 1976, the Commission announced that it was resuming licensing of nuclear power plants under the condition set forth by the Court of Appeals on October 8. The Commission said that it was resuming issuance of full power operating licenses, construction permits and limited work authorizations, pending a final decision on adoption of an interim rule, on the basis of the breadth and quality of the new analysis of reprocesssing and waste impacts, and its belief that there would be no substantial error in the staff's conclusion that such impacts would not be significantly changed from what they were under the existing rule.

Licensing Reactor Operators

The safety of a nuclear facility depends not only on the facility itself but on the qualifications of those who operate it. To assure that the "human element" of each nuclear power plant is capable of directing and performing the activities necessary to reactor operations, the NRC requires each individual who handles the controls to be licensed. The requirements for issuance of operators' licenses are set forth in 10 CFR Part 55.

Two types of licenses are issued by the Commission: one for "operators" and one for "senior operators." Anyone who manipulates the reactor controls must be a licensed operator while anyone who is designated by the nuclear

Table I. Nuclear Power Plant Licensing Actions—Fiscal Year 1976

LIMITED WORK AUTHORIZATIONS

Applicant	*Facility*	*Date Issued*	*Location*
1. Washington Public Power Supply System	WPPSS 1 & 4	8-1-75	Richland, Wash.
2. Delmarva Power & Light Co.	Summit 1 & 2	8-7-75	Summit, Del.
3. Houston Lighting and Power Co.	South Texas 1 & 2	8-12-75	Matagorda County, Tex.
4. Union Electric Co.	Callaway 1 & 2	8-14-75	Callaway County, Mo.
5. Gulf States Utilities Co.	River Bend 1 & 2	9-5-75	West Feliciana Parish, La.
6. Illinois Power Co.	Clinton 1 & 2	10-1-75	DeWitt County, Ill.
7. Toledo Edison Co.	Davis Besse 2 & 3	12-3-75	Ottawa County, Ohio
8. Tennessee Valley Authority	Hartsville 1, 2, 3 & 4	4-22-76	Hartsville, Tenn.
9. Duke Power Co.	Cherokee 1, 2 & 3	5-28-76	Cherokee Country, S.C.

CONSTRUCTION PERMITS

Applicant	*Facility*	*Date Issued*	*Location*
1. Duke Power Co.	Catawba 1 & 2	8-7-76	York County, S.C.
2. Houston Lighting and Power Co.	South Texas 1 & 2	12-22-75	Matagorda County, Tex.
3. Commonwealth Edison Co.	Byron Station 1 & 2	12-31-75	Ogle County, Ill.
	Braidwood Station 1 & 2	12-31-75	Will County, Ill.
4. Washington Public Power Supply System	WPPSS 1	12-23-75	Benton County, Wash.
5. Illinois Power Co.	Clinton 1 & 2	2-24-76	DeWitt County, Ill.
6. Union Electric Co.	Callaway 1 & 2	4-16-76	Callaway County, Mo.
7. Arizona Public Service Co.	Palo Verde 1-3	5-25-76	Maricopa County, Ariz.

OPERATING LICENSES

Applicant	*Facility*	*Date Licensed*	*Power Capacity (MWe)*	*Reactor Type*	*Location*
1. Northeast Nuclear Energy Co.	Millstone 2	8-1-75	828	PWR	New London, Conn.
2. Portland General Electric Co.	Trojan	11-21-75	1130	PWR	Columbia County, Ore.
3. Consolidated Edison Co.	Indian Point 3	12-12-75	965	PWR	Westchester County, N.Y.
4. Duquesne Light Co.	Beaver Valley 1	1-30-75	852	PWR	Beaver County, Pa.
5. Florida Power & Light Co.	St. Lucie 1	3-1-76	810	PWR	St. Lucie County, Fla.
6. Tennessee Valley Authority	Browns Ferry 3	7-2-76	1067	BWR	Limestone County, Ala.
7. Public Service Electric & Gas Co.	Salem 1	8-13-76	1090	PWR	Salem County, N.J.
8. Baltimore Gas & Electric Co.	Calvert Cliffs 2	8-13-76	845	PWR	Calvert County, Md.
9. Carolina Power & Light Co.	Brunswick 1	9-8-76	821	BWR	Brunswick County, N.C.

plant licensee to supervise the activities of licensed operators must be a licensed senior operator. As a general practice, the reactor operator is a licensed operator and his or her immediate supervisor is a licensed senior operator. An application for an operator's license must include a certification by an authorized representative of the nuclear facility licensee that the applicant has completed training and can "operate the controls in a competent and safe manner." A medical report must also be submitted by each applicant.

Each year the NRC administers over 600 operator examinations to test the qualifications of applicants. Both written examinations and on-site operating tests are conducted. The scope of the examination is based, in part, on the technical features of the facility to which the applicant expects to be assigned; the facility's administrative controls and responsibilities assigned to operators are also considered by NRC examiners in preparing each examination. (Information on the scope of NRC examinations is included in NUREG-0094, "A Guide for the Licensing of Facility Operators, Including Senior Operators," published in July 1976.)

Each operator or senior operator license is valid for one specific nuclear facility and is effective for two years, at the end of which time application for renewal must be submitted. The renewal application must present evidence of satisfactory performance, including approximate hours of experience in facility operation, and a statement that the facility-administered requalification program has been satisfactorily completed.

During fiscal year 1976, the NRC issued 261 new operator licenses, 297 renewals, and 79 amendments, bringing the number of operator licenses in effect on September 30, 1976 to 807. During the same period 331 new licenses, 558 renewals and 100 amendments were issued for senior operators, bringing the total to 1,261 in effect.

Ensuring Safe Design

Section 307(c) of the Energy Reorganization Act of 1974 directs the Commission to include in its annual report to Congress, among other things, a description of activites and findings in the area of assuring the safe design of nuclear power plants. These activities are addressed in the section that follows.

DEFENSE-IN-DEPTH

The safety of nuclear power plants is assured primarily by the "defense-in-depth" approach employed in designing the plants. Designers are required to provide in each nuclear plant successive and mutually reinforcing echelons for defense that act to prevent the occurrence of serious accidents and to protect the public from exposure to nuclear radiations.

It is convenient to describe the defense-in-depth concept in terms of three echelons. The first echelon is concerned with accident prevention; the second is concerned with preventing failures, malfunctions, or minor accidents from escalating into major accidents; and the third is concerned with protecting the public in the unlikely event that a major accident occurs.

The first defense echelon—accident prevention—is based on sound and conservative design and on construction, testing, operation and maintenace in accordance with stringent quality standards and the best engineering practices. The extensive testing required of each nuclear power plant during its initial operation is of particular value in probing the soundness of this echelon.

The second defense echelon—compensating for failures or operating errors that may occur—depends on conservative design and redundant and diverse detecting and actuating equipment in the protection systems. In a sense, the second echelon can be visualized as all the back-ups for the safety-related systems, components and structures of the first echelon. The same high quality standards must be observed in fabricating, installing, testing, inspecting, and maintaining the second defense echelon as in the first.

The third defense echelon—protecting the public in the event of a major accident—consists of supplementary features that can provide additional margins of safety to protect the public from the consequences of a serious accident. The designs of these features are based primarily on the calculated consequences of a

series of severe hypothetical accidents, called "design basis accidents." In some design basis accidents, a redundant protective system is assumed to fail concurrently with the accident it is intended to control. In hypothesizing a series of design basis accidents which the nuclear plant must be able to withstand, the designer is assuming that "Murphy's Law"—anything that can go wrong will go wrong—is operating.

DEFENSE IN DEPTH APPROACH TO NUCLEAR POWER PLANT SAFETY

1. Careful design, construction and operation, so that malfunctions which could lead to major accidents will be highly improbable
2. Systems to prevent such malfunctions as do occur from turning into major accidents, e.g., SCRAM and leak detection systems
3. Systems to limit offsite consequences of postulated, major accidents, e.g. emergency core cooling systems

The defense-in-depth concept is embedded in the NRC regulations (see, for example, Appendices A and B of 10 CFR Part 50) and in the guidance provided by NRC to the nuclear industry. Perhaps more than any other safety measure, the use of the defense-in-depth concept in nuclear power plant design has been responsible for the excellent safety record experienced to date, and its continued application in the future will provide ample protection for the public.

LIMITED WORK AUTHORIZATION (LWA-1)

PURPOSE:

- Permit certain site activities prior to issuance of construction permit

REQUIREMENTS FOR ISSUANCE:

- Complete site suitability and NEPA reviews and issuance of FES
- Public hearing and affirmative decision on environmental matters and site suitability

POSSIBLE SCOPE OF AUTHORIZATION:

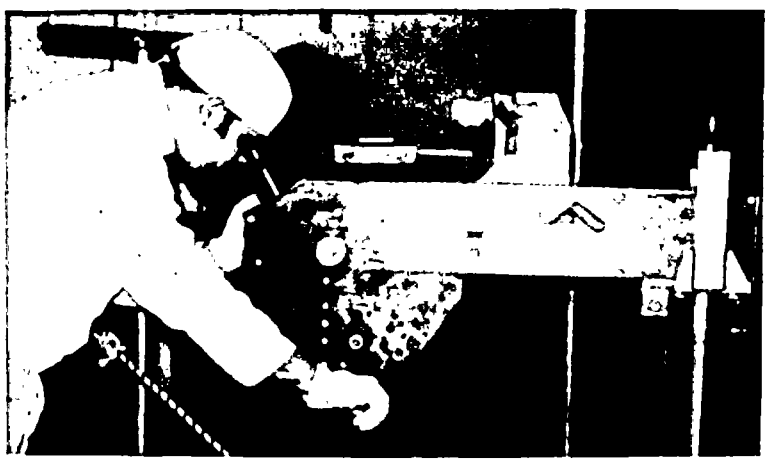
- Site exploration, preparation, excavation and measures to protect excavation
- Construction of roadways, railroad spurs, transmission lines, and nonnuclear facilities
- Driving of piles for facility structures

LIMITED WORK AUTHORIZATION (LWA-2)

- In addition to work authorized under LWA-1, safety-related work may be authorized after NRC review and public hearing on specific items

ACTION ON TECHNICAL PROBLEMS

Applying the lessons of experience is one of the most important ways in which the NRC and the nuclear industry can assure themselves, the Congress and the public that nuclear power operations are safe and growing safer. Not all the latent vulnerabilities in a complex technology can be anticipated and eliminated by design. For that reason, the "defense-in-depth" concept is applied to contain and neutralize the



An NRC inspector uses a periscope to peer down into a water-filled canal to inspect nuclear fuel elements being moved from Yankee-Rowe's reactor to to the spent fuel storage pool.

THE LICENSING PROCESS

Obtaining an NRC construction permit—or a limited work authorization pending a decision on issuance of a 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 license. The process is set in motion with the filing and acceptance of the application, generally comprising ten or more large volumes of material covering both safety and environmental factors, in accordance with NRC requirements and guidance. The second phase consists of safety, environmental, safeguards and antitrust reviews undertaken by the NRC staff. Third, a safety review is conducted by the independent Advisory Committee on Reactor Safeguards (ACRS); this review is required by law (see discussion under heading, "Advisory Committee on Reactor Safeguards," in this chapter). Fourth, a mandatory public hearing is conducted by a three-man Atomic Safety and Licensing Board (ASLB), which then makes an initial decision as to whether the 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 final NRC decision. The law provides for appeal beyond the Commission in the Federal courts.

As soon as an initial application is accepted, or "docketed," by the NRC, a notice of that fact is published in the *Federal Register*, and copies of the application are furnished to appropriate State and local authorities and to a public document room (PDR) established in the vicinity of the proposed site, as well as to the PDR in Washington, D.C. At the same time, a notice of a public hearing is published in the *Federal Register* (and local newspapers) which provides 30 days for affected 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 the ASLAB. (See Chapter 14 for ASLB and ASLAB actions during fiscal year 1976.)

The NRC staff's safety, safeguards, environmental 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 a 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 prior to submission of the report, NRC staff conducts a substantive review and inspection of the applicant's quality assurance program covering design and procurement. The safety review is performed by NRC staff in accordance with the Standard Review Plan for light-water-cooled reactors published in September 1975. This plan states the acceptance criteria used in evaluating the various systems, components and structures important to safety and in assessing the proposed site, and it describes the procedures 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 carried out; whether the applicant has conducted his analysis and evaluation in sufficient depth and breadth to support staff approval with respect to safety. When 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 summarizing the results of their review regarding the anticipated effect of the proposed facility on the public health and safety.

When the ACRS has completed its review, the NRC staff issues a supplement to the Safety Evaluation Report incorporating any changes or actions adopted as a result of ACRS recommendations. A public hearing can then be held, generally taking place in a community near the proposed site, on safety aspects of the licensing decision.

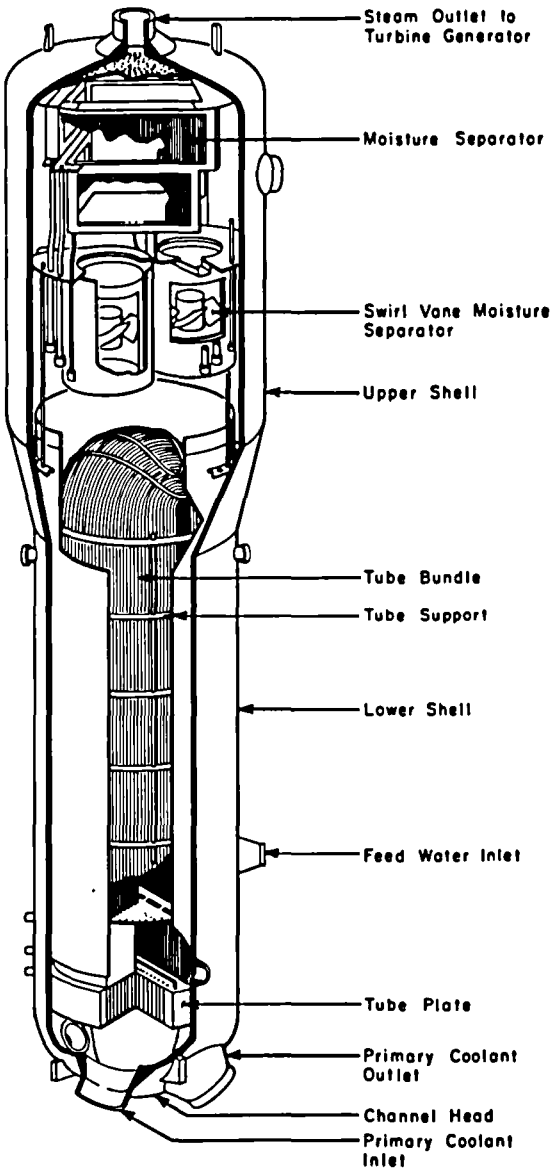
The environmental review (discussed more fully in Chapter 4) begins with preparation by NRC staff of a Draft Environmental Statement, assessing the consequences to the environment of the operation of the proposed facility at the proposed site. The statement is published and distributed with specific requests for review by Federal, State and local agencies and other interested parties. Their comments are then taken into account in the preparation of a Final Environmental Statement. Both the draft and the final statement are made available to the public at the time of respective publication. A public hearing, with the appointed ASLB presiding, can then be conducted on environmental aspects of the proposed licensing action (or a hearing on both safety and environmental matters may be held, if that is indicated).

The antitrust reviews of license applications (see discussion under the heading "Antitrust Reviews," below) are carried out by the NRC and the Attorney General in advance of, or concurrently with, other licensing reviews. If an antitrust hearing is required, it is held separately from those on safety and environmental aspects.

In appropriate cases, NRC may grant a Limited Work Authorization to an applicant in advance of the final decision on the construction permit in order to allow certain work to begin at the site, saving as much as seven months' time. The authorization will not be given, however, until NRC staff have completed environmental impact and site suitability reviews and the appointed ASLB has conducted a public hearing on environmental impact and site suitability with a favorable finding. To enable the staff and licensing board to make these safety determinations, the applicant must submit the environmental portion of the application early.

When a plant is nearing completion, the applicant must go through virtually the same process to obtain an operating license as to obtain a construction permit. The application is filed, NRC staff and the ACRS review it, a Safety Evaluation Report and an updated Environmental Statement are issued. A public hearing is not mandatory at this stage, but one may be held if requested by affected members of the public or at the initiative of the Commission. Each license for operation of a nuclear reactor contains technical specifications which set forth the particular safety and environmental protection measures to be imposed upon the facility and the conditions that must be met for the facility to operate. Once licensed, a nuclear facility remains under NRC surveillance and undergoes periodic inspections throughout its operating life. In cases where the NRC finds that substantial, additional protection is necessary for the public health and safety or the common defense and security, the NRC may require "backfitting" of a licensed plant, that is, the addition, elimination or modification of structures, systems or components of the plant.

PWR STEAM GENERATOR



effects of abnormal events in nuclear facilities. Equally important, design changes or backfitting are required when any safety-related deficiencies are revealed through such occurrences or through confirmatory research into potential problem areas. The following are the principal phenomena which have posed technical problems within nuclear power plants.

Steam Generator Tube Integrity

Steam generator tubes in pressurized water reactor facilities are an integral part of the reactor coolant pressure boundary, keeping the radioactive primary coolant intact in a closed system and sealed off from the environment. Tube degradation may occur by wastage, stress corrosion cracking, denting, or support plate cracking. The primary concern is the capability of degraded tubes to maintain their integrity during normal operation and under postulated accident conditions with adequate safety margins.

Degradation associated with corrosion, or wastage, has prompted changes in the chemicals used in the treatment of secondary system water. Some plants have experienced tube degradation in the form of a reduction in tube diameter and cracking of tube support plates. Studies indicate that the annulus between the tube and tube support plate became filled with hardened corrosion products that expanded to exert sufficient force to "dent" the tube diametrically and to crack the tube support plate ligaments between the tube holes and circulation flow holes. Safety analyses did not indicate immediate safety concerns. The degree of denting has increased in several plants, and with tubes tightly locked in the support plates the thermal and pressure stresses resulting from normal plant heat-up and shutdown may cause further deformation that may affect the tube integrity in the long term operation of steam generators.

An in-service inspection technique is used to evaluate the degree of degradation experienced. When unacceptable degradation has occurred the tube is plugged. NRC is also sponsoring confirmatory research to further evaluate the safety margins of operation of plants with various forms of tube degradation including the effects of plugging.

Fire Protection

As a result of a fire in electrical cable trays in the Browns Ferry Nuclear Plant in Alabama (discussed in Chapter 7 of the 1975 Annual Report), the NRC initiated a program to evaluate the need for improving fire protection in

nuclear power plants. As part of this continuing evaluation, the NRC, in February 1976, published a report by a special review group, "Recommendations Related to Browns Ferry Fire" (NUREG-0050). This report recommends that improvements in the areas of fire prevention and fire control should be made in most existing facilities and that consideration should be given to requiring design features that would increase the ability of nuclear facilities to withstand large fires without the loss of important functions. In May 1976, the NRC's Office of Nuclear Reactor Regulation issued specific recommendations for fire protection programs and included them in the acceptance criteria of the licensing review for Nuclear Power Plants. The NRC is reevaluating fire protection programs at all nuclear power stations. (See Chapter 8 for discussion of current status of Browns Ferry Power Plant.)

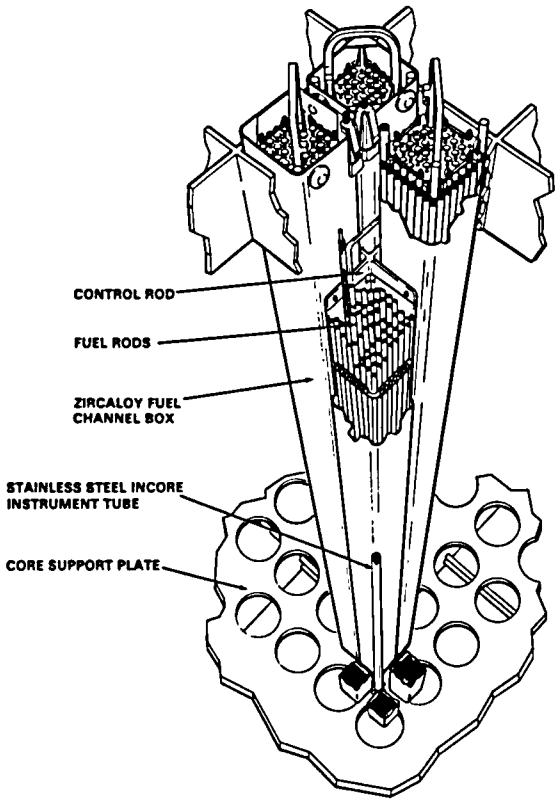
Pressure Suppression Containments

Transient short-term hydrodynamic loads during certain low probability postulated accidents were identified during the testing of the Mark III containment for boiling water reactors. These loads would likely occur for a very short time during the early stages of reactor depressurization during a postulated loss-of-coolant accident, when gases are forced into a pool of water. A downward load on the wall of the pool is generated as a result of high pressure bubbles moving in the water. An upward load is generated as the expanding air bubbles rise in the pool causing its surface to swell upward and compressing the air above the surface. In addition, other tests have identified the existence of lateral loads on the involved pipes which occur during the latter stages of the steam blowdown. (See Chapter 8 for diagram of boiling water reactor and suppression pool.) These loads are considered in the structural design of the new Mark III containment concept in license applications currently under review. The same loading phenomena would occur in the earlier Mark I and Mark II pressure suppression containment concepts, but were not included in the design calculations.

As an interim measure, changes in operating procedures have been implemented for operating reactors with the Mark I containment to accommodate these loads. Additional tests are being performed for the Mark II containment to quantify these loads (no plant with a Mark II or Mark III containment is as yet operative). Design changes will be made in all three containments if tests and analysis so indicate.

Fuel Channel Box Wear

As noted in Chapter 7 of the 1975 Annual Report, a significant amount of damage to some fuel channel boxes adjacent to incore instrument tubes had been found in certain foreign and American reactors. It was determined that the wear was occurring as a result of the vibration of the incore instrument tubes. The affected class of boiling water reactors, the BWR-4, was designed with one-inch diameter



BWR FUEL ASSEMBLIES, CHANNEL BOX AND INSTRUMENT TUBE

bypass holes in the lower core support plate, which created localized flow conditions that caused vibration of the instrument tubes. Channel box corner wear at the foreign reactor was first indicated by a change in the normal reading from the incore instrument adjacent to the damaged channel boxes. During a routine inspection, cracks at the corners of three channel boxes were discovered.

The presence of cracks at the channel box corners could reduce the coolant flow, raising fuel temperatures, and weaken the channel boxes. These effects could significantly decrease the safety margins associated with the reactor core, particularly under certain postulated accident situations.

The surveillance of the operating BWR-4 class of reactors in this country was increased. Limits were placed on the allowable magnitude of the anomalies in incore instrument readings. Subsequently, the NRC ordered a reduction in reactor power and coolant flow. Later an interim modification—consisting of plugging the one-inch bypass holes in the lower core support plate—was accepted by the NRC. This resulted in a slight power level reduction at four reactors.

The General Electric Co. developed a permanent modification for affected reactors to eliminate detrimental instrument tube impact on the channel box corners without imposing restrictions on power generation. This included plugging the one-inch bypass holes (the interim modification) and adding alternate bypass flow holes in the lower tie plate for each fuel assembly, in order to restore the bypass flow to its original design value and thus remove any operational restriction due to reduced bypass flow. The NRC approved the modification in March 1976.

Cracks In Steel Piping

As reported in Chapter 7 of the 1975 Annual Report, cracks were found in the piping of several boiling water reactors. A report by an NRC special study group (NUREG 75-067) concluded that the hairline cracks that occurred in the recirculation bypass lines and the core spray system were the result of intergranular stress corrosion. Although additional hairline cracks may develop in localized areas under similar circumstances in the future, the study indicates such cracks do not pose a significant threat to public health and safety, since they can be detected by periodic inspection or sensitive leak detection equipment and repaired. In no instance was the structural integrity of the pipes affected by the cracks.

Licensees are continuing efforts to monitor for and identify cracks or leaking piping. Early identification and correction of degraded piping is a primary objective of the in-service inspection programs. Industry is also continuing to sponsor research to reduce the occurrence of pipe cracking. The reactor manufacturer is investigating combinations of stress, oxygen and sensitization that can cause cracking of piping; the problem is also the subject of NRC-sponsored research. Following NRC's recommendations, replacement materials and alternate fabrication processes are being considered in the test program by the manufacturer.

New procedures and fabrication methods as well as the use of materials more resistant to intergranular stress corrosion cracking are being specified for new reactors to the extent practical. Affected pipes in operating facilities are being replaced by better materials or particular sections of piping are being eliminated on a reasonable schedule or as required if cracking occurs.

Loads on Reactor Vessel Supports

In the very unlikely event of a rupture of the coolant inlet piping near the primary coolant inlet of pressurized water reactors, lateral (or asymmetric) loads would be imposed upon the reactor vessel. Not all of these loads, which would result from the rapid depressurization of the reactor system, were analyzed during the design of some facilities. These forces could affect the integrity of the reactor vessel supports under the postulated, low probability, accident condition; thus the existing margins of safety may be less than intended. Because of the low probability of the condition in question, no immediate risk is discerned in the situation.

The NRC has requested that all licensees of

operating pressurized water reactors conduct analyses to determine whether the reactor vessel supports will sustain the postulated loads. The NRC is also studying a licensee-proposed augmented inservice inspection program and the effects this would have on further decreasing the probability of occurrence of this event.

The NRC is conducting confirmatory research into and is planning additional analytical studies of the problem. These investigations will provide a basis for the NRC to assess the adequacy of the vessel supports under asymmetrical loads.

Water Hammer

During the past year two pressurized water reactor facilities reported the occurrence of "water hammer" in the steam generator feedwater systems.

Water hammer occurs when water rapidly replaces steam in the feedwater distribution piping (sparger) or in the feedwater inlet nozzle of the steam generator. This happens when the steam generator water level drops below the level of these components. Feedwater flow instability, leading to water hammer, can damage feedwater system piping and associated components. This instability has occurred with varying severity at a number of plants during the last several years when feedwater flow was restarted following an operational adjustment, such as might be required by some abnormal condition like a rapid change in the steam generator water level. Corrective actions have been implemented. These include changes to the feedwater piping arrangement, modifying the feedwater distribution ring or steam generator refilling procedures, or limiting refill flow rate to reduce condensation.

The NRC is sponsoring independent evaluations to identify the basic causes of water hammer and to determine whether more effective corrective measures could be devised. Since the steam generator feedwater systems do not connect directly with the reactor core, the problem does not represent an immediate hazard. As the piping in the plant gets older, however, the potential consequences of the water hammer phenomenon could become increasingly serious.

Anticipated Transients Without Scram

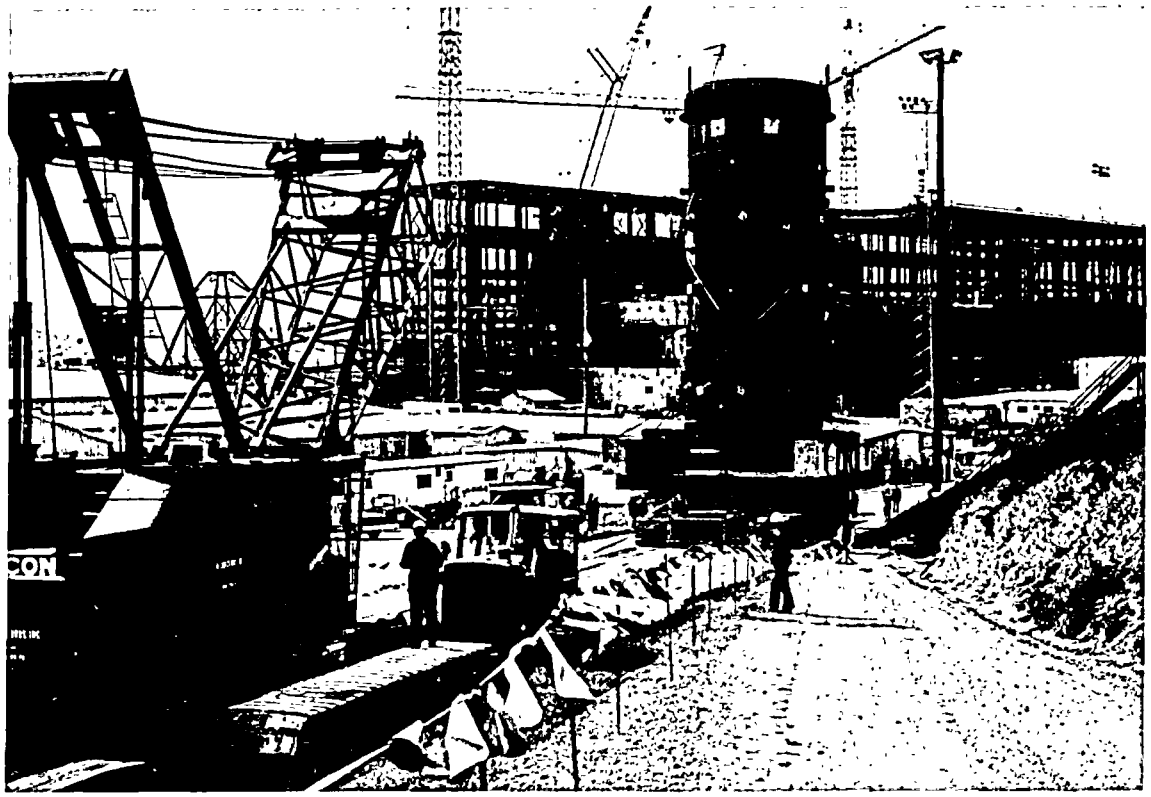
Nuclear plants are designed with numerous safety and control systems to limit the consequences of abnormal operating conditions referred to as "anticipated transients." Some deviations from normal operating conditions may be quite trivial; others, occurring less frequently, may impose significant demands on plant equipment. In some anticipated transients, shutting down the nuclear reaction, and hence rapidly reducing the generation of heat in the reactor core, is an important step in assuring that public risk is minimized. A very rapid shutdown of the reactor is called a "scram." If such a potentially severe "anticipated transient" should occur and the reactor shutdown system did not "scram" as desired, an "anticipated-transient-without scram," or ATWS, would have occurred.

The NRC recognizes that an ATWS which could affect the public health and safety is unlikely. However, a "Technical Report on Anticipated Transients Without Scram for Water Cooled Power Reactors" (WASH-1270), published by the then AEC staff in September 1973, established formal acceptance criteria to protect against ATWS events. Some of these criteria have recently been sharpened and brought up to date.

During a two-year period, each of the four nuclear manufacturers submitted analyses and supporting information on ATWS. Following the review of this material, the NRC published in December 1975 four status reports on ATWS, addressing the information submitted by each light-water reactor manufacturer. The NRC reports evaluated the information for conformance to the NRC criteria nad noted where design changes and additional analyses were required. The staff is presently pursuing a program to implement design changes to meet the safety requirements.

ACTION ON SITING PROBLEMS

The other main category of regulatory concerns with nuclear power plants—besides in-plant technical problems like those discussed above—relates to the siting of the plants and the



The reactor pressure vessel for Limerick Generating Station Unit 1 near Pottstown, Pa., is moved down a hill to a place where it will be installed in the reactor containment. The 1100-ton vessel inched along as an NRC inspector (in white helmet, below vessel) checks on its progress.

geological and environmental considerations involved in appraising a proposed location. Current problems with particular sites and actions taken in response to them are described in the following.

Diablo Canyon Unit 1. The existence of a fault system approximately 3.5 miles offshore from the proposed plant site at Diablo Canyon, California was made known in 1971 by the publication in a technical journal of previously undisclosed Shell Oil Company data. Subsequently, extensive offshore seismic surveying has been performed by the applicant and the United States Geological Survey (USGS). This seismic profiling substantiates the published Shell Oil Company observations and indicates that the near surface of the zone comprises many small segments, some of which may represent fissures in the ocean floor. The USGS has recommended that the fault, having exhibited evidence of lateral movement, be considered active, and that a magnitude 7.5 (Richter scale) earthquake be postulated in a reanalysis of plant design.

Both the NRC and the applicant, Pacific Gas and Electric Co., have employed consultants to recommend design procedures for use in the reanalysis, and the NRC staff is currently involved in reviewing them.

North Anna. During April of 1973, a fault zone was observed to lie under the reactor containment building of the North Anna Nuclear Power Station Units 1, 2, 3, and 4, at Mineral, Va., which are not yet licensed to operate. Subsequent detailed geologic mapping of outcrops and of the containment excavations and trenches revealed that the fault zone had probably not moved since the Triassic period (approximately 200 million years ago) and definitely not within the last 500,000 years. Thus the fault zone is "non-capable" or inactive, according to NRC siting criteria.

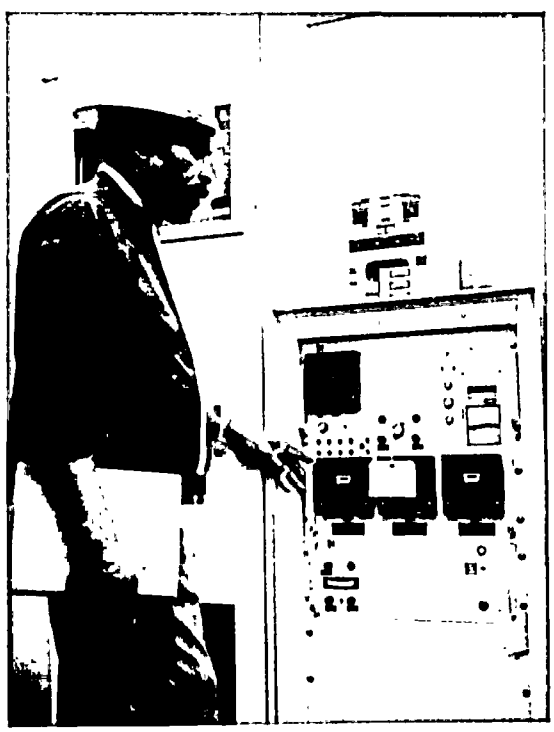
In order to provide assurance that filling of the North Anna reservoir would not reactivate

the faults underlying the containment buildings, the NRC in September 1973 required that Virginia Electric and Power Co. install a network of seismographs to record microearthquake activity in the site area. A report on microearthquake monitoring for a period of more than two years was submitted to NRC in May 1976.

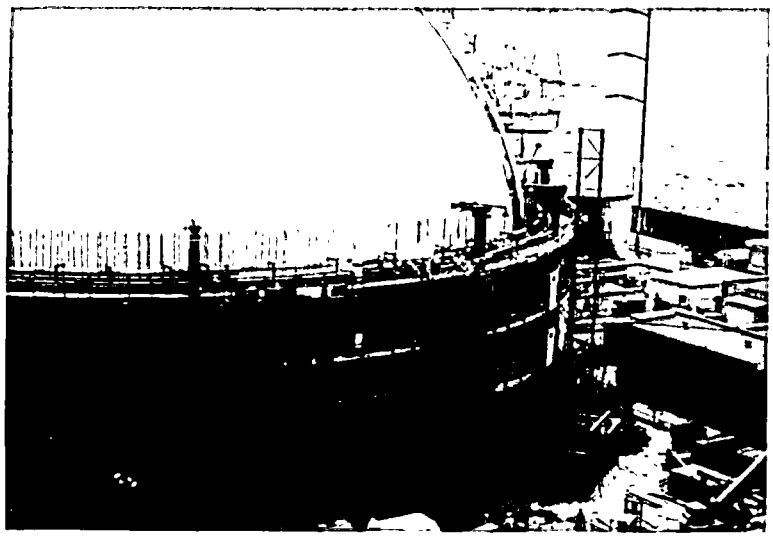
After review of the report, NRC concluded that there is no aspect of the data which indicates in any way that the microearthquakes recorded or the faults below the plant site pose a hazard to the safe operation of the plant. However, the NRC recommended continued operation of the monitoring network for at least one more year in order to determine if the relationship between microearthquake activity and the faults changes in such a way that additional action would be required. Appropriate reports will be submitted by the utility to the NRC.

Humbolt Bay. Continuing review of geologic and seismic conditions at the Humboldt Bay Nuclear Generating Station—an operating nuclear power plant near Eureka, California—resulted in new data submitted to NRC early in 1976. These data indicated that several geologic features of the area had not formerly been defined clearly enough to evaluate their impact on site safety. Consequently, NRC issued an "Order for Modification of License" on May 21, 1976, containing conditions to the operating license by which the features in question would be thoroughly analyzed prior to start-up after the 1976 refueling outage. The additional investigations necessary to clarify the origin and significance of the geological features were discussed at several meetings with the licensee, Pacific Gas and Electric Co., and their consultants. Members of the NRC staff, the U.S. Geological Survey, and the California Division of Mines and Geology have made site visits to keep abreast of progress in the investigation. Resolution of the geological and seismological questions were expected in late 1976 after the staff had reviewed results of the investigations in progress.

Indian Point. During NRC's review of the Operating License application for Indian Point Unit No. 3, in New York State, faulting was discovered in the plant site area. The staff visited the site and inspected the fault exposures. Following meetings with the applicant, NRC required investigations to determine the geologic characteristics of the faulting and its safety significance to the Indian Point units. The applicant reported the results of his investigation in early December 1975. The study concluded that the faulting on the Indian Point site is geologically old and poses no hazard to the plant. The NRC staff, after review of the applicant's report and intensive technical discussions with the applicant and his consultants, substantially agreed with that conclusion. Because of the complexity of the geologic structure in the region of the Indian Point site, NRC required the utility to undertake additional geological investigations in the region and expand the earthquake monitoring activities which were begun in 1974. The results of the geological investigations are to be reported to the NRC by April 1977, and the results of the earthquake monitoring are to be reported by January 1979.



An NRC inspector checks the utility's seismic monitoring system at the Diablo Canyon Nuclear Power Facility Unit No. 1.



Construction is in progress on an NRC-approved shield building surrounding the containment sphere of the San Onofre Unit 1 plant located on the Pacific coast. The shield building, which would provide additional biological protection in the unlikely event of a loss-of-coolant accident in the plant, is a part of the licensee's program to obtain NRC approval of reduction in the size of the plant's exclusion area consistent with the public's use of the nearby beach.

ADVANCED NUCLEAR POWER PLANTS

Liquid Metal Fast Breeder Reactor

The proposed Clinch River facility near Oak Ridge, Tennessee is to be a 975 megawatt (thermal) demonstration project that includes a liquid metal fast breeder reactor (LMFBR), fueled with a mixture of plutonium and uranium oxides. Although it will be designed to generate 380 megawatts of electrical power, the generation of electricity is a secondary benefit. The Clinch River project is intended to provide design, construction and operating data and experience which will be considered by the Energy Research and Development Administration (ERDA) in deciding whether to proceed with the commercialization of LMFBR technology. Although the facility is a joint government-industry project, ERDA has the direct management responsibilities for the project and is the primary contact with the NRC staff during the present licensing review. The Environmental Report prepared by ERDA for Clinch River was reviewed and a Draft Environmental Statement was issued for public comment by the NRC on February 12, 1976. Numerous comments were received and considered in preparation of the Final Environmental Statement, which was issued in December 1976.

ERDA conducted the environmental assessment of the LMFBR program and issued its Final Environmental Statement on December 31, 1975. In response to contentions filed by intervenors, the need for an independent staff review of the ERDA program statement was considered by the Commission and rejected in August 1976.

As originally proposed by the applicants, the Preliminary Safety Analysis Report for the Clinch River project consisted of two design approaches. One, called the Reference Design, did not address postulated "core disruptive" accidents and accordingly did not incorporate any design features to accommodate such severe events. Another approach, called the Parallel Design, consisted of the Reference Design augmented with analyses and design features to accommodate the consequences of an assumed core disruptive accident. In this approach the applicants had proposed the so-called core catcher. On May 6, 1976, the NRC staff informed the applicants of its tentative conclusions regarding the adequacy of the dual approach described above and provided specific guidance and comments on how the plant design should proceed in order to achieve its desired safety objectives. The staff stated its position as to the minimum requirements and characteristics to be met for the principal items of concern, including the assessment of the need for and adequacy of the design to accommodate core disruptive accidents. Resolution of differing judgments in this regard and implementation of the appropriate requirements in the

design is a complex technical matter which requires close technical interaction between project personnel and the NRC staff. This procedure is being carried out on a variety of subjects to assure that the unique aspects of the nation's first large-scale demonstration LMFBR are properly considered in the formulation of those requirements.

A special ACRS subcommittee, as well as the full ACRS itself, have held technical meetings with the Clinch River Project Office and the NRC staff; the Atomic Safety and Licensing Board has held several prehearing conferences and various local, State and public organizations are actively participating in the licensing process. It is estimated that the environmental hearings will commence in early 1977; satisfactory completion of these hearings is a prerequisite for a Limited Work Authorization.

The Fast Flux Test Facility (FFTF) also has a role in the development of the LMFBR technology, related mainly to fuels and materials. On April 2, 1976 ERDA submitted to the NRC a Final Safety Analysis Report for the FFTF, currently under construction, and requested NRC to provide advice on matters pertaining to safety. Although FFTF is a government-owned facility, operated under contract with ERDA by the Hanford Engineering Development Laboratory, and is not an NRC-licensed facility, a radiological safety review will be performed by NRC under an interagency agreement with ERDA.

A two-year safety review, similar to those conducted for an operating license for a commercial nuclear power plant, is planned for completion prior to fuel loading in FFTF, currently scheduled for August 1979.

Beginning in 1974, the Advisory Committee on Reactor Safeguards had undertaken a generic review of the question of whether or not a hypothetical core disruptive accident should be considered as a "design basis" accident in evaluating the safety of the LMFBR, and to what extent provision should be made for a core retention system (core-catcher) in the design of the LMFBR. This review culminated in a report issued in August 1976.

The ACRS took note of the significant body of opinion that a core-disruptive accident was extremely unlikely to occur but felt that, in the absence of any actual experience here or abroad with core behavior in severe accident situations or full knowledge of the kinds of events that might initiate core disruption, the core-disruptive accident must be included as part of the safety evaluation of an LMFBR. The NRC staff is giving careful consideration to the ACRS position.

Floating Plants

The floating nuclear plant was conceived by the electric power industry some years ago as an alternative to land siting with several potential advantages, including a freedom from earthquake motions, an abundance of cooling water, and a relative isolation from populated areas.

In April 1972, Offshore Power Systems (OPS), a subsidiary of Westinghouse Electric Corporation, requested that the Atomic Energy Commission (AEC) review the conceptual design of a floating nuclear power plant. The OPS application is for a license for the manufacture, assembly and preoperational testing of eight floating nuclear power plants at a facility in Jacksonville, Florida. The AEC review found the concept to be feasible, and the application was docketed in July 1973.

An NRC staff final environmental statement related to the manufacturing activity in Jacksonville was issued in October 1975. The staff's Safety Evaluation Report was issued in September 1975; Supplement No. 1 was issued in March 1976 and Supplement No. 2 was issued in October 1976. Public hearings on certain safety issues are currently being held before an Atomic Safety and Licensing Board (ASLB). An NRC staff draft environmental statement was published in December 1975 covering the generic issues pertaining to the proposed siting of floating nuclear plants in the coastal regions of the Atlantic Ocean and the Gulf of Mexico.

An important NRC staff study, known as the Draft Liquid Pathway Generic Study (NUREG-0140), issued September 1976, was undertaken to assess, on a comparative basis with land-based plants, the possible radiological consequences of releases through liquid pathways from a wide spectrum of hypothetical accidents, including a core melt. Four typical land-based

and four typical water-based sites were evaluated. The study concluded that the consequences of postulated accidents in floating nuclear plants were comparable with results of the same accidents in land-based plants. This finding provided the basis for the October 1976 supplement to the generic siting environmental statement cited earlier. In 1974, the Public Service Electric and Gas Company of New Jersey (PSE&G) filed the first application for a permit to construct and operate an offshore station using two of the floating nuclear plants. PSE&G's proposed Atlantic Generating Station would be located nearly three miles off the coast of New Jersey, near Atlantic City. Hearings have not yet been scheduled to consider the issuance of a construction permit for the Atlantic Generating Station. The only NRC document issued to date concerning this application is the draft environmental statement (NUREG-0058), dated October 18, 1976.

IMPROVING THE LICENSING PROCESS

Many management actions have been taken during the past several years to improve the efficiency and effectiveness of NRC reviews for licensing nuclear power plants, with neither compromise to safety nor needless delay. Areas of greatest concern for which improvements could be most beneficial include developing approaches that could lead to a significant reduction in the contribution of the regulatory process to the 10-year average lead time needed to place a nuclear plant in an operational status, and establishing a more structured and consistent licensing process—with appropriate guidance to both industry and the NRC staff—in order to minimize licensing delays while assuring public safety. The specific efforts that were undertaken include development of Standard Review Plans, development of standard technical specifications governing plant operation, documentation of acceptance criteria for plant design, continued development of the standardization program, and development of an early site review process for planned nuclear power stations.

Standard Review Plans

Safety Review. The Standard Review Plans for safety reviews were completed during 1975 and fully implemented during 1976. The plans describe the process by which the staff determines that a proposed design provides adequate protection of the public health and safety. The primary purposes of the plans are to improve the quality and uniformity of staff reviews, to stabilize the safety review process, and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. Another important goal in adoption of these plans is to assure that only essential requirements are imposed on license applicants.

Environmental Review. In September 1975, NRC announced plans to develop and employ Standard Review Plans for its environmental reviews. The intent of these plans is to give clear guidance both to applicants and NRC staff as to information and criteria considered essential to the environmental review process, and to provide a basis for excluding unnecessary items. The plans are being prepared to specify NRC internal procedures and positions, to document the content and bases for the environmental review, and to reconsider the scope of the environmental review process to assure that only essential items are considered.

The Environmental Standard Review Plans (ESRP's) will be indexed to generally follow the format of the staff Environmental Statements rather than the format of the applicant's Environmental Reports as set forth in Regulatory Guide 4.2.

The present schedule calls for issuing draft ESRP's for comment in the early part of 1977 and the final ESRP's during the latter part of 1977.

Standard Technical Specifications

Safety. The NRC initiated the Standard Technical Specification (STS) Program in the spring of 1972 as part of its overall licensing standardization effort. This program has resulted in the development of uniform and technically consistent STS's for each of the nuclear steam supply system vendors and associated

balance-of-plant equipment. The STS's are currently being used as the basis for all technical specifications issued with facility operating licenses and have contributed to the promotion of uniform application and interpretation of NRC requirements by the nuclear industry.

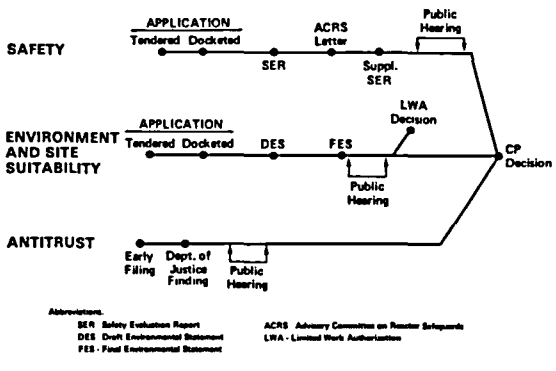
Certain utilities have sites with one unit operational and a similar unit scheduled for operation with STS in the future. In these situations, a conversion of the older unit's specifications to STS has been found to be beneficial in ensuring uniform operational practices. This conversion effort, undertaken in close cooperation with the utilities, will involve facilities at five sites during the next several years.

Ten facilities using STS's were scheduled to be in operation by December 31, 1976.

Environment. Included as part of each operating license for a nuclear power plant are requirements for monitoring certain aspects of operation which may have impact on the environment. These requirements, known as Environmental Technical Specifications, include limiting conditions of operation and data collection to assure that the actual impact is not significantly different from that on which the licensing decision was based. The data collected may also disclose a need for action to mitigate unanticipated environmental impact.

Because the environmental review process has evolved on a case-by-case basis, the Environmental Technical Specifications have differed considerably among licensed stations. In order to make the license conditions more uniform for all stations, Standardized Environmental Technical Specifications are being developed. These will include a standard approach to monitoring for items common to all stations. They will assure adequate coverage of critical concerns, while eliminating the collection of irrelevant information.

PARALLEL TRACKS IN CONSTRUCTION PERMIT REVIEW PROCESS



Regulatory Guides

Development and issuance of Regulatory Guides continued during 1976. The purpose of these guides is to make available to applicants certain methods which are acceptable to the staff for implementing specific parts of the NRC regulations, to delineate the techniques used by the staff in evaluating specific problems or postulated accidents, and to provide guidance to applicants concerning certain of the information needed for review of applications (See Chapter 12). In this way, stabilization of NRC safety and environmental requirements and uniformity of implementation are facilitated.

Topical Reports/Generic Reviews

The major nuclear steam supply system manufacturers, architect-engineering firms, and major component manufacturers are encouraged to prepare and submit topical reports which describe proposed solutions to safety problems, results of research and development programs, and current analytical techniques. These reports generally have broad applicability to several plants or designs, and, if found acceptable by the NRC staff, they can be referenced in any number of applications, thus reducing repetitious review and accelerating the process. A related step is the staff's effort to identify issues and problems which have applicability to a number of plants or review cases and resolve them generically rather than on a case-by-case basis.

Impact of Changing Requirements

Changes in NRC licensing requirements have been frequently cited as a cause of onerous delays and additional costs in the licensing

process. While many of these changes involve significant safety matters, and are viewed as a justifiable part of the licensing review process, the NRC staff has made increasing use of impact/value assessments by which to ensure that the expected benefit of a new requirement justifies its probable cost in time, money, and effort. All new regulatory guides, which inform the industry of acceptable licensing positions, are critically reviewed by the Regulatory Requirements Review Committee, representing top NRC management, before approval. Additionally, guidance on staff review considerations and positions is written into the staff's Standard Review Plans. Finally, NRC management will meet with applicants, members of the staff, or others, to try to resolve any disagreements with staff positions on an application. These procedures are clearly established, and information regarding them has been made public.

STANDARDIZATION PROGRESS

Continued progress was made during 1976 toward the goal of nuclear power plant standardization, initially announced by the Atomic Energy Commission in April 1972. The NRC regards standardization of plant designs—complemented by the early review of sites proposed for the location of nuclear plants—as one of the most important means for improving the efficiency and effectiveness of the licensing process.

Each of the standardization approaches accepted by NRC is based on the multiple use of previously approved plant designs. The procedural options now available to applicants for standardization of nuclear power plants are:

- Reference System—a design of an entire facility or major portion thereof can be reviewed once and utilized repeatedly by reference, without further staff review, in individual applications for licenses;
- Duplicate Plants—the design for several identical plants that would be constructed within a limited time span by one or more utilities at one or more sites can be reviewed once;
- License to Manufacture—the design of an entire facility can be reviewed once for manufacture at a central location, and pre-approved facilities can then be constructed on specific utility sites.

As an expansion of the duplicate plant option, a policy for "replication" was established in 1974. Replication provides for the reuse of a recently approved custom design in a construction permit application for another plant.

The industry's response to the Commission's standardization program has been gratifying, particularly with respect to reactor manufacturers and utilities. By the end of fiscal year 1976, all five reactor vendors had submitted at least one standard reactor design and three architect-engineering firms had submitted balance-of-plant designs. Other architect-engineering firms were contemplating the submission of balance-of-plant designs. A total of 20 different utilities had applied for permits to build 42 "standard" units. Table 1 indicates standardization applications submitted as of September 30, 1976 or identified for submission soon. Preliminary Design Approvals had been previously issued during 1975 to the General Electric Co. for its GESSAR-238 nuclear island design; to Combustion Engineering, Inc. for its CESSAR nuclear steam supply system design; and to Westinghouse Electric Corporation for its RESAR-41 nuclear steam supply system. During 1976, additional Preliminary Design Approvals were issued to the Stone & Webster Engineering Corporation for its balance-of-plant designs matched to RESAR-41 and CESSAR, and to C. F. Braun & Co. for its turbine island design matched to GESSAR-238 (NI).

STANDARDIZATION
MAIN FEATURES OF NRC'S APPROACH

- MAXIMUM CAPACITY—3800 MW THERMAL
- NRC WILL REVIEW:
  - Entire Facility
  - Nuclear Steam Supply System
  - Balance of Plant
- OPTIONS:
  - Reference Systems
  - Duplicate Plants (Including Replication)
  - Licenses to Manufacture

NUCLEAR STEAM SUPPLY SYSTEM (NSSS) AND
BALANCE OF PLANT (BOP)

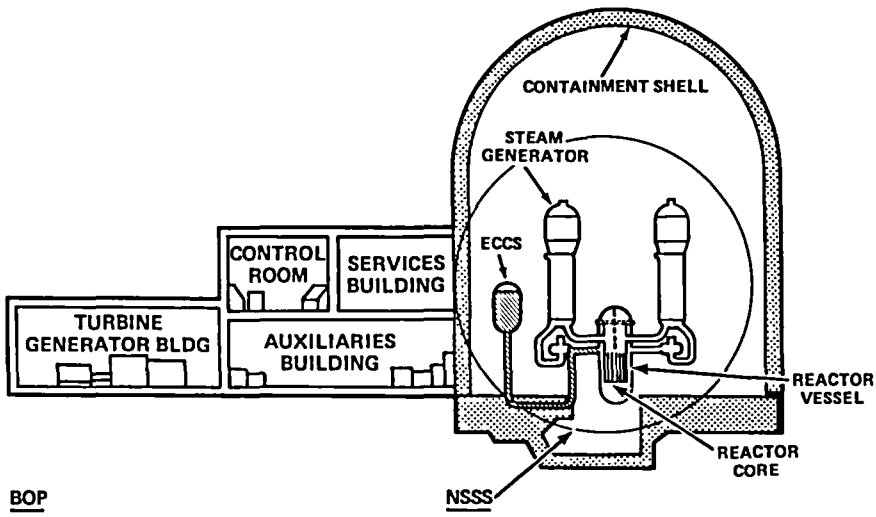


Table II. Standardization Applications

(as of September 30, 1976)

PROJECT	*APPLICANT*	*DOCKET DATE*	*COMMENTS*
Reference Systems			
GESSAR-28 (NI)	General Electric	7-30-73	Nuclear island. PDA-1 (Preliminary Design Approval) issued 12-22-75
CESSAR	Combustion Engineering	12-19-73	Nuclear Steam Supply System (NSSS). PDA-2 issued 12-31-75
RESAR-41	Westinghouse	3-11-74	NSSS. PDA-3 issued 12-31-75
B-SAR-241	Babcock & Wilcox	5-14-74	NSSS (Withdrawn)
SWESSAR RESAR-41	Stone & Webster	6-28-74	Standard balance-of-plant (BOP) design matched to RESAR-41. PDA-4 issued 5-5-76
CESSAR		10-21-74	BOP matched to CESSAR. PDA-6 issued 8-16-76
RESAR-3S		10-2-75	BOP matched to RESAR-3S
B-SAR-205		12-22-75	BOP matched to B-SAR-205
C. F. Braun SSAR	C. F. Braun	12-21-74	Turbine Island matched to GESSAR-238 (NI) PDA-5 issued 5-7-76
GASSAR	General Atomic	2-5-75	NSSS (Under review)
GESSAR-251	General Electric	2-14-75	NSSS (Under review)
RESAR-3S	Westinghouse	7-31-75	NSSS (Under review)

PROJECT	*APPLICANT*	*DOCKET DATE*	*COMMENTS*
Reference Systems (Continued)			
GESSAR-238 (NSSS)	General Electric	10-16-75	NSSS (Under review)
B-SAR-205	Babcock & Wilcox	3-1-76	NSSS (replaces B-SAR-241)
BOP-SSAR	Fluor Pioneer	1-27-76	BOP matched to RESAR-41
GIBBS-SSAR	Gibbs & Hill	(soon)	BOP matched to RESAR-41
RESAR-414	Westinghouse	(soon)	NSSS
Utility Applications Using Reference Systems			
Cherokee 1, 2 & 3	Duke Power	5-24-74	References CESSAR
Perkins 1, 2 & 3	Duke Power	5-24-74	References CESSAR
South Texas 1 & 2	Houston Light & Power	7-5-74	References RESAR-41 CP issued 12-22-75
WNP-3 & 5	Washington Public Power Supply System	8-2-74	References CESSAR
Palo Verde 1, 2 & 3	Arizona Public Service	10-7-74	References CESSAR CP issued 5-25-76
Hartsville 1, 2, 3 & 4	Tennessee Valley Authority	11-22-74	References GESSAR-238 (NI)
Black Fox 1 & 2	Public Service of Oklahoma	12-23-75	References GESSAR-238 (NSSS)
Phipps Bend 1 & 2	Tennessee Valley Authority	11-7-75	References GESSAR-238 (NI)
Yellow Creek 1 & 2	Tennessee Valley Authority	7-16-76	References CESSAR
Duplicate Plants			
Byron 1 & 2/ Braidwood 1 & 2	Commonwealth Edison	9-20-73	Two units at each of two sites
SNUPPS			Five units at four sites
Wolf Creek	Kansas Gas & Electric Kansas City Power & Light	5-17-74	Under review
Callaway 1 & 2	Union Electric	6-21-74	CP issued 4-14-76
Tyrone 1	Northern States Power	6-21-74	Under review
Sterling	Rochester Gas & Electric	6-21-74	Under review
WUPS			As many as six units on three sites
Koshkonong 1 & 2	Wisconsin Electric Power Madison Gas & Electric Wisconsin Power & Light Wisconsin Public Service	8-9-74	Under review Under review Under review Under review
License to Manufacture			
Floating Nuclear Plant (FNP) 1-8	Offshore Power Station	7-5-73	Entire plant design
Utility Applications Using License to Manufacture			
Atlantic 1 & 2	Public Service Electric & Gas	3-1-74	References FNP
Replication			
Jamesport 1 & 2	Long Island Lighting	9-6-74	Replicates Millstone 3
Marble Hill 1 & 2	Public Service of Indiana	9-17-75	Replicates Byron/Braidwood
New England 1 & 2	New England Power & Light	9-9-76	Replicates Seabrook

Legislative Proposal

In May 1975, the Commission forwarded to the Congress a legislative proposal to improve the licensing process for major nuclear facilities, which was introduced as S. 1717 and H.R. 7002. In subsequent hearings conducted in 1975 by the Joint Committee on Atomic Energy, the Commission strongly supported the proposed licensing reform legislation as a measure that could lead to reduction of the time now required to bring a nuclear power plant on line from eight or more years to about six years. The basic concepts of early site approvals and standard plant designs are at the heart of the proposed legislation, which was still pending before Congress at the end of the report period.

EARLY SITE REVIEWS

The Commission is planning to implement a policy of Early Site Reviews (ESR)—to the extent possible under existing regulatory authority—which is designed to separate the review and approval process for the site from the review and approval process for the facility to be constructed on that site. For any applicant (utility, State, or other), this ESR could take the form of staff (and ACRS) approval to be carried through the Safety Evaluation Report and Environmental Impact Statement; or, for utility applicants only, it could comprise a partial decision on site suitability issues through the hearing process. This early site review policy would permit the applicant to determine those site suitability issues to be reviewed, provided certain acceptance criteria are met. Therefore, the issues to be considered could range from a single safety issue (such as seismicity) to a full review of all safety and environmental issues.

Draft regulations implementing these policies were issued for public comment on April 22, 1976, and the comment period was extended until July 15, 1976. The regulations seek three main objectives: (1) early identification and resolution of site-related problems before substantial commitments of resources are made by the applicant; (2) bringing in public participation at any early stage when it can be most effective in the decision-making process; and (3) removing the resolution of siting issues as a delaying item in the review and decision-making process for Construction Permit applications. It is anticipated that the final rulemaking will be effective in early 1977.

ANTITRUST ACTIVITIES

Since December 1970, the NRC has been required to conduct prelicensing antitrust reviews of all applications for nuclear reactors or other nuclear facilities for commercial use. These reviews assure that the issuance of any license will not create or maintain a situation inconsistent with the antitrust laws. NRC will hold a hearing when it is recommended by the Attorney General and must also consider whether antitrust issues raised by NRC staff or intervenors should be the subject of a hearing.

Antitrust hearings are held separately from those on environment, health, and radiological safety matters. In order that the antitrust review does not delay the NRC licensing decisions, the applicant is required to submit specified antitrust information to the NRC at least nine months—but not earlier than 36 months—before other parts of the construction permit application are filed for acceptance review.

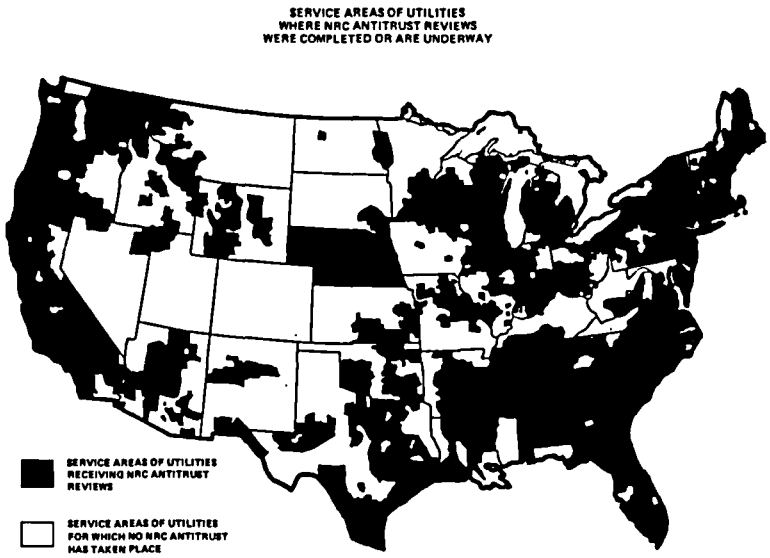
Since the inception of NRC's antitrust program, 91 reviews have been or are being performed. Of the 88 applications reviewed by the Department of Justice, 17 were recommended for hearing; 24 were recomended for "no hearing" because applicants agreed to antitrust license conditions; and 47 were recommended for "no hearing," without need for conditions.

In the period July 1, 1975 through September 30, 1976, 14 reviews have been or were being performed. Of these, the Department of Justice has recommended in one case that a hearing be held; in two cases that no hearing be held because applicants agreed to antitrust license conditions; and in 8 cases that no hearing be held, without license conditions. Three other reviews are in their initial stages.

Important developments have taken place in several antitrust proceedings:

- The direct cases of the intervenors, the Government, and the applicant have been

Since December, 1970, the AEC/NRC performed or is performing antitrust reviews of applicants for nuclear facilities that include 74 of the 100 largest electric utilities in the United States. These utilities account for approximately 77 percent of the total kilowatt hour sales in the United States.



concluded in the first phase of a two-part hearing on Alabama Power Co.'s Farley Units 1 and 2.

- The Department of Justice, the NRC staff, and the intervenors have appealed to the Atomic Safety and Licensing Appeal Board on the Atomic Safety and Licensing Board decision of July 18, 1976 on Consumer Power Co.'s application to construct Midland Units 1 and 2 (Michigan).
- Antitrust hearings have been completed for a consolidated group of construction permit applications involving Davis-Besse Units 1, 2 and 3 (Ohio and Pennsylvania). Proposed findings were submitted to an Atomic Safety and Licensing Board in August 1976.
- On April 14, 1976, an Atomic Safety and Licensing Appeal Board upheld the decision of an Atomic Safety and Licensing Board that an operating license could not be issued to Toledo Edison Co. for its Davis-Besse Unit 1 until a decision is rendered on the antitrust proceeding.
- A hearing on Kansas Gas and Electric Co.'s application to construct the Wolf Creek Unit was ended when the applicant and intervenor filed and were granted a motion for dismissal based upon a settlement agreement that was incorporated into license conditions.

INDEMNITY AND INSURANCE

The Price-Anderson Act currently provides a system of private insurance and government indemnity totaling $560 million to pay public liability claims in the unlikely event of a nuclear incident involving personal injury and property damage. On December 31, 1975, the Price-Anderson Act was modified and extended until August 1, 1987 with the passage of Public Law 94-197. Among other things, this legislation provides for the phasing out of government indemnity by 1985 through a mechanism whereby utility industry licensees would collectively share in the financial risk of a nuclear incident through payment of a retrospective premium to the nuclear insurance pools. In September 1976, the Commission published in the *Federal Register* (41 F.R. 4051) a proposed rule to set this retrospective premium at $5 million per reactor.

The new legislation (P. L. 94-197) provides that in the remote situation of a nuclear incident resulting in damages exceeding the current $125 million primary insurance layer, each licensee of a large power reactor would then be called upon to pay a prorated share of the damages in excess of the primary layer up to the maximum of $5 million per reactor. The present $560 million limit on liability for a single nuclear incident would be retained until

the combined primary and retrospective insurance layers reach $560 million. After that point, the combined liability coverage would rise with the increases in the primary and retrospective insurance layers. No ultimate dollar limit on liability would be set.

Constitutionality of Price-Anderson. In September 1976, a hearing was held in the U.S. District Court for the Western District of North Carolina, Charlotte Division, in a lawsuit in which the constitutionality of the Price-Anderson Act's limitation on liability provisions is being challenged. The September hearing was confined to the issues of whether the plaintiffs —the Carolina Environmental Study Group, Inc. and its individual members—had standing to challenge the constitutionality of the Act and whether the issue was ripe for present determination. Only if the court rules for the plaintiffs on the issues of standing and ripeness will the court have occasion to rule on the constitutionality of the Act.

Indemnity Operations

As of September 30, 1976, 121 indemnity agreements with NRC licensees were in effect. Indemnity fees earned by the NRC from July 1, 1975 through September 30, 1976 totaled $4,700,303. Total fees collected since inception of the program are $15,178,040. No payments have been made under the NRC's indemnity agreements with licensees during the 19 years of the program's existence.

Insurance Premium Refunds

The two private nuclear energy liability insurance pools—the Nuclear Energy Liability and Property Insurance Association, and Mutual Atomic Energy Liability Underwriters—paid to policyholders the tenth annual refund of premium reserves under their Industry Credit Rating Plan. The refunds totalled $1,681,622, which is 69.8 percent of all premiums paid by the affected policyholders in 1966, and 98.7 percent of the reserve established from these premiums.

Under the rating plan, a portion of the annual premiums is set aside as a reserve for either payment of losses or ultimate return 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.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

The Advisory Committee on Reactor Safeguards (ACRS) is a group of independent advisors established by law to review and report to the Nuclear Regulatory Commission on safety studies and license applications for nuclear power reactors and other major nuclear facilities such as spent fuel processing plants. The Committee also provides advice to the Commission on a wide range of safety-related matters such as the adequacy of proposed reactor safety standards, reactor safety research, specific technical issues of various kinds, and the safety of operating reactors.

During the period July 1, 1975 to September 30, 1976, the ACRS provided advisory reports to the NRC concerning construction permits for 14 nuclear power plants, including the first multi-site standard plant proposal, consisting of the Sterling (New York), Tyrone (Wisconsin), Wolf Creek (Kansas), and Callaway (Missouri) sites. The NRC's progress toward standardization of nuclear power plant design was reflected in this period by the Committee's review and approval of four standard safety analysis reports from major reactor designers and architect-engineering firms: Combustion Engineering Standard Safety Analysis Report (CESSAR-80), Westinghouse Reference Safety Analysis Report (RESAR-41 and RESAR-3-S), Stone and Webster Engineering Standard Safety Analysis Report (SWESSAR P1), and C. F. Braun Safety Analysis Report (BRAUN-SAR).

Of major interest in the period was the Committee's review of the allegations of three employees of the General Electric Co. and of a former NRC employee regarding the safety of the U.S. nuclear power program. The ACRS Chairman and four ACRS members testified before the Joint Committee on Atomic Energy with respect to these allegations. Further, at

The ACRS subcommittee established to review Unit 2 of the Three Mile Island nuclear power plant observed ongoing construction during a visit to the plant site near Harrisburg, Pa., in September 1976. ACRS Subcommittee Chairman John Arnold (second from left) was accompanied by ACRS consultants and staff and plant construction personnel.

the request of the Commission, the ACRS conducted a detailed review to provide answers to questions raised by NRC Chairman Anders regarding the allegations. Specifically, the questions were: (1) whether the allegations raise issues affecting the safety of nuclear facilities of which the ACRS had not been aware; (2) whether they present new information concerning generic or specific issues which indicates a need for regulatory action; and (3) whether they present any other basis for altering Commission regulatory requirements or research priorities. The ACRS reported to the Commission that only six of the numerous matters raised in the allegations had not been the subject of previous ACRS review. The Committee concluded that no new information had been disclosed requiring a need for immediate regulatory action, and that no basis was found for altering Commission regulatory requirements or research priorities.

During the report period, the ACRS conducted special reviews of the proposed operation of the Light Water Breeder Reactor at Shippingport, Pa., and the evaluation model for the proposed upper head injection system for the Westinghouse Emergency Core Cooling System. The Committee also submitted special studies to the NRC on the physical conditions, mechanisms and probabilities of a hypothetical core disruptive accident in liquid metal fast breeder reactors and on design provisions in nuclear power plants to protect against sabotage. An interim report on the technical aspects of management of radioactive wastes was also prepared.

Other special reports were provided by the ACRS to the NRC during fiscal year 1976 on numerous facilities and safety topics, including: Loss-of-Fluid Test facility; Fast Flux Test Facility; Exxon Nuclear Co.'s Emergency Core Cooling System evaluation model for reload cores in pressurized water reactors; floating nuclear plants; the NRC nuclear reactor inspection program; and the proposed operation of MARF/S7G naval reactor facility at West Milton, N.Y. Following the Browns Ferry fire,

the Committee completed a review of repairs and modifications to Units 1 and 2 at the facility prior to their restart and provided a report to the NRC. Comments were also provided to the Executive Director for Operations regarding use of "fault tree" and "event tree" analysis in reactor safety assessment, stress corrosion cracking in boiling water reactors, qualifications for radiation protection personnel, reevaluation of reactor siting criteria and policies, alternate additives to reactor containment sprays, development of loss-of-coolant "best estimate" analytical models, and alternatives to the NRC staff position regarding Anticipated Transients Without Scram. The ACRS also reviewed and approved 13 Regulatory Guides and proposed modifications to existing Guides.

Near the end of the report period, the ACRS was actively engaged in the review of a number of generic items, including the adequacy of packaging for air shipment of plutonium; the development of criteria for shipment of radioactive materials; and the safety and safeguards aspects of possible widespread use of mixed oxide fuels. The Committee has also been requested to review the general design criteria for fuel enrichment plants—a new area of ACRS participation—and consideration is being given to ACRS review of fuel fabricating plants.

In performing its reviews and preparing its reports during the period, the Committee met in full session 15 times. All of these meetings were partially or fully open to the public. Of the 116 subcommittee and working group meetings held during the period, 106 were partly open to the public. A total of 27 site/facility visits were made in fiscal year 1976.

NUCLEAR ENERGY CENTER SITE SURVEY

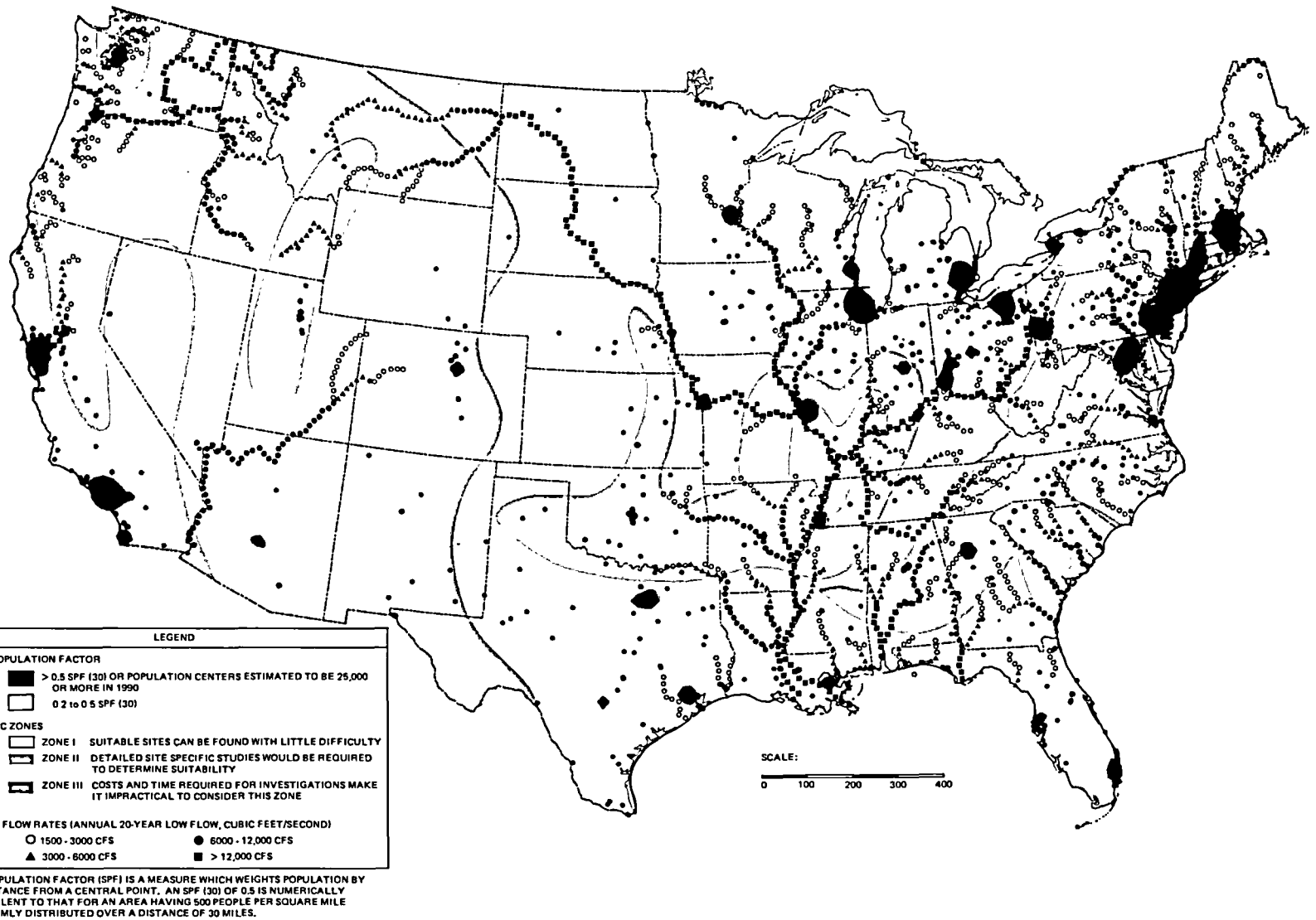
The Energy Reorganization Act of 1974 which created the NRC also directed the NRC to conduct a national survey to locate and identify potential sites for nuclear energy centers, as well as to assess the technical feasibility and social practicality of locating multiple and various nuclear facilities at a single site. As defined in the Act, such sites would be large enough to support utility operations or other stages in the nuclear fuel cycle or both, including, if appropriate, nuclear fuel reprocessing facilities, fuel fabrication plants, nuclear waste storage facilities, and uranium enrichment facilities. The mandated study was also to include: (1) a regional evaluation of natural resources, estimates of future electric power requirements that could be served by each site, assessment of economic impact, and consideration of other relevant factors; (2) evaluation of the environmental impact of such centers; (3) consideration of federally owned land except national parks, forests, wilderness areas and monuments; and (4) cooperation with other Federal, State, and local agencies, and consultation with others, as needed.

On January 19, 1976, one year after NRC came into being, the mandated report, entitled "Nuclear Energy Center Site Survey—1975" (NECSS-75; NUREG-0001), was completed and delivered to the Congress and the Council on Environmental Quality. The five-part, 2000-page report had been prepared by NRC's Office of Special Studies.

The NECSS is a study of an alternative siting approach for nuclear power and fuel cycle facilities—an approach that would cluster sizable groups of such facilities on a relatively small number of sites, as contrasted with current "dispersed siting" practices. The largest aggregation of reactors on a single site being planned today is four, and this "quad" was assumed, for purposes of the study, to be typical of a "dispersed" site by the year 2000. Three basic types of centers were considered: (1) power plant centers, consisting of 10 to 40 nuclear electric generating units of 1,200 MWe capacity each; (2) fuel cycle centers, consisting of at least one fuel reprocessing plant, one mixed oxide fuel fabrication facility, and one radioactive waste management facility; (3) combined centers, consisting of both power plants and fuel cycle facilities.

Assessing issues related to the technical feasibility of such centers involved studies of the dissipation of waste heat from the energy centers; transmission systems design, reliability, and economic aspects of both; the economics of energy center construction; and radiological and environmental impacts. The major "practicality" issues included: jurisdictional and

NECSS COMPOSITE COARSE SCREENING MAP



*SITE POPULATION FACTOR (SPF) IS A MEASURE WHICH WEIGHTS POPULATION BY ITS DISTANCE FROM A CENTRAL POINT. AN SPF (30) OF 0.5 IS NUMERICALLY EQUIVALENT TO THAT FOR AN AREA HAVING 500 PEOPLE PER SQUARE MILE UNIFORMLY DISTRIBUTED OVER A DISTANCE OF 30 MILES.

institutional constraints; political and economic factors; financing; questions related to accident risk, natural disasters, and national security; and the safeguarding of nuclear materials from theft and nuclear plants from sabotage. The survey also included a screening of nuclear sites in each of the nine "electric reliability regions" of the United States, which are regions into which the contiguous United States is divided for coordinated planning of dependable electric power supply. The screening undertook to identify large land areas with certain characteristics—water resources, seismicity, population distribution, availability of public lands—that would make it likely that suitable nuclear energy center sites would be found within them.

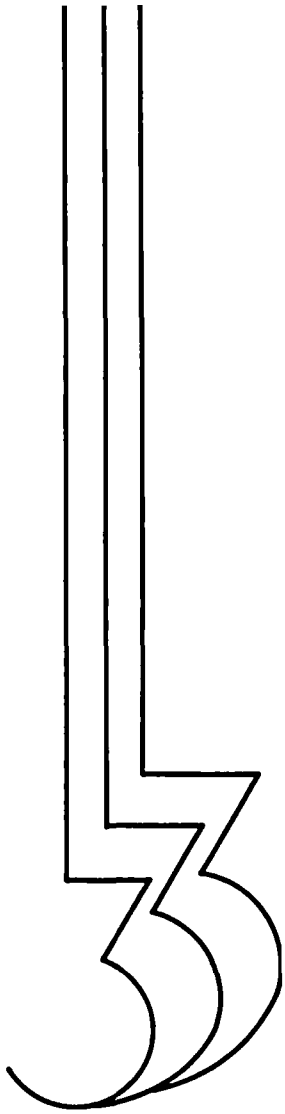
Contributions to the year-long study were made by the National Laboratories; experts from other Federal agencies, education, labor, private industry; State and local government; public interest groups; and the NRC staff. Hundreds of people participated in the survey and related studies and contributed substantially to the final report.

The NECSS report concluded that, with respect to locating clusters of power reactors at a single site, it would be feasible and practical to construct and operate up to about 20 nuclear power reactors of 1,200 MWe capacity each at one site. However, no compelling advantage or need for doing so was identified.

The survey also concluded that locating nuclear fuel cycle facilities—or combined power and fuel cycle facilities—on nuclear energy center sites was both feasible and practical and that, although the present need for such centers is not compelling, there were real benefits associated with them, for example, in reducing safeguarding problems.

In transmitting the report to the Congress, the Commission noted that the NECSS analyses support the possibility of a nuclear power system that accommodates both dispersed sites and nuclear energy centers. The Commission recommended that such centers neither be made mandatory nor be excluded, but affirmed that careful account of the natural and social characteristics of any potential specific center site would have to be taken by the appropriate State and Federal authorities before approving it for such use.

Technicians at Florida Power & Light's Turkey Point plant supervise the transfer of fuel elements via fuel cask from Unit No. 4 to Unit No. 3 spent fuel pool in preparation for installation of fuel storage racks for increased pool capacity. Part of the construction work also will include installation of a new stainless steel liner to correct the water seepage that was experienced through the old liner. Work on Unit No. 4 is scheduled to be completed in mid-1977, and on Unit No. 3 by late 1978.



Regulating Nuclear Materials

Besides exercising regulatory authority over the operation of commercial power plants using nuclear fuel, as described in the preceding chapter, the NRC is also responsible for regulating the nuclear material that goes into the fuel and the "spent fuel" that remains. Other uses of radioactive material—in medicine or industry—also come under NRC regulation.

Because of the importance of the subject, the chapter opens with a discussion of the reprocessing-recycle issue, the question of whether to recover plutonium and unused uranium from spent fuel and use them to make new fuel. The chapter goes on to cover the problem of mill tailings, uranium enrichment and fuel fabrication facilities, medical and other uses of radioisotopes, and the transportation of radioactive materials.

The Reprocessing-Recycle Issue

The NRC is in the process of arriving at a decision as to whether the wide-scale use of mixed oxide fuel (a mixture of recycled plutonium oxide and uranium oxide) should be permitted in light-water-cooled nuclear power reactors and, if permitted, under what regulatory constraints.

Light water reactors (LWRs) currently are fueled with uranium of different enrichments—up to 4 percent in the isotope uranium-235, as compared to the 0.7 percent found in natural uranium. While the reactor operates, some of the uranium is converted into plutonium, some of which fissions in place, providing about one-third of the reactor's total energy output over the useful life of the fuel. Fuel burnup also creates other by-products which gradually impede the nuclear reaction even though substantial quantities of fissile uranium and plutonium remain in the fuel. When the useful life of the fuel is over, the remaining fissile uranium and plutonium could be separated at chemical reprocessing plants from the other materials in the spent fuel, converted into uranium and plutonium oxides, and recycled as reactor fuel. Whether or not to license such reprocessing and recycling on a wide scale is the issue which

currently confronts the NRC. Pending resolution of this issue, the spent fuel remains in storage at the various reactor sites and at inactive reprocessing plants.

A draft environmental impact statement on factors involved in the decision regarding plutonium recycle had been issued by the former Atomic Energy Commission for public review and comment in August 1974. When the NRC was established as a separate agency in January 1975, it assumed ongoing responsibility for the plutonium recycle assessment.

In a *Federal Register* notice on May 8, 1975, the NRC published, and requested comment on, its provisional view that a cost-benefit analysis of alternative programs for protecting plutonium against theft and sabotage should be set forth in draft and final environmental impact statements before a Commission decision was reached on the plutonium recycle question. In the same notice the NRC stated its further provisional views that future licensing actions related to the wide-scale use of mixed oxide fuels should be addressed within the context of individual licensing proceedings and that the following guidelines should be observed: (1) there should be no additional licenses granted for use of mixed oxide fuel in light water nuclear power reactors except for experimental purposes; and (2) with respect to light water nuclear power reactor fuel cycle activities which depend for their justification on wide-scale use of mixed oxide fuel in light water nuclear power reactors, there should be no additional licenses granted which would foreclose future safeguards options or result in unnecessary "grandfathering." This would not preclude the granting of licenses for experimental and/or technical feasibility demonstration purposes.

On November 14, 1975, after consideration of public comments on its provisional views, the Commission announced its final conclusions on the decisional course it would follow in the matter of wide-scale use of mixed oxide fuel in LWRs. The Commission directed its staff to prepare a safeguards supplement to the August 1974 draft environmental statement. The draft Safeguards Supplement, to be released for public comment in early 1977, will include an analysis of the costs and benefits of alternative safeguards programs, and a recommendation as to safeguards requirements associated with wide-scale use of mixed oxide fuel. An overall cost-benefit analysis of wide-scale use, including health, safety, environmental and safeguards factors, and the international implications of a U.S. decision to recycle will be issued at a later date. (The draft environmental statement which had been issued in August 1974 is considered the draft statement relating to health, safety and environmental factors.)

Final Environmental Statement

The Commission also directed its staff to expedite preparation of those portions of the final environmental statement dealing with health, safety and environmental matters. This document, published in August 1976 under the publication number NUREG–0002, was entitled: "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors—Health, Safety and Environment," and is referred to as GESMO 1. The final statement, which consists of 5 volumes and contains a total of 1700 pages, includes the NRC staff responses to the comments received on the 1974 draft environmental impact statement. It was prepared by a special NRC task force of fuel cycle and reactor specialists assisted by scientists from National Laboratories in Oak Ridge, Tenn.; Richland, Wash.; Los Alamos, N.M.; and Argonne, Ill. The task force considered five LWR fuel cycle alternatives:

(1) Early reprocessing of spent fuel and recycle of uranium but with a delay in introducing plutonium recycle;
(2) Delay of both reprocessing and plutonium recycle;
(3) Early reprocessing of spent fuel and recycling of recovered plutonium and uranium;
(4) Delayed reprocessing of spent fuel and recycle of uranium, and no plutonium recycle; and
(5) No reprocessing and recycling of spent fuel.

The principal staff findings based on health, safety and environmental—but not safeguards—considerations, were as follows:

- The safety of reactors and fuel cycle facilities would not be affected significantly by recycle of fissile materials.
- Adverse nonradiological environmental impacts resulting from recycle of fissile materials from spent fuel would actually be slightly less than those from a fuel cycle that does not reclaim residual fuel values.
- Plutonium recycle would extend uranium resources and reduce enrichment requirements, but would introduce the need for reprocessing and fabrication of plutonium-containing fuels.
- While there are uncertainties, wide-scale recycle would be likely to have economic advantages as compared to a fuel cycle that does not reclaim residual fuel values.
- Differences in health effects attributable to alternative fuel cycles would be too slight to provide a significant basis for selection among the alternatives.
- No waste management considerations were identified that would bar recycle of recovered uranium and plutonium.

In reaching these findings the NRC staff analyzed the projected effects of nuclear fuel operations under each alternative throughout the remainder of this century. The analyses were based on documented information on the operation of existing facilities—including those that have used recycle plutonium for experimental purposes—and design data for plants already planned. A range of energy resource needs was considered; however, the analyses were centered on a low energy growth rate projection made by the Energy Research and Development Administration which predicts that 507,000 megawatts of light water nuclear generating capacity will be installed in the United States in the year 2000. The effects of both higher growth rates and the possible advent of breeder reactors were also considered.

In addition, the analyses took into account such environmental impacts as effluents from fossil-fired power plants that provide power for certain nuclear power-related facilities (such as uranium enrichment plants), and radiation exposures of workers employed in the nuclear industry and of the general public, including exposures from the transport of nuclear materials.

The Commission decision on whether to license wide-scale use of mixed oxide fuel will be based both on the final environmental statement (including the final safeguards supplement), and on the record of public hearings started on November 30, 1976, by a special board established by the Commission.

Public hearings on the Generic Environmental Statement on Mixed Oxide Fuel opened on November 30, 1976, in Washington, D.C. Special Hearing Board members are, left to right: Kline Weatherford, attorney, former President of Morton Salt Co.; Dr. Frank L. Parker, Professor of Environmental and Water Resources Engineering, Vanderbilt University; George Bunn, Chairman of the Hearing Board and faculty member of the University of Wisconsin Law School; Dr. Melvin W. Carter, Director, Office of Interdisciplinary Programs, Director, Bioengineering Center, and Professor of Nuclear Engineering, Georgia Institute of Technology; and Dr. Albert Carnesale, Associate Director, Program for Science and International Affairs and Lecturer on Engineering and Applied Physics, Harvard University.

The President issued a nuclear policy statement on October 28, 1976, announcing decisions that (1) the reprocessing and recycling of plutonium should not proceed unless there is sound reason to conclude that the world community can overcome effectively the associated risks of proliferation of nuclear explosives capability, (2) the avoidance of proliferation must take precedence over economic interests, and (3) the U.S. and other nations should increase their use of nuclear power for peaceful purposes even if reprocessing and recycle of plutonium are not found acceptable.

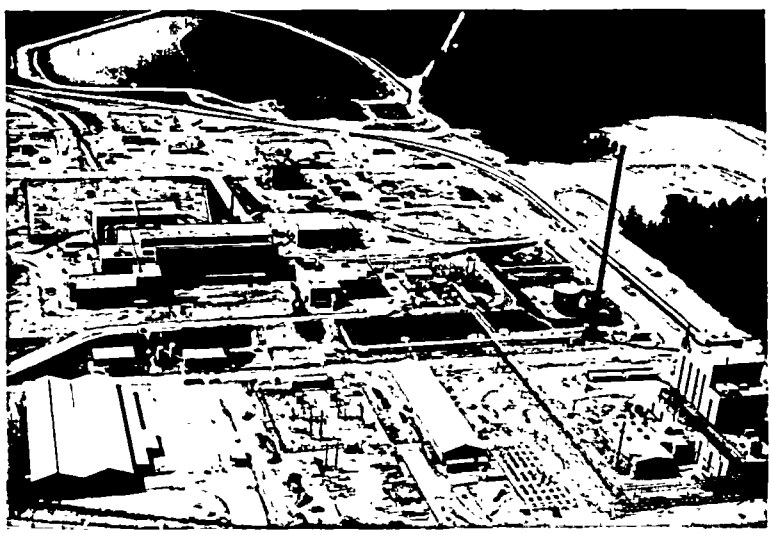
The President directed that ERDA identify research and development efforts needed to define a reprocessing and recycle evaluation program consistent with the U.S. goal of building an effective system of international controls to prevent proliferation of nuclear explosives capability; to investigate the feasibility of recovering energy value from used nuclear fuel without separating plutonium; to speed up the program to demonstrate all components of waste management technology by 1978; and to demonstrate the operation of a complete repository for nuclear wastes by 1985. The waste repository plans will be submitted to NRC for licensing.

The results of the ERDA work will be considered in the NRC's plutonium recycle decision process as a supplement to the record of facts, views and recommendations developed in GESMO 1 and the public hearings. The GESMO 1 public hearings began on November 30, 1976, with consideration of matters relating to the health, safety and environmental impact statement. Upon publication of the final Safeguards Supplement (see Chapter 6) the hearings will take up the safeguards matters.

Licensing Reviews of Reprocessing Plants

Although the future of reprocessing (and recycle of plutonium into LWRs) is uncertain and licensing of activities based upon wide-scale use of mixed oxide in LWRs prohibited, the NRC staff nevertheless continued to review applications for licenses to construct and operate fuel reprocessing plants to the extent permitted under the terms of the Commission's announcement of November 1975.

Construction of Allied-General Nuclear Services' separations plant at Barnwell, S.C. is virtually completed; however, work on the projected plutonium conversion and waste solidification facilities at Barnwell has not yet begun. The hearing on the application to license the operation of Barnwell is continuing, but is limited to safety and environmental issues. The NRC's final environmental impact statement, which was introduced into the hearing record, has been supplemented by a draft statement deal-

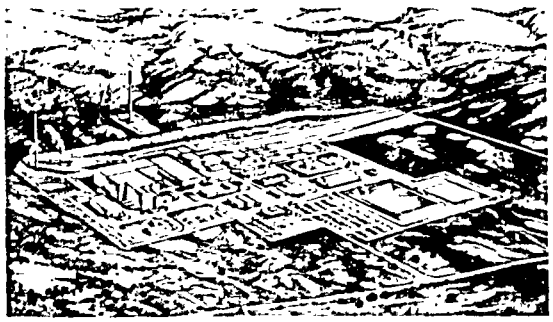


Aerial photograph of Allied-General Nuclear Services' nearly completed Barnwell Nuclear Fuel Plant at Barnwell, S.C. The fuel receiving and storage station and separations facility are located in the left center. The UF_6 facility is in the lower right corner. Beacon Pond, a man-made water conditioning pond serving the BNFP, is at upper left.

ing with impacts from the full range of activities expected to be conducted at Barnwell and vicinity as well as with krypton-85, tritium and carbon-14 gas removal and collection technology. Comments on the draft supplement were received but a final supplement had not been issued by year-end. A second supplement, dealing with the final cost-benefit analysis and with safeguards, is planned when a licensing basis is established, that is, after the Commission's decision on recycle and reprocessing.

Nuclear Fuel Services, Inc., operator of the reprocessing plant at West Valley, N.Y., which has been shut down since 1972 pending major modifications, announced in September that it intended to withdraw from the nuclear fuel reprocessing business. The NRC safety and environmental reviews of the proposed modifications continued until then, concentrating on the question of how to apply seismic design criteria for new facilities to an existing facility such as the NFS plant. Further decisions on operation or disposition of the facility and transfer of responsibility for existing high-level wastes are pending reviews with NFS's co-licensee, the New York State Energy Research and Development Authority. These decisions are expected in 1977. NRC staff has reviewed the licensee's operations to assure that the facility is being maintained in a safe shutdown condition.

Exxon Nuclear Company, Inc. submitted an application in 1976 for a license to construct and operate a 2,100-metric-ton-per-year reprocessing plant (capable of supporting seventy 1,000-MWe power reactors), including capability to store up to 7,000 metric tons of spent fuel. This plant would be located at Oak Ridge, Tenn., on the ERDA reservation. The NRC has begun its detailed safety and environmental reviews of this application.



Conceptual view of a proposed Nuclear Fuel Recovery and Recycling Center. The NRC staff is reviewing Exxon Nuclear Co.'s application for a permit to build the facility at Oak Ridge, Tenn.

Spent Fuel Storage

Since no reprocessing of spent fuel from light-water reactors is taking place pending NRC's resolution of the issues regarding recycle, disposition of the growing inventory of spent fuel has become a problem for an increasing number of utilities. Typical storage capacity at a reactor is about one and one-half core loads, or six years of accumulated spent fuel. Nuclear utilities have been contacting NRC regarding storage capacity at their nuclear power plants in increasing numbers. Thirteen applications, letters of intent and other indications of interest to increase storage capacity were received during calendar year 1975, and an additional 17 during calendar year 1976. By December 31, 1976, the NRC had approved 18 requests.

All increases in storage capacity approved to date will be achieved with existing storage pools, utilizing one or a combination of the following methods:

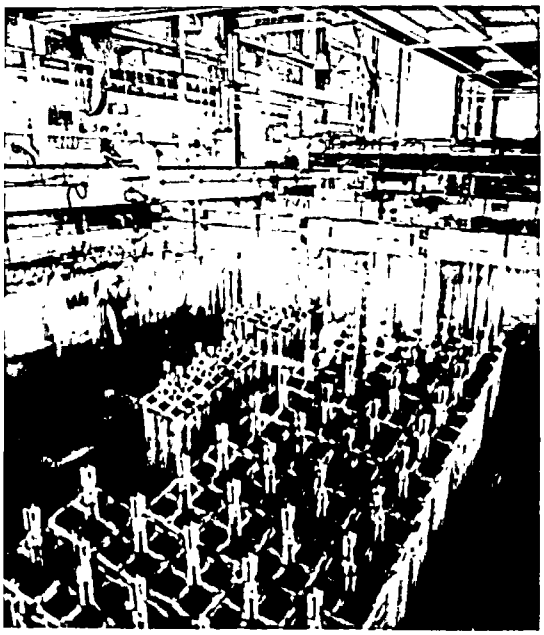
(1) Adding new racks of the same design in unused space;

(2) Reducing the spacing among existing racks; and

(3) Replacing existing racks with new ones incorporating neutron poisons.

Increases of 200 percent to 300 percent in storage capacity can be achieved by design changes, resulting in the capability to store 8 to 12 additional years of discharged fuel. Still more applications for storage capacity increases, larger storage pools for new reactors and independent spent fuel storage installations may be expected in the future if the reprocessing delays continue.

The General Electric Co. modified its Morris, Ill., storage pool to increase capacity from 100 metric tons to about 750 metric tons and began to accept spent fuel for various customers. GE



This interior photograph shows spent reactor fuel stored at the General Electric Co.'s Morris Operation at Morris, Ill. About 750 metric tons of spent fuel can be stored in this basin. Due to an optical illusion, the fuel appears to be close to the water surface, but it is actually about 15 feet below the surface.

is considering a modification to the existing storage basin which would result in a further significant increase in storage capacity.

An Atomic Safety and Licensing Board hearing on Allied-General Nuclear Services' request to authorize use of its 400-metric-ton spent fuel storage pool at Barnwell, S.C., had not yet begun due to delays resulting from the consideration of an extensive list of contentions.

While the reviews and approvals of increases in spent fuel storage capacity at individual reactor sites were in progress, the NRC was also evaluating the environmental impact of handling, shipping and storing spent light-water power reactor fuel during the approximate 10-year period in which interim storage will be required regardless of any NRC fuel cycle decisions. A draft generic environmental impact statement covering this evaluation is expected to be issued in early 1977, and the final environmental statement and any possible rulemaking or other guidance on spent storage are anticipated later in the year.

The Uranium Mill Tailings Issue

The uranium in the ore extracted by mining is separated and concentrated in milling operations. The milling of uranium results in the accumulation of large quantities of waste product material called tailings. These tailings, comprised primarily of ore residues, contain almost all of the radioactivity that was originally present in the ore. Although the concentration of radioactivity in tailings is relatively low, they represent a waste management problem because of the large quantities involved and the long half-life of the radionuclides present. Uranium mill tailings are, accordingly, the subject of increasing attention by the NRC, other Federal agencies, and affected States.

There are currently 16 uranium mills in operation, all located in Western States. Eight of these mills are licensed by NRC, and eight are licensed under the "Agreement States" program (see Chapter 9). The various mill sites already contain about 100 million tons of tailings. There are also a number of new mills presently under construction or in the planning stage. It is estimated that, by the year 2000, between 80 and 110 uranium mills may be in operation and one billion tons of uranium mill tailings will have been generated.

In addition to the active sites, there are 21 former uranium mill sites (inactive sites) which contain 25 million tons of tailings. These sites are the subject of a federally-funded joint study by ERDA and the Environmental Protection Agency.

NRDC Petition

In March 1975 NRC received a petition for rulemaking from the Natural Resources Defense Council (NRDC). The petitioners requested the Commission to issue regulations that would require uranium mill operators licensed by the Commission or by Agreement States to post performance bonds that would cover the cost of stabilizing and ultimately disposing of uranium mill tailings.

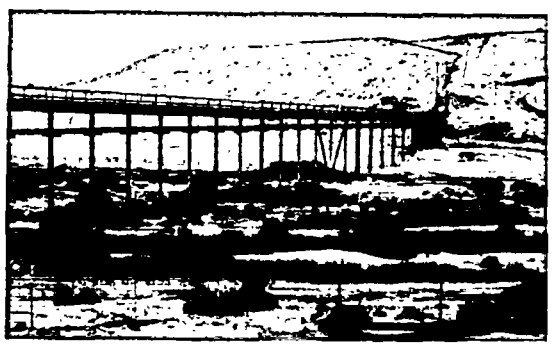
The petitioners also requested that the Commission prepare a draft environmental impact statement on the NRC's uranium milling regulatory program, including that part administered by the Agreement States. The petition further asked that no licenses be issued or renewed during the time the environmental impact statement was being prepared that would permit a licensee to escape any new regulations promulgated as a result of the requested statement.

Preparing Environmental Statement

On June 3, 1976, the Commission announced its intention to prepare a generic environmental impact statemet (GEIS) on uranium milling operations. The purpose of the GEIS will be:

(1) To assess the local, regional and national environmental impacts of uranium milling on both a short- and long-term basis;
(2) To provide a basis for deciding whether additional regulatory requirements are needed for uranium mills, with emphasis on the waste management of mill tailings;
(3) To support any rulemaking and/or modification of statutory authorities which may be determined to be necessary; and
(4) To provide an opportunity for public participation in decisions concerning any proposed changes in NRC regulations or regulatory authority.

During preparation of the GEIS, which has begun, the NRC will continue to review applications for new or renewed licenses for uranium milling on a case-by-case basis. The NRC will also continue to assure that adequate financial security arrangements, through bonding or other feasible methods, are made for the reclamation and stabilization of mill tailings. Furthermore, it will be a condition of any licensing actions that are taken regarding waste generating processes and mill tailings management practices that they may later be revised in accordance with the conclusions of the final GEIS and any related rulemaking. A draft GEIS is expected to be issued for public comment in August of 1978.



This uranium mill tailings pile is still "growing" at the site of an active mill.

The decision to prepare a generic environmental impact statement and to continue processing related applications in the interim, subject to specified criteria, was a partial response to the NRDC petition. Decisions on other aspects of the petition, such as regulations covering financial responsibility for uranium mill waste management over the long term, had not been reached at year-end. The Commission's intent is that proposed rules be published for public comment no later than the time of publication of the final GEIS. Such rules will be developed from the information derived from the preparation of the GEIS and from an assessment of alternatives.

Research on Mill Tailings

A research program to provide data for the GEIS and associated rulemaking will be carried out concurrently with preparation of the GEIS. The program will mainly involve: (1) an assessment of the public health and environmental impact of uranium milling operations with emphasis on mill tailings, and (2) identification and development of alternative strategies for mill tailings waste management, including assessment of their practicality and costs.

The NRC has asked a 13-member task force to develop information from which acceptable methods for handling and storing tailings can be devised. The task force will examine current procedures for handling tailings and for choosing waste storage sites and will identify areas where further research is needed to form the basis for regulatory requirements. Members of the task force represent several scientific disciplines and a number of private and governmental institutions, including Argonne National Laboratory.

View of a stabilized uranium mill tailings pile near Riverton, Wyoming. The stabilized pile extends to the right of the photograph. The structures in the background are an operating sulfuric acid manufacturing plant and the shell of the abandoned mill building.

Interim Licensing

The Commission has decided that during preparation of the draft generic environmental statement on uranium milling, the review of applications for renewal of existing or for new milling licenses will continue on a case-by-case basis. This decision was based on consideration of the following:

(1) It is likely that each individual licensing action of this type would have some specific benefit independent of any other licensing action.

(2) It is not likely that any licensing action taken during the time frame under consideration would involve so great a commitment of resources as to foreclose the alternatives available in other licensing actions of this type.

(3) It is likely that environmental impacts associated with any licensing action of this type could be addressed within the context of the individual license application without overlooking any cumulative environmental impacts.

(4) It is likely that technical issues arising during review of an individual license application can be resolved within that context.

(5) A deferral on licensing actions of this type could result in substantial harm to the public interest because of uranium fuel requirements of operating reactors and reactors under construction.

An environmental impact statement will be issued by NRC in connection with each licensing action taken, and the five considerations set forth above will be applied in each licensing decision.

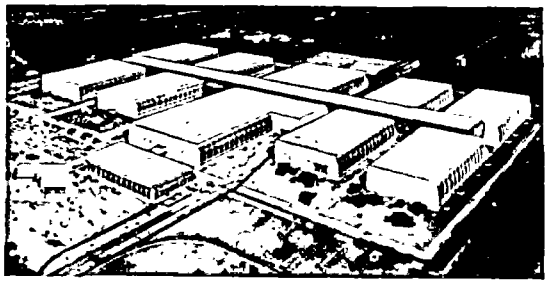
Licensing activities during 1976 included review of one proposed new mill and processing of renewal requests. A renewed license was issued to Petrotomics Company for its milling operation in the Shirley Basin region of Wyoming. Six additional renewal applications for conventional milling operations and one for heap-leach research and development were received and are being reviewed.

Continuing interest is being shown by government and industry in "solution mining" of uranium; that is, dissolving the ore in place and pumping the mineral solution to the surface for extraction of the uranium. Two applications for full-scale solution milling operations were received and are under review.

Other Fuel Cycle Regulatory Actions

Uranium Hexafluoride Facilities

After the milling operation, the uranium ore concentrates move to a facility for refinement and conversion to uranium hexafluoride (UF_6), a volatile compound of uranium and fluorine which is the chemical form used for enrichment in the gaseous diffusion process (see below). There are two commercial facilities producing UF_6—an Allied Chemical plant at Metropolis, Illinois, and a Kerr-McGee plant at Sequoyah, Oklahoma. During the year, review of license renewal applications continued for both plants, the Kerr-McGee application involving also an increase in capacity from 5,000 to 10,000 tons of uranium per year.



An artist's conceptual view of a possible commercial centrifuge enrichment facility. The building has a floor area of 1,600,000 square feet.

Uranium Enrichment Facilities

The enrichment of uranium to the degree needed to make it usable in reactor fuel continues to be the only major step in the nuclear fuel cycle not performed by industry as a commercial enterprise. Three ERDA-owned gaseous diffusion plants, originally constructed for national defense purposes, constitute the entire U.S. enriching capacity and are not regulated by NRC. However, the proposed Nuclear Fuel Assurance Act would encourage commercial enrichment facilities. The NRC has accordingly conducted a program to prepare for evaluating license applications for such facilities.

Uranium enrichment facilities are considered "production and utilization facilities," as defined in the Atomic Energy Act. The procedural requirements for licensing them would therefore be the same as for nuclear power reactors and fuel reprocessing facilities under 10 CFR Parts 50 and 51. The required licensing steps would include a two-stage safety review, an environmental review, a mandatory public hearing, and reviews by the Advisory Committee on Reactor Safeguards. The NRC is considering possible amendments to Part 50 or the development of a new part to the regulations which would differentiate uranium enrichment facilities from reactors and reprocessing facilities on the basis that they pose a lower hazard to public health and safety.

Fuel Fabrication Facilities

The final steps in producing fuel for nuclear power reactors are the conversion of the enriched uranium hexafluoride to uranium dioxide (UO_2) and the processing of the UO_2 into pellets which are enclosed in long, pencil-like tubes made of zircaloy. These steps are generally performed in the same facilities that fabricate the finished assemblies. Currently, there are five firms actively engaged in the processing and fabrication of UO_2 fuel for nuclear power reactors.

Fuel fabrication licensing actions in fiscal year 1976 included renewal of licenses for the following: General Electric Co. (Wilmington, N.C.) UO_2 fuel fabrication plant; Babcock & Wilcox Co. (Lynchburg, Va.) nuclear fuels plant; Combustion Engineering, Inc. (Windsor, Conn.) commercial fuel fabrication plant; United Nuclear Corp. (Wood River Junction, R.I.) scrap recovery operation; General Atomic Co. (San Diego, Calif.) research and production facility.

In addition, United Nuclear's Naval Fuel Fabrication Plant at New Haven, Conn., was decontaminated and decommissioned and the site released, and the Kerr-McGee Corporation's UO_2 and mixed oxide facility at Cimarron, Okla., was shut down by the company and placed in standby condition.

Protection of plutonium fabrication facilities aganst natural phenomena. In 1971, changes were made to AEC regulations that specified additional requirements applicable to plutonium processing and fuel fabrication plants. Those changes required that applications for licenses ". . . shall contain . . . a description and safety assessment of the design bases of the principal structure, systems, and components of the plant, including provisions for protection against natural phenomena . . ."

The Statement of Considerations for the rulemaking stated that: "Existing licensed plutonium processing and fabrication plants will be examined with the objectives of improving to the extent practicable their ability to withstand adverse natural phenomena without loss of capability to protect the public and their capability for coping with inplant accidents."

The NRC staff undertook this year the task of examining and evaluating all existing plutonium fuel fabrication facilities that are licensed to possess and process more than five kilograms of unencapsulated plutonium to determine the

effects of natural phenomena such as tornadoes and floods upon the public health and safety. The decision to review all facilities at one time rather than one by one at the time of license renewal or other timing was made to promote the highest degree of uniformity of review. The staff, including expert consultants, is reviewing the selected facilities on a site-specific basis and will provide a safety assessment for each. These assessments will provide a basis for determining the extent of backfitting, if any, necessary to protect each facility from the effects of natural phenomena.

Radioisotopes Licensing

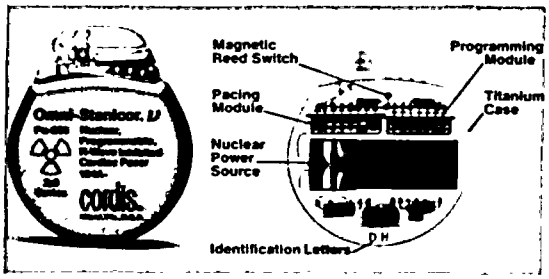
Use of Radioisotopes

Radioactive materials are widely used for medical diagnosis and treatment, basic and applied research, teaching, consumer products, and industrial applications. These activities are conducted under approximately 19,000 nuclear material licenses, over half of which are administered by 25 States under regulatory agreements with the NRC. The 8,600 licenses administered directly by NRC include approximately 2,800 for medical use, 700 issued to academic institutions for teaching and research, and over 4,000 for industrial applications. The NRC processes 6,000-8,000 new applications and license amendments and renewals annually. Each application is given a thorough review to assure that the proposed use will not endanger the public health and safety.

Nuclear Powered Pacemakers

The "Final Generic Environmental Statement on the Routine Use of Plutonium-Powered Cardiac Pacemakers," NUREG-0060, was published in July 1976. The statement concludes that, based on a balancing of the benefits and risks involved, plutonium-powered pacemakers can be licensed for routine use. Previously, the Commission had licensed plutonium-powered cardiac pacemakers on a limited, investigational basis.

The Final Generic Statement concludes that



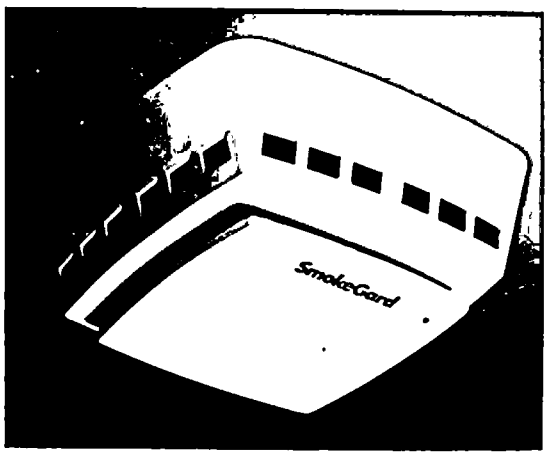
This nuclear powered cardiac pacemaker measures approximately 2.2" by 2.6" by .7", and weighs about 3.2 ounces.

the plutonium-powered pacemakers have sufficient longevity to eliminate the need for surgical replacement operations which are required in the case of pacemakers powered by chemical batteries; also that plutonium-powered units can provide long-term maintenance-free pacing to patients for whom rechargeable pacemakers are either physically or psychologically unacceptable. The statement notes further that the use of plutonium power sources will have a positive impact on pacemaker technology since new or additional pacemaker functions that require high power drains can be accommodated by plutonium batteries without significantly affecting battery life.

New Radioisotopes Applications

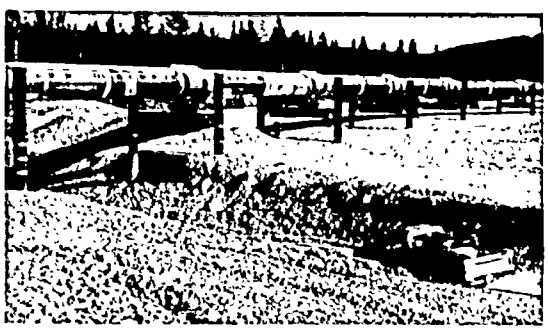
A license has been issued authorizing testing of a new system for detecting and giving an in-flight indication of incipient helicopter rotor failure. The new system uses a small amount of radioactive material sealed in a metal capsule to signal the loss of rotor blade internal pressure. The helicopters that will use the system do not presently have an in-flight warning system and must therefore be operated at lower than optimum speeds in order to reduce the probability of rotor failure without warning. The system will be less costly than electromechanical in-flight systems presently used on larger helicopters.

Several licenses have been issued authorizing the use of small amounts of the radioactive gas tritium sealed in glass tubes to illuminate watches. The loss rate (leakage) of tritium from these light sources is much lower than from



Some consumer products which contain small amounts of certain radioactive materials may be distributed without the individual consumer having a specific license if the product has been reviewed for safety by the NRC, if it is determined to be of sufficient benefit to the consumer, and if any risk to the consumer through normal use or misuse is very small. Products reviewed and approved for such general distribution include certain smoke detectors, such as that shown above, timepieces, and static elimination devices.

tritiated self-luminous paint, which is also used in watches. The light sources are used in conjunction with a liquid crystal display (LCD) in watches with a digital display. The most common digital watch uses light-emitting diodes (LEDs) in conjunction with an electric power cell. This power cell is unnecessary with self-luminous lights and LCD. In addition, the watch can be read at any time without the need to operate a switch as is necessary with battery-powered LEDs.



The Alaska pipeline near Fairbanks, Alaska. At this location, the 48-inch pipeline is above ground and insulated. Much of the examination of welds on the pipeline is performed by NRC-licensed industrial radiographers.

Transportation of Nuclear Materials

Coordination Among Federal Agencies

Both national and international regulations pertaining to safety in the transport of radioactive materials rely principally upon the integrity of the packaging and the proper preparation of the packages for shipment. Accordingly, it is the policy of the NRC to make an independent review of all package designs submitted by applicants to assure that the packages meet the standards set forth in NRC regulations (10 CFR Part 71).

NRC, the Department of Transportation, the U.S. Postal Service, and the States all have a part in regulating the safety of commercial shipments of nuclear material. NRC regulations apply to its licensees and generally specify procedures and standards for packages and shipments. DOT regulates certain types of packaging, labeling and conditions of carriage. Since DOT and NRC jurisdictions overlap in providing for safety in shipment of nuclear materials in interstate and foreign commerce, the agencies operate under a Memorandum of Understanding in order to provide consistent, comprehensive and effective regulation without publication. The Postal Service regulates shipments of nuclear materials by mail, and the States have regulatory authority over intrastate transport of nuclear materials.

The Memorandum of Understanding between the Department of Transportation and the Nuclear Regulatory Commission sets forth the areas in which each agency will exercise prime responsibility, a distinction made necessary by overlapping jurisdiction in regulating radioactive material transport. This Memorandum, originally executed between the Interstate Commerce Commission and the Atomic Energy Commission (AEC) in 1966 and revised in 1973, is being changed to reflect the subsequent division of the AEC into ERDA and NRC and to indicate the respective roles of DOT and NRC in certain regulatory areas.

The United States has had a favorable safety record in the shipment of radioactive materials.

The relatively small number of reportable incidents—less than 500 over a 30-year period—have resulted in no serious injury or death attributable to radiation exposure from the many millions of packages shipped.

Environmental Statement

From its inception in January 1975, the NRC has reviewed the existing regulations and procedures for transportation of radioactive materials. As part of its review, the Commission initiated in June 1975 a public rulemaking proceeding regarding the air transport of all nuclear materials, including plutonium and enriched uranium. This step was especially timely in view of increasing public concern being expressed over the air transport of special nuclear material. With the technical assistance of Sandia Laboratories, a draft generic environmental impact statement was prepared to assess the impacts associated with the transportation of radioactive materials, including relative costs and benefits of alternative modes of transportation. Information derived from research into the accident-resistant properties of plutonium shipping packages and data collected from the NRC's 1975 Radioactive Material Shipments Survey were used in preparing the statement. The draft statement (NUREG-0034) was completed in March 1976 and made available for comment to the general public and other Federal and State agencies. About 30 letters of comment were received and analyzed, and changes to the statement will be made, as appropriate, before the final environmental impact statement is issued in 1977.

Developing a Safe Plutonium Package

Public Law 94–79 requires the NRC to prohibit its licensees from transporting plutonium by air until it has certified to the Joint Committee on Atomic Energy of the Congress "that a safe container has been developed and tested which will not rupture under crash and blast testing equivalent to the crash and explosion of a high-flying aircraft." Except for plutonium contained in a medical device designed for individual human application, for example, a cardiac pacemaker, the restriction applies to air transport of plutonium in any form or quantity, whether for export, import or domestic shipment.

The approach being taken by NRC is to require a high degree of assurance that plutonium packages for air transport can withstand virtually any type of aircraft accident. To achieve this objective, the NRC has initiated a program (1) to evaluate the conditions which could be produced to severe accidents; (2) to develop qualification criteria prescribing performance requirements and acceptance standards for plutonium air packages; and (3) to perform physical tests and engineering studies to demonstrate that a plutonium package design meets the qualification criteria.

Qualification criteria are being developed to assure that package integrity in aircraft accidents occurring during takeoffs, landings, or ground operations will approach certainty. These types of accidents not only represent the majority of all aircraft accidents, but also are the kind most likely to occur in an urban area. The criteria will also afford a high degree of protection against accidents which occur in other phases of flight, including accidents of extreme severity such as mid-air collisions, high-speed crashes and fires.

A two-phase program to develop and test a high integrity package that meets the qualification criteria is in progress. In the first phase, Sandia Laboratories (under NRC contract) has developed a package design for plutonium oxide powder and has established, through preliminary testing, that the design is capable of meeting the qualification criteria. In the second phase, Sandia Laboratories will conduct a sufficient number of tests for certifying that the design meets the criteria. (See "Fuel Cycle Safety Research," in Chapter 13.)

The qualification criteria, the package design, the test results and the supporting documentation are to be reviewed by the Advisory Committee on Reactor Safeguards (ACRS) and the Assembly of Engineering of the National Academy of Sciences prior to NRC's certifying the design to the Joint Committee on Atomic Energy. In the fall of 1976, the ACRS endorsed the criteria developed by the NRC staff as

being properly responsive to Public Law 94-79. Both the review by the Assembly of Engineering and the certification procedure are expected to be completed in 1977.

Survey of Radioactive Material Shipments

To determine the total number and types of packages of radioactive material being transported annually in the U.S., the NRC conducted a survey among some 2,300 NRC and Agreement State licensees and ERDA contractors. A detailed report of this survey (BNWL-1972) was issued in April 1976 by Battelle-Pacific Northwest Laboratories, and a summary report (NUREG-0073) was made available by NRC in May 1976. Based on the survey data, the estimated total number of packages of radioactive material transported each year in the United States is about 2.5 million. About one-third of these packages contain such small quantities of radioactive materials that they are exempt from packaging and labeling requirements. Most transported packages contain the radioisotopes iodine-131, iodine-125, technetium-99m, and molybdenum-99 for medical uses. Large amounts of the radioisotopes cobalt-60, iridium-192 and uranium-238 were also transported. The data from the survey were used in other studies to estimate radiation exposures from normal transport of radioactive material, and to calculate the risk to persons and the environment from transportation accidents involving such packages.

Transport in Urban Areas

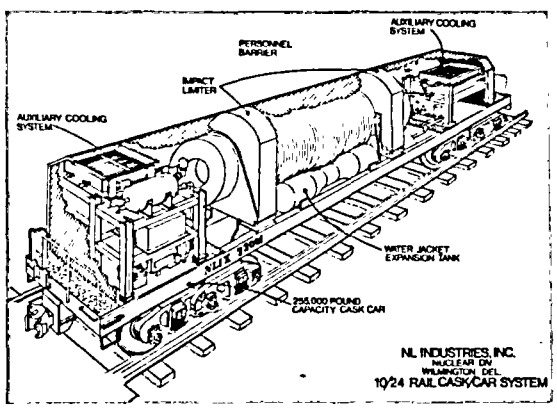
The NRC has undertaken a study of the special features of radioactive material transport —under both normal and accident conditions— in large densely populated areas that will result in a generic environmental impact statement on the transport of radionuclides in urban environs. The study will evaluate the effects, including radiological safety, of characteristics peculiar to large cities, such as high population density, local meteorology, and numerous tall buildings. Sandia Laboratories, the NRC contractor for this study, has begun model formulation and preliminary data gathering. The study will take about two years to complete.

IAEA Transport Standards

Safety regulations for transporting radioactive material in the United States are based on standards developed internationally by the International Atomic Energy Agency (IAEA). The international standards were developed through the active participation of IAEA member states. The United States participated through representatives from both NRC and DOT. Adoption by member states of the IAEA standards contributes significantly to the safe and efficient international transportation of radioactive materials for medical and industrial uses. Adoption of recent revisions in the IAEA standards in U.S. domestic regulations is being considered in a joint effort by NRC and DOT.

Irradiated Fuel Packaging

Spent (irradiated) nuclear fuel is transported offsite in specially designed shipping casks which are capable of containing the radioactive fuel assembly materials during normal and postulated design accident transportation conditions. Two regulatory guides which outline the NRC staff recommendations for design loading conditions



The NLI-10/24 shipping cask, licensed by NRC in June 1976, is the largest irradiated fuel shipping cask licensed to date. The cask is designed with lead and water shields for gamma ray and neutron radiation protection.

and design criteria for the shipping casks were under development in fiscal year 1976.

An approval was issued to NL Industries, Inc., for a multi-assembly cask for irradiated nuclear fuel. The cask is designed to use an inert helium gas coolant instead of a liquid coolant for removal of fuel decay heat. This limits internal pressure buildup. The Model No. NLI-10/24 cask will accommodate 10 pressurized water reactor fuel assemblies or 24 boiling water reactor fuel assemblies. Designed for rail shipment, it is the largest capacity fuel cask authorized for use, having a loaded weight of about 100 tons.

Transportation Litigation

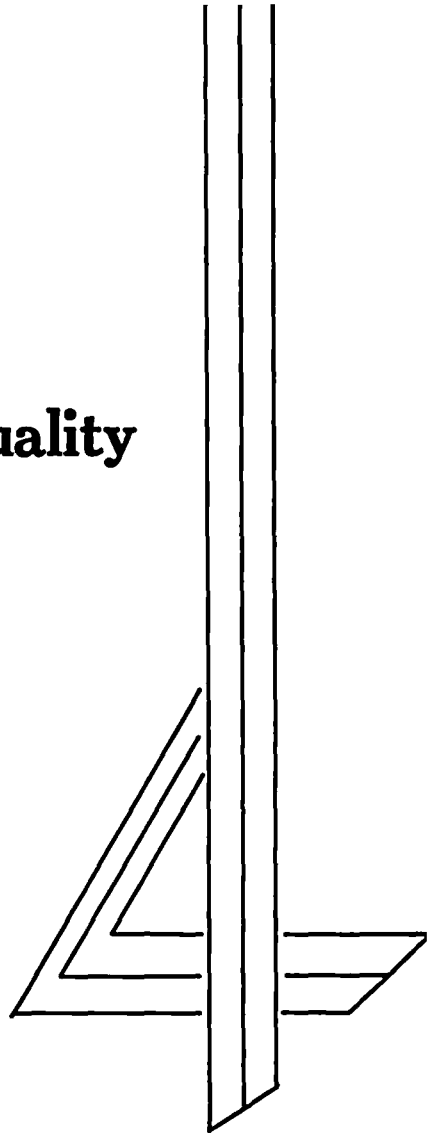
New York State filed suit against the NRC and six other Federal agencies in the Federal District Court in New York City in May 1975 to ban air shipments of certain radioactive materials, including plutonium, in the United States and, in particular, through John F. Kennedy Airport. In September 1975 the court denied a motion for a preliminary injunction. This decision has been appealed by the State to the Second Circuit of Appeals.

New York City passed a health ordinance in September 1975 which requires city approval for the transportation of significant amounts of radioactive material within the city. The NRC presented testimony at hearings on this matter in opposition to the ordinance. The legality of this action is being challenged in a suit brought by the United States against the City of New York.

NRC is also involved in an attempt by several railroads to require the use of special trains for carriage of certain radioactive materials. In a matter before the Interstate Commerce Commission, the NRC contends that, insofar as the proceedings involve issues of safety in the transportation of radioactive materials, those concerns should be addressed to the NRC and/or the Department of Transportation.

Preserving Environmental Quality

Weighing Benefits Against Impacts



The National Environmental Policy Act of 1969 and Executive Order 11514 of March 5, 1970, mandate that all Federal agencies, to the fullest extent possible, direct their policies, plans and programs to protect and enhance environmental quality. Agencies are required to view their actions in a manner calculated to encourage productive and enjoyable harmony between man and his environment, to promote efforts preventing or eliminating damage to the human environment, and to enrich the understanding of the ecological systems and natural resources important to the Nation.

Under NEPA and the guidelines established by the Council on Environmental Quality, NRC must evaluate the full range of anticipated environmental effects—both radiological and nonradiological—that may result from each proposed major action and must compare these with the environmental consequences of available alternatives to that action. Each decision to grant or deny a license must be based on a balancing of environmental, economic, technical and other benefits against environmental and other costs.

A significant portion of the regulatory review process consists of environmental impact analyses and evaluation of possible measures to eliminate or mitigate anticipated adverse effects on environmental quality. This effort is factored into the decision-making process for licensing major nuclear facilities; amending and terminating licenses; rulemaking and adoption of standards with widespread application; and monitoring, inspection and enforcement activities. NRC conducts a research program to develop the methods and data needed to support the environmental phase of the regulatory process. (See Chapter 13.)

Each applicant proposing to construct a nuclear facility must submit a comprehensive environmental report, which is generally based on two or more years of work in accumulating and analyzing environmental and other data required by the NRC. The report must demonstrate through a cost-benefit analysis why,

in the applicant's judgment, the aggregate benefit to society of the proposed facility will outweigh the aggregate costs.

The NRC staff's independent review and cost-benefit analysis are set forth in a draft environmental impact statement which is circulated for comment to Federal, State and local agencies and the public. Comments are taken into account in a final environmental statement which, in each construction permit proceeding, must be considered at a public hearing by an Atomic Safety and Licensing Board. The same procedure is followed in updating the environmental statement at the operating license stage, with a hearing held if warranted by public interest. Table 1 lists the draft and final environmental statements issued during the year 1976.

In some instances (for example, a proposed amendment or renewal of a license) where no significant environmental impact is indicated, the Council on Environmental Quality issues a brief appraisal report and publishes a negative declaration in the *Federal Register* announcing that no environmental statement will be prepared. Seventy negative declarations were issued in fiscal year 1976.

Apart from the environmental reviews performed in individual facility licensing proceedings, the NRC conducts surveys and evaluations of the impact of devices, processes and generic rulemakings, such as the widespread use of nuclear-powered cardiac pacemakers (Chapter 3) and several areas in the nuclear fuel cycle (Chapters 3, 5 and 6). As part of the rulemaking proceeding, generic environmental impact statements are prepared.

This chapter covers NRC procedures and actions in reviewing the environmental impact of nuclear power plants and other facilities; measures to mitigate environmental effects, including control of low-level radioactive material in effluents; improvements in analytic techniques; and coordination efforts with other Federal agencies having overlapping environmental responsibilities.

Table 1. Nuclear Power Plant Environmental Impact Statements Issued from July 1, 1975 through September 30, 1976 *

DRAFT STATEMENTS

Plant		Date Issued
1.	Wolf Creek, Unit No. 1	7-3-75
2.	McGuire, Units Nos. 1 & 2 (operating license)	10-29-75
3.	Montague, Units Nos. 1 & 2	11-5-75
4.	Palo Verde, Units Nos. 1, 2 & 3 (Supplement)	12-2-75
5.	Floating Nuclear Power Plants (Part II)	12-9-75
6.	Sterling, Unit No. 1	1-6-76
7.	Clinch River Breeder Reactor	2-13-76
8.	Indian Point, Unit No. 2 (closed-cycle cooling)	2-23-76
9.	Marble Hill, Units Nos. 1 & 2	3-5-76
10.	Greene County	3-11-76
11.	Atlantic, Units Nos. 1 & 2	4-8-76
12.	Arkansas, Unit No. 2 (operating license)	5-24-76
13.	LaCrosse (full-term operating license)	6-25-76
14.	Tyrone, Unit No. 1	6-28-76
15.	Indian Point, Unit No. 2 (extension of once-thru cooling)	7-8-76
16.	Skagit, Units Nos. 1 & 2	7-9-76
17.	Black Fox, Units Nos. 1 & 2	7-16-76
18.	Phipps Bend, Units Nos. 1 & 2	8-10-76
19.	Koshkonong, Units Nos. 1 & 2	8-12-76
20.	North Coast, Unit No. 1 (site suitability review)	8-26-76

FINAL STATEMENTS

1.	Palo Verde, Units Nos. 1, 2 & 3	9-25-75
2.	Davis Besse, Units Nos. 2 & 3	9-30-75
3.	Cherokee, Units Nos. 1, 2 & 3	10-1-75
4.	Floating Nuclear Power Plants (Part I)	10-6-75
5.	Jamesport Units Nos. 1 & 2	10-7-75
6.	Perkins, Units Nos. 1, 2 & 3	10-31-75
7.	Davis Besse, Unit No. 1 (operating license)	10-31-75
8.	Wolf Creek, Unit No. 1	10-31-75
9.	Palo Verde, Unit Nos. 1, 2 & 3 (Supplement)	2-20-76
10.	Douglas Point, Units Nos. 1 & 2	3-4-76
11.	McGuire, Units Nos. 1 & 2 (operating license)	4-20-76
12.	Diablo Canyon, Units Nos. 1 & 2 (addendum, operating license)	5-28-76
13.	Sterling, Unit No. 1	6-24-76
14.	Three Mile Island, Unit No. 2 (operating license)	7-23-76
15.	Indian Point, Unit No. 2 (closed-cycle cooling)	8-9-76
16.	Marble Hill, Units Nos. 1 & 2	9-22-76
17.	Floating Nuclear Power Plants (Part II)	9-30-76

* Statements pertain to construction permit applications unless otherwise indicated.

Environmental Review of Nuclear Power Plants

Discussed below are various aspects of the environmental review of nuclear power plants that received special attention in fiscal year 1976. These include specific site-related problems, improving analytic techniques, monitoring and mitigating measures, and control of effluents.

SITE-RELATED PROBLEMS

Socioeconomic Impacts

The construction of a nuclear power plant results in an influx of workers and may affect the social and econmic life of neighboring communities. In most instances, the increase in property taxes attributable to the nuclear plant allows local governments to mitigate adverse impacts through construction of new public facilities (such as schools, parks, and roads) and expansion of public services (such as police and fire protection). For example, the Calloway Plant Units 1 and 2 under construction in Missouri will provide, at current rates, an estimated $42 million in taxes during the construction period, and $7.1 million per year during operation.

A special case where this does not apply is the Hartsville project of the Tennessee Valley Authority, which does not pay property taxes. TVA does make payments to the State of Tennessee "in lieu of taxes," but the two counties in Tennessee where the project is located will receive less than $18,000 per year or 0.2% of the payment to the State.

Because of the severity of anticipated socioeconomic impacts from the four-unit Hartsville project and the negligible allowance to the two affected counties, NRC has required TVA, within six months of the beginning of construction, to submit for NRC review an extensive program to monitor and evaluate both the socioeconomic impacts and the effectiveness of mitigating actions in the affected areas. Semiannual reports of the results of this program must be provided to the staff throughout the construction period.

Archaeological Investigations

One requirement of NEPA is that, in the balancing of costs and benefits, the importance of preserving the historic, cultural and natural aspects of our national heritage must be considered. An example of compliance with this requirement is afforded by the Seabrook Station, which is being constructed in Rockingham County, New Hampshire. In order to determine whether evidence of historic and prehistoric civilizations exists in the area, the utility constructing the station retained an anthropology instructor and students from the University of New Hampshire.

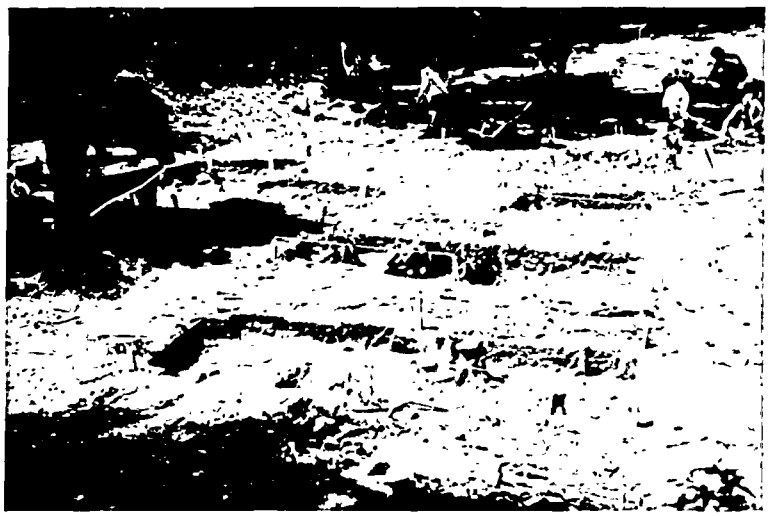
During several test diggings, clamshells, flint chips and pieces of pottery were unearthed, indicating the presence of prehistoric Indian sites dating back to 1000 A.D. In the summer of 1974 some 200 pits, each approximately 1.5 meters square, were excavated and the soil therefrom carefully sifted. Numerous remnants were uncovered, including shells, animal and fish bones, stone tools, and projectile points (arrowheads). Apparently the Seabrook site was a warm weather camping area for pre-Columbian New Englanders. Two Indian skeletons, each estimated to be between 500 and 1,000 years old, were discovered. Late in summer of 1975, the remains of a great auk, a large, flightless seabird that once ranged along the North American coast from Labrador to Florida, were discovered. Live specimens have not been found in New Hampshire for several hundred years.

The utility has agreed to fund a program planned to recover and package artifacts from the construction area.

Studies of Marine Borers

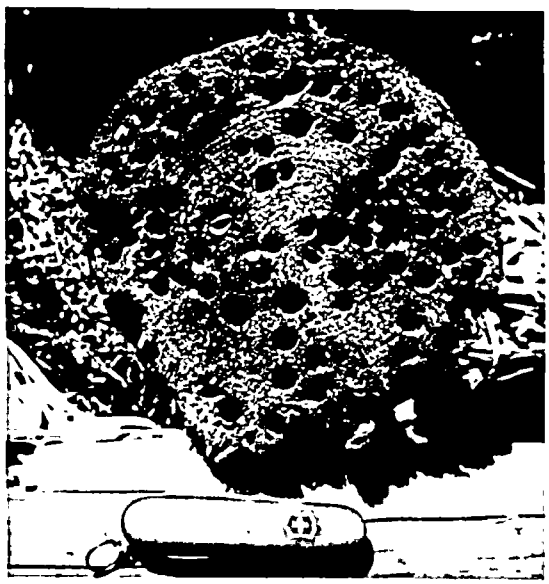
Among the environmental impacts of nuclear power plants are the effects on aquatic life in bodies of water used as sources of cooling water during operation of the plants. An example is the Oyster Creek Nuclear Generating Station

located on Barnegat Estuary near Toms River, New Jersey, which has been the site of an extensive biological study for the past year and a half. Earlier studies conducted since the late 1960's have linked the heated effluent from the plant's cooling discharge with an increase in the activity of marine borers or shipworms. These proliferate in wood below the surface of the water, particularly in the hundreds of cedar pilings located in the discharge canal-creek. The resulting structural damage severely impacted the marinas located in the canal-creek, and there is a potential for further damage in the area of Barnegat Bay.



Archaeological digging at Seabrook. Wooden stakes mark diggings or "grids" (top left, lower left). The earth removed from each grid is sifted and carefully examined (lower right) for possible clues or artifacts.

Jersey Central Power and Light Co., the licensee, in response to the results of the preliminary studies and recommendations from the NRC staff, has instituted a large-scale field study on the effects of heated effluents on the distribution and abundance of marine borers in the adjacent estuary. The NRC has contracted with Lehigh University to conduct confirmatory and complementary research on marine borers in the vicinity of the power station. These studies may indicate ways to control or mitigate damage by marine borers.



This photo shows the end of a piling removed from a marina that was located in the discharge canal of the Oyster Creek Nuclear Generating Station. The piling shows heavy borer infestation. Rapid destruction of untreated pilings in the discharge canal is thought to be linked to increased temperature and salinity caused by operation of the power plant.

IMPROVING ANALYTIC TECHNIQUES

In preparing environmental impact statements and participating in hearings, the NRC staff has found that certain areas of cost-benefit and environmental impact analysis need to be improved. Where possible, generic positions and methodolgies are being developed to standardize the analytical techniques while maintaining the necessary flexibility regarding application to specific cases. The projects are continuing into fiscal year 1977. Examples of such work are described below.

(1) **Construction Costs and Total Generating Costs**
NEPA requires consideration of alternatives to the proposed action. A principal alternative to constructing a nuclear power plant is constructing a coal-fired plant, and a comparison between the two involves the relative economics of generating electricity. NRC is undertaking to update, revise, and expand a computer code and documentation that has been used to estimate costs of constructing nuclear and coal-fired plants. Included are tasks to develop cost adjustments for different cooling systems, radiological treatment systems, and seismic conditions; to estimate cost of the nuclear and coal fuel cycles; and to compare total generating costs for nuclear and coal units.

(2) **Health and Safety Impacts of Coal**
In considering coal-fired plants as alternatives to nuclear plants, the NRC needs not only to deal with their relative economics but also to compare and evaluate their environmental effects. As part of this effort, NRC has sponsored a generic study to collect available data and assess the public health and safety impacts of the coal fuel cycle.

(3) **Cooling Tower Evaluations**
More stringent requirements for preserving the quality of aquatic resources have led to a shift to closed cycle cooling systems for most large power plants. Such systems have their own particular problems, including: water consumption (evaporation), potential for increased fogging and icing, visible vapor plumes, and deposition of salts and dissolved solids that have been concentrated due to evaporation and have been entrained in the air flow out of the cooling system. NRC is testing the usefulness of the Oak Ridge fog and drift computer simulation model for assessing the environmental impacts of cooling systems as proposed in several individual license applications.

(4) **Cooling Tower Visual Impacts**
Concern has been expressed that large natural-draft cooling towers may represent an undesirable visual intrusion in some localities. For this reason, NRC is supporting a group of studies to assess differences in appearance of alternative types of cooling towers for nuclear power plants and their visual impacts on surrounding communities.

(5) **Impacts on Tourism**
As part of the required cost-benefit analysis, NRC is supporting a series of studies on the social and economic impact of nuclear power plant construction and operation on nearby communities. A particular issue is the degree to which tourists might tend to avoid coastal resort areas because of the nearby location of offshore or coastal nuclear power plants.

(6) **Forecast of Electricity Demand by State**
An alternative to constructing a nuclear power plant for operation at a certain time is to defer such construction on the grounds that the output from the plant is not needed at that time. Forecasts of need are made by applicants, but an independent assessment is required. For this purpose, NRC is supporting the development of a model to forecast the need for electricity in each State. This model will be used in the review of license applications to assess the need for the generating capacity which the proposed nuclear power plant would supply.

MONITORING AND MITIGATING MEASURES

All nuclear power plant operating licenses that have been issued since January 1972 contain detailed environmental technical specifications which establish operating limitations and procedures and require monitoring programs to verify the anticipated environmental impacts of the plants. Considerable time, effort, and money are being spent by utilities to accumulate the required monitoring data. Therefore, the degree to which environmental technical specifications adequately address real ecological problems and the degree to which conformance with specifications is determined by monitoring are currently being reviewed by NRC.

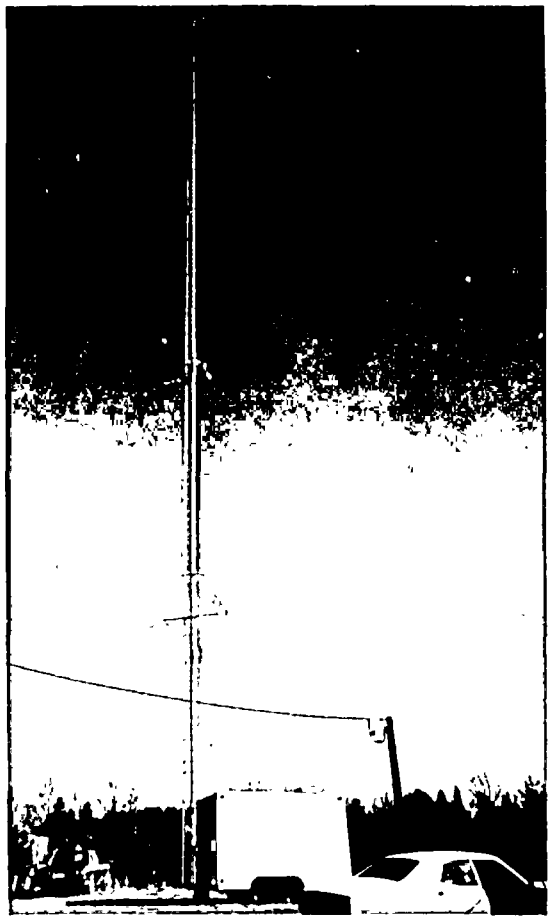
The major objectives of this review program are: (1) to evaluate preconstruction environmental studies: (2) to examine data collection, data analysis, and reporting format for operational monitoring; (3) to determine whether monitoring data validate thermal and ecological impact predictions made in the final environmental statement; and (4) to identify possible environmental impacts common to several power plants with similar hydrological and ecological profiles. The review will also assist in the development of ecosystem models that could be used by the NRC, as well as by applicants and licensees, in impact analysis.

The review program consists of studies made by the Argonne National Laboratory, the Oak Ridge National Laboratory, and the Pacific Northwest Laboratory and is based on ecological monitoring data on the aqueous environment at a number of nuclear power plants operational for at least one year. Included are plants using cooling water from rivers, lakes, estuaries, and the ocean. In-depth analysis has been concentrated on: (1) effects of thermal effluents from the plants on the major aquatic trophic groups (that is, phytoplankton, zooplankton, benthos, and fish); (2) impingement of fish in the cooling systems of the plants; and (3) entrainment of plankton in the cooling systems. Final reports are being prepared for issuance in early 1977.

Environmental reviews often result in NRC's requiring licensees to take specific environmental protective measures. These may range from minor changes in construction practices to major modifications in plant design. Examples of protective measures have been: selecting an alternative site for construction of plant, major cooling system redesign, rerouting of transmission lines, redesign of intake structure, addition of fish screens, augmentation of radwaste systems, and monitoring of socioeconomic impacts.

New guides issued. Regulatory Guide 4.11, "Terrestrial Environmental Studies for Nuclear Power Stations," was issued for comment in

The meteorological tower and recording equipment at the site of the proposed Clinch River breeder reactor are used to measure and record the speed and direction of the wind and the ambient air temperature at various levels of the tower. Data extending over at least one year must be submitted with a license application in order to estimate potential radiation doses to the public as a result of routine or accidental release of radioactive materials.



July 1976. This guide provides information to applicants on the types of ecological and land-use surveys and environmental monitoring studies that should be considerd for evaluating the terrestrial environmental impact of proposed power plants during site selection, for preparation of the construction permit application, and during construction.

Regulatory Guide 4.8, "Environmental Technical Specifications for Nuclear Power Plants," was issued for comment in December 1975. This regulatory guide provides guidance to applicants on their preparation of proposed environmental technical specifications for light-water-cooled nuclear power stations. Environmental technical specifications, which are incorporated as Appendix B of each operating license, include those conditions and limitations necessary to protect the environment which have been identified during the NEPA environmental review process.

CONTROL OF EFFLUENTS

Effluent Guidelines for Light-Water Reactors

On April 30, 1975, the Commission announced guidelines for levels of radioactive material in effluents from light-water-cooled nuclear power reactors to meet the criterion "as low as is reasonably achievable" (see 1975 Annual Report, pp. 43-47).

A major effort was made during the year to improve the models used by the staff for estimating effluent levels, environmental dispersion, and dose calculations; to employ more realistic assumptions; and to develop guidance for licensees on implementing the cost-benefit analysis requirements contained in Section II D of the new regulation (Appendix I to 10 CFR Part 50). This effort culminated in the issuance for public comment of the following regulatory

guides and technical reports:

- Regulatory Guide 1.109, "Calculations of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," issued in March 1976.
- Regulatory Guide 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," issued in March 1976.
- Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," issued in March 1976.
- Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Reactors," issued in April 1976.
- NUREG-0016, "Calculation of Releases of Radioactive Material in Gaseous and Liquid Effluents from Boiling Water Reactors (BWR-GALE Code)," issued in April 1976.
- NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE Code)," issued in April 1976.
- Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," issued in May 1976.

These guides and reports present calculation models and values of parameters acceptable to the NRC staff for calculating the average expected releases of radioactive material in liquid and gaseous effluents from normal operation, the dispersion of effluents in the atmosphere and different bodies of water and the associated radiation doses to man, and for performing the cost-benefit analysis required by Appendix I.

A number of licensees have been required to add control systems and radwaste equipment to meet the individual dose design objectives in the regulation.

Environmental Monitoring

Each nuclear facility licensee is required to monitor releases of gaseous and liquid radioactive effluents during normal operation. NRC inspectors check the licensee's radiological monitoring and waste systems to assure they are built as designed and operated to keep releases within regulatory limits. If a regulatory limit or design objective is exceeded, the licensee must so inform the NRC and take appropriate action.

Each power plant licensee also is required to monitor major paths of radiation exposure in the environment. During NRC inspections, random samples of monitoring records, procedures, and reports are examined. In addition, confirmatory measures are made to assess the accuracy and consistency of licensee measurements of radioactivity in effluent and environmental samples.

Regulatory Guide 4.13, "Performance, Testing and Procedural Specifications for Thermoluminescence Dosimetry: Environmental Applications," was issued for comment in November 1976. Thermoluminescence dosimetry (TLD) is widely used to measure levels of x- and gamma radiation in the environs of NRC-licensed facilities. The American National Standards Instiute has published a standard (ANSI-N545-1975) that specifies minimum acceptable performance of TLDs used for environmental measurements; outlines methods to test for compliance; and provides procedures for calibration, field application, and reporting. Regulatory Guide 4.13 endorse the ANSI standard, subject to a number of provisions and qualifications.

NRC's Interagency Program

NRC for several years has enlisted the cooperation of the National Bureau of Standards, the Energy Research and Development Administration, and State health and environmental agencies to provide corroborative evidence of the environmental and effluent radioactivity measurements submitted by licensees. This system provides some specific evidence for the evaluation of the capability of licensees to perform radioactivity measurements. The Health Serv-

ices Laboratory (HSL) of the ERDA Idaho National Engineering Laboratory functions as the NRC reference laboratory in such matters, and NRC inspectors regularly compare licensee effluent measurements with those made by HSL on identical effluent samples.

The State agencies assist in long-term, repetitive sampling to evaluate licensees' overall environmental programs. At the end of fiscal year 1976, the 19 States participating in this program were Alabama, Arkansas, California, Colorado, Connecticut, Florida, Illinois, Maine, Maryland, Michigan, Minnesota, Nebraska, New Jersey, New York, Pennsylvania, South Carolina, Vermont, Virginia and Wisconsin. For most States this arrangement is under written contract, with NRC providing these States with funds, technical support and training to assist in improving their analytical capabilities.

FUEL CYCLE PLANT ACTIONS

The same NEPA review procedures are followed in NRC nuclear fuel facility licensing actions as for nuclear power plants. Environmental reviews and appraisals performed during fiscal year 1976 included the following.

- Final environmental impact statement issued January 30, 1976 on the Allied-General Nuclear Services Receiving and Storage Station, Barnwell, S.C.
- Draft supplement to the final environmental statement concerning construction and operation of the Barnwell Nuclear Fuel Plant, Allied-General Nuclear Services, Barnwell, S.C., issued June 28, 1976.
- Final environmental impact statement issued April 22, 1976 related to operation of the Humeca Uranium Mill, Rio Algom Corp., La Sal, Utah.
- Environmental impact appraisals and negative declarations issued concerning the following actions: (1) General Electric Co., license amendment to permit increased spent fuel storage capacity at its Morris, Ill., facility, December 3, 1975; (2) Nuclear Fuel Services, license amendment to authorize increased spent fuel storage capacity at the NFS reprocessing plant, West Valley, N.Y., March 4, 1976; (3) Babcock and Wilcox Co., special nuclear material license renewal for Commercial Nuclear Fuel Fabrication Plant, Lynchburg, Va., February 26, 1976; (4) Utah International, Inc., license amendment authorizing addition of a tailings retention system at its uranium mill, Shirley Basin, Wyoming, March 4, 1976; (5) United Nuclear Corp., special nuclear material license renewal for its uranium recovery plant, Wood River, R.I., July 22, 1976; and (6) General Atomic Co., special nuclear material license renewal for its fuel fabrication facility, San Diego, Calif., August 8, 1976.

Interagency Coordination

In order to avoid duplication and increase efficiency in meeting the requirements of the National Environmental Policy Act, close coordination between NRC and other Federal and State agencies is necessary.

NRC-EPA Interface

Frequent interaction between NRC and the Environmental Protection Agency is required for the effective performance of their respective functions with minimal duplication and overlap. Coordinating efforts in the area of developing and implementing standards for protection of the public and the environment against radiation are described in Chapter 12 under "Siting Standards." Memoranda of Understanding concerning implementation of water quality requirements are described below.

- *First Memorandum of Understanding* In early 1973, the former Atomic Energy Commission and the Environmental Protection Agency agreed through a formal Memorandum of Understanding that AEC would accept EPA's decisions under specified sections of the Federal Water Pollution Control Act (FWPCA). Reserved to AEC under this Memorandum was the right to establish certain effluent release standards, including limits for release of byproduct, source and special nuclear materials.

Accordingly, the discharge permit issued by EPA under the FWPCA for the Fort St. Vrain Nuclear Generating Station included no limitations or standards for radioactive releases.

- *Court Review*

In December 1974, based on a suit brought by environmental groups, the U.S. Court of Appeals for the 10th Circuit ruled, in *Colorado Public Interest Research Group v. EPA,* that EPA is required by the provisions of the FWPCA amendments of 1972 to issue radioactive effluent discharge permits for individual nuclear power plants. This decison resulted in concurrent jurisdiction by the EPA and the NRC in regulating and controlling releases of liquid radioactive effluents from nuclear power reactors and fuel cycle facilities.

In June 1975, the U.S. Supreme Court decided to review the Court of Appeals' decison. Oral argument was heard by the Court in early December 1975 and on June 1, 1976, the Supreme Court ruled that the FWPCA definition of "pollutants" does not include source, byproduct and special nuclear materials, and that EPA is not required to regulate radioactive effluents in discharge permits for nuclear power plants.

- *Second Memorandum of Understanding*

In order to make the analysis of the water quality impact of nuclear power plants more effective and meaningful, and to reduce the demands for data being placed upon applicants for licenses, NRC and EPA, with the concurrence of the Council on Environmental Quality (CEQ), entered in late 1975 into a Second Memorandum of Understanding, which became effective in January 1976.

For all activities covered under the Second Memorandum of Understanding:

(1) NRC serves as the "lead agency" for preparation of environmental statements.
(2) NRC and EPA work together to identify environmental information needed to evaluate the impact on water quality and biota.
(3) EPA evaluates impacts on water quality and biota as far as possible in advance of the issuance of NRC's final environmental impact statement.
(4) EPA endeavors to issue, where appropriate, a complete Section 402 permit under the National Pollutant Discharge Elimination System as far as possible in advance of the NRC licensing action (construction permit, operating license, or early site approval).
(5) EPA and NRC consider the feasibility of holding combined or concurrent hearings on EPA's proposed Section 402 permits and NRC's proposed licensing actions.

- *Effect on States*

The Second NRC/EPA Memorandum of Understanding is an agreement between two Federal agencies and, as such, has no direct effect on the States. Twenty-seven states have been approved by EPA to be

Signing the Second NRC/EPA Memorandum of Understanding on December 17, 1975, are (at head of table, left to right) Lee V. Gossick, Executive Director for Operations, NRC; Gary Widman, General Counsel, Council on Environmental Quality; and Stanley W. Legro, Assistant Administrator for Enforcement, Environmental Protection Agency.

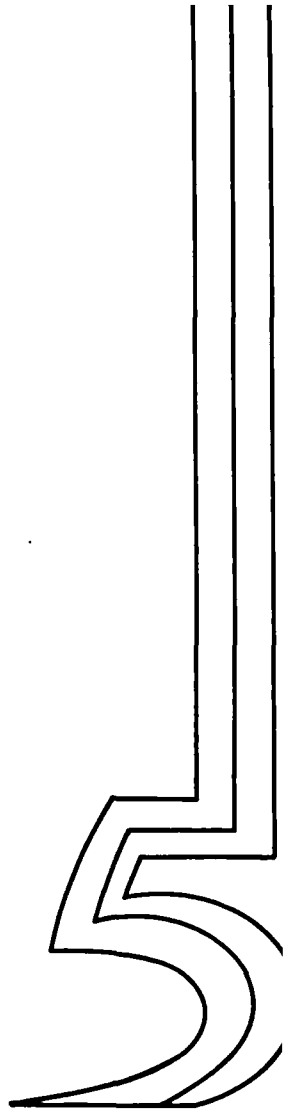
"permitting States" under the FWPCA. In recognition of the desirability of early NRC-State cooperation in licensing nuclear power plants and related facilities, the National Governors' Conference in March 1976 wrote to each permitting State describing the purposes of the Second Memorandum and suggesting the possibility that the States might individually enter into letters of agreement with NRC modeled after the principles embodied in the Second Memorandum. Favorable written responses have been received from nine States, and seven others have responded favorably during conversations with NRC representatives.

Relations with Other Agencies

- *Department of the Interior*
  The San Diego Gas and Electric Co. has proposed the development of the Sundesert Nuclear Power Plant, a two-unit facility on a desert site near the California-Arizona border. The Department of the Interior will be responsible for actions concerning proposed water supply contracts for the plant (which will use agricultural waste water), land exchange for the plant site, and portions of the rights-of-way for transmission lines and access roads. These will constitute a "major federal action significantly affecting the quality of the human environment." To avoid duplication of effort, NRC and the Interior Department entered into a working agreement which will result in a joint environmental review by the two agencies and a single environmental impact statement prepared by NRC as the "lead agency."

  A letter of June 23, 1976, from the Secretary of the Interior to the Chairman of the NRC invited the NRC to reconsider on its own motion the construction permit it issued for the Bailly Nuclear Power Plant on a site in an industrial area near Portage, Indiana, adjacent to the Indiana Dunes National Lakeshore. The reply of July 15, 1976, from the Chairman of the NRC referred to the past history of extensive and thorough consideration of this matter and stated that, in the absence of new information, reopening the matter appeared unwarranted.
- *Department of Agriculture (REA)*
  The Rural Electrification Administration makes loans to qualified borrowers to finance the construction and operation of electric utility facilities in rural areas. NRC and REA are working together to reach an understanding whereby, with input from REA, NRC environmental impact statements would also meet REA's responsibilities under NEPA—related primarily to the transmission line portion of nuclear power facilities financed in whole or in part by REA.

Managing Nuclear Wastes



Planning for the Present and Future

A crucial problem in the utilization of nuclear fission energy is the management of the resulting radioactive wastes in a safe, workable, and environmentally sound manner now and in the future. The Nuclear Regulatory Commission assumed an increasingly active role in seeking an early resolution of the issues involved, particularly with regard to long-term disposal.

During the year the NRC:

- Conducted a task force study to propose goals against which nuclear waste management programs can be evaluated;
- Participated in an interagency task force program to review activities of all Federal agencies concerning high-level radioactive waste management in order to help structure an integrated Federal effort in this area;
- Began development of performance criteria for high-level solidified waste, and scheduling of standards required to regulate all licensed waste categories;
- Began development of licensing procedures to provide for an independent assessment of high-level waste repositories proposed by the Energy Research and Development Administration, which has statutory responsibility to develop and demonstrate such facilities;
- Reassessed the technical and regulatory bases for the operation of existing shallow land burial sites for other than high-level wastes, and initiated an interagency study of needs for improvements in this area now and in the future;
- Conducted workshops to assist in considering the partitioning of radioactive wastes, the formulation of a waste classification system, and factors that might affect the long-term performance of geological repositories for high-level wastes; and
- Carried out a thorough analysis of the environmental impacts of nuclear fuel reprocessing and waste management which will be the basis for new rulemaking proceedings on such impacts in the licensing of nuclear power plants.

In addition to the above activities, covered in this chapter, the NRC's waste management efforts continued toward resolution of the problem of uranium tailings piles resulting from uranium mining and milling in certain Western States (see Chapter 3).

Major Tasks

To create a comprehensive program for waste mangement regulation, the NRC is developing:

(1) Objective performance goals—technical, social, cost-benefit, and environmental—against which nuclear waste management programs and strategies can be evaluated;
(2) A methodology—and the information base needed to use it effectively—for assessing proposed programs against these performance goals; and
(3) A framework of regulations, standards and guides for waste management within which NRC can effectively carry out its mandate to protect the public health and safety.

PERFORMANCE GOALS

In January 1976, the NRC set up a task force to define goals against which nuclear waste management programs could be evaluated. The task force began by interviewing a wide range of individuals from industry, conservation groups, and agencies involved in waste management.

The interviews pointed up the complexity of waste management—that the issues involved transcend technology. Social, political, institutional, and ethical problems are interwoven with technological considerations.

The task force identified several time horizons pertinent to dealing with nuclear wastes: the coming decade, the next few centuries, and the next few hundred millenia. NRC's statement of goals and objectives will address each of these.

The first—a period of five to ten years—is fixed by the urgent need for selection of some viable solution of the problem now.

The second time horizon is established by the issue of how long man-made structures and institutions can be relied upon.

As to the third horizon, uncertainties relating to such factors as demography, climate and earth movements necessarily are attached to predictions that go beyond several thousand years.

Considerations of long-term safety were universally cited as the most important requirement, yet judgments in this area varied widely —understandably so, because of the extended time periods involved.

A few examples of the considerations that sound regulatory practice seems clearly to dictate, are:

(1) The need to handle, treat, and dispose of radioactive wastes already in existence should not dictate the nature of solutions for wastes yet to be generated.
(2) The system should be designed so that its operation does not depend on the existence of commercial nuclear power. Moreover, the other nuclear fuel cycle operations should not limit the flexibility of the waste management system to cope with changes in scale or waste type or past errors.
(3) Adequate documentation of present activities and decisions should be provided to allow future generations the bases for action.
(4) The system should not have to depend on stability of social and governmental institutions for secure and continued operation.

The recommendations of the task force were conveyed to the Commission early in 1977, following an oral report at the Conference on Public Policy Issues in Nuclear Waste Mangement at Chicago in October. After considering the policy issues and priorities that should be assigned to the various goals, the Commission will request public comments on recommended goals and will establish policy based on the report and the comments received.

HIGH-LEVEL WASTES

During 1976 the efforts of the NRC and other concerned Federal agencies focused on implementing in a timely manner safe and acceptable methods of long-term management

and dispositon of existing and accumulating high-level radioactive wastes.

Liquid high-level wastes in interim storage at the end of 1976 included 600,000 gallons of commercial waste containing 400 million curies of radioactivity (measured as strontium and cesium 10 years after generation), and 80 million gallons of military waste containing from 400 million to 700 million curies of radioactivity.

In addition, there were 6,000 spent nuclear reactor fuel assemblies in fuel storage pools, both at reactor sites and at independent facilities. Nuclear reactors generating commercial electric power are currently using fuel at a rate of about 3,200 assemblies per year. If these fuel elements were reprocessed, they would produce approximately 200,000 gallons per year of liquid high-level waste containing 230 million curies of radioactivity.

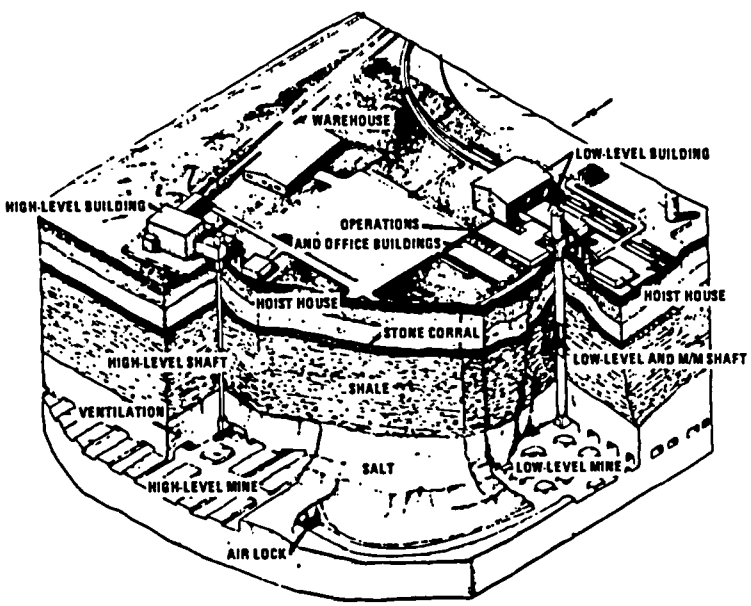
Interagency Task Force Activities

An interagency task force was convened by the Office of Management and Budget (OMB) in late 1976 to review waste management programs currently underway or proposed by Federal agencies, to help structure the various agency programs into an integrated Federal program directed toward the effective management of radioactive wastes, and to facilitate the redirection of jurisdictional matters which might otherwise result in some aspects being overlooked or in some duplication of efforts in the Federal program. The task force is chaired by OMB and includes representatives from the NRC, ERDA, Environmental Protection Agency, Council on Environmental Quality, National Science Foundation and U.S. Geological Survey. Significant issues addressed by the task force include ERDA's proposed schedule for the construction of a high-level waste repository, the NRC's role in licensing the first such repositories planned by ERDA, and the agencies' roles in developing waste management criteria. The task force will report its findings and recommendations to the affected agencies in 1977.

Criteria Development

The development of performance criteria, rather than design criteria, is a major part of the NRC's current waste management program effort. The evaluation of specific designs will be done when they are submitted to the NRC for licensing review.

Development work supporting the formulation of performance criteria for solid matrices for



This is the Energy Research and Development Administration's conceptual design of the probable layout of a bedded-salt repository for high-level and transuranic wastes. NRC will be responsible for the safety review and licensing of these facilities.

high-level wastes was completed by Lawrence Livermore Laboratories and the University of Arizona under contracts with NRC. Based on this work, preparation of a proposed regulation setting forth performance criteria for the solid matrices has been initiated.

Preliminary identification and scheduling of the standards required for the regulation of all categories of licensed wastes is nearing completion. Similar efforts directed toward scheduling the development of licensing methodologies and predictive models are underway. Regulations governing the performance of high-level waste solids, setting forth waste classifications for regulatory purposes, and setting forth site suitability criteria for high-level waste repositories are scheduled to be proposed for public comment in 1977 and 1978. The addition of a new part to the Commission's regulations specifically for the regulation of waste management facilities and operation is being considered.

NFS Waste Disposition

A policy statement issued by the former Atomic Energy Commission in 1971 (Appendix F to 10 CFR Part 50 of NRC regulations) provided that high-level radioactive liquid wastes produced at reprocessing plants must be converted to an approved solid form within 5 years and shipped to a Federal repository within 10 years after separation of the fission products from the irradiated fuel. The rule provided that its application to existing wastes (produced by the Nuclear Fuel Services plant at West Valley, N.Y., the only spent fuel reprocessing plant to be licensed for operation) would be the subject of a further rulemaking proceeding.

The NRC staff moved toward initiation of the NFS rulemaking proceeding with publication in April 1976 of a report concerning disposition of the liquid high-level waste currently being stored at the closed-down facility at the Western New York Nuclear Service Center, West Valley. The waste being managed at the site includes 600,000 gallons of neutralized (non-acid) high-level waste and 12,000 gallons of acid from high-level waste which are by-products of spent reactor fuel reprocessing that took place there from 1966 to 1972.

The report, "Alternative Processes for Managing Existing Commercial High-Level Radioactive Wastes" (NUREG-0043), prepared for NRC by Battelle Pacific Northwest Laboratories under an ERDA contract, discusses the nature of the NFS wastes and reviews the available technology that may be applicable.

Licensing of ERDA Facilities

While ERDA has the task of developing and demonstrating technologies for storage and disposal of high-level nuclear wastes, the Energy Reorganization Act of 1974 assigns NRC the responsibility to license and regulate the facilities to be employed for the safe storage and/or disposal of these wastes.

The NRC is actively preparing for the licensing of these ERDA facilities. Factors being considered in the development of licensing procedures include assuring the protection of the health and safety of the public, the timely development of the facilities, and obtaining public participation to the fullest extent possible. With these factors in mind, the preparation of a licensing procedure which will provide for effective NRC regulation is well underway.

The NRC licensing procedures will provide for an independent assessment of proposed ERDA waste management facilities. A study under NRC direction has been initiated at Sandia Laboratories to develop the procedures, methods, and guidelines which will be used for assessing the risks and evaluating the acceptability of proposed geologic storage facilities. The evaluation of performance will be in terms of meeting NRC goals and objectives for waste management in areas including safety, environmental, technical, societal, economic, and public involvement factors.

Panels conducted by the National Academy of Sciences will also support the development and implementation of NRC licensing procedures for radioactive waste repositories. Initial panel studies will include:

- The conversion of high-level radioactive waste into a suitable stable physical form, so that it may be transported or disposed of with greater safety; and
- The establishment of general geological

selection criteria for burial or disposal sites for radioactive waste.

A report on panel results is expected by the end of fiscal year 1977.

WASTE BURIAL FACILITIES

Reassessment of Low-Level Disposal

Six commercial shallow land burial facilities have been licensed for the disposal of radioactive wastes categorized as "other than high-level" wastes. The NRC has complete responsibility for one site—the Sheffield, Illinois facility. "Agreement States" license the operation of the other five sites, with the NRC sharing licensing responsibilty at three sites. (See Chapter 9.)

The need for reassessment of existing commercial burial sites has been highlighted in recent reports, occurrences, and Congressional hearings. The principal reasons for reassessment are: (1) to assure that present operations are safe, and (2) to reexamine the regulatory base for licensing and control of the sites.

Although there has been, to date, no adverse effect on public health and safety from any of the existing commercial sites, a philosophy is emerging among the concerned Federal agencies (EPA, NRC, ERDA, USGS, CEQ) that consignment of radioactive wastes to shallow land burial should be decided more on the basis of the longevity of the hazard than on its magnitude. Thus, long-lived radionuclides—principally the transuranic wastes—should not be disposed of by shallow land burial. Achievement of "zero-release" of radioactivity from the sites, because of site characteristics alone was assumed feasible in the past but is now being reevaluated. A combination of site engineering, water management, and the packaging and treatment of wastes can minimize migration from sites, and taking account of such factors in site evaluation represents a new direction in waste management philosophy.

The reassessment of existing sites involves interrelated activities by NRC, the States, and other Federal agencies—including some parts of the NRC staff review of the Federal/State programs; Agreement State and NRC licensing and inspection programs; work of the NRC in-house task force on criteria; a State bonding task force report; USGS and EPA data base site studies; and interagency task force efforts.

As part of the Commission's ongoing program to reexamine the technical and regulatory bases for the management of radioactive wastes and in response to Congressional concerns, the NRC undertook a study of Federal/State programs for the regulation and operation of the commercial low-level burial facilities. The NRC staff study was a concentrated effort to assess the overall programs for these sites and to identify needed corrective actions.

During July and August, 1976, NRC staff met with representatives from the States of Illinois, Kentucky, Nevada, New York, South Carolina, and Washington. (A commercial disposal facility is located in each of these States.) The purpose of the meetings was to discuss the States' experience and views concerning the regulation and operation of commercial low-level radioactive waste burial facilities. The views expressed at these meetings were incorporated into the ongoing staff study. The NRC staff also visited five of the six existing commercial sites during this time.

A report was expected to be issued in early 1977 to present the staff's findings and recommendations, covering a range of issues including:

(1) National public need and concern for safe, effective, and economic methods for the management and disposal of such wastes;

(2) The need for national projections which define regional demands for waste disposal capacity to serve as a planning base for the States and Federal government;

(3) Consideration of alternative technologies for disposing of such wastes;

(4) The need for better technical criteria and standards for the selection, development, utilization and long-term care and maintenance of the commercial burial sites;

(5) Assurance of adequate financial and institutional resources to care for such wastes during their hazardous lifetime;

(6) Minimization of the number of sites requiring long-term care; and

(7) Coordination of Federal/State activities in this area.

INDEPENDENT HEARINGS/REPORTS

JCAE Hearing

On May 12, 1976, the Joint Committee on Atomic Energy held a hearing on nuclear waste management. The hearing was separated into two sessions: one dealing with high-level wastes, and one dealing with low-level wastes. The session on high-level waste was a follow up to the JCAE hearings on the same subject held in November 1975. Top level NRC officials presented testimony at both sessions in which they described the status of the NRC waste management program.

ACRS Report

In early 1976, the Commission requested that the Advisory Committee on Reactor Safeguards (ACRS) perform an independent review of the NRC nuclear waste management program. The ACRS sent an interim report to Chairman Rowden in April 1976 in which they recommended, among other things, that "NRC assume an aggressive role in the development and implementation of a comprehensive long term waste management program."

GAO Report on Waste Management

In June 1974, the U.S. General Accounting Office (GAO) initiated a review of nuclear waste burial grounds. In January 1976, the GAO issued its report to Congress, entitled "Improvements Needed in the Land Disposal of Radioactive Wastes—A Problem of Centuries." The report dealt with both commercial burial activities and the burial practices at facilities operated by the Energy Research and Development Administration (ERDA). The GAO made several recommendations to the NRC concerning the need for comprehensive studies of waste disposal sites, development of site selection criteria, improvements in monitoring programs and development of long-term care requirements.

The most broad-ranging GAO recommendation was for studies of existing commercial and ERDA sites to better evaluate their ability to retain radioactive waste and, on the basis of those studies, to develop site selection criteria for determining the long-term suitability of existing disposal sites and for selecting future sites. Full implementation of all the recommendations will involve a number of Federal agencies and State groups who have overlapping charges and ongoing studies.

An informal interagency working group to deal specifically with shallow-land burial and with the implementation of the GAO recommendations has been established following an NRC initiative. The group consists of representatives of NRC, ERDA, EPA and USGS, plus a representative of the National Conference of Radiation Control Program Directors, to provide input from the States. The group has agreed to define areas of responsibilities, to coordinate the timing of programs, and to see that the GAO recommendations are fully implemented, while minimizing duplication of effort.

WORKSHOPS ON WASTE

Workshop on Partitioning

A substantial problem in the development of a waste management scheme is the great difference that exists between time-projections of a thousand years and those on the order of a million years. A number of improvements in current waste disposal approaches might be implemented, if a system could be devised to permit the reduction in the time frame for waste storage to a scale of a thousand years, through separation of the radioactive wastes into segments with different half-lives (partitioning), with special handling of the long-lived heavy elements produced or remaining from fuel irradiations. These elements might, for example, be transmuted to shorter half-life radioactive products by reirradiation techniques.

In view of the foregoing considerations and

others—including accord with the National Enviromental Policy Act's mandate to achieve the ". . . maximum attainable recycling of depletable resources . . ."—NRC sponsored a technical workshop on radioactive waste partitioning to:

- Discuss the question of why (or why not) radioactive wastes should be partitioned, considering environmental safety, economic, or other viewpoints;
- Review existing separations technologies and assess their potential in radioactive waste management activities; and
- Identify areas where research is required to confirm developmental and design aspects of this process alternative for radioactive waste management

Approximately 70 participants were involved in the workshop proceedings, representing government agencies such as ERDA, EPA and NSF, ERDA-sponsored laboratories, utilities, academic institutions and concerned citizens (for example, the Union of Concerned Scientists and Natural Resources Defense Council).

The workshop proceedings were compiled, edited, and published as the document NR-CONF-001, in June 1976. In summary, the consensus of the workshop participants was that:

- Before a requirement for partitioning can be considered by NRC, additional research and development studies would be required. Thus, a near-term decision on the partitioning alternative for a waste management system is precluded.
- Some possible objections to waste partitioning are that increased waste stream volumes could be added to the disposal problem; increased occupational exposures could occur; and increased costs could be incurred from the additional separation operations.
- There is no reason why a deferral in deciding on the merits of requiring partitioning would impede either commercial fuel reprocessing or consideration of the recycling of plutonium.

NRC is continuing to analyze the information in the proceedings with a view to developing a policy statement, if indicated.

Workshops on Waste Classification

To provide for more appropriate regulation of the storage of nuclear waste, it is necessary to devise a more detailed and specific waste classification method than is in current use.

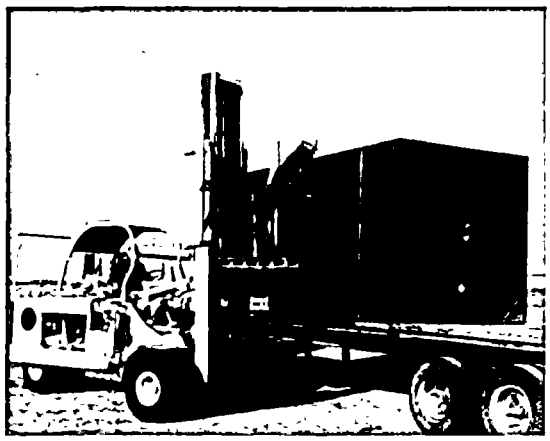
A technical advisory panel has been set up under NRC contract to formulate a classification system for nuclear wastes which can be used as a tool for developing regulations for the management and disposal of these wastes. Proposed classification criteria are scheduled to be published for public comment in late 1977. This will provide a basis for the development of regulations specifically designed to optimize the storage of the various defined waste types.

Workshop on Planet Earth's Stability

As part of its efforts to develop criteria for the siting and evaluation of waste repositories, the NRC sponsored a workshop of experts in such fields as natural resources, geology, biology and demography, to discuss what developments in the far distant future might affect the performance of a nuclear waste repository. The workshop was entitled, "Resource Potential and Environmental Stability of the Planet Earth for the Next Million Years," and was held near Denver in November 1976.

The meeting was an exploratory effort at cataloguing the factors important to assessing these repositories in the long term. From the workshop the NRC and the National Academy of Sciences (under contract with NRC) will carry through separate and parallel programs aimed at defining criteria important for an independent assessment of the geological disposal of high-level wastes.

The question posed to the workshop was simply, "Does the new knowledge in the several areas represented provide us with any startling new insights into what should be done with the nuclear wastes?" The answer from the group was that no new guidelines could be identified, but some powerful new tools were available to



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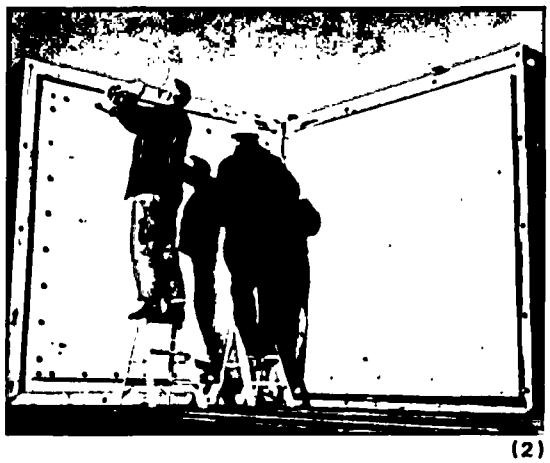


(2)

(3)

These photos were taken at Nuclear Engineering Co.'s shallow land burial ground near Richland, Wash., one of six commercial sites in the United States for disposal of low-level radioactive wastes. The burial ground is licensed by the State of Washington, except that the handling of any special nuclear material is licensed by NRC. Featured in the photos, running clockwise from upper left are: (1) a Type B container, "Super Tiger," is delivered by truck; (2) the inner door of the Super Tiger is unbolted after the spacer end has been unbolted and opened; (3) the 55-gallon metal drums are removed to a forklift pallet after direct and smear survey for leakage is performed; (4) interior of a burial trench; and (5) a trench that has been backfilled and marked with a monument and placard.

(5)

(4)

aid our understanding and our review of possible sites and disposal methods.

ENVIRONMENTAL IMPACT OF LWR FUEL CYCLE

AEC's 1974 Rule

The "Environmental Survey of the Uranium Fuel Cycle" (WASH-1248) was published by the Atomic Energy Commission in April 1974, for the purpose of establishing a technical basis for informed consideration of environmental effects of the uranium fuel cycle in the environmental impact statements for individual light water reactors proposed for licensing.

The survey treated the nuclear fuel cycle generically, permitting an overview of the entire industry without the need to evaluate particular plants. To compensate for the lack of specific site and design detail, it made estimates of effluent concentration, radiation dose rates, and human population densities appropriate to the model fuel-cycle facilities. Table S-3 of the survey presented the summary of the environmental impacts of the fuel cycle attributable to one 1,000-MWe light water reactor, to be used in the cost/benefit analysis for the plant. The fuel cycle rule (Table S-3 of 10 CFR § 51.20 (e)) had as its base a modification of the uranium-only recycle process in which separated plutonium was stored for possible later use rather than being recycled or treated as a waste stream. High-level wastes were taken to the point of retrievable surface storage, but the disposal of high-level and transuranic wastes was never addressed.

NRC's 1976 Analysis

Supplement 1 to WASH-1248, "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle" (NUREG-0116), was published by the NRC in October 1976, as a result of the July 21st decision by the U.S. Court of Appeals, D.C. Circuit, remanding the reprocessing and waste management portions of the fuel cycle rule (see Chapter 2). The supplement considers two fuel cycles: uranium-only recycle, and the no recycle case. In the supplement, the model fuel cycle facilities, in terms of capacities, waste generation rates, and types of waste produced are drawn from GESMO,* and the environmental impacts associated with reprocessing and waste mangement activities are normalized to a model reactor corresponding to that in WASH-1248.

The supplement presents a full discussion of spent fuel reprocessing and waste management impacts, and is based on a thorough survey of the available data. In general, the supplement indicates that the available data are adequate for a quantitative assessment of impacts from normal operations of all parts of the reprocessing and waste mangement system. Accidents were analyzed for most components of the complete system but the basis for these analyses in the literature were varied, and all accident sequences could not be analyzed. The NRC report found that environmental impacts of fuel reprocessing and waste mangement as they relate to individual nuclear plants continue to be small, even when impacts which were not completely accounted for in the past were considered.

In areas where information necessary for a complete quantitative assessment of environmental impacts is lacking (risks from sabotage, special risks from disposal of spent fuel or separated plutonium, and risks from failure in the long-term of the geologic repository for high-level waste), various Federal programs are underway to resolve existing uncertainties.

At the time of the adoption of the fuel cycle rule, the AEC indicated that the rule and survey would be re-examined from time to time to accommodate new information. In this regard, the NRC staff is initiating a study designed to examine information that has developed since promulgation of the fuel cycle rule in 1974 for the purpose of generally updating the rule.

* "Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors," NUREG-002, USNRC, August 1976.

Domestic Nuclear Safeguards

Protecting Materials and Facilities

The area of nuclear safeguards—those measures used to prevent the theft or diversion of nuclear materials or the sabotage of nuclear facilities—was one of intense study, evaluation and activity during 1976. This chapter will cover significant developments and decisions related to domestic safeguards. International safeguards and export-import control are discussed in Chapter 11.

Domestic safeguards for licensed nuclear materials and facilities are an increasingly important element in the overall NRC licensing process and the subject of specific regulations, guidance and standards, as well as the research needed to confirm or revise them. Safeguards are an important aspect of NRC's review of license applications for reactor and fuel cycle operations and a major concern in NRC's inspection and enforcement activity. Regulations related to safeguards are set forth in 10 CFR Part 73, "Physical Protection of Plants and Materials," and 10 CFR Part 70, "Special Nuclear Material." The protection of special nuclear material (SNM), whether in use, in transit or in storage, is the principal objective of safeguards. SNM includes plutonium, uranium-233, uranium enriched in uranium-235, and any other material determined by the NRC to be special nuclear material under Section 51 of the Atomic Energy Act of 1954. SNM does not include source material (for example, natural uranium and thorium) from which nuclear fuel is processed. Some nuclear wastes may contain SNM.

The continuing development and expansion of the nuclear power industry has prompted continual review and upgrading of safeguards requirements. In recognition of the importance of this function, the Congress explicitly provided in the Energy Reorganization Act of 1974 for an Office of Nuclear Material Safety and Safeguards within the NRC, mandated to review existing safeguards for nuclear facilities and materials and, in particular, to carry out (1) monitoring, testing and recommendations for upgrading material accounting systems; (2) development of contingency plans to deal with threats, thefts and sabotage of

materials or facilities; and (3) a study of the need for, and feasibility of, establishing a Federal security agency to administer safeguards. Results of NRC activity in each of these areas are discussed below, under the heading "Meeting Congressional Mandates."

DEVELOPING SAFEGUARDS POLICY

The Commission's continuing assessment of licensee performance in the safeguards area during 1976 proceeded from two basic questions: Are present-day safeguards satisfactory in terms of present needs? and, What new or augmented measures will be necessary to protect public health and safety and national security in the future? More specifically, the Commission focused on the following kinds of critical safeguards questions during 1975-76:

- What are the crucial security problems facing nuclear licensees?
- What are the highest priority safeguards research needs?
- What level of protection is adequate?
- What are the surest and most efficient means by which to enhance (1) transportation security, (2) fuel plant protection, (3) reactor protection, and (4) material controls?
- Should current "systems-oriented" regulations, which specify how a required objective is to be met, be supplemented with "performance-oriented" regulations, which focus on the goal and allow a licensee flexibility in going about meeting it?
- What kinds of tests are demanded to provide assurance that industry security systems are affording the necessary degree of protection?
- Are workable contingency plans in place to guide responses to any attempted thefts or attacks?
- Are safeguards early warning systems sufficiently fast and reliable to thwart overt or covert attacks against nuclear plants and materials?

In seeking a resolution of these questions, the NRC made three fundamental policy determinations from which to approach all safeguards issues. First, while NRC must define the levels of safeguards protection needed and incorporate them into regulation, the licensees themselves will have primary responsibility for designing safeguards systems, making security improvements, and maintaining the capability to assure that nuclear plants and materials were effectively protected. NRC will continue, through inspection and enforcement, to assure that licensees are complying with applicable requirements for implementing safeguards. Second, NRC would establish, with a high degree of confidence, that safeguards systems were satisfactory by use of such improved techniques as on-site validations, operational readiness tests to probe for weaknesses in the system, or the revamping of data systems to speed the flow of vital security information to the proper licensee personnel and to the NRC. The third policy determination was that nuclear safeguards will be tailored to the degree of risk associated with particular materials and facilities. For example, low-enriched uranium does not pose the same security problems that high-enriched uranium or plutonium does, and safeguards prescribed for their protection should differ accordingly.

In 1976, the Commission tightened existing safeguards requirements after plant-by-plant evaluations and a thorough review of transportation routes. The assessments resulted in issuance of stronger license conditions to govern specific plant and transport operations, and the upgrading of safeguards regulations and guides. An equally strong effort was made to complete ongoing planning and carry out the Congressional mandates cited above.

Meeting Congressional Mandates

As noted, the Energy Reorganization Act of 1974 charges the NRC to develop recommendations for the upgrading of material accounting systems; to develop contingency plans for dealing with threats, thefts and sabotage of nuclear materials or facilities; and to determine the need, if any, for a Federal Security Agency to administer safeguards.

MATERIAL ACCOUNTING SYSTEMS

In 1976, NRC staff completed its review of plans drawn up by licensees for fundamental nuclear material control, in response to regulations issued in November 1974. These plans represent an upgrading of the accounting requirements by which the storage and use of nuclear materials is monitored and controlled. The industry's plans were predicated on a need for detailed accounting procedures for the control of quantities of SNM in exces of one "effective" kilogram (one kilogram for plutonium or uranium-233; larger amounts of material enriched with uranium-235, depending on the degree of enrichment). The improved controls proposed by industry involve the use of advanced technology, such as nondestructive analysis, and automatic data systems to provide rapid accounting reports. The plans were assessed by the staff and used to modify individual licenses to ensure industry-wide compliance with them. Under the new requirements, licensees must:

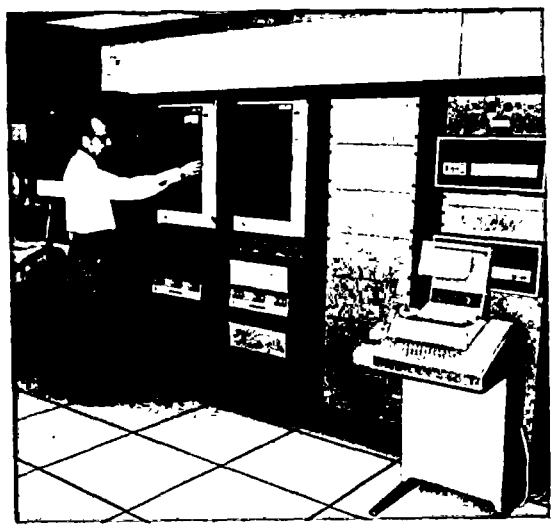
- Establish additional checks to prevent diversion of the material;
- Increase the number of material control areas to localize any inventory discrepancies;
- Improve the measurement base for material control and accounting;
- Establish controls to provide current knowledge of identity, quality and location of discrete items and containers of SNM;
- Reduce the time required to process scrap material, which is difficult to measure; and
- Formalize audit procedures.

The new requirements also specify new controls in certain other areas such as shipping and receiving procedures, materials storage practices, records and reports, and management practices.

Twenty licensees (all those affected by the more stringent rules) were found by NRC to have adopted acceptable implementation plans in 1976.

Measurement Control Plans

In order to further improve the quality of nuclear material measurements by licensees, the NRC imposed, in August 1975, more exacting quality control requirements on the industry by again revising 10 CFR Part 70. The new requirements are intended to strengthen and



Nuclear material accountability at General Electric Co.'s reactor fuel manufacturing plant at Wilmington, N.C., is performed with the aid of special measuring equipment and computer systems. One of the computers, at left, contains information fed into it from terminals in more than 100 locations throughout the plant. Information from the scale at the fuel rod loading station at right is entered directly into the computer. Similar scales are employed at other locations to measure and record weights for uranium dioxide powder containers and uranium hexafluoride cylinders.

complement present accounting and measurement techniques. They apply to the same group of licensees which were required to submit fundamental nuclear material control plans. The rules apply to all nuclear material facilities authorized to possess and use more than one "effective" kilogram of SNM. Written plans submitted by the licensees to implement the NRC's new provisions were under review at the end of fiscal year 1976.

CONTINGENCY PLANNING

A safeguards contingency is any unusual or nonroutine event that requires the execution of security plans and procedures not normally performed on a day-to-day basis. Such events are to be expected, and the safeguards staff at the licensed facility is responsible for anticipating and dealing with them effectively.

A safeguards contingency plan is a documented plan developed to respond to threats, thefts or sabotage in connection with SNM or nuclear facilities licensed by the NRC, in such a way that, if normal safeguards fail, SNM will be held secure or recovered and/or nuclear facilities will be kept secure or restored to a protected condition. Contingency plans contain: (1) a predetermined set of decisions and actions required to satisfy stated objectives; (2) an identification of the data, criteria, procedures, and mechanisms necessary to make and carry out the decisions and actions efficiently; and (3) a specification of the individual, group or organizational entity responsible for each decision and action.

The contingency planning staff of the NRC has, over the period of this report, worked to develop a methodology for determining when a given threat or situation should be perceived as serious. It has also focused efforts on constructing a base for the assessment of information from other Federal agencies.

There are important differences between "safeguards" and "safety" as the terms are employed by NRC in the regulation of nuclear material and facilities. Safeguards contingency plans are directed against adversaries; safety emergency preparedness plans are directed against accidents. Contingency plans are carried out primarily by security forces; emergency plans are carried out primarily by health physics, medical and other technical staffs.

Interagency Agreements

An important aspect of contingency planning is a knowledge of all available resources and of the means to mobilize them should they be needed. NRC staff has established contact with 60 organizational elements of 23 Federal agencies and two national associations. These contacts were made to find out what resources are available to cope with the loss of nuclear materials and what procedures would be necessary to obtain any desired assistance. Interagency agreements are being drafted with those agencies and organizations that have been found of potential help in responding to safeguards contingencies, including the Energy Research and Development Administration, the Federal Bureau of Investigation, the Central Intelligence Agency, the Secret Service, the Department of State, components of the Department of Defense, the Coast Guard, the Federal Aviation Administration, and others. Procedures will be clearly defined in writing and the options and resources identified. Formal interagency agreements will spell out the criteria for agency involvement, the responsibilities of NRC and the assisting agency, the information channels and flow, and procedures to be followed.

Incident Response Center

NRC is establishing an Incident Response Center (IRC), with on-call duty officers available for responding to events arising after normal working hours. With the installation within the IRC of secure telecommunications with other Federal agencies, the center will become the focal point for implementation of NRC's headquarters contingency plans.

Information Assessment Team

To ensure prompt, coordinated action on all information regarding threats to licensed nuclear

facilities and materials, the NRC has also established an Information Assessment Team (IAT). The team is responsible for rapidly reviewing the authenticity of sources and data on each reported threat and determining the seriousness of the threat. It then recommends a course of action to be taken by NRC management.

There were occasions during the fiscal year when NRC or its licensees deemed it advisable to intensify the state of readiness at certain nuclear facilities to deal with threats of varying severity. Such an occasion arose during the period of the Fourth of July 1976 bicentennial observance, when the IAT maintained contact with the intelligence community, national agencies, and State and local law enforcement agencies. No attempts to breach security were made, but plans for responding to such attempts were in readiness. (See also Chapter 7.)

A prototype licensee safeguards contingency plan was prepared by NRC for the Plutonium Fuels Development Laboratory of the Westinghouse Corporation, and a plan for safeguarding highway transportation of SNM was developed with the cooperation of Tri-State Motor Transit Co., in order to verify and demonstrate the NRC methodology in actual application. A regulation is being formulated which would require licensees authorized to possess significant quantities of SNM to develop and use safeguards contingency plans. An industry-wide meeting was held in April 1976 with fuel-cycle licensees at which NRC staff set forth the philosophy, methodology and objectives of safeguards contingency planning and plans for implementing the Congressional mandate were explored. In addition, NRC staff has consulted with, and briefed ERDA on regulatory activities in order to promote compatibility and to fulfill requirements of the Energy Reorganization Act.

SECURITY AGENCY STUDY

The third NRC undertaking mandated by the Energy Reorganization Act was the determination of whether a Federal security agency was needed to safeguard commercial nuclear operations, and if it was feasible to create such an agency within the NRC. Of concern in this regard were nuclear power reactors, certain fuel plants, and special nuclear materials. The basic question was whether the licensees, in concert with local law-enforcement bodies, could provide adequate armed security personnel with appropriate back-up resources, or if Federal guards were called for.

Sixteen criteria, based mainly on consultants' reports, were used by NRC to compare the effectiveness of private and Federal guard forces. The criteria included: general and local security knowledge; mental and physical fitness; alertness; motivation; arrest power; authority to use deadly force; chain of command and controllability during crisis; compatibility in normal operations; liaison with offsite forces; and weapons. Other issues considered in the study included the role of offsite reaction forces; administrative implications for licensees and NRC; and the possible use of Federal security forces from other agencies. More than 300 persons contributed to the study, including special contractors to report on specific aspects of the issue, and consultants from the Federal Bureau of Investigation, the Department of Defense, the Department of the Treasury, the U.S. Marshals Service, and the Energy Research and Development Administration.

As a result of the study, the NRC concluded, and reported to the Congress on September 7, 1976, that there is no need at this time to create a Federal security agency within the NRC to protect commercial nuclear facilities from sabotage and nuclear materials from theft or diversion. The creation of a special security force within NRC would not result in a higher degree of guard force effectiveness than can be achieved through the use of private guards who have been properly trained and certified by NRC. The study identifies means by which guard forces could be upgraded through the imposition of new requirements under current authority. The study also concluded that new legislative authority would be necessary for the creation of a guard force within NRC.

A salient finding of the security agency study was that no difference in potential impact on civil liberties could be discerned between the use of Federal and the use of private guard forces.

Tests and Evaluations

SITE ASSESSMENTS

In January 1976, the NRC began a special review of safeguards which focused on fuel cycle facilities possessing strategic quantities of highly enriched uranium or plutonium. Evaluations were made at 15 facilities to assess the effectiveness of their programs. The review teams studied the licensees' ability to meet current regulations and judged their safeguards capabilities against specified threat levels.

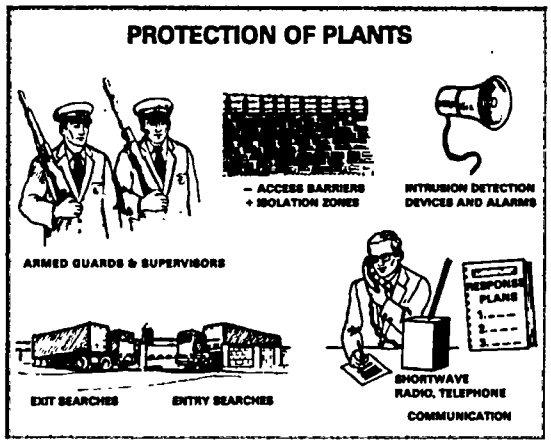
Weaknesses were found at each of the 15 facilities, the most prevalent related to control of access to strategic quantities of SNM (both stored and in process), exit search procedures, and adequacy of response by onsite and offsite security forces. The review teams were satisfied that short-term measures could correct most of the deficiencies and that some could be resolved by procedural changes alone. The licensees took immediate corrective actions.

During their initial review, the teams found that the guard forces of some licensees were admittedly reluctant to engage an attacking force, to some degree for lack of strength in numbers. Licensees have significantly increased guard strength since that review and affirmed their commitment to intervene with force, if need be, to protect strategic quantities of special nuclear material.

Of the 15 facilities involved in the review, eight were judged adequate to withstand the postulated threats. Correction of the safeguards deficiencies of the remaining seven was monitored by NRC staff using existing inspection, enforcement and licensing procedures and including the imposition of plant-specific license conditions.

Some examples of the types of license conditions imposed as a result of site assessments are:

- Increase in the number of guards and weapons;
- Corrections and improvements in alarm systems;
- Strengthening of communications systems with local law enforcement agencies for back-up support;
- Improvement of surveillance of plant personnel inside those material areas of the plant considered to be critical;
- Improvements in penetration detectors inside plant boundaries; and
- Tightening of exit search procedures.



Additional license conditions and orders were also issued as a result of observing nuclear material shipments; these are discussed below, under "Vulnerability Analysis of Land Transport."

All fuel cycle licensees were required to achieve the capability by the end of August 1976 to withstand, at a minimum, the internal and external threats postulated above. To confirm that this capability was achieved, NRC assessment/evaluation teams again visited all fuel cycle operations involved during September and October 1976 and found that the safeguard capability at all facilities was sufficient to meet the design threats under the evaluation criteria applied.

SAFEGUARDING POWER REACTORS

NRC continued to emphasize safeguards for nuclear power plants during 1976, and initiated major efforts to evaluate current physical security at operating plants and the need for new regulations. At the end of the fiscal year these efforts were nearing completion. A proposed new regulation was prepared to codify specific physical security requirements for re-

actors. Emphasis in nuclear plant safeguards is placed on preventing acts of sabotage which could endanger public health and safety through releases of radioactivity to the environment. NRC requires licensees to submit physical security plans outlining protective features—including armed guards, fences, communications systems, and access controls—to be maintained at the plant. The agency reviews and approves compliance through periodic site visits.

As part of its continuous assessment of safeguards generally, the NRC reviewed during 1976 the physical protection provisions currently in force at all operating plants, and conducted special inspections at each plant. A small number of plants were found to need near-term improvements in the physical security system. These improvements were initiated by the licensees.

In a second action, the NRC selected six representative reactor sites for onsite evaluations to check the effectiveness of safeguards requirements in the projected new regulation (10 CFR Part 73.55). Results of this survey were considered in developing the proposed regulation. (See also Chapter 12 under "Safeguards Standards.")

THE USE OF FORCE

As a consequence of contacts with the nuclear industry concerning the protection of special nuclear material, the NRC determined that the matter of guard responsibility was one that required more positive definition. It was clear that a commitment from industry would be needed to assure that their guards would take appropriate response action—including the use of force as circumstances dictated to protect the material.

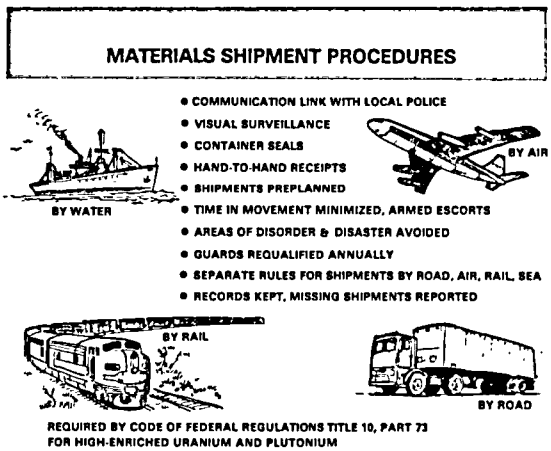
In November 1975, the NRC informed fuel cycle licensees of the full intent of NRC regulations concerning guard response, following up with additional clarification in direct discussions during site visits. From these discussions it became apparent that there were wide variations in prescribed guard response actions and procedures among the licensed plants. To remedy this situation, a message was sent to licensees in March 1976 which further defined and clarified the NRC's policy in this regard. Responses to the message were positive, and a better understanding of the sensitive nature of the problem and the need for protecting SNM with force was achieved.

VULNERABILITY ANALYSIS OF LAND TRANSPORT

It has been widely believed, but never demonstrated, that transportation is the weakest link in the safeguards system. The reality is that moving security vehicles have, almost uniquely, been excluded from the targets of terrorism in the last decade. However that may be, the NRC conducted a series of field tests of

As a part of the program to safeguard nuclear power plants from sabotage, NRC regulations require that all vehicles entering the plant site must be checked and any package carried onsite inspected.

transportation vulnerability, with the assistance of the U.S. Army Special Forces, in the spring of 1976. The tests evaluated the road transportation system on routes which had carried more than 75 percent of the special nuclear material transported by truck in 1975. The joint test team observed shipments as they traversed these routes and evaluated the routes, the equipment and procedures employed, communications, and the availability of police response in case of emergency. The principal carriers of SNM—operating under NRC physical security rules—cooperated fully in the tests and contributed significantly to the final appraisal.



Several areas where vulnerability could be reduced were identified through the tests, and new license conditions which were imposed to rectify the weaknesses materially improved the security of truck transport. The most important of the new requirements were the addition of an armed escort in a separate vehicle for all shipments, the addition of appropriate communication equipment, and the provision of supplementary training for security personnel. All of these actions were implemented by May 1976, and NRC-monitored shipments since then have used the improved system.

The route vulnerability assessment had, as noted, identified a need for additional training of security personnel in convoy escort procedures and defensive tactics. Training procedures outlined in the NRC guides are currently being rewritten, and the future version will include a greater amount of practical field training. To meet the immediate need, NRC formed a mobile training team which presented a four-hour seminar at four different locations in the U.S. Drivers and guards participating in this training were certified as having received the supplementary instruction prescribed.

The route vulnerability assessment also demonstrated the desirability of increasing the awareness of local law enforcement authorities of their role as response forces in the national nuclear safeguards effort. This was partially accomplished, relative to the highway transport of SNM, during police interviews in one phase of the route vulnerability assessment. A more systematic program, however, is currently being developed.

During observations of SNM shipments prior to and during the assessment, the Citizens Band (CB) Radio was recognized as a valuable communications backup to the radiotelephone required in vehicles transporting strategic quantities of SNM. Since May 1976, all such vehicles have been equipped with CB transceivers. In addition, NRC is working closely with local law enforcement officials to enlist their assistance in protecting the public in the event of an attempted nuclear theft, sabotage or threat. The NRC effort to develop strong ties with local law enforcement agencies will continue in the form of NRC-developed programs which increase their awareness of the role of law enforcement in safeguards, close staff liaison, improved cross-communications systems and other cooperation.

VULNERABILITY ANALYSIS OF FIXED SITES

After the results of the transportation field tests and evaluation were released, several NRC licensees volunteered to cooperate in similar assessments of their fixed-site vulnerability. The first of these assessments was made at the General Atomics facility at La Jolla, Calif., in July 1976. The assessment team, following measurement of the plant's safeguards capability against a determined outside assault, recommended means for improving security procedures and awareness.

Upgrading Safeguards

During the year NRC continued to implement measures to improve safeguards systems, and moved toward the development of performance-oriented regulations that would establish higher protection levels which the nuclear industry would have to achieve, based on specific threat levels.

The upgrading of safeguards was based on industry-wide site and transportation safeguards adequacy assessments conducted by NRC. The approach being adopted is to develop performance capabilities which establish the safeguards levels that nuclear facilities and shippers must achieve, while allowing them flexibility to design site-specific safeguards systems. This new direction recognizes that there are options as to how safeguards can be accomplished, and encourages the licensee to be inventive in designing and implementing his safeguards program as long as acceptable protection levels are achieved. The performance-oriented regulations will be supported by regulatory guides which will outline methods to be used to evaluate whether a licensee's proposed safeguards system satisfies established performance capabilities and will explain the scope, intent, and application of particular regulatory provisions.

In addition to the reorientation and upgrading of regulations for existing facilities, NRC has been developing safeguards requirements to protect the plutonium that would be produced at future facilities should the Commission approve the mixed oxide fuel cycle.

PLUTONIUM SAFEGUARDS STUDY

To aid in reaching a decision on the proposed wide-scale use of mixed oxide (MOX) fuel in light water nuclear reactors, the NRC continued throughout the year to develop an environmental impact statement in accordance with the National Environmental Policy Act of 1969. The Commission has described the scope, procedures, and schedule for completing that statement and indicated that, before it reaches a decision on the wide-scale use of MOX fuel, it would make a full assessment of safeguards issues. Accordingly, the Commission directed its staff to prepare and circulate for written comment a draft safeguards supplement to the former Atomic Energy Commission's draft "Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors" (the GESMO statement on health, safety and environmental aspects is discussed in Chapter 3).

The safeguards implications of the MOX fuel cycle would stem from the introduction into the commercial nuclear power industry of substantial quantities of special nuclear material in the form of compounds of plutonium. The primary concern over plutonium is based on its potential use by malefactors in a nuclear explosive or a radiological dispersal weapon.

The Commission's decision on the wide-scale use of MOX fuel will ultimately be based on a balancing of the potential societal benefits and risks from such use. The purpose of the draft safeguards supplement is to illuminate factors which would affect this risk-benefit balance, including new or incremental risks or additional burdens to society stemming from the safeguards systems needed to protect a wide-scale MOX industry. In addition, the cost of safeguards, included in the document, represents a basic input into the overall cost-benefit analysis of the wide-scale use of MOX fuel.

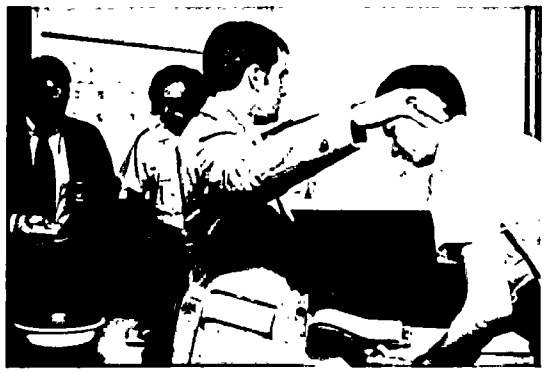
In performing the assessment of safeguards for the wide-scale use of MOX fuel, the NRC staff sought answers to three basic questions:

- What would be the potential incremental risks to society from malevolent acts directed at large quantities of plutonium in the commercial sector?
- Could MOX in wide-scale commercial use be sufficiently protected to assure that the risks to society from malevolent acts would be acceptably low?
- If adequate safeguards could be provided, would their economic and other societal impacts (that is, on civil liberties, laws, institutions, physical environments, etc.) be acceptable to the public?

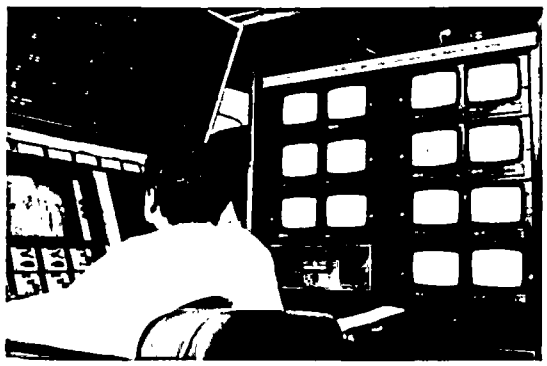
To answer the first question, regarding risks from malevolent acts, it was necessary to identify the characteristics of a projected MOX fuel cycle industry, the potential threats to

that industry, and the consequences that might ensue if safeguards failed and a threat were successfully carried out.

To answer the question whether a commercial MOX industry in the United States could be adequately safeguarded, it was necessary to determine what level of protection should be accorded to MOX materials, bearing in mind the protection given to other forms of SNM, and to determine what would be required to achieve necessary safeguards for a MOX industry, by actually undertaking the conceptual design of a reference safeguards system and assessing various other safeguards options as well. It was also necessary to consider the dimensions that could be added by international



A team from NRC's Division of Safeguards recently visited Nuclear Fuel Services high-enriched uranium processing plant near Erwin, Tenn. for the purpose of evaluating plant security facilities and procedures. Some of the plant security measures are illustrated here. Above left, the plant is surrounded by an intrusion alarm system. Above right, all employees and visitors are searched for weapons and explosives at entrances to protected areas of the plant. Any person entering a material access area (below left) must also pass through a metal detector arch and, when leaving the area, be further searched with instruments for detecting special nuclear material (SNM). As shown at lower right, a central alarm station maintains constant surveillance over all entrances to the plant, unoccupied areas that contain SNM, and areas where workers are performing certain material handling operations.



MOX commerce, with or without U.S. participation.

The third question, concerning the economic and societal impacts of MOX safeguards, was addressed by comparing the burdens that would be borne by a mature light water reactor industry which used MOX against one that would continue the present reliance on low-enriched uranium fuel.

Preliminary views of the NRC staff concerning these three principal questions were that:

- There is no known current threat against licensed nuclear fuel cycle facilities.
- Use of MOX fuel would have no significant impact on the potential consequences of sabotage to nuclear reactors.
- A potential risk to society could exist if threats to the MOX fuel cycle industry materialized and adequate safeguards were not provided.
- By building on extensive and successful U.S. experience in safeguarding SNM utilized in defense programs, in civilian (ERDA) research and development activities, and in commercial channels, safeguards systems can be designed to protect a future MOX industry to an extent that reduces the risk of theft and malevolent use of plutonium.
- The incremental burdens on society from the imposition of such safeguards would consist principally of relatively small increases in MOX industry costs and in the number of individuals affected by plant security and safeguards systems. The draft safeguards supplement was scheduled to be issued for public comment in 1977.

NRC/ERDA COOPERATION

The Energy Research and Development Administration, which is responsible for researching and developing alternate energy sources, including nuclear energy, has authority over certain nuclear facilities of the U.S. Government. The NRC is concerned with regulation for safety, environment and safeguards primarily in civilian nuclear activities, but also including certain of ERDA's operations. It is desirable that nuclear safeguards applied by NRC and ERDA be consistent, since the purpose for safeguards is the same in both areas.

In order to maintain comparability and encourage mutual reinforcement in their respective safeguards, NRC and ERDA adopted, in 1976, a working agreement committing both staffs to close and continuing cooperation. The agreement encompasses contingency planning, safeguards measures for facilities and transport, evaluative methodology and criteria, long range planning, research requirements, technical assistance studies, and international programs. Also in 1976, the two agencies collaborated in a joint report to the National Security Council on the status of domestic nuclear safeguards, making recommendations for the strengthening of both of their programs.

A significant area of NRC/ERDA cooperation was launched on March 12, 1976, when the NRC Chairman and the ERDA Administrator met with top officials of the two agencies to review the safeguards status of nuclear fuel cycle facilities licensed by NRC and processing fuel under ERDA contracts. A joint action plan was adopted to determine the overall status of present safeguards controls at these so-called mixed facilities (involved with both NRC and ERDA), which handle significant amounts of high-enriched uranium or plutonium, and to recommend any necessary improvements. As a result of task force findings, the team recommended that measures be taken to improve the security of future operations. The NRC is developing a timetable to provide for the upgrading of safeguards in order to meet foreseeable future threats.

SAFEGUARDS INFORMATION SYSTEM

NRC began development of a comprehensive information system to collect, process and disseminate safeguards-related information. The Integrated Safeguards Information System (ISIS) will be utilized to anticipate and meet safeguards information requirements into the mid-1980's and beyond. Although detailed information requirements have not been drawn up, it is evident that certain basic data related to physical security, material control and ac-

counting, contingency planning, inspection records, and vulnerability test results can be usefully consolidated.

The need for ISIS arises from the need to define the kinds of information needed to fulfill the safeguards mission set forth in NRC regulations. As time brings greater complexity and potential risk in the safe-keeping of nuclear materials and plants, data dissemination becomes increasingly important. A safeguards information system is to be developed which will include in-depth requirements analysis, followed by a general systems, then a detailed systems design, testing and installation of the system, and, finally, operation of the system.

NRC rules permit classification of certain sensitive detailed plant design information. The question of what types of data dealing with licensee and NRC safeguards should be withheld from public disclosure is being explored jointly by NRC, ERDA, and the National Security Council.

NRC activities related to international safeguards and export-import licensing and control are discussed in Chapter 11.

Inspection and Enforcement

Ensuring Compliance with Requirements

The NRC's inspection and enforcement program is based on the precept that requirements placed on licensed nuclear activities to provide safety, safeguards, and environmental protection are mandatory and enforceable under Federal law. NRC therefore inspects licensees on a continuing basis and takes enforcement action where necessary. The inspection program also covers quality assurance activities of applicants for NRC permits and licenses and their major suppliers. This chapter describes the NRC inspection program and summarizes the investigations conducted and enforcement activities taken during the past year.

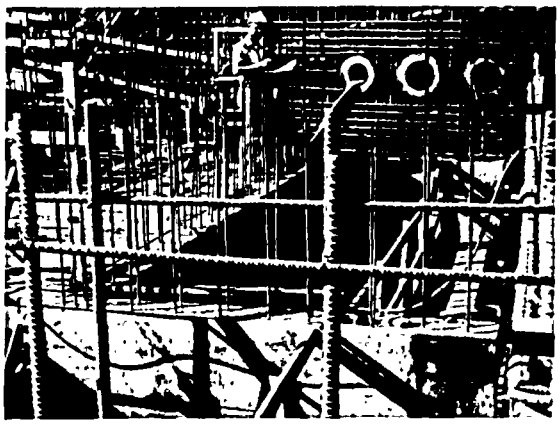
Scope of Program

The Office of Inspection and Enforcement inspects licensees to ensure compliance with Commission rules, regulations and license conditions, and to verify that they are acting to protect nuclear materials and facilities in their charge, the environment, and the health and safety of the public. It inspects license applicants and makes recommendations regarding the issuance of authorizations, permits and licenses. It inspects suppliers of safety-related services, components and equipment to assure the quality of their services and products. It investigates incidents, accidents, allegations, and unusual circumstances associated with nuclear materials and facilities, and it enforces Commission regulations, rules and license provisions. Implicit in these basic functions is the evaluation of licensee performance—the actual functioning of his plants, components and systems—to identify problem areas or safety issues, and to take corrective action or recommend changes to the regulatory process. The Inspection and Enforcement Office manages resources necessary to implement the Commission's response to events and incidents that present potential or actual dangers and keeps the Commission, other agencies, the

nuclear industry, and the public informed on such matters.

NRC INSPECTION PROGRAM

The NRC's regulatory philosophy is based on licensee responsibility for the proper design, construction, testing, safe operation, and safeguarding of a facility or activity involving source, byproduct or special nuclear material. NRC inspections do not relieve an applicant or licensee of his responsibility. Rather, they are directed to the evaluation of a licensee's efforts to meet his responsibility and to assure that corrective action is taken if he is not.



Unannounced inspections by NRC are made periodically during construction of a nuclear power plant. Here an inspector examines reinforcing steel to determine that the proper grade and size were installed.

An essential feature of the inspection program is that it is decentralized to place the inspectors near licensed operations to facilitate inspections and quick reaction. All inspections and investigations, and most enforcement actions, are handled by NRC regional offices located near the centers of licensee clusters. Those offices are: Region I, Philadelphia, Pa.; Region II, Atlanta, Ga.; Region III, Chicago, Ill.; Region IV, Dallas, Texas; and Region V, San Francisco, Calif. About 56 percent of the Office of Inspection and Enforcement's personnel are assigned to inspection duties.

NRS inspectors are highly qualified by academic education, specialized training and experience to perform the types of inspections and investigations that are required by the functions assigned to the agency. About 83 percent of the staff have a bachelor's degree and 27 percent also have advanced degrees. Because of the scope of activities and facilities covered by the NRC regulatory program, inspectors with a wide variety of skills are employed. These include professionals experienced in plant design, testing and operation; quality assurance; metallurgy; electrical and instrumentation systems; concrete; welding; health physics; physical protection; materials measurements; and accounting.

Two Types Of Inspections

The NRC inspection effort comprises planned routine inspections and reactive inspections, both of which are primarily preventive in nature.

Planned NRC inspections are based on a defined program expressed in detailed inspection procedures and are accomplished at prescribed intervals by NRC regional inspectors. The principal objective of such inspections is to provide reasonable assurance that licensed activiites are conducted safely and in compliance with NRC requirements. This objective is met through selective examinations of systems and functions, both administrative and physical, that have an impact on the safety and protection provided by each licensee.

A planned inspection consists primarily of a systematic sampling of selected licensee operations. The Commission does not expect to detect every minor deficiency that may exist. The vast numbers and the diversity of plant operations make such an approach impracticable. Rather, the NRC probes the activities of a licensee in sufficient depth to assess the effectiveness of his managerial systems—his controls—to assure that his performance is consistent with license requirements and that the health and safety of the public is protected.

Reactive NRC inspections respond to particular conditions or events which may affect the public's health and safety. Information on such conditions or events comes to NRC through notification by an applicant, licensee, contractor or supplier, or as a result of allegations by a

This inspection was performed at a pumping station under construction on the Alaska pipeline on the North Slope at Prudhoe Bay, about 250 miles north of the Arctic Circle. The NRC inspector (at left) independently verifies the radiation dose rate being measured by the radiographer (at center).

member of the public. Each licensee is required to report any abnormal condition or event to the Commission, thus providing for continuous NRC monitoring of licensee operations. Compliance with these reporting requirements is examined during the planned on-site NRC inspections.

NRC's response to such reports depends on the significance of the particular event. The principal objective of a reactive inspection is to obtain sufficient information, through independent in-depth examination, to establish the significance of the particular condition, event or allegation and to effect the appropriate corrective action.

Constant vigilance. Inspectors are the "eyes and ears" of NRC in the field. They report back to their regional offices any situations or conditions that may indicate inadequate licensee performance. All such reports are evaluated by the Office of Inspection and Enforcement, and corrective action is taken. When warranted, recomendations are submitted to the Commission for changes to pertinent parts of the regulatory program.

Facility Inspections

The inspection program for reactors and fuel facilities is consistent with the design philosophy used for these systems, as described elsewhere in this report. It is structured to determine if the licensee is constructing and operating the facility in accordance with the provisions of his license; the Safety Analysis Reports he must submit as parts of his applications for authorization, permits and licenses; and the rules, regulations, and standards of the Commission. The program concentrates on components and systems which prevent or limit the release of radioactivity to the environment, and on the licensee's program for physical security of his plant and the nuclear material it uses, both in-plant and in transit.

An NRC inspector takes field notes on his inspection of the implacement of foundation pilings at the construction site of the Hope Creek Generating Station. The two units of the Salem Station are in the background.

Levels of Inspection During Construction

During the construction of a nuclear facility, there are normally four levels of inspection. "First-party" inspections are carried out by the suppliers of the components or systems, or by the contractors who install these components and systems; licensees or their agents review this work as "second-party" inspectors; "third-party" inspections are performed by other outside organizations such as authorized inspectors for State governments, or insurance agencies; and NRC performs the "fourth-party" inspections.

In its "fourth-party" inspections, NRC reviews the inspection programs of licensees and others to assure that they have implemented quality assurance and management control programs and that their personnel are trained and qualified to perform their assigned functions. In general, such inspections (conducted on a sampling basis) fall in three categories:

- Examination of quality assurance procedures—the planning;
- Observation of work performance, testing and examination—the performance; and
- Examination of records relative to work performance—the followup.

Reactor Inspection Program

NRC nuclear power plant inspections cover four phases of a facility's life: (1) preconstruction activities, when inspections focus on the applicant's quality assurance program for the design and procurement of safety related systems; (2) the construction period, when NRC inspects to verify the suitability of the materials used and the adequacy of fabrication and construction activities; (3) the preoperational testing and startup phase, which involves intensive NRC inspections and checking of procedures, tests, results, and vital safety aspects of operating plans, training, personnel qualifications, etc.; and (4) operational activities, when periodic inspections are made throughout the facility's life to ascertain whether the licensee is operating safely and responsibly and is conforming with NRC requirements. (The safety matters inspected by NRC during each phase of a power reactor's life are described in detail in NRC's "Annual Report for 1975," page 80.)

The reactor inspection program is carried out by 181 inspectors located in the five NRC regional offices. More than half of these inspectors are engaged in inspection of reactors during the design, construction and pre-operational testing stages; and the remaining inspectors are assigned to inspect reactors in operation. During the 15-month report period, this staff conducted 2,420 inspections, with items of noncompliance found in 34 percent of the inspections.

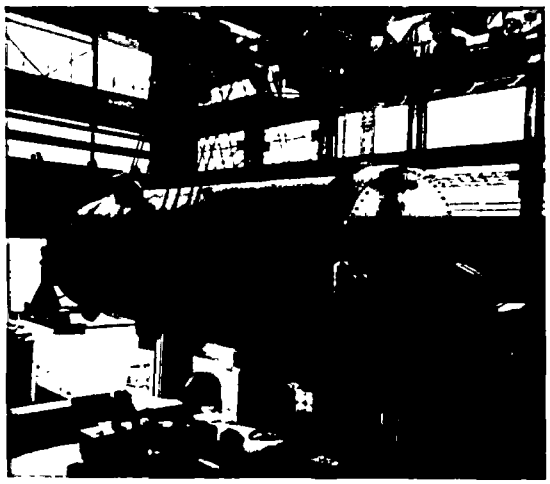
Vendor Inspection Program

Equipment malfunctions that cause reactor facilities to perform improperly often can be attributed to errors in the selection, design or fabrication of equipment. NRC's current licensee contractor and vendor inspection program was established in 1974 to minimize the number and significance of such events and to assure conformance with NRC's quality assurance criteria specified in 10 CFR Part 50, Appendix B. Vendor quality assurance programs are inspected directly by NRC. However, responsibility for product-acceptance examinations rests with the individual licensee or his agent.

The NRC Region IV Office (Dallas) carries out the vendor inspection program. A staff of 20 inspectors conducts inspections throughout the country, and in a few firms in foreign countries where mechanical components are being manufactured for installation in U.S. plants. During the 15-month period ending September 30, 1976, NRC made 184 inspections involving 100 shops of nuclear steam system suppliers, architect-engineers, and suppliers of mechanical components.

As a means of reducing duplication of inspection effort, NRC is evaluating the use of existing "third-party" inspection programs. These are inspections conducted by a party who does not have a financial interest in a vendor-supplied product or service, as do the customer

As well as inspecting construction at the site of a nuclear power plant, the NRC also visits reactor vendors to inspect during the manufacture of the reactor components. These photos were taken at Combustion Engineering's manufacturing facility at Chattanooga, Tenn.



and the seller. Among such third-party systems is the "N" stamp program for certain nuclear components designed and manufactured under the rules of the American Society of Mechanical Engineers (ASME). NRC has been working with ASME to achieve a program whereby NRC would accept inspection results from the ASME program, rather than make its own inspections. NRC would audit the ASME program to insure adequate performance. This concept, if adopted, will be tested over the next two years.

Fuel Facility and Materials Inspections

A staff of 31 inspectors, located in the five NRC regional offices, conducted 152 fuel facility inspections and 2,278 materials inspections during the report period. Items of noncompliance were found in 49 percent of fuel facility inspections and 48 percent of materials inspections.

Fuel facilities perform fuel reprocessing, plutonium processing and fuel fabrication, uranium processing and fuel fabrication, uranium hexafluoride (UF_6) conversion, and uranium milling. Materials licenses include waste disposal, radiopharmaceuticals, radiography, medical and industrial uses and academic programs. Frequency of inspection of of these licenses and facilities varies in accordance with potential safety and health hazards from use of the material and operation of the facility—for example, the inspection program for a plutonium facility requires four routine inspections per year, while that for radiography requires one routine inspection per year.

Safeguards Inspections

Safeguards inspections are of two types: material control and accounting inspections, and physical protection inspections. Fuel cycle

facilities, power reactors, and research reactors undergo safeguards inspections with the frequency depending on the amount and quality, strategic value, and accessibility of the nuclear materials a licensee is authorized to possess.

During fiscal year 1976 there were 41 inspectors in regional offices who made 482 inspections of licensee safeguard programs. Items of noncompliance were found in 44 percent of these inspections.

Material Accountability

The material control and accounting program consists of routine nuclear material control reviews, and independent verification.

Material control inspections ascertain whether the licensee is performing in accordance with his license and other applicable regulatory requirements. NRC inspectors examine the facility organization and its operation. They check the licensee's measurements and statistics, his shipping and receiving systems, his inventory controls, records and reports, and his management audits.

Verification inspections involve actual measurements of material inventories by NRC or laboratories under NRC contract, independent of the licensee. The results of these inspection measurements are used to assure the accuracy and credibility of licensee measurements and statements of material inventories. Where appropriate, verification inspections also include detailed assessments of the licensee's measurement systems, his inventory practices and procedures, and the methods he uses to verify quantities of material receive and shipped.

In its verification inspections, NRC employs both destructive and non-destructive assay techniques to monitor licensee SNM inventories. Effective safeguards depend on timely and accurate assays to determine the status of nuclear material in the fuel cycle at any given time. With this in mind, during fiscal year 1976, NRC intensified its effort to develop and employ mobile nondestructive measurement vans, so that inspectors can more quickly and accurately perform on-site sampling of licensee material and get immediate results from measurement equipment and computers housed in the vans. Presently three NRC regional offices—located at Philadelphia, Atlanta, and Chicago—have this mobile, non-destructive assay capability. Samples of licensee special nuclear material also are sent to the ERDA New Brunswick Laboratory for destructive analysis, as reported in detail in the NRC Annual Report for 1975. In fiscal year 1976, the Laboratory, under NRC contract, analyzed 706 inspection samples of uranium and plutonium.

NRC licensees are responsible for measuring the radioactivity in the effluents from their facilities to assure that releases of radioactivity are kept within allowable limits. Independent measurements are made by NRC inspectors of samples collected during periodic inspections. At left, an inspector inside a mobile laboratory driven to the facility site instructs an analyzer to examine a liquid effluent sample to determine what isotopes are present and in what quantity. At right, an inspector operates a gamma spectrometer located in a laboratory at the regional office to examine the samples.

Physical protection program. Physical protection inspections for facilities encompass the independent testing of all elements of a licensee's security program. NRC inspectors check all systems for both effectiveness and conformance with license specifications. In addition, licensee records pertaining to the security guard organization, security logs and security operating procedures are reviewed by NRC inspectors and verified through interviews and through direct observation of the process by which those records are produced. NRC inspectors are required to observe the licensee's plant-protection operations during at least two different shifts.

Materials in transit inspections. In addition to the facility program outlined above, NRC maintains a physical protection inspection program for nuclear materials in transit. This program stipulates that NRC inspectors monitor/inspect export and import shipments of significant quantities of special nuclear material, and not less than 20 percent of other domestic shipments of strategic quantities of special nuclear material.

Under a December 1975 change to regulation 10 CFR 73, licensees report all shipments, by any mode of transportation, to NRC regional offices seven days in advance of the shipment date. Thus, all shipments are subject to unannounced inspection which may include examination at points of origin, points of transfer, or at the destination, in addition to observation or surveillance by NRC inspectors along any segment of the shipment route.

SPECIAL INVESTIGATIONS

A significant part of the NRC's inspection and enforcement effort is involved in responding to reports of radiation incidents, abnormal occurrences, equipment problems, and allegations of improper or unsafe operations. Although many of these events prove minor, and can be reviewed during scheduled inspections, some require special response. In these cases, a special inspection is scheduled or, as appropriate, an immediate, full investigation may be initiated.

During this reporting period, 57 investigations were conducted by the Office of Inspection and Enforcement. Two involved exposures of licensee personnel as a result of radiation incidents; 32 dealt with allegations of improper or unsafe working conditions, operations or construction activities; 4 concerned alleged loss of material; and the remaining 19 involved other matters. In 25 of the 57 investigations, licensees were cited for failure to meet NRC requirements.

Substantial inspection effort was given to three major investigations during the year (see Chapter 8 for details):

- NRC review of circumstances related to the March 1975 fire at the Browns Ferry nuclear plant in Alabama and inspections of cleanup, restoration and retesting of the two units involved, which continued throughout most of fiscal year 1976;
- Excessive radiation doses to 393 patients at a Columbus, Ohio hospital, attributable to improper calibration of a cobalt-60 teletherapy unit; and
- Unauthorized removal of contaminated equipment and items from a radioactive waste disposal facility near Beatty, Nevada.

Security Alert

In addition to responding to abnormal incidents, technical problems, or allegations of these, NRC responds to actual or potential threats to the security of nuclear facilities or materials.

During the several weeks preceding Memorial Day, 1976, the NRC received information from various sources—including utilities and other Federal agencies—that intrusions might be attempted at several nuclear power plants. It is not unusual for individual threats to be received regarding a specific plant. What was unusual during this period was the number of threats and the fact that several plants, widely separated geographically, appeared to be potential targets.

Information received in May suggested a pattern of suspicious activities in Illinois (over the Memorial Day weekend), Washington, and California. Also during May, there were reports of persons, under unexplained circumstances, in the vicinity of two power plants in Connecticut (one nuclear, one fossil-fueled), and a bombing

of a utility office building in Maine. In two separate incidents several weeks preceding Memorial Day, the NRC credentials of two inspectors were stolen along with other personal belongings. Their unauthorized possession created concern that they might be used to attempt entry to a nuclear facility.

As a result of these events and circumstances, the NRC informed owners of operating reactors and major fuel facilities of possible plans by two groups to take over or occupy one or more nuclear power plants on Memorial Day weekend or to take actions in early June, and that incidents had recently occurred at two other utility facilities with possible security implications. NRC requested the licensees to confirm that security plans, personnel, and equipment was fully operational during the period Friday, May 28 through Tuesday, June 8. Subsequently, licensees reported no unusual incidents during the period.

To deal promptly with incidents and threats, the NRC established an interim Incident Response Center at headquarters in Bethesda, Md., as the precursor of a permanent, specially-equipped center with on-call duty officers available to respond to events at all times (See also Chapter 6, under "Contingency Planning.")

Contamination of West Chicago Park

On July 9, 1976, a newspaper reporter relayed an allegation from an anonymous source to NRC's Region III office that thorium ore processing residues had been dumped in an area in West Chicago, Illinois now used as a community park, called Reed-Keppler Park.

A preliminary survey of the park was conducted by Region III personnel on July 9, and radiation levels greater than natural background were measured. A more detailed survey was conducted on July 12, and it was determined there were areas within the park where radiation levels exceeded natural background—surface level readings of from 10 to 50 mrad/hr were obtained in isolated areas. This information was transmitted to State and local authorities and the park was closed by the City of West Chicago on July 13.

In cooperation with the Illinois Department of Public Health, inspectors from NRC's Chicago regional office assisted in surveying areas of a West Chicago park where higher-than-normal radiation had been found. Low-level radioactive waste had been buried in the 1930s and 1940s at the site of the present park, long before licensing and regulatory standards were developed.

A comprehensive survey of the park and all structures in it was conducted on July 13 and 14 by a team composed of NRC, ERDA and State of Illinois personnel. It was determined that excess radiation levels were confined to two areas of the park—a 150 x 200 foot plot within an undeveloped area, and a 24 x 45 foot area adjacent to a tennis court. The thorium residue was relocated by the City from the tennis court to the undeveloped area. With the exception of the tennis courts and the undeveloped area, the park was reopened to the public on July 14; the tennis courts were reopened on July 15. Two small areas presently used as a City of West Chicago sewage treatment plant were also found to have slightly elevated radiation levels.

It was determined that the thorium residues originated at a nearby West Chicago plant

which originally was owned and operated by Lindsay Light and Chemical Co. Lindsay processed thorium bearing ore at its plant beginning in 1931. Residue was last dumped at the Reed-Keppler site in 1947. The Lindsay plant was first licensed by the AEC in 1956. The present owner of the plant, Kerr-McGee Chemical Corporation, purchased it in 1968 from American Potash and Chemical Co., which earlier had purchased it from Lindsay.

At present, access into the undeveloped area of Reed-Keppler Park and the areas at the Sewage Treatment Plant is restricted by fence. The NRC in concert with ERDA, State and local authorities, is reviewing the situation to determine the ultimate disposition of the material.

ENFORCEMENT ACTIVITIES

The primary objective of the NRC enforcement program is to ensure correction of items of noncompliance and, thus, to improve the licensees' performance.

An enforcement action is taken by the NRC in response to reports of noncompliance. Severity of the action is based on the seriousness of an item of noncompliance, or on the collective seriousness of several related circumstances, concurrent items of noncompliance, or on a licensee's previous compliance record, or all of these.

Several threshold levels of NRC action are provided to allow flexibility in the enforcement action response:

- Written "notices of violation" are provided for a spectrum of matters where severity and punitive considerations are below the threshold of orders and civil penalties.
- Civil monetary penalties are provided as an incentive for licensees to assure compliance on a continuing basis. They are considered for licensees evidencing chronic, deliberate, or repetitive items of noncompliance, generally where a "notice of violation" has not been effective. Civil penalties may also be imposed for certain first-of-a-kind violations.
- Orders to "cease and desist" operations, or for modification, suspension, or revocation of licenses are used to deal rapidly and conclusively 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.

Civil Fines Imposed

During the period July 1, 1975 through September 30, 1976 a total of 15 civil monetary penalties were imposed upon licensees by NRC in order to enforce compliance with NRC rules and regulations:

Darrill Industries Inc., Springfield, N.J.; $1,800. Investigation of the loss of a 500-millicurie cesium-137 sealed source revealed items of noncompliance involving failure to maintain a radioactive source in a secure manner, improper disposition of the source, and failure to properly pay license fees.

International Testing Labs, Newark, N.J.; $2,250. Inspections of the laboratories revealed excessive radiation levels in an unrestricted area, that sealed source leak tests were not performed at the required frequency, and that a radiographer was performing radiographic operations without having received adequate instructions on the provisions of governing regulations.

Rochester Gas & Electric Co., Ontario, N.Y.; $10,000. A contractor employee inside the Ginna Unit 1 plant containment was exposed to a concentration of airborne radioactive materials which was 19 times the regulatory limit when averaged over a 40-hour week, and certain employees failed to use proper respiratory protective equipment.

Commonwealth Edison Co., Rock Island, Ill.; $25,000. Inspections at Quad Cities Units 1 and 2 revealed noncompliance items including personnel error and ineffective management controls over reactor startup procedures, and items in the area of security.

United States Testing Co., Hoboken, N.J.; $3,550. Weaknesses in the management of the radiation safety program included failure to establish adequate controls in a high radiation area during radiographic operations at a construction site, and repetitive radiation

exposures to four employees in excess of regulatory limits. The exposures were not reported to the NRC or the employees.

Carolina Power & Light Co., Brunswick, N.C., $5,000. This penalty resulted from items of noncompliance found during a security inspection at Brunswick Unit 2.

Associated Piping & Engineering Corp., Clearfield, Utah; $6,500. Items of noncompliance discovered during inspections included absence of proper alarm and protective devices in a high radiation area, failure to post warning signs and conduct radiation surveys in a high radiation area, failure to maintain records of surveys and maintenance of exposure devices, and use of radioactive materials in a manner which permitted radiation levels above regulatory limits in unrestricted areas. The licensee's history of noncompliance and findings of the last NRC inspection indicated a need for improvements in the licensee's radiation safety program.

Metropolitan Edison Co., Goldsboro, Pa.; $8,000. Noncompliance items related to the security program were revealed during an inspection of Three Mile Island Unit 1.

Babcock & Wilcox Co., Apollo and Leechburg, Pa.; $19,000. Physical security noncompliance items were found during inspections at the licensee's Parks Township plutonium facility and Apollo uranium facility.

Commonwealth Edison Co., Lake, Ill.; $13,000. At Zion Nuclear Plant Unit 1, an employee was exposed to radiation in excess of regulatory limits. The licensee failed to conduct radiation level surveys, and to maintain certain controls over the work being conducted in a radiation area. (See Chapter 8 for details under "Abnormal Occurrences.")

Exam Co., Tulsa, Okla.; $7,800. Two individuals were exposed to radiation in excess of regulatory limits. The licensee failed to conduct a physical survey to determine if a sealed source had been returned to a shielded condition following radiographic operations, and failed to submit a written report of the overexposures to the NRC. (See Chapter 8 for details under "Abnormal Occurrences.")

Consolidated Edison Co. of New York, Peekskill, N.Y.; $20,850. Items of noncompliance at Indian Point Station Unit 2, related to the radiation safety program, included the exposure of an individual to radiation in excess of regulatory limits, failure to maintain proper safety controls over an area with high levels of radiation, failure to post radiation areas in accordance with regulations, and failure to assure that employees were utilizing protective equipment in a radiation area. (See Chapter 8 for details under "Abnormal Occurrences.")

Jersey Central Power and Light Co., Toms River, N.J.; $18,000. Items of noncompliance related to the Oyster Creek Nuclear Power Plant security program were revealed during an investigation at this facility.

Niagara Mohawk Power Corp., Syracuse, N.Y.; $18,000. Items of noncompliance related to the James A. FitzPatrick Nuclear Generating Station security program were revealed during an inspection at this facility.

Nuclear Energy Services, Inc., CONAM Inspection Division, Danbury, Conn.; $11,300. Four individuals received whole-body exposures and two individuals received extremity exposures in excess of regulatory limits. A physical survey had not been performed to determine the shielded condition of the source and the radiographers recharged their dosimeters and reentered a high radiation area before evaluating the hazard involved.

On November 12, 1976, the Commission imposed a fine of $32,500 on the Virginia Electric and Power Co. for making false statements to the NRC concerning seismic conditions at the utility's proposed plant site at North Anna, Va. The Commission acted after review of an earlier decision levying a fine on the utility by an Atomic Safety and Licensing Appeal Board, which was itself acting in review of a fine assessed by the Licensing Board in the case. The utility has appealed the Commission's decision in the U.S. Court of Appeals for the Fourth Circuit (see Chapter 14 under "Judicial Review.")

Enforcement Orders

In addition to the civil penalties listed above, the following orders were issued during the same reporting period:

Trail Clinic, Detroit, Mich. On August 15, 1975, an order to suspend a license and an order to show cause why the license should not be revoked were issued. This action was based on an investigation which revealed that radiopharmaceuticals were being administered to patients by an individual who had not received formal training and experience in the diagnostic use of radiopharmaceuticals as had been specified on the license application. The license was permanently revoked on March 23, 1976.

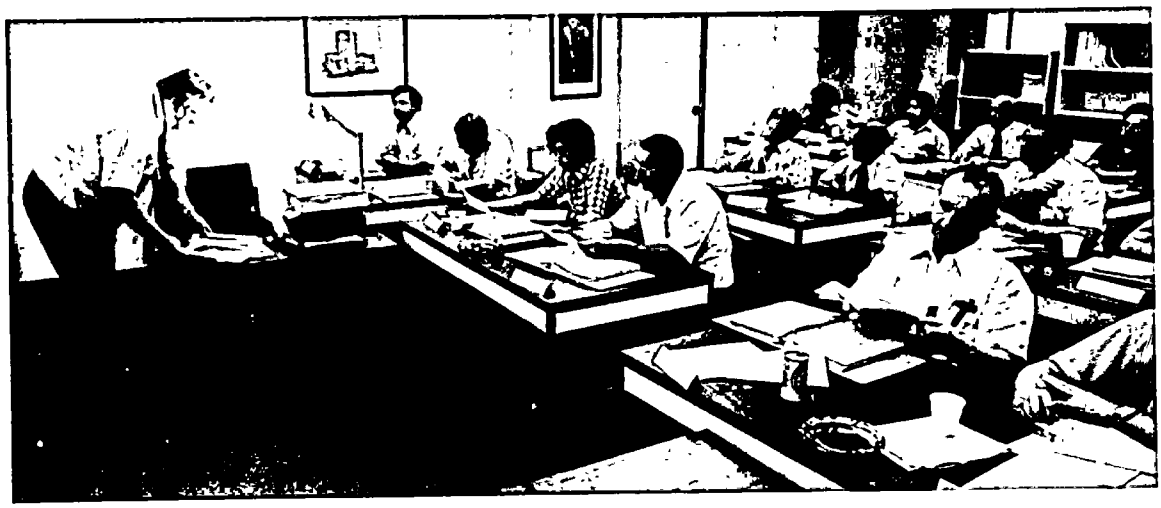
Nuclear Fuel Services Inc., Erwin, Tenn. On February 20, 1976, the NRC issued an order to NFS to keep all of its records pertaining to its licensed fuel cycle activities secure, intact, on the premises and undisturbed until examination by NRC personnel. This order was rescinded on February 24 after certain records had been reviewed. (See Chapter 8 for details under "Abnormal Occurrences.")

Value Engineering Laboratory, Alexandria, Va. On March 2, 1976, the NRC issued an order to show cause why all activities under the industrial radiography firm's license should not be suspended. This was the result of items of noncompliance reflecting the failure of employees to follow NRC requirements, and a history of seven apparent exposures in excess of permissible quarterly limits going back to 1971. After a subsequent NRC investigation revealed that the necessary corrective actions had been taken by the licensee, the order was rescinded on April 20, 1976. (See Chapter 8 for details under "Abnormal Occurrences.")

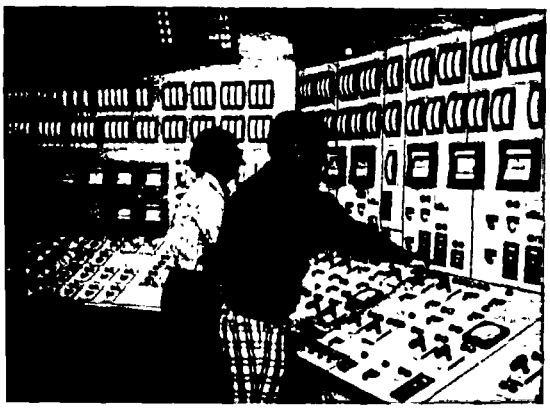
Nuclear Engineering Co., Louisville, Ky. On March 11, 1976, an order was issued suspending licensed activities at the Beatty, Nevada special nuclear materials burial site. This was based on the failure of the licensee to control radioactive materials received for burial. (See Chapter 8 for details under "Abnormal Occurrences.")

Dakota Midland Hospital, Aberdeen, S.D. On June 1, 1976 an order to cease and desist from unauthorized possession and use of byproduct material was issued to the licensee. This action was taken when an inspection revealed that quantities of certain radioactive material were being used without being authorized by the licenses in effect.

Dr. Peter Kamperschroer, Aberdeen, S.D. On June 1, 1976, an order to cease and desist from unauthorized possession and use of byproduct material was issued to this physician when it was determined that he had acquired and was using certain byproduct material not authorized by his license.



In addition to on-the-job training and other training activities by regional offices, there is a central NRC training facility in Bethesda, Md. Its mission is to train inspectors and engineers from the Office of Inspection and Enforcement and to provide reactor technology training to other NRC offices as needed. During the period, 84 IE inspectors and engineers went through basic orientation, 315 other IE staff members took courses in reactor technology, and 127 NRC engineers from other offices also received this type of training. The reactor technology courses include reactor design and operation, radwaste systems, quality assurance, concrete structures, welding and nondestructive evaluations.



Inspectors from IE region offices are taught, with the use of a nuclear power plant simulator, how to evaluate power plant operating conditions and the status of technical specifications compliance.

PROGRAM DEVELOPMENT

Comprehensive Study Begun

Towards the end of the year, the Office of Inspection and Enforcement began a comprehensive study of the policies and programs it uses to carry out its assigned responsibilities. The total study will take about two years to complete.

It includes three major topical areas: (1) definition of the mission and strategies of the NRC inspection and enforcement programs, 2) evaluation of alternative inspection and enforcement methods, and (3) application of quantitative methods for efficient use of resources and to measure performance of licensees and the inspection program. Three broad topics are partitioned further into 11 study modules, each of which is an identifiable work package with its own objectives. The following examples from the 11 study modules will illustrate the nature of the study:

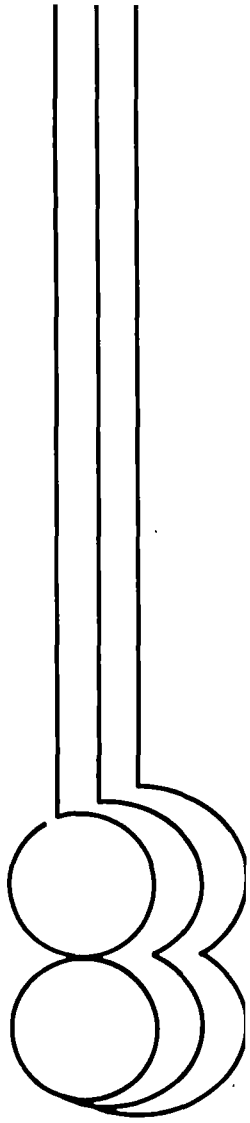
Direct Inspection. Currently NRC verifies, through direct measurement, the results of licensees' environmental monitoring programs and material control and accounting systems for safeguarding material. Under contract with NRC, State agencies analyze the radioactive content of samples from the environment near operating nuclear plants. Verification samples of safeguarded materials are processed in a Federal laboratory. The question is: To what extent should this concept be utilized in reactor safety inspections by replicating selected reactor licensee measurements, tests and examinations in order to increase NRC's confidence that licensees' quality control procedures are adequate?

Application of Reactor Safety Study. This study module will evaluate the applicability to reactor safety inspection of the Rasmussen study, "An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," to determine whether the methods used in that study can realistically be applied to the inspection program, whether quantitative relationships between public risk and inspection effort can be developed, and whether these relationships can be converted into an improved inspection program and a better allocation of inspection effort.

Incentive Systems for Licensees. The purpose of this study is to develop an improved system of incentives that will encourage NRC licensees to meet fully their safety, safeguards and environmental responsibilities.

An NRC inspector (left) lifts a soil sample into a container held by the Rohm & Haas radiation safety officer. The sample will undergo an independent laboratory analysis of the radioactivity in the soil. The Rohm & Haas Research Farm is applying chemicals bearing radioisotope tracers to the soil in the cornfield to check the uptake of chemicals by plants.

Nuclear Operational Events



The Lessons of Experience

When the basic design, construction, materials and procedures associated with any technology are once adopted and employed, there are two principal ways in which improvements in the technology can come about: through research into and testing of current or proposed designs and their theoretical basis, and through actual operating experience. Experiment and experience alter original concepts and specifications, revealing weaknesses and areas where reinforcement is desirable or, on occasion, where basic design failed to take some reality of operation into account. Both of these sources of information—planned research and planned and unplanned operational events—are of great concern to NRC in seeking assurance that civilian nuclear activities are safe. Chapter 13 describes NRC's varied and extensive pursuits in confirmatory research; this chapter deals with actual events occurring in licensed facilities or related to licensed activities, especially those which constituted a departure from intended and controlled operation and have some implication for public health and safety.

MONITORING OPERATIONS

Through September 30, 1976, operating experience of commercial nuclear power plants in the United States had produced more than 300 reactor-years of operation without any radiation accident resulting in a death among plant personnel or the general public. At the end of the year, there was a total of 62 nuclear power plants licensed to operate in the United States with an aggregate electrical generating capacity of 45,000 MWe (megawatts electric; one megawatt electric equals 1,000 kilowatts of electrical capacity). During 1976, nuclear power plants generated 9.4 percent of all electricity generated by utilities in the United States.

Occupational Exposure Reports

In 1968, the former Atomic Energy Commission (AEC) adopted a plan for the collection in a central repository of radiation exposure records for persons working with radioactive materials or in radioactive environments, under AEC license. The NRC and the Energy Research and Development Administration (ERDA) have continued the program—each in its respective area of interest—and collected reports from operating nuclear power reactor licensees; industrial radiographers; fuel processors, fabricators and reprocessors; commercial processors and distributors of specified quantities of nuclear byproduct materials; certain contractors of NRC licensees; and other NRC licensees.

For the calendar years 1968 through 1975, a total of 416,849 annual radiation exposure records ("whole-body" exposures) have been amassed by NRC from its various licensees. About 95 percent of these record an annual exposure of less than 2 rems per person. Generally, Federal regulations allow up to 5 rems per person per year exposure, and, under carefully monitored circumstances, permit a nuclear worker to receive up to 3 rems per quarter, or 12 rems per year, depending on his cumulative exposure record. In the period 1968-1975, 22 of the more than 400,000 recorded annual exposures exceeded 12 rems. Only one such exposure was reported in each of the last three years of the period. More than half of the 78,713 exposures reported in 1975 were too small to be detected by personnel radiation monitoring devices, and more than 99 percent of the total were less than 5 rems. The average exposure for 1975 was 0.36 rem per person (NUREG-0119).

Browns Ferry Restart

As reported at length in the 1975 NRC *Annual Report,* the two operating reactor units of the Browns Ferry Nuclear Power Plant in Limestone County, Ala., were shut down in March 1975 following a fire in the plant's electrical cables that burned for about seven hours. (A third unit at the facility was under construction at that time.) Although there were no serious injuries sustained by plant personnel and no adverse impact on the general public resulting from the fire, the safety implications of the event evoked a full-scale investigation by the NRC, involving several offices and a special review group within the agency. (See "Fire Protection" in Chapter 2 for recommendations of this group and follow-up activity.)

A public hearing was held in August 1976 by an Atomic Safety and Licensing Board on an application by the licensee for the facility, the Tennessee Valley Authority, for return to full-power operation of the two units. Later in August, the licensee was authorized by the NRC to operate units 1 and 2 at full power, in accord with the Licensing Board's decision, and also to operate the new unit 3 at full power, following a determination by NRC of the satisfactory completion of a detailed fire protection training program.

Discussion of other occurrences reported in the 1975 NRC *Annual Report*—steam generator tube failure, pipe cracks, fuel channel box wear, feedwater flow instability—may be found under "Action on Technical Problems," in Chapter 2 of this report.

ABNORMAL OCCURRENCES—1976

Complex industrial operations of any kind are subject to incidents that may involve human failure (misjudgment or negligence in the design, construction, operation or maintenance of a plant, machine, vehicle, etc.) or mechanical failure (from inadequate material strength, breakdown of or interference with normal function), or both. Deficiencies in management control and prescribed procedures may also be involved. To assure that any incident occurring in NRC-licensed facilities or activities and related to safety is quickly identified and corrected, NRC imposes extensive reporting requirements on licensees to supplement its own inspection and enforcement program.

Reportable occurrences are not usually accidents in the ordinary sense of the word, but are any unplanned events of actual or potential

significance to the safe operation of a nuclear facility or radiological instrument under NRC license. Those that are generic in nature, with implications for several facilities or operations, may result in the issuance of NRC bulletins to all licensees affected, calling for immediate inspection, testing and correction where indicated. Data regarding regular plant operations are also recorded and disseminated by NRC to the nuclear industry and the public. This information enables all parties concerned to avoid or correct problems and to gain insight and foresight from the nation-wide experience. The data are disseminated through publication of status reports, bulletins and "Current Events" reports. In addition, special statistical, analytical and evaluative reports are prepared and issued from time to time for NRC and industry use and for information of the Congress and the public. All relevant data derived from nuclear plant operations are stored in a computer-based data file for expeditious retrieval and analysis in developing standards, formulating regulations, and giving general guidance to the industry.

Under Section 208 of the Energy Reorganization Act of 1974, NRC is required to ". . . submit to the Congress each quarter a report listing for that period any abnormal occurrences at or associated with any facility which is licensed or otherwise regulated pursuant to the Atomic Energy Act of 1954, as amended, or pursuant to this Act. For the purpose of this section, an abnormal occurrence is an unscheduled incident or event which the Commission determines is significant from the standpoint of public health or safety. . . ."

To make the requisite determination, NRC has developed two major interim criteria, according to which abnormal occurrences are: (1) events involving an actual loss of the protection provided for the health or safety of the public; and (2) events involving major reduction in the degree of protection provided for the health or safety of the public.

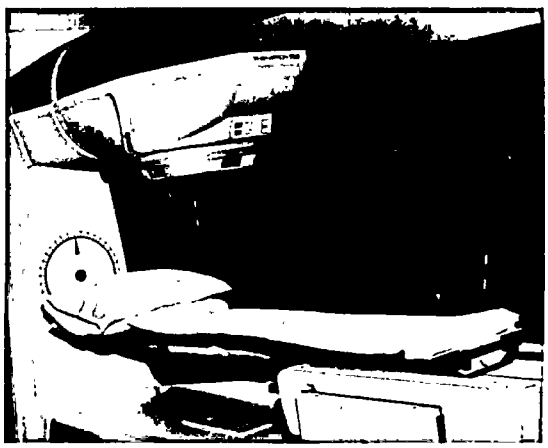
Only one of the events occurring at an NRC licensed facility from July 1975 through June 1976 had any direct impact on or consequence to public health and safety. This was the exposure of certain hospital patients to amounts of radiation in excess of those prescribed, at Riverside Methodist Hospital in Columbus, Ohio, described below. Of some 2,200 Licensee Event Reports received during this time (NRC licensees are required to report even minor deviations from normal operating conditions), a total of three events at operating nuclear power plants were considered to have sufficient safety significance to be abnormal occurrences. For operating fuel cycle facilities other than reactor plants, there was one abnormal occurrence, and for other materials licensees—hospitals, radiographers, waste disposal contractors, etc.—there were six abnormal occurrences. A summary of these 10 occurrences follows.

Hospital Patients Overexposed

In April 1976, the NRC was informed by the Riverside Methodist Hospital in Columbus, Ohio that certain of their patients had received radiation treatment doses in excess of those prescribed and intended by their physicians over the period of March 1, 1975 to January 30, 1976. Approximately 400 patients taking cobalt-60 teletherapy treatment during this time received doses that ranged from 10 percent to 40 percent in excess of the prescribed amounts, with an average overdose of about 19 percent. The persons affected were primarily patients taking radiation treatment for cancer, although, in some of these cases, radiation was prescribed as preventive therapy following other medical procedures, and, for some others, to moderate the intensity of the condition. A radiologist's concern about the response of patients to the treatment led to a calibration check on the teletherapy unit in January 1976, whereupon it was revealed that the actual doses exceeded those prescribed. The unit was correctly calibrated at once, and treatment schedules of patients still taking radiation therapy were adjusted, wherever possible, to avoid exceeding the overall total dose intended for each. All patients and physicians involved were informed by the hospital of the situation. With regard to patients who had died since the time of treatment, reviews were undertaken to determine whether excess radiation was a contributing factor in their deaths. The coroner for Franklin County, Ohio, stated that, of 30 cases reviewed,

autopsies showed that radiation exposure was a contributor to death in two instances.

The cause of the excessive doses to the patients was human error. In the first instance, the radiation physicist on the hospital staff prepared erroneous data regarding the teletherapy unit's radiation output, resulting in a false calibration of the unit. The error was not corrected for 11 months because the hospital's management control system did not assure that the output of the radioactive source had been accurately and competently determined and was regularly verified. There was no mechanical malfunction of the teletherapy unit.



This cobalt teletherapy unit, used primarily for treatment of cancer patients, is located at the National Naval Medical Center in Bethesda, Md. In the lower photo, the unit is being calibrated using a radiation detection instrument called an "R chamber." This instrument is used to measure the radiation intensity in a phantom—material whose chemical composition is close to that of human tissue—so that the therapist can determine the dose to the tumor to be treated.

While the NRC licenses the medical use of nuclear materials, the amount of radiation prescribed in the diagnosis and treatment of a patient is exempt from NRC's regulatory control. Upon notification, the NRC instituted an investigation and engaged a medical consultant to review the coroner's findings and advice on medical aspects of the incident. In July 1976, the NRC issued an order modifying the hospital's licenses to specifically require periodic calibration of the teletherapy unit by a qualified expert, in accord with accepted professional procedures. The order also required that management control systems be improved to ensure that public health and safety are protected. In August 1976, NRC sent a bulletin to all licensees using teletherapy units, directing them to perform comparison tests between their units' actual measured output and the calculated output and, if variances between the two were found, to perform a full calibration of the instrument. NRC also initiated a program to verify independently that the difference between measured and calculated output in the licensees' units was acceptably small. NRC is studying ways to prevent recurrence of this kind of event with the teletherapy unit involved or the approximately 500 other units licensed by NRC through regulation. Besides these, there are about 600 teletherapy units operated under licenses administered by 25 States in the NRC's "Agreement States" program (see Chapter 9). NRC has urged the State authorities to strengthen their licensing programs along the same lines, and State personnel have participated in a three-day training course in teletherapy unit calibration under NRC sponsorship.

This occurrence is the only "abnormal occurrence" taking place in fiscal year 1976 which directly affected members of the general public.

Material Inventory Anomaly

On December 1, 1975, the NRC was notified by Nuclear Fuel Services, Inc., a company

licensed by NRC to fabricate highly enriched uranium fuel, that a significant anomaly had been discovered in its inventory of nuclear material on hand at its facility in Erwin, Tenn. The fuel produced at this plant is the property of the Energy Research and Development Administration (ERDA) and is intended for the use of the military; it contains a much higher proportion of the fissionable isotope uranium-235 than does fuel in commercial nuclear power reactors. Pursuant to NRC regulations, the bimonthly inventory of this highly enriched material was conducted on October 27, 1975, and the results did not comport with the "book value," the record of quantities of nuclear material on hand. The inventory anomaly concerned materials from two distinct processing plants at the facility, one of which is given over to the fabrication of nuclear fuel and the other to the recovery of uranium scrap generated during the fabrication process. The discrepancies uncovered by the inventory consisted of a shortage in one of these areas and an excess of the quantity expected to be found in the other. Taken together, the disparities showed a net gain in the quantity of material on record.

Transfers of uranium scrap and recovered uranium routinely occur in the fuel fabrication plant, and an apparent gain in material is usually indicative of material accounting problems—either in the bookkeeping or in the measurement and assignment of values to the physical inventory. Large inventory anomalies are of concern because of nuclear safeguards considerations, but there were no indications in the instant case of any material actually missing or of any attempt to breach plant security. The licensee suspended activity in both areas of the plant for reinventory and investigation into possible causes.

One plausible cause developed from the investigation was a plugged line in the "accountability weigh tank" in the scrap recovery area of the plant. The plugged line could have caused an error in measuring uranium transferred from the production area and received in the scrap recovery area. Another possible cause was the licensee's practice of recording measurements of trace quantities of certain nuclear materials as "less than" a given quantity, rather than showing an actual measurement of material discarded. This practice could have led to an overestimation of the amount of highly enriched uranium in liquid effluents.

The licensee has taken action responsive to both possible causes. In order to reduce the possibility of plugged lines in the weigh tank, the licensee has instituted better control of in-process solids. The licensee will also measure the values of highly enriched uranium in the liquid effluents more precisely in all future processing.

The NRC imposed an immediate and specific requirement on this licensee calling for an upgrading of its nuclear material accounting and physical protection program. The Commission also assigned a special task force to investigate the incident, in addition to its regular inspection and enforcement activity.

Overexposure of Radiographers

Virginia Licensee. This incident involved an overexposure of a radiographer which may have resulted in his absorbing a whole-body dose as high as 28 rems. On November 11, 1975, after completing work at a jobsite in Washington, D.C., a radiographer employed by the Value Engineering Laboratory of Alexandria, Va., discovered that his pocket dosimeter showed an "offscale" reading. He immediately sent his film badge for processing and, on November 14, the processor reported that the badge showed an exposure of 28 rems. (The maximum exposure allowed under NRC regulations for persons working with radioactive material is 3 rems per calendar quarter.)

Investigation by the licensee and the NRC disclosed that all the radiographic equipment and survey instruments involved were operating properly and that all the survey results and radiographs taken during the day of the incident were as expected. Both the radiographer and his assistant stated that the proper procedures were followed and precautions observed. Subsequent investigation, however, revealed that the proper method was not used by the radiographer and his assistant in performing certain of their surveys, although the latter suffered no abnormal exposure, according to his two dosimeters. Reenactment of his activities

on the day in question confirmed that the radiographer may have received a radiation dose of the magnitude shown on the film badge, if the radiation source had been in an unshielded position while the radiographer was handling the equipment. Extensive medical studies failed to confirm that the dose received was as high as 28 rems, and the possibility exists that it was 15 rems or less; medical tests could not conclusively confirm or refute either level of exposure.

The cause of the overexposure was personnel error, consisting of the radiographer's failure to perform radiation surveys in the prescribed manner; a contributory factor was a deficiency on the part of company management in its radiation safety program.

A number of interim measures were taken pending the outcome of the investigation by NRC. The radiographer was suspended from all duties involving radiation for at least the remainder of the calendar quarter; all radiographers employed by the company were issued personal radiation monitors equipped with an audible alarm; and it was reemphasized to all personnel involved in the radiography program that a proper use of survey meters at the jobsite was required.

The NRC issued an order to this licensee by which it was required to show cause why its license should not be suspended for repeated noncompliance with NRC regulations. The licensee satisfactorily demonstrated that it had improved its monitoring capabilities and training programs and had instituted an audit program on field surveys, and the show cause order was therefore rescinded. NRC has continued regular inspection and enforcement procedures with the licensee.

California Licensee. On January 20, 1976, NRC received telephoned notification from the Peabody Testing/X-ray Engineering Co. of Foster City, Calif., that an overexposure of one of its radiographers had occurred during operations at a jobsite in Clearfield, Utah on one or more occasions in the period of January 1 to January 14. Formal notice followed. The first evidence of possible overexposure came on January 8, when the radiographer reported to the project manager on the scene that his pocket dosimeter showed an offscale reading. They consulted by phone with the radiation safety officer for the licensee, and, when the radiographer affirmed that he had not received excess radiation and the dosimeter was inaccurate, he was given another dosimeter and authorized to return to work. Again, on January 14, the same individual reported an offscale pocket dosimeter. On this occasion, his film badge was dispatched for processing in Sunnyvale, Calif. On the next day, however, the radiographer was permitted to return to work, with a new film badge and pocket dosimeter issued for that day only. These instruments later showed readings of 45 millirems and 22 millirems respectively, for January 15. On January 16, the radiographer terminated his employment with the licensee. On January 19, the film badge processor reported that the radiographer had received an exposure of 6.9 rems during the period of January 1 to January 14, inclusive.

The cause of the overexposure was the radiographer's entering a high radiation area one or more times during the two-week period; deficiencies in administrative controls were also involved. The company convened a safety meeting to discuss requirements, problems and conditions at the job site, and a "Radiation Safety Training Refresher Course" was given to all personnel working there. NRC inspectors investigated the occurrence and interviewed the radiographer at his home in South Carolina. As a result of its investigation, the NRC issued a notice of violation to the licensee.

Oklahoma Licensee. Two incidents involving the overexposure of a radiographer's assistant to radioactive sources were reported to the NRC by the Exam Company of Tulsa, Okla. The first occurred on February 7, 1976, when a radiographer and his assistant, employees of the licensee, were radiographing pipe fabrication using a nuclear source (iridium-192). The assistant was overexposed when he entered the area to retrieve some equipment while the source was still unshielded. His film badge showed he received a whole-body dose of 5 rems. On April 27, 1976, the same radiographer and another assistant were radiographing pipe fabrication when, as in the first instance, the assistant entered the area while the source was unshielded. His film badge showed a 5.5 rem

whole-body exposure. Neither individual was expected to suffer any adverse biological consequences from these exposures.

The cause of the overexposure in both instances was the failure of the assistant to conduct the prescribed radiation survey to ensure that the radiation source was in a shielded condition before entering the area around it. Administrative procedures were also found to be inadequate.

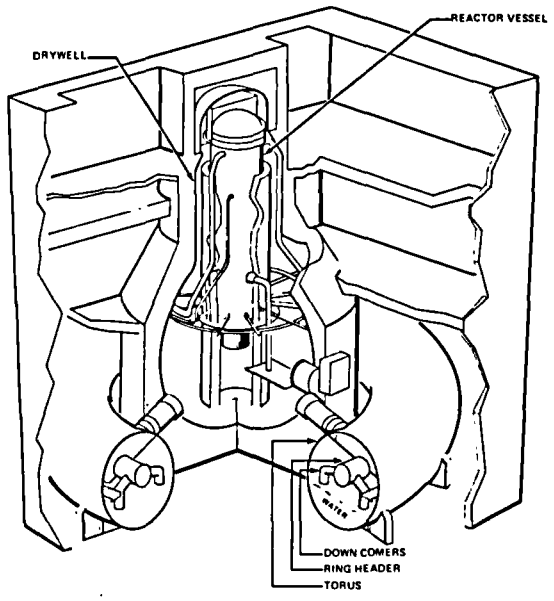
The licensee reprimanded the personnel involved in the incidents, retrained two of the technicians using an accredited instructor of radiography, and notified all field personnel of the incidents and their safety implications. The NRC inspected the licensee's activities and imposed a civil penalty on the company.

Deficiencies In Containment

Late in January of 1976, the NRC received the results of tests conducted by the General Electric Co. (GE) in conjunction with a group representing utilities owning boiling water reactors with the "Mark I" containment design. Potential problems with the design first came to light in April 1975, during safety reviews of the advanced Mark III containment by the reactor vendor. In the course of these reviews, GE identified for the first time the possibility of certain hydrodynamic loads which the containment must be able to accommodate, but which had not been considered in the design of the earlier Mark I and Mark II containments. NRC notified all utilities using or planning to use Mark I, Mark II or Mark III containments of the need to review these designs to assess structural adequacy and to ensure proper safety margins. Nineteen units among operating power plants have Mark I containments; six units among plants under construction will have Mark I containments.

The potential difficulty with this type of containment relates to a phenomenon called "suppression pool swell." The suppression pool is a pool of water inside a torus or doughnut-shaped cylinder installed beneath and connected with the reactor vessel (see diagram) to condense the steam—and thus suppress the pressure—which would be produced in the event of a severe loss-of-coolant accident. Such an accident would result in a complete, instantaneous rupture of the largest pipe in the primary cooling

BWR CONTAINMENT CONCEPT - MARK I



system of a boiling water reactor, with unrestricted flow from the pipe. The magnitude of the loads that would be imposed by this highly unlikely accident was discovered to be great enough to cause the suppression pool to swell and possibly move the torus off its supports and impair other reactor safety systems. The vendor's testing of scale models also indicated that the safety margins at the 19 operating units with Mark I containment were not as great as originally forecast. In the case of one plant—the Vermont Yankee Generating Station —test results revealed that the impact of the load on the suppression pool consequent upon the severe accident postulated might be too great for the structure to sustain. The licensee voluntarily shut down the facility for about one month, while undertaking to confirm the test results and carry out corrective actions. The other 18 operating units were found to have adequate safety margins even under the newly postulated load conditions; all of the 18, however, have increased those safety margins by instituting operating procedures which reduce the potential loads on the suppression pool.

The NRC's review of the matter led to the conclusion that the Mark I containment system

at operating facilities, including the Vermont Yankee station, would perform the containment function and would not impair the function of other emergency systems, even under the new load assessments. The review and its conclusions were explored in hearings on nuclear safety conducted in February 1976 by the Congressional Joint Committee on Atomic Energy.

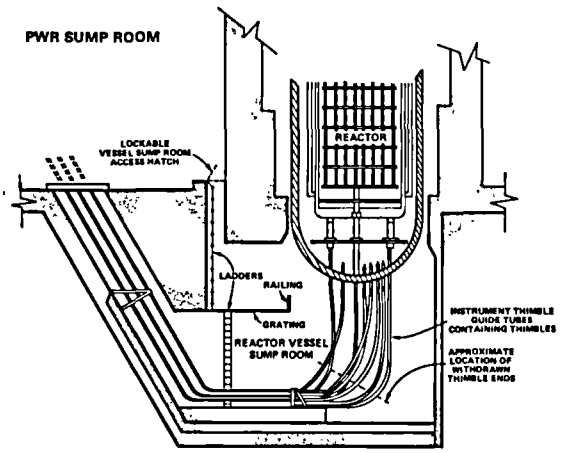
The cause or reason for the tests, reviews and actions undertaken with respect to the Mark I containment design was the postulation of load stresses in the review of a new containment design which had not been considered in the evaluation of earlier designs. Although the kind of accident which would impose the stresses is unlikely to occur, it must be considered in establishing and confirming adequate safety margins for all designs in use.

Since the potential problem was identified in April 1975, the NRC has: requested the additional information which led to the tests conducted by the vendor and owners' groups; closely reviewed the test results as they were developed; and required all licensees employing or planning to employ boiling water reactors with these kinds of containments to increase the safety margin attributable to them by altering their mode of reactor operation. One exception to the requirement for plants with these types of containments was the Brunswick plant (Unit 2) in North Carolina, whose suppression pool has a concrete enclosure and does not depend on columns for external support.

All of the utilities involved as well as the vendor have undertaken continuing efforts to obtain the data needed to confirm design adequacy or to plan further actions to provide the safety margins intended in their original designs. NRC is following their long-term programs to achieve this result and is conducting independent research to confirm the adequacy of existing safety margins. Meanwhile, all plants affected have been required to adopt the new mode of operation which, of itself, increases the structural safety margin presently in effect.

Overexposure of Plant Employees

Zion Unit 1. On March 19, 1976, the NRC was notified by the Commonwealth Edison Co.



of the apparent exposure on March 18 of one of its employees to a whole-body dose of 8 rems, at the power plant in Zion, Illinois (Unit 1). The exposure was in excess of the allowable limit of 3 rems per quarter-year.

The incident occurred during refueling of the reactor, which was shut down for that purpose. The affected individual was carrying out an inspection of an area below the reactor in search of leaks. He was carrying a survey meter to register the presence of radiation; as soon as he noticed that the instrument showed an off-scale reading, he left the area. He had been at the location under the reactor for from one to one-and-one-half minutes and had been exposed to a cumulative dose of at least 200-250 millirems of radiation, as shown on the survey meter. He then moved to another area for another one to one-and-one-half minutes, having informally estimated that his total exposure at the two locations would be within 500 millirems. Subsequent surveys showed the dose rate at this second location to be at least 200 rems-per-hour, far higher than the individual's estimate. His film badge later indicated that he had received a whole-body exposure of 8 rems. Although this level exposure exceeds the normal limit, it was not expected that medical problems would result. There were no potential consequences to anyone but the person affected.

The cause of the incident was identified as personnel error compounded by insufficient administrative control within the plant. The reactor cavity was known to have higher than normal radiation levels during the refueling process, and access to the cavity should have

been more closely governed. The individual also should have had a survey meter which would measure dose rates in each locale he entered.

The licensee's Station Safety Committee investigated the incident and went over it at a general safety meeting at the plant, stressing to all station personnel the importance of following approved procedures. All accesses to the cavity area are to be padlocked during periods of cold shutdown of the reactor—as during refueling—and stringent procedures imposed. The NRC, having completed its investigation of the occurrence, initiated a civil penalty against the licensee for acitvities not in compliance with NRC regulations.

Indian Point 2. On April 5, 1976, Consolidated Edison Co. of New York, Inc., reported an overexposure of one of its employees at the Indian Point facility (Unit 2) in Westchester County, N.Y. As was the case with the incident at the Zion plant of the Commonwealth Edison Co. described above, this mishap occurred while the reactor was shut down for refueling. During the outage, one of the plant operators entered the reactor vessel sump room to replace light bulbs in an area used for certain maintenance activities. Entering through an unlocked access hatch, the operator spent a short time in a high radiation area which he did not know existed. When he saw that his dosimeters were reading "offscale," he left the area at once and notified the health physics supervisor.

Measurement of the radiation field in the sump area showed levels in the range of 650 roentgens-per-hour, and the operator's film badge indicated that he had received a whole-body dose of 10 rems. The exposure was in excess of the quarterly 3-rem limit. The dose was not expected to produce any medical problems for the operator, and there were no consequences to other plant personnel or the public.

The cause of this occurrence was a weakness in the implementation of radiation safety controls for protecting plant personnel. Radiation levels in the sump room changed significantly during the reactor outage, when the incore detector thimbles were retracted. The required administrative controls to protect employees from normal and changing radiation conditions in the plant were not adequately carried through.

The licensee took immediate corrective action to prevent recurrence of an overexposure by locking the sump room access hatch, posting conspicuous warning signs, placing a radiation monitor in the area to alert personnel to increases in radiation fields and partially reinserting the detector thimbles into the reactor vessel, thereby lowering the radiation level. Other power plants with similar operating units were advised of the occurrence and the circumstances that led to it, as was the reactor vendor. The NRC conducted a special inspection of the situation and required immediate corrective action to improve the implementation of safety controls. NRC staff imposed a civil penalty on the licensee.

Cesium Lost In Transit

The Holy Cross Hospital in Chicago reported on January 22, 1976 that a small quantity of radioactive cesium-137 had been lost in transit between the hospital and its destination in Houston, Tex. The medical radiation source had been shipped on January 15. Investigation by the licensee and the NRC disclosed that the source—which emitted 0.9 roentgen-per-hour radiation at a distance of six inches—had been removed from its shielded container before being packaged, although both source and container were shipped in one package. The shipping crate was damaged in transit and the source and its shield were separated. When the container arrived in Houston without the radioactive source, an immediate search was undertaken which located the source, on January 27, in the refuse container of a salvage goods dealer in Atlanta, Ga. The source had been relegated to the salvage goods warehouse by the carrier, where it was discarded as trash. The recovered source was delivered to its original destination without further incident.

The determination was made that an individual could have received significant radiation exposure from the source only if he or she were in close proximity to it for several hours. By means of an extensive examination of records and procedures, interviews with personnel actually or possibly in contact with the source, radiation surveys and observations by the investigators, it was ascertained that no such

exposures occurred. The incident is treated as an abnormal occurrence because of the fact that an unmarked, unshielded and potentially hazardous source of radiation had been in the public domain for nearly two weeks.

The principal cause for the temporary loss of the radiation source was that the licensee's shipping clerk had not been informed that the container to be shipped held a radioactive source which required special packaging and handling; consequently it was not packaged and labeled or handled by the carrier according to applicable Federal regulations.

The licensee has amended its policies and procedures to assure that the shipping and handling of radioactive materials will be done in the future only by persons trained in the proper procedures and relevant regulations. Education programs will also be provided for all employees of the licensee who may have occasion to deal with radioactive materials. The NRC, having carried out the investigation which resulted in recovery of the source, held meetings with the licensee and subsequently verified the adequacy of corrective actions through a series of follow-up inspections.

Unauthorized Removal of Waste

The Nevada Department of Human Resources advised the NRC on February 24, 1976 that material contaminated with radiation had been removed from a disposal facility operated by the Nuclear Engineering Co. (NECO) at a site 10 miles south of Beatty, Nev. As one of the Agreement States (see Chapter 9), Nevada licenses and regulates activities at the Beatty site which involve source and byproduct nuclear material, while the NRC regulates activities at that site involving special nuclear material, which is material containing the fissionable elements uranium-233, uranium-235 or plutonium in any percentage higher than that found in natural substances containing these elements. Such material comes under direct NRC authority regardless of agreements by which the States regulate certain nuclear facilities and related activities. Only a small portion of the activity at the NECO site near Beatty dealt with special nuclear material.

Internal investigations by NECO management revealed that certain of their employees had allowed a cement mixer used for solidifying low-level liquid radioactive waste to be used for pouring concrete slabs at a local saloon, a new municipal building, and several private properties in Beatty. NECO notified Nevada au-

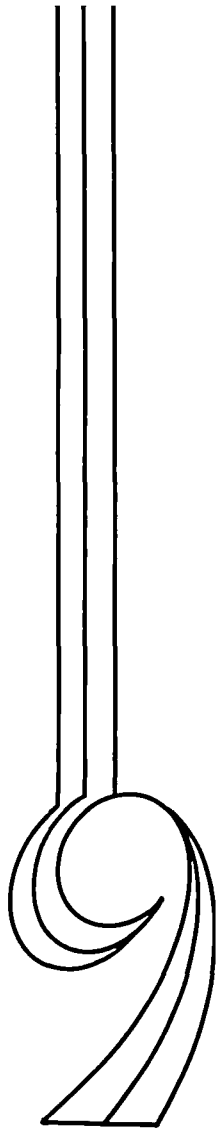
An NRC inspector and a member of an Energy Research and Development Administration's Radiological Assistance Team survey salvaged equipment on a private ranch near Beatty, Nevada, for radioactive contamination. Contaminated equipment which had been removed from a waste burial facility near Beatty was recovered from a number of sites through joint efforts of the Environmental Protection Agency, ERDA, NRC, and the Nevada Department of Human Resources.

thorities who then requested assistance from an office of the Environmental Protection Agency (EPA) in Las Vegas. The EPA sent a radiation monitoring team to Beatty for preliminary evaluation of the situation.

Subsequent to this initial survey, an investigation into the removal of contaminated items from the NECO facility was undertaken jointly by the ERDA, the Nevada Department of Human Resources, the EPA and the NRC, during the period March 10 through April 15, 1976. This investigation disclosed that other violations of the facility's license had been taking place over a period of years, involving the unauthorized relocation of materials from the disposal site. Monitor teams were brought in to canvass the town of Beatty and its environs using sophisticated radiation detection equipment, aerial support, a mobile laboratory and a van designed to locate radioactive material. About 250 residences were surveyed, of which three which were occupied were found to contain items with traces of radioactive contamination. However, materials that should have been buried were found in yards, sheds and other storage areas at about a dozen locations. This material consisted of hundreds of separate items—hand tools, electric motors, lumber, and light equipment of various kinds. About 25 pick-up truck loads were required to return the material to the disposal site. Heavier equipment was also confiscated, along with numerous radium-dial clocks, watches, compasses and similar items found in private homes and voluntarily turned in by the residents. Some 23 large metal tanks which had been used to ship contaminated equipment to the NECO disposal site were found in the town and surrounding farms, but none of these was found to be contaminated. Neither were most of the tools and equipment removed from the NECO site to the town, and those that were contaminated did not represent a serious health hazard because the level of contamination was low. Nonetheless, the pattern of activity constituted a serious violation of licenses and regulations on the part of the licensee, with potentially serious consequences to the residents of the area. As a further precautionary check, selected residents of Beatty were whole-body counted for signs of internally deposited radioactive substances at the EPA's facility at Las Vegas; no health hazards or problems were observed.

The cause of the unauthorized diversion of contaminated articles to uncontrolled areas was negligent and possibly criminal behavior on the part of the licensee and its agents. Three NECO employees were discharged as a result of the incident, and the licensee took action to establish firm material control and security, according to directives of the State. Both the State of Nevada and the NRC had suspended the facility's licenses in March of 1976, pending the completion of the investigation. The State authorized the licensee to resume operations in May 1976 under the new material control requirements and is considering further action. The NRC conveyed the results of its investigation to the Justice Department for consideration of the possible violation of Federal criminal statutes by the licensee. NRC review of the matter is continuing, and further actions may issue from that review. The Justice Department has the question of criminal violation and possible prosecution under consideration.

Cooperating with the States



As the peaceful use of nuclear energy increases, more communities in the Nation are affected, the interest and concern of their citizens are aroused, and their State and local governments become involved. The responsibilities of State and local governments, particularly those concerning public health and safety and the preservation of environmental values, may be closely related to the regulatory responsibilities of the NRC. Accordingly, close cooperation between NRC and State and local governments is necessary.

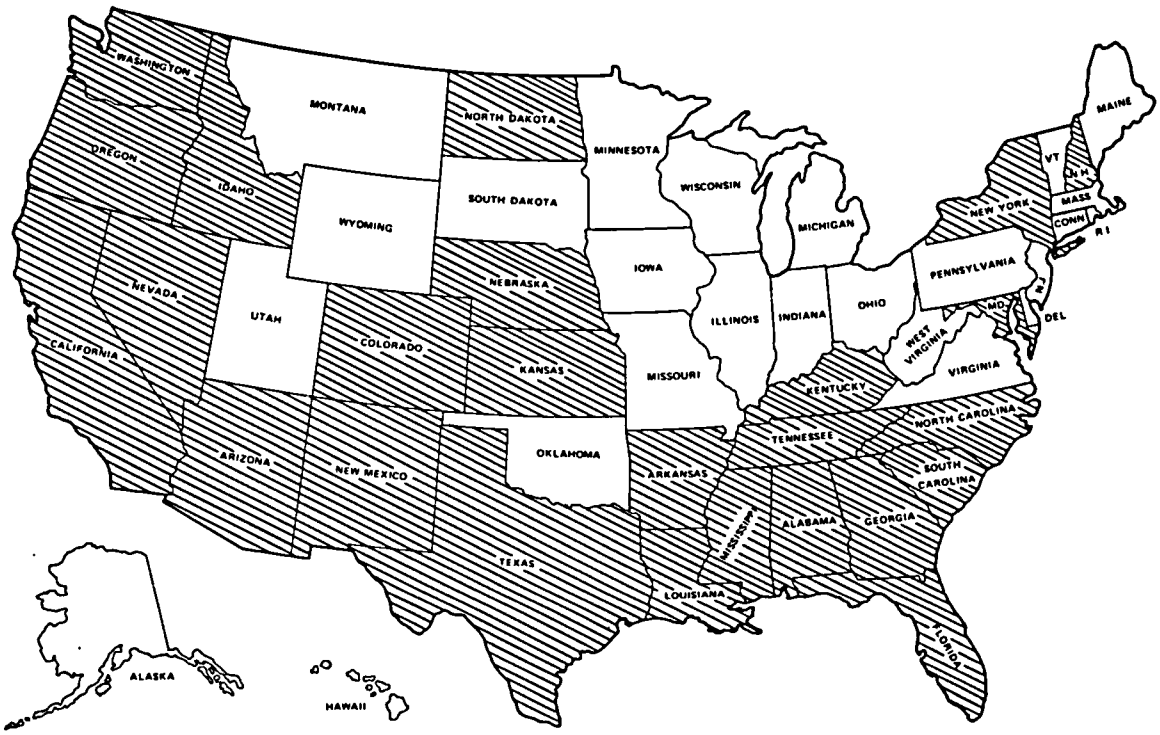
In June 1976 the NRC established an Office of State Programs, charged with assuring that the fullest possible assistance is given to States in their regulatory efforts, that State concerns are addressed in NRC regulatory programs, and that cooperation between State and Federal governments in the regulation of nuclear energy is maximized and wasteful duplication minimized.

The principal areas of NRC-State activities described in this chapter are (1) the State Agreements program, whereby States may assume certain of the NRC's regulatory authority over nuclear materials; (2) the NRC's "lead agency" role in assisting State and local governments in planning responses to radiological emergencies; and (3) a wide range of liaison and cooperative activities aimed at coordination in such areas as licensing and siting functions.

State Agreements Program

Section 274 of the Atomic Energy Act, as amended, authorizes the Commission to enter into agreements with States whereby the NRC relinquishes and the States assume regulatory authority over byproduct, source, and special nuclear materials in quantities not sufficient to form a critical mass (a mass capable of supporting a self-sustaining chain reaction). These are normally referred to as agreement materials. Before entering into an agreement with any State, NRC must find that the State's radiation control program is adequate to protect public health

AGREEMENT STATE PROGRAM



AGREEMENT STATES

NON-AGREEMENT STATES

and safety and that it is compatible with the regulatory program of the NRC.

At the end of fiscal year 1976, there were 25 Agreement States exercising regulatory jurisdiction over approximately 10,700 radioactive material licenses, as compared to about 8,500 such licenses administered directly by NRC. The Agreement States were: Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Idaho, Kansas, Kentucky, Louisiana, Maryland, Mississippi, Nebraska, Nevada, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Oregon, South Carolina, Tennessee, Texas, and Washington.

During the fiscal year, negotiations were underway with Illinois and Michigan. Other States expressing interest in negotiating agreements were Indiana, New Jersey and Rhode Island.

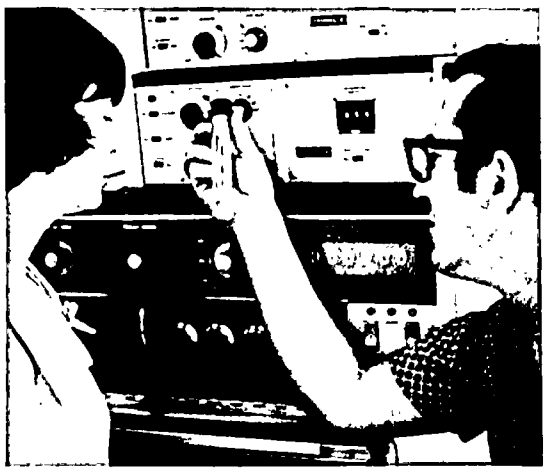
MAINTAINING COMPATIBILITY

To promote an orderly regulatory pattern, NRC conducts a program of cooperation with the Agreement States, which includes: providing technical training courses for State personnel; exchanging statistical information on licensing and inspection activities and incidents; exchanging current information on regulations, licensing, inspection, and enforcement practices; exchanging technical information; and providing consultation and technical assistance on specific regulatory problems.

NRC conducts annually a formal review of each Agreement State's radiation control program to determine whether it continues to be adequate and compatible with NRC's program. The review covers six major elements of a State's program: organization, administration, person-

nel, regulations, licensing, and compliance. During 1975 and 1976, the NRC placed increased emphasis on reviewing uranium mills and commercial burial grounds regulated by the Agreement States. Following each review, NRC provides comments and recommendations to the State.

All 25 Agreement State programs were determined to be adequate and compatible during fiscal year 1976.



A representative of NRC's Office of State Programs observes as an Idaho Department of Health and Welfare inspector performs an analysis of an environmental sample taken at an industrial facility. The NRC representative also accompanied the Idaho inspector during inspections of a radiographer and two hospital nuclear medical programs as a part of the NRC's periodic review of Agreement States' radiation control programs.

The U.S. Department of Labor accepts NRC's certification that Agreement State radiation control programs are adequate to protect the health and safety of the public and of radiation workers and does not assert its own regulatory authority over agreement material activities in Agreement States under the Occupational Safety and Health Act. During 1976, areas of duplicative regulation for licensees possessing both agreement materials and non-agreement sources of radiation were noted relating to occupational safety and health programs of some States. NRC and Labor Department staffs resolved these issues cooperatively and the Agreement States were notified.

The NRC State Agreements program also serves as a central point of contact for the affected States in their relations with other Federal agencies (for example, the Food and Drug Administration, Department of Transportation, U.S. Geological Survey and Energy Research and Development Administration) on matters involving the regulation of radioisotopes.

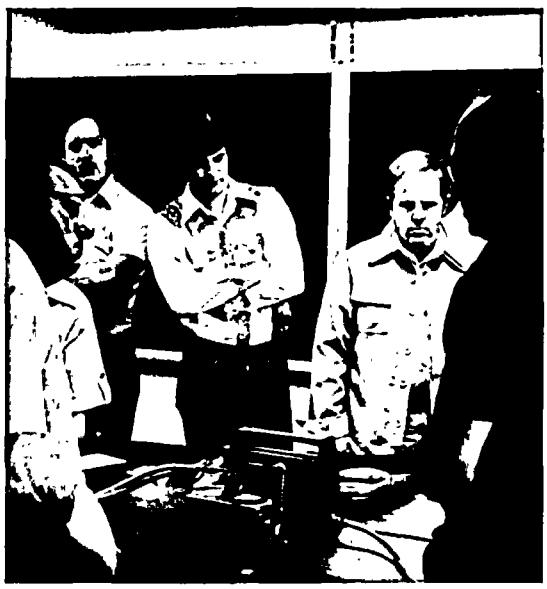
TRAINING STATE PERSONNEL

NRC conducts training programs for State personnel to help them prepare for Agreement State status and to help existing Agreement States train new staff. The training is designed to improve technical and administrative skills and to develop regulatory capability.

During the past year a total of 134 State staff members received 383 man-weeks of training through attendance at the following courses:

Subject	*Presented by*
Health Physics and Radiation Protection	Oak Ridge Associated Universities
Inspection Procedures	NRC Region III Office (Chicago)
Regulatory Practices and Procedures	NRC (Headquarters)
Management for State Radiation Control Personnel	U.S. Civil Service Commission Management Training Institute
Medical Use of Radionuclides	Baylor College of Medicine (Texas)
Safety Aspects of Industrial Radiography	Louisiana State University

The NRC also provides individual on-the-job training for State personnel. During the year, such training was provided on four separate occasions, each relating to an aspect of inspection and enforcement.



An inspector at NRC's Chicago regional office instructs Agreement State personnel on inspection techniques during a weeklong training session.

TECHNICAL ASSISTANCE

The NRC also carries out a program of providing technical assistance to the Agreement States. Such assistance includes reviewing major licensing actions, regulations, inspection and enforcement matters, and technical reports; and providing health physics evaluations of complex technical problems. Additional assistance is provided to the Agreement States in reviewing and evaluating significant license applications and environmental impact assessments. Four such reviews have been undertaken to date. The NRC also assists Agreement States in the review of applications and technical documents relating to commercial burial grounds for low-level radioactive wastes. Such assistance was provided in the review of the renewal application for the Beatty (Nevada) burial ground, and in the review of a State report and two Environmental Protection Agency reports on the environmental monitoring program at the Maxey Flats (Kentucky) burial ground. NRC assisted in reviewing the conditions imposed by Nevada on operations at the Beatty site following a major incident at the site which involved the unauthorized removal by employees of materials sent to the site for burial. (See Chapter 8.)

OVERSIGHT OF URANIUM MILLS AND TAILINGS PILES

NRC Reviews

NRC evaluates, on a continuing basis, uranium milling operations and the conditions of mill tailings piles in the Agreement States. This activity includes reviews of uranium mill licenses issued by the Agreement States to evaluate the adequacy of the supporting information in the license files; reviews, including on-site visits, to determine the adequacy of uranium mill inspections; reviews of the condition of stabilized and unstabilized mill tailings piles; and reviews of the States' environmental surveillance programs.

Active uranium mills and other beneficiating operations on uranium ore are located in Colorado, New Mexico, Texas, and Washington. In Texas there is one mill obtaining ore from a strip-mining operation, four commercial *in situ* leaching operations, two pilot *in situ* leaching operations, and one heap leach operation. Colorado has two mills obtaining ore from deep mines, one heap leach operation, and one pilot ion-exchange process involving old liquid slurries. Washington has one mill obtaining ore from strip mining, and New Mexico has four active mills, one of which obtains ore by strip mining.

Control over mill tailings is exercised by the States in various ways. Colorado, New Mexico, and Washington have regulations covering the long-term maintenance of tailings piles. Texas and New Mexico incorporate similar requirements into uranium mill licenses. Colorado requires a financial commitment from licensees to insure long-term maintenance of the piles. Colorado, New Mexico, and Texas have active environmental surveillance programs at mill tailings sites. Washington and New Mexico are expanding their surveillance programs.

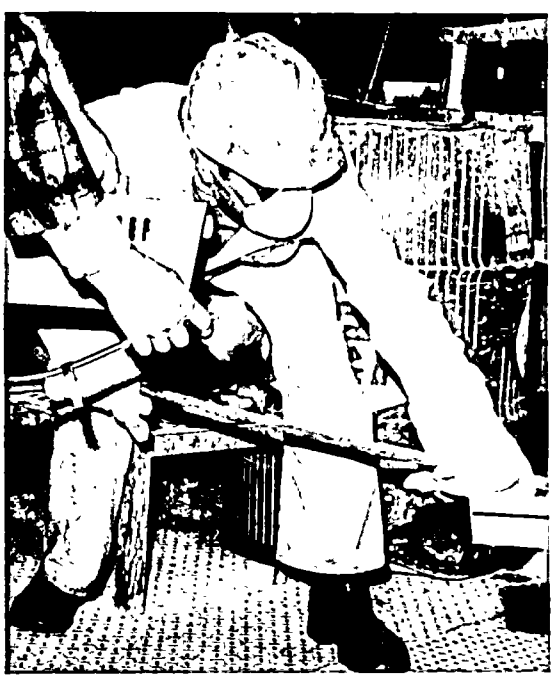
As discussed in Chapter 3, the overall problem of controlling uranium mill tailings is being addressed by the NRC, involving a generic environmental impact review, research, and development of alternative strategies for managing these wastes.

OVERSIGHT OF COMMERCIAL LOW-LEVEL WASTE DISPOSAL

NRC continually reviews commercial burial sites for low-level radioactive wastes in the Agreement States. Such burial facilities are now located in Kentucky, Nevada, New York, South Carolina and Washington. NRC's activities include examination of licenses to evaluate the adequacy of supporting information; periodic on-site visits to determine the adequacy of inspections; review of criteria and funding for perpetual care and maintenance; and review of environmental surveillance programs.

During the year the NRC established a task force to reassess the roles of Federal and State governments in the regulation and operation of commercial low-level radioactive waste burial grounds. This was done to meet a commitment to the Joint Committee on Atomic Energy and to respond to recommendations of the House Committee on Government Operations. The task force visited the various burial sites. It also held meetings with management representatives in the respective States to discuss each State's experience and obtain its views. A report containing the task force's findings and recommendations was in preparation at year-end. (See Chapter 5 under "Waste Burial Facilities.")

At left, NRC, State and mill representatives are standing on top of an inactive, stabilized tailings pile during an Agreement State inspection of a New Mexico-licensed mill. Below left, both State and licensee personnel take air samples near a worker in the yellowcake processing building. The air samples are taken as close as possible to the breathing zone of the worker, who is wearing respiratory protective equipment. Below right, a mill employee takes a water sample of the effluent from the ion-exchange plant.



ANNUAL MEETING

NRC conducts an annual meeting with representatives of Agreement States to consider regulatory matters of common interest. Following the 1975 meeting, the Agreement States offered comments and recommendations to which the NRC has responded. One recommendation, which was also made following the 1974 meeting, was that NRC initiate legislation to bring accelerator-produced and naturally-occurring radioactive material under NRC's jurisdiction. A task force of Federal and State representatives was established to consider this recommendation. If the task force concludes that the Federal Government should regulate these materials, it will develop a model program, estimate the resources needed and propose any necessary legislation.

As part of its program of assistance to States that assume responsibility for regulating certain radioactive materials, the NRC sponsors a ten-week training course in health physics and radiation protection. The course is conducted by the Oak Ridge Associated Universities and is designed to help meet the growing need for persons trained in the principles of radiation protection.

Emergency Response Planning

The planning discussed in this section relates to NRC assistance to State and local governments in planning their emergency responses to radiological incidents.

State and Local Planning

The responsibilities of Federal agencies for assisting State and local governments in developing plans for responding to radiological emergencies are outlined in a *Federal Register* notice of December 24, 1975, promulgated by the Federal Preparedness Agency (FPA) of the General Services Administration. This notice, entitled "Radiological Incident Emergency Response Planning: Fixed Facilities and Transportation," gives the "lead agency" role to NRC, while assigning specific responsibilities to the Environmental Protection Agency; Energy Research and Development Administration; Departments of Transportation and Health, Education and Welfare; Defense Civil Preparedness Agency; and the Federal Disaster Assistance Administration of the Department of Housing and Urban Development. The entire effort is monitored by the FPA.

In carrying out its "lead agency" role, NRC's main efforts have been concentrated on the preparation and issuance of planning guidance, the development and conduct of training courses, the provision of field assistance to States in development and testing of radiological emergency response plans, the review and evaluation of these plans, and the determination of the instrumentation requirements for measuring off-site consequences of radiological incidents.

ASSISTANCE TO STATES

"Guide and Checklist"

The basic document for the guidance of State and local governments in the development of their radiological emergency response plans is the NRC publication NUREG-75/111 ("Guide and Checklist for Development and Evaluation of State and Local Government Radiological Emergency Response Plans in Support of Fixed Nuclear Facilities").

A study of the criteria in the Guide and Checklist was undertaken in early 1976 by eight Federal agencies. The views of the Conference of

(State) Radiation Control Program Directors, the National Association of State Directors for Disaster Preparedness, and the U.S. (local) Civil Defense Council were solicited. A principal result of the study, expected to be completed by the end of 1976, will be a rating of the items in the Guide and Checklist according to whether they are considered essential or merely desirable. The goal of this effort is to help identify those emergency response plans which meet minimum criteria.

Training Programs Offered

NRC, in cooperation with the other Federal agencies involved, has identified a number of areas where training is needed for State and local government personnel involved in radiological emergency response planning and operations, and has developed, or is currently developing, formal training courses for each of several areas. These courses are offered, or are planned to be offered, at Federal expense, using funds made available by the agencies assigned responsibilities in the *Federal Register* notice.

A one-week course in radiological emergency response planning has been conducted 11 times since its inception in March of 1975. As of the end of fiscal year 1976, approximately 360 State and local government emergency planning personnel from the 48 contiguous States have attended. Some of the sessions were conducted at the Defense Civil Preparedness Agency Staff College in Battle Creek, Michigan; other sessions were held at locations considered more convenient to the participants. The course will continue to be offered about once or twice a year.

In addition to this course on planning, NRC and other Federal agencies are developing a series of courses for State and local government personnel on the operations involved in responding to a radiological incident and dealing with any consequences of accidental radiological releases to the environment. Pilot courses in radiological monitoring and radiological emergency medical response, developed and conducted by ERDA contractors, were formally evaluated by a working group composed of Federal, State and local government emergency preparedness personnel. These evaluations were used in developing revised curricula. Joint funding of the courses on operations by some of the agencies assigned responsibilities in the *Federal Register* notice is anticipated, and a modest start will be made in offering these courses during fiscal year 1977.

Field Assistance, Drills and Exercises

In support of the interagency field effort in radiological emergency response planning assistance, the NRC Office of State Programs published in June a document entitled "Radiological Emergency Response Planning—Handbook for Federal Assistance to State and Local Governments," NUREG-0093/1. This document sets forth guidelines for the activities of the eight Federal agencies involved. It outlines, for example, the responsibilities and activities of a headquarters advisory committee and 10 regional advisory committees, each of which has membership from Federal agencies and is headed by an NRC representative. The advisory committees are the main sources of emergency planning assistance for the States and local governments.

Twelve field reviews of State plans were initiated by regional advisory committees during fiscal year 1976. The reviews were designed to give the States specific guidance as to what parts of their plans need to be improved.

During the fiscal year, 20 radiological emergency response exercises were initiated or participated in by State and local governments. Federal field assistance cadres observed 12 of these.

Radiological Emergency Instrumentation

A Federal interagency task force is developing guidance needed to establish emergency off-site radiation detection and measurement systems for use by the States and local governments and to select the appropriate instrumentation for these systems. The task force's first draft report, issued in October 1975, has been formally reviewed by the NRC and other Federal agencies and by a

selected group of State radiological health officers. Efforts to complete the report and to develop appropriate guidance based on the committee's work are continuing.

GAO Report on Federal Assistance to States

In March the General Accounting Office (GAO) issued a report, "Stronger Federal Assistance to States Needed for Radiation Emergency Response Planning," which made two specific recommendations to NRC in its "lead agency" role. The first was that NRC report periodically to the Congress on the status of Federal efforts to help the States in their planning, setting out: (1) State actions to improve their plans; (2) the relationships and commitments of the various Federal agencies involved; and (3) any recommendations for legislation which would enable NRC to increase its help to States in preparing adequate plans. NRC indicated that it would comply with the recommendation by including in future annual reports to the Congress a more comprehensive section on the status of the effort to assist States in their planning.

The second GAO recommendation to NRC was that the Office of State Programs have representatives at the NRC regional offices to provide better liaison with State and local governments. NRC indicated its intent to comply with this recommendation as funding allowed. A study on increased regionalization of NRC activities, including assistance to State and local governments in emergency response planning, was near completion at year-end.

In addition to making specific recommendations, the GAO report presented several conclusions. One was that State plans for dealing with radiation emergencies need improvement, notwithstanding NRC's progress in support of this effort. The report also concluded that "the success of Federal efforts to improve State radiation emergency plans now depends substantially on how committed the States are to developing adequate plans." It then described several alternatives which would provide, in GAO's opinion, greater leverage for NRC in its "lead agency" role:

- NRC could be given authority to provide funds to the States under a grant program or under a program with contract authority.
- With the assistance of the Office of Management and Budget (OMB), NRC could work with the Federal Disaster Assistance Administration (FDAA) to encourage States to use part of their FDAA grant funds for developing radiation emergency response plans.
- With the assistance of OMB, NRC could work with the Defence Civil Preparedness Agency to encourage States to use part of their civil defense assistance funds to develop and operate radiation emergency response plans.
- If delays in funding training programs for State and local personnel are not resolved, NRC and the Federal Preparedness Agency might ask OMB to provide adequate funding through participating Federal agencies.
- NRC might have to determine whether to continue to license nuclear facilities in States which do not have adequate radiation emergency plans.

With regard to the funding of training activities, NRC indicated in its reply to GAO that it had requested funding from five other Federal agencies to support the program through fiscal year 1982. If the funding situation cannot be resolved shortly, NRC may approach OMB, in coordination with FPA, to assure necessary funds for continuing the program.

Problem Areas in State and Local Planning

The problem areas in State and local government radiological emergency response planning can be considered under four general headings:

1. Lack of funds. Many State and local governments lack money and staff to put forth any meaningful effort into developing emergency plans. In many cases this work is assigned on a part-time basis to individuals in

civil defense or health agencies. At the Federal level, a recent OMB opinion suggested that the Defense Civil Preparedness Agency (DCPA), which has been involved in both wartime and peacetime emergency planning, restrict itself henceforth to wartime emergency planning. Consequently, local civil defense organizations may find in the future that DCPA funds are unavailable for peacetime radiological emergency planning.

2. Requirements in the "Guide and Checklist." In the *Federal Register* notice referred to earlier, the NRC was given the responsibility to "review and concur" in State and local radiological emergency response plans. Since the inception of this program in 1973, however, the NRC has not concurred in any State plans because none has met the criteria in the "Guide and Checklist." At the time of its first publication in 1973, this document had the approval of the cognizant Federal agencies and the tacit approval of most States. Now, however, many States have indicated that they cannot accomplish all the planning elements listed in the "Guide and Checklist." The NRC and other involved Federal agencies are currently reexamining the "Guide and Checklist" in order to distinguish between those planning elements considered "essential" and those considered "desirable." The NRC has also asked the States for their opinions on this matter and expects to be able to set priorities for the planning elements by the end of calendar year 1976.

3. Magnitude of Hypothetical Accidents. The States are concerned about the types of nuclear facility accidents for which plans should be developed. The NRC "Guide and Checklist" recommends that they plan for the most serious design-basis accidents analyzed for siting purposes, but also notes that other more serious accidents could possibly occur. On the other hand, the Reactor Safety Study (NUREG-75/014), issued in October 1975, which examines much more severe accidents of very low probability, is envisioned by some States and local authorities, certain segments of the public and by the U.S. Environmental Protection Agency (EPA) as being an appropriate basis for emergency planning. To provide clearer definitions of the types of radiological accidents that State and local governments should plan for, an NRC/EPA Task Force on Emergency Planning has been established. Task Force recommendations are expected to be available early in 1977.

4. Public Discussion and Proceedings. Emergency planning to cope with accidents at nuclear power plants has received much attention during the last year in proceedings before the NRC and State public utility commissions. There has also been considerable press coverage of this subject. NRC was formally petitioned by the Public Interest Research Group (PIRG) and 30 other citizen groups to amend its emergency planning regulations.

The petitioners requested that the Commission amend 10 CFR Part 50 to require nuclear facility licensees and license applicants to instruct citizens in public evacuation procedures and actually test public evacuation plans in realistic drills. The petitioners also requested that the Commission amend 10 CFR Part 50, Appendix E, to require that Final Safety Analysis Reports include details of emergency plans and implementation procedures.

The petitioners contend that public education is essential to making evacuation plans effective, that public discussion of evacuation plans and full-scale public drills are necessary to ensure the soundness of emergency plans, and that the Commission has a duty to minimize the damage which might be caused by a nuclear incident.

A notice was published in the *Federal Register* requesting all interested persons to submit written comments or suggestions concerning this petition.

Since none of the State governments commented on the notice, and recognizing that State governments have a vital role as well as extensive experience in the areas of handling and planning for emergencies, the NRC sent a letter to the governor of each State requesting comments on the PIRG petition. The responses, together with the extensive public comments which were received, have been reviewed and final Commission action is expected in 1977.

In addition, several State public utility commissions have been petitioned to require that, once each year, licensees perform one or more of the procedures proposed in the PIRG

petition submitted to NRC.

New York and Maine PIRGs have petitioned the NRC to order utilities operating nuclear power plants to show cause why their licenses to operate should not be rescinded because of the petitioners' claim that the applicable State emergency response plan is inadequate. These petitions were extensively evaluated and ultimately denied.

In New York, the State emergency response plan is the subject of contention in a proceeding before an Atomic Safety and Licensing Board. The intervenors claim that a construction permit should not be issued because the plan is inadequate.

Finally, in California, the State energy commission is conducting hearings to gather information on emergency evacuation planning. This information is to be used in determining the adequacy of future sites for nuclear power plants in that State.

Further Assistance in Prospect

During the forthcoming fiscal year expanded training programs and improved interagency field assistance efforts should help State and local governments improve their emergency response capabilities. Also during the coming year the NRC will offer additional guidance on such matters as: accident scenarios for drills and exercises to test emergency plans, State and local government emergency plans related to transportation accidents involving radioactive material, and radiological instrumentation for use in emergencies.

During fiscal year 1977 NRC plans to review its standards for concurrence in State radiological emergency response plans, accelerate reviews of such plans, and evaluate an increased number of State and local emergency response exercises.

Other Liaison and Cooperative Activities

In addition to maintaining its Agreement States program, NRC seeks to cooperate with States and with regional and national organizations in other ways to achieve more effective regulation of nuclear energy. Several cooperative programs were undertaken during the past year.

Work with State Organizations

Contracts relating to facility siting procedures were entered into with the Western Interstate Nuclear Board and the Southern Interstate Nuclear Board. These are regional associations of States formed by statutory agreement to foster the sound and orderly utilization of nuclear energy in furthering regional development, public health and safety, and environmental quality.

The National Governors' Conference Energy Program is providing NRC with data on individual States' facility siting procedures in order to identify areas where cooperation would minimize duplication of effort. The NRC continued, along with other Federal agencies, to sponsor the Conference of (State) Radiation Control Program Directors and to participate in the work of its Executive Committee and specific task forces.

The task forces included those concerned with: regulations for State radiation control programs; evaluation and distribution of radioactive sources and devices not regulated under the Atomic Energy Act; measurement of the effectiveness of State radiation control programs; management of radioactive wastes; bonding and perpetual care of nuclear facilities; and improvement of interstate and State-Federal communications.

NRC also participated in conferences and meetings sponsored by the National Association of Regulatory Utility Commissioners and the National Conference of State Legislatures, and in the work of their committees and working groups.

State Legislation and Initiatives

Nuclear power has been the focus of keen concern in a number of States during the past year. This was reflected in the large number of

nuclear-related bills introduced in the legislatures, as well as by initiatives placed on election ballots.

NRC continued to provide guidance and assistance to States on proposed legislation when requested, and in several instances presented testimony before legislative committees. Following enactment of various State bills into law, NRC also conducted briefings for State agency personnel on pertinent NRC policies, programs and procedures.

Licensing and Siting Coordination

NRC has been actively exploring ways to work with the States to avoid duplication and to minimize cost and delay in the licensing of nuclear power plants.

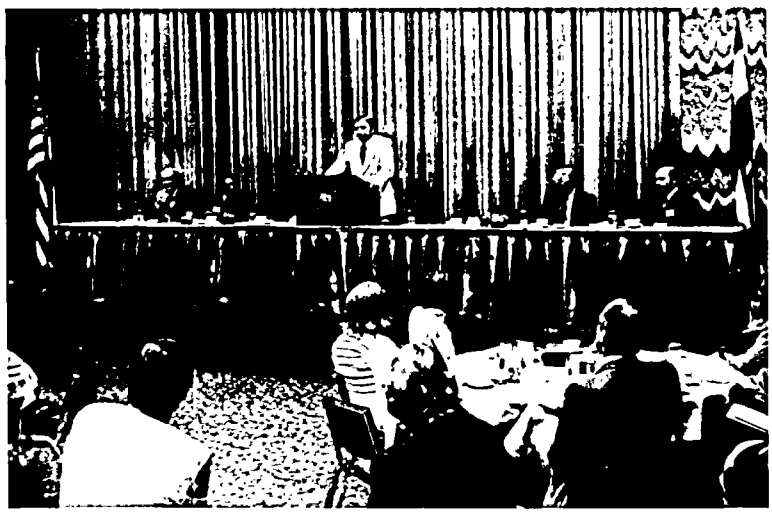
One approach to achieving this objective has been to conduct annual State-Federal conferences on power plant siting. The second such conference, sponsored jointly by NRC and the Energy Program of the National Governors' Conference, and co-hosted by the Western and Southern Interstate Nuclear Boards, was held June 16-18, 1976, in Denver, Colorado, and was attended by representatives from 40 States. A wide range of mutual regulatory interests was discussed, including early site review, water quality issues as related to siting, radiological emergency response planning, socio-economic impact of plant construction and operation, and waste management.

Another aspect of this cooperative program was the appointment of NRC liaison officers to coordinate licensing and siting responsibilities wth the States. Twelve States have appointed liaison officer counterparts, and the other States are being encouraged to do so.

Another mechanism instituted in the effort to improve coordination of NRC and State licensing activities is the conduct of joint public hearings. The first joint hearing was conducted during the past year with the State of Maryland on the proposed Douglas Point Nuclear Power Plant. A similar protocol has been adopted by NRC and the State of New York for the conduct of joint hearings on an application from the Power Authority of the State of New York for permits to construct the proposed Greene County Nuclear Power Plant. Those hearings are expected to be held in 1977.

Monitoring Transportation

During 1976, NRC initiated a long-term State-Federal collaborative program to assess the current practices in the transportation of radioactive materials under existing regulations. Under this program a State contracts with NRC to engage in a two-year cooperative effort for the surveillance of radioactive materials in transport. The surveillance is conducted at



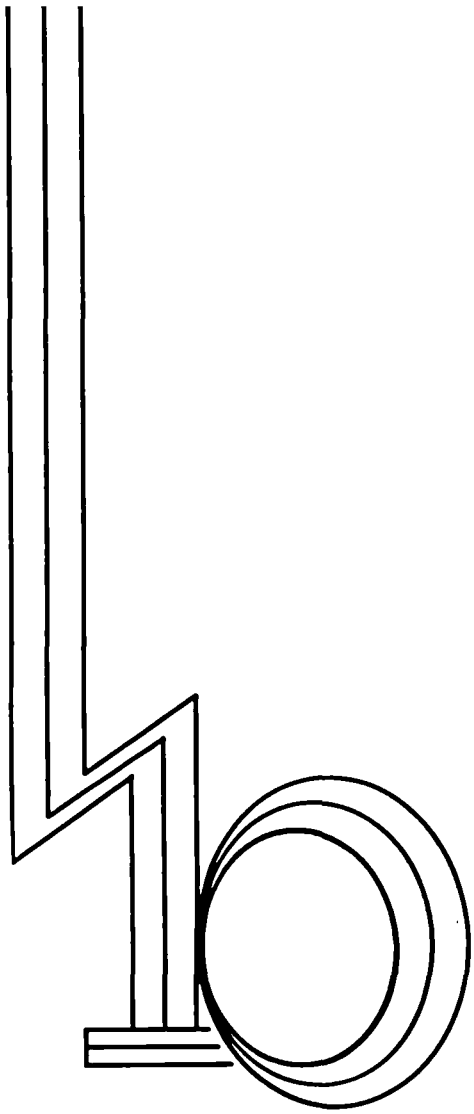
Pat Moran, Chairman of the Arkansas Public Service Commission, addresses a luncheon meeting at the 2nd State-Federal Power Plant Siting Conference held in Denver in June 1976. Sitting at the head table are, left to right, Ben Rusche, NRC; Matthew Holden, Wisconsin PSC; Noel Clark, Nevada PSC; and Robert Borlick, Federal Energy Administration.

designated locations in order to obtain information on the condition of packages, handling practices, and other pertinent data.

An ancillary benefit to the States is the enhancement of their expertise to deal with radioactive material shipments.

For the first time, the NRC joined with a State to hold a combined public hearing to consider the licensing of a nuclear power plant. In July 1976 the NRC and the Maryland Public Service Commission held hearings in Waldorf, Md. on Potomac Electric Power Co.'s proposal to construct the Douglas Point Nuclear Generating Station. Since the NRC and the PSC each must decide for or against licensing the plant, the joint hearing was an effort to reduce time and expenditures of the public, the utility, and other participants in the proceeding. The three PSC hearing board members sit at the left side of the bench and the three NRC licensing board members at the right. At the four tables in the foreground are representatives of: (1) PSC and State Attorney General, (2) Chesapeake Bay Foundation and Citizens Council for a Clean Potomac, (3) NRC, and (4) PEPCO.

International Cooperation



Toward Worldwide Nuclear Safety

The NRC's interaction with foreign governments and organizations continued to broaden in scope and purpose during fiscal year 1976. In recognition of the increasing importance of its international nuclear activities, the Commission, in June 1976, created a separate Office of International Programs by joining the international relations function, the export-import licensing function, and responsibility for international safeguards policy and coordination in the new office.

The organizational change centralized NRC's operations in the international area, including development of programs of regulatory information exchange and safety research agreements with foreign nuclear energy regulatory authorities, participation in nuclear standards development and regulatory personnel training in concert with international organizations, furtherance of international safeguards, and administration of the Commission's export-import licensing policies. The International Office works closely with NRC's Office of Nuclear Material Safety and Safeguards in the area of international safeguards operations and expertise.

This chapter presents an overview of NRC's international activities in seeking safe and secure operation of nuclear facilities and responsible, peaceful use of nuclear fuels—goals which are shared with an increasing number of foreign governments and international organizations. The Commission's policies and actions in the export-import and international safeguards areas are discussed in Chapter 11.

EXCHANGE OF REGULATORY INFORMATION

The principal reason for establishing working channels of communications between NRC and the nuclear regulatory authorities of other countries is to share, on a timely basis, experience in nuclear safety matters as a means of enhancing

the public safety throughout the world.

Two kinds of formal exchange compacts with foreign governments are negotiated and implemented by the NRC: bilateral arrangements for exchange of information on regulatory safety matters and agreements on cooperation in specific programs of safety research.

Bilateral Information Arrangements Increase

Four new bilateral arrangements for the exchange of regulatory information and cooperation in standards development were signed during the 15 months covered by this report. The nuclear regulatory authorities of Brazil, Denmark, the Federal Republic of Germany, and South Korea joined those of France, Italy, Japan, Spain, Sweden, Switzerland, and the United Kingdom in concluding formal information exchange arrangements with NRC, bringing to 11 the number currently in effect. As fiscal year 1976 ended, NRC was engaged in negotiations for similar arrangements with Belgium, Canada, Mexico, and the Netherlands.

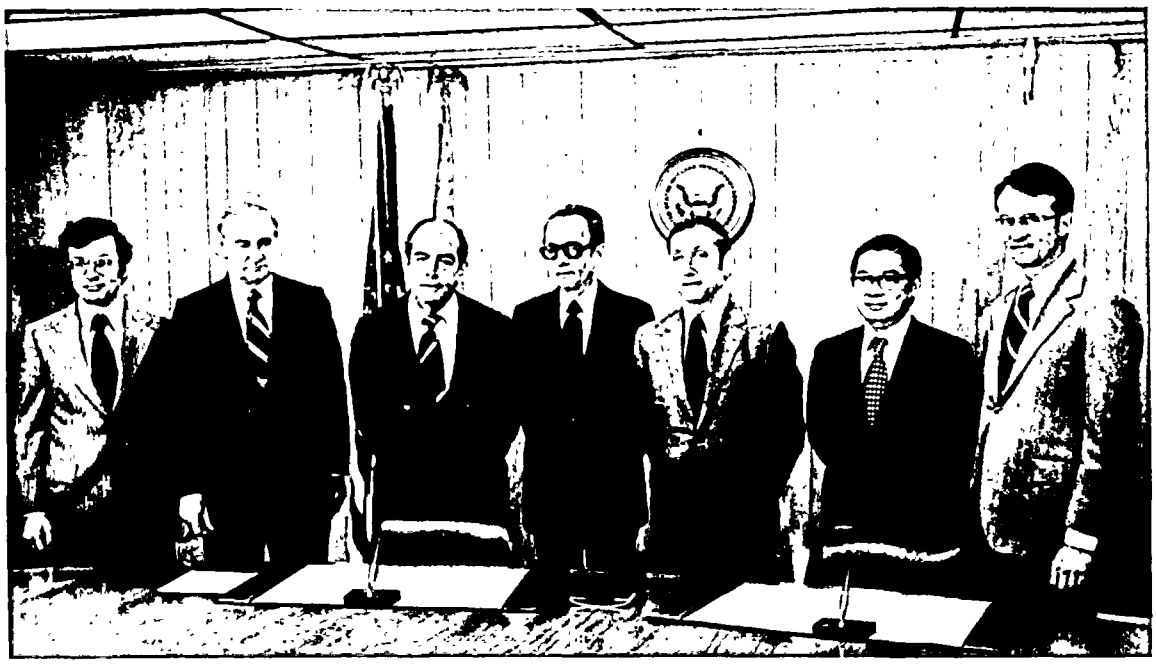
The primary objectives of these arrangements are to establish formal communications with foreign regulatory authorities for the reciprocal, prompt notification of safety problems; to exchange information related to public health, safety, and environmental protection; and to foster an expert consensus on regulatory matters and safety standards and experiments. The arrangements provide for the reciprocal exchange of regulatory information in the form of technical reports, correspondence, newsletters, meetings, and any other means agreed upon. In some cases, they also provide for future cooperation in light water reactor safety research and long-term assignments of personnel to laboratory programs under the sponsorship of both parties.

On October 3, 1975 in Copenhagen, Lee V. Gossick (at left), NRC Executive Director for Operations, and Hans von Buelow, Secretary General of the Danish Atomic Energy Commission, sign an Arrangement for Exchange of Technical Information in Regulatory and Safety Research Matters and Cooperation in Development of Safety Standards.

Research Cooperation Agreements

In addition to the regulatory safety information exchange agreements discussed above, the NRC has bilateral reactor safety research agreements with 11 countries and one multinational organization. (Details of NRC research activities are discussed in Chapter 13.) At the end of fiscal year 1976, research agreements and arrangements in effect covered cooperative programs with Brazil, Denmark, Finland, France, Germany, Italy, Japan, South Korea, Norway, Sweden, the United Kingdom, and the International Energy Agency (IEA). Under the terms of these agreements, NRC and other countries exchange reports, computer codes, research results on specific programs and, in certain cases, personnel on extended assignments. Supplementary to these bilaterals, agreements have also been established under the auspices of the IEA for German, Japanese, and Nordic Group (Denmark, Finland, Norway, and Sweden) participation in the Loss-of-Fluid Test (LOFT) program, as well as for participation by various IEA countries in the Power Burst Facility (PBF) and Heavy Section Steel Technology (HSST) programs. Japan and the Federal Republic of Germany each have agreed to contribute approximately $1 million per year to the LOFT program.

The foreign research exchanges provide a means of acquiring reactor safety research results in many areas where available U.S. technical and monetary resources are limited. The urgency of establishing improved safety criteria for the operation of nuclear facilities and the handling of nuclear materials, and the



Ranking Brazilian and U.S. Nuclear Regulatory Commission representatives gather for the signing of the Arrangement Between the U.S.N.R.C. and the Comissao Nacional de Energia Nuclear of Brazil for the Exchange of Technical Information and Cooperation in Safety Research, Washington, D.C., May 20, 1976. (Left to Right: USNRC Commissioner Victor Gilinsky; USNRC Commissioner Richard T. Kennedy; Professor Hervasio G. de Carvalho, President, Comissao Nacional de Energia Nuclear, Brazil; Charge d'Affaires Celso Diniz, Brazilian Embassy; USNRC Chairman Marcus A. Rowden; Minister of Mines and Energy Shigeaki Ueki, Brazil; and USNRC Commissioner Edward A. Mason.)

requirements for large expenditures of technical effort and funds to support experimental facility development and operation, provide ample incentive for such international cooperation. Additional cooperative agreements are being negotiated to augment present exchange provisions.

Multinational Projects. NRC also participates in the multinationally-supported Halden nuclear fuel performance project in Norway and in the Marviken containment response project in Sweden.

As an associate member of the Halden project, the NRC is currently contributing about $300,000 annually, for which it participates in the technical planning and management of the program, and receives experimental data on the thermal and mechanical behavior of fuel rods subjected to long-term irradiation. Such data have contributed significantly to the understanding of the problems of fuel densification, fuel-cladding mechanical interaction and in-pile release of fission products, all of which are relevant to the safe operation of nuclear power reactors.

U.S. participation in the Marviken project was initiated in March 1973 when experiments were being conducted to study the response of a pressure-suppression reactor containment to simulated ruptures of reactor system piping. The current test program is investigating pressure oscillation phenomena in the containment system, where the data obtained permit testing of the validity of computer codes being developed for containment system evaluation. NRC is currently contributing approximately $200,000 per year to the multinational Marviken program, and participates, together with the other members, in the technical management and planning of the project.

Selected NRC-sponsored specialists are assigned to laboratories in foreign countries to participate in and follow various reactor safety research problems. These specialists are currently stationed in the Marviken facility in Sweden, the Halden project in Norway, and in

Karlsruhe, F.R.G., and Saclay, France. It is also planned that U.S. scientists will participate in the Japanese Nuclear Safety Research Reactor program. The overall evaluation of the exchange is accomplished through periodic meetings between the coordinators for the respective countries.

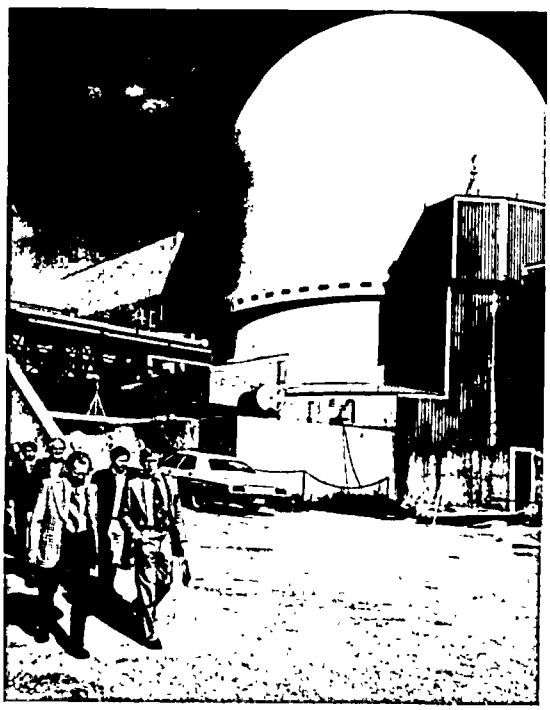
The information NRC receives on foreign nuclear safety research is promptly distributed to key domestic users in government, industry, and educational institutions unless there are proprietary or other restrictions.

Foreign Visitor Increase

The increased tempo of NRC international cooperative activities has been accompanied by a surge of visitors from foreign countries and organizations interested in holding in-depth discussions with the staff on technical and policy concerns. From July 1, 1975, through September 30, 1976, NRC received 510 visitors from 32 countries and 3 international organizations (Argentina, Australia, Austria, Belgium, Brazil, Canada, Republic of China, Denmark, Egypt, Finland, France, Federal Republic of Germany, Great Britain, the British Crown Colony of Hong Kong, India, Iran, Israel, Italy, Japan, Korea, Mexico, the Netherlands, Nigeria, Norway, Pakistan, the Philippines, Romania, South Africa, Spain, Sweden, Switzerland, the U.S.S.R.; the Commission of European Communities, the International Atomic Energy Agency, and the OECD Nuclear Energy Agency). This represents a 27 percent increase over the 401 visitors during the previous comparable 15-month period.

One hundred twenty-six foreign technical experts attended the NRC's Fourth Annual Water Reactor Safety Research Information Meeting, held September 27-30, 1976, in Gaithersburg, Md. NRC's Office of Nuclear Regulatory Research hosted the conference of more than 500 representatives of government, industry, universities and foreign nations which focused on results of U.S. research concerning loss-of-coolant accidents, fuel behavior, analysis development, and metallurgy and materials. (See Chapter 13.)

The NRC staff also visits nuclear safety agencies and facilities overseas, especially in the advanced nuclear countries, to keep abreast of ongoing work pertinent to the safety of nuclear power plants and the preservation of environmental quality.



Interested foreign visitors and others toured the Loss-of-Fluid Test facility in Idaho following the NRC's annual water reactor safety research information meeting held in Gaithersburg, Md., in September, 1976. Visits were also arranged to other research facilities at the Idaho National Engineering Laboratory and the Oak Ridge (Tenn.) National Laboratory in conjunction with the meeting.

Assignments to NRC Staff

The NRC permits a small number of employees of foreign regulatory agencies to work temporarily on the NRC staff within their areas of expertise to gain experience that can be usefully applied upon their return home. Arrangements provide that all out-of-pocket expenses of these foreign nationals be paid by their permanent employers. While at NRC, they are assigned duties which do not require access to either classified material or sensitive fuel cycle information such as enrichment or reprocessing technology.

Three foreign nationals began long-term assignments at NRC during the period covered by this report. These were an engineer and a physicist from the Spanish Junta de Energia Nuclear, and the senior legal officer of the Philippine Atomic Energy Commission.

INTERNATIONAL ORGANIZATIONS

NRC participates in the work of several international organizations dealing with nuclear safety or safeguards matters. The most extensive cooperation is with the International Atomic Energy Agency (IAEA) in Vienna, Austria, a self-governing agency under the aegis of the United Nations, with a membership of more than 100 countries. NRC also works with two energy agencies of the Organization for Economic Cooperation and Development (OECD) in Paris, France, and with other groups such as the International Standards Organization, the International Electrotechnical Commission, the International Commission on Radiological Protection, and the United Nations Scientific Committee on the Effects of Atomic Radiation.

IAEA Standards Program Progresses

The IAEA has partially completed a major task, begun in early 1975, of developing codes of practice and safety guides for nuclear power plants. The codes and guides will provide a basis for national regulation of the design, construction and operation of power reactors in countries being assisted by the IAEA.

NRC staff members have represented the United States on the IAEA Technical Review Committees working in the five areas of primary interest: Governmental organization, siting, design, operation, and quality assurance. During 1976 these committees, and working groups under them, essentially completed all five proposed codes of practice, and also completed drafts of 17 related safety guides. During the drafting process, the NRC standards staff coordinated reviews within the United States, soliciting comments from industry, other government agencies, and interested members of the public.

IAEA Safeguards

During 1976 the Commission continued joint efforts with the Department of State, the Arms Control and Disarmament Agency, and the Energy Research and Development Administration in planning a special U.S. program of technical support designed to strengthen IAEA safeguards. (See also Chapter 11.)

NRC experts advised the IAEA on current U.S. safeguards standards, technology, and systems in the U.S. during various meetings with the Agency.

The U.S.-IAEA Safeguards Agreement was approved on September 17, 1976, by the IAEA Board of Governors. Under this agreement, U.S. nuclear facilities, except those with national security significance, will be subject to IAEA safeguards inspection procedures. The IAEA procedures will build upon U.S. domestic safeguards which will remain in effect. (See also Chapter 11.)

Work with OECD Agencies

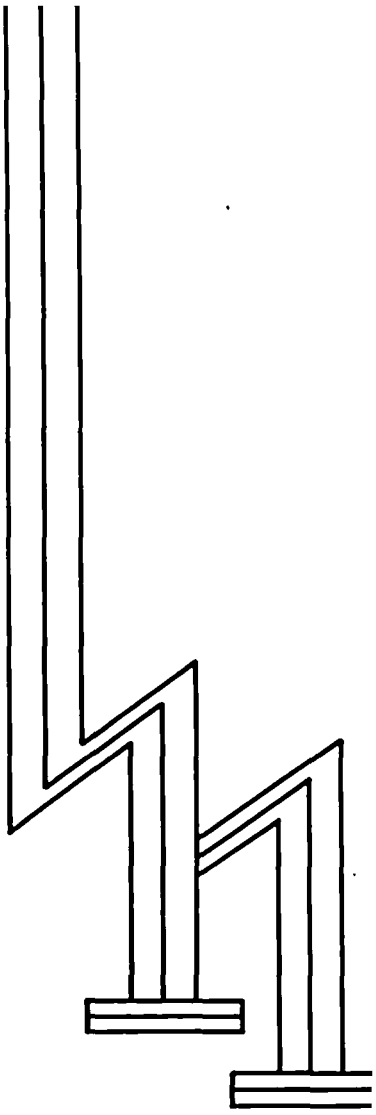
In 1976, the U.S. acceded to full membership in the OECD's Nuclear Energy Agency (NEA), joining 20 European countries, Canada, Japan, and Australia. For the last several years, the U.S. had cooperated with the NEA and participated in its technical activities as an associate member.

Full U.S. membership is involving NRC and

other interested U.S. agencies more closely in the planning and management of the NEA programs. In the regulatory field, NEA is developing criteria and standards for protection of workers and the public against ionizing radiation, for waste management, and for safety and reliability of nuclear plants. It is also promoting an international legal regime in the field of nuclear third-party liability and insurance.

Another OECD organization, the International Energy Agency (IEA), was formed by 18 countries in 1974. Among its programs is one for cooperative research on nuclear safety questions. An NRC staff member chairs the IEA Working Group on Nuclear Safety.

Dr. Byoung Whie Lee (at left), Energy Commissioner of the Republic of Korea, and Dr. Edward A. Mason, NRC Commissioner, sign an Arrangement in Seoul, Korea on March 18, 1976. The Arrangement calls for the exchange of technical information in regulatory and safety research matters, and for cooperation in the development of safety standards.



Export-Import and International Safeguards

The problem of the proliferation of nuclear weapons capabilities and the potential security risks associated with the worldwide spread of nuclear materials and facilities has increasingly commanded the attention of the Nuclear Regulatory Commission. In meeting its responsibility for licensing the export of nuclear materials and facilities, the NRC gives prime consideration to ensuring that the overall structure of safeguards, agreements, and understandings provides adequate assurance that U.S. nuclear exports will not be diverted to unauthorized uses.

This assurance is essential to the NRC's determination, as required by the Atomic Energy Act of 1954, that a proposed export or import would not be inimical to the common defense and security of the United States. It is also key to ensuring that the U.S. nuclear export-import program is conducted in a manner that will effectively contribute to U.S. efforts to inhibit nuclear proliferation and strengthen safeguards on an international basis.

At the same time, the Commission is aware of the need to avoid unnecessary delay and uncertainty in export and import licensing. Achieving U.S. nonproliferation goals requires that the United States continue to be a responsible and stable nuclear supplier. Export license applications come to the NRC under already existing agreements and supply contracts. Still, to meet the requisite "common defense and security" finding, which is the basic export standard, each application must be reviewed against a set of current facts and national policy considerations.

License Review Procedures

From its inception, the NRC has been concerned with the development of export and import license application review procedures which would take into account all information relevant to its licensing decisions. Since the Executive Branch

has manifold duties and interest in this area, as well as a broad information base and substantial analytical resources, the NRC has developed procedures for the review of export and import license applications to take full account of the views of the Executive Branch. Current procedures for export and import license review employed by the Executive Branch are set forth in Executive Branch are set forth in Executive Order 11902, issued by President Ford on February 2, 1976.

EXPORT LICENSE REVIEW

The review of applications for export licenses, as carried out by the NRC and the Executive Branch, proceeds in three stages:

(1) The NRC staff conducts a preliminary review of each export license application, upon receipt, to ensure completeness and consistency, to identify applicable provisions of NRC regulations, the United States Code, international agreements and instruments, and the like. Additional information, when needed, is sought from the applicant.

(2) Applications are forwarded by the NRC to the Department of State, which is the lead agency for coordinating the review by the Executive Branch. (Copies of the applications are simultaneously sent to the Arms Control and Disarmament Agency, the Energy Research and Development Administration, and the Departments of Defense and Commerce.)

Information bearing on consideration of the license application which falls within the purview of the Executive Branch is developed at this stage. This information is transmitted to the NRC, together with a formal expression of the Executive Branch's views on whether or not the proposed export would be inimical to the common defense and security of the United States and confirmation that the proposed export will be subject to the terms and conditions of an appropriate agreement for cooperation between the U.S. and the government of the recipient country, or international organization.

(3) The NRC staff reviews the analysis and coordinated views of the Executive Branch.

Export applications which do not involve production or utilization facilities, do not have policy implications, and pertain to less than 10,000 kilograms of source material or less than one effective kilogram (defined in 10 CFR 70.4(t)) of uranium-235, uranium-233, or plutonium are designated minor cases. Within NRC, these are reviewed exclusively by the NRC staff, which issues or denies a license without further review by the Commission. On certain types of minor cases, the Staff notifies the Joint Committee on Atomic Energy of NRC's intention to issue a license.

Major cases are currently defined as those which have policy implications or which involve the export of facilities, or more than one effective kilogram of the nuclear materials cited above, or more than 10,000 kilograms of source material. In such cases, the staff prepares an action paper, accompanied by the information from and judgment of the Executive Branch, for the Commission's consideration. Following Commission review and, in certain cases, notification to the Joint Committee on Atomic Energy, the license is issued or denied.

Both the staff-level and Commission-level stages of the licensing review process involve the development and analysis of information necessary to the consideration of a license application. This includes classified briefings by the State Department and other Executive Branch agencies, as appropriate, and review of unclassified and classified cables bearing on export licensing issues.

Elements of Export Review

Under established procedures, the NRC has formulated eight standing questions on which the Executive Branch focuses its review of export license applications. The State Department collects,

synthesizes and forwards the Executive Branch's responses to the NRC. The questions are:

(1) What is the purpose for the export?
(2) Does the recipient country have an Agreement for Cooperation with the United States under Section 123 of the Atomic Energy Act, as amended? And, if so, is the export in question covered by the Agreement?
(3) Has the recipient country accepted and implemented International Atomic Energy Agency (IAEA) safeguards and/or other appropriate supplementary bilateral conditions (including, where applicable, understandings regarding reexport) imposed by the United States?
(4) In cases in which the recipient country is not required by the Nonproliferation Treaty (NPT) to accept IAEA safeguards, does the recipient country or organization have accounting and inspection procedures such as to assure compliance with the requirements of the relevant U.S. Agreement?
(5) Does the recipient country have adequate physical security arrangements to deal with threats of subnational diversion of significant quantities of nuclear weapon materials (plutonium or highly enriched uranium)?
(6) What is the position of the recipient country with regard to nonproliferation?
(7) What understandings does the United States have with the recipient country with respect to the use of U.S.-supplied material or equipment to acquire or develop nuclear explosive devices for any purpose, and as to the recipient country's policies and actions as to such development using equipment and material from any source?
(8) What other factors are there which bear on the issuance of the export license, such as further U.S. understandings with the recipient country, other supplier countries, or interested regional countries?

Any additional information needs or special questions that may arise during the license application review process are evaluated by the NRC and the Executive Branch to ensure that all relevant information is carefully considered. The information and views from the Executive Branch, combined with that developed within the NRC, provide the basis for NRC's analysis and determinations.

All phases of the export licensing review are intended to provide a firm foundation for the NRC's determination as to whether or not a proposed export would be inimical to the common defense and security of the United States. No license is issued unless and until the NRC has determined that the intended export will not be inimical to those interests.

IMPORT LICENSE REVIEW

The NRC's review of applications for import licenses proceeds as follows:

(1) Upon receipt of an import license application, the NRC staff conducts an initial review, again focusing on the completeness of the application, the applicable regulations, and any special aspects requiring further information or analysis.
(2) If a subsequent export of nuclear material is contemplated—as when material is imported for enrichment, conversion, or fabrication—the application is forwarded to the Department of State for its review and preliminary judgment on whether the intended export presents any reason to disallow the import license request.
(3) After its initial review, and receipt of the State Department's preliminary review when called for, the NRC staff concentrates on the safety and environmental aspects of importing the material into the United States. This includes examining such factors as the mode of transport and the type of packaging for the material. In cases involving the import of significant quantities of strategic nuclear material, like highly enriched uranium or plutonium, attention is also focused on the physical security measures to be applied to the material.
(4) As with export license reviews, the NRC staff issues or denies licenses in minor cases after its own review, while major

cases are forwarded for review by the Commission.

IMPROVING THE PROCESS

The NRC's experience in reviewing export and import license applications over the past two years has, as with any new system, revealed the need for adjustments and improvements.

At the Commission's direction, an NRC task force was set up in January 1976 to conduct a comprehensive study of export licensing procedures, related issues, and options. The task force's efforts include evaluation of possible licensing criteria to provide more guidance and to reflect concerns about the control of risks associated with the spread of nuclear materials and facilities. It is anticipated that the work of the task force will provide a basis for the Commission's formulation of regulations which will spell out both substantive and procedural standards to clarify the export licensing process to the public, the Congress, industry, and U.S. foreign trading partners and to produce an overall framework that will be both sound and predictable.

Also at the Commission's direction, the NRC staff has been evaluating possible changes in existing licensing rules to permit more flexibility and to provide for general licensing authority wherever this can be accomplished consistent with NRC's statutory responsibilities and with the overriding criterion of protecting the common defense and security. The staff review has drawn upon suggestions from interested Executive Branch agencies. It focuses, among other things, on certain routine and minor cases where more flexible procedures may prove desirable. At the same time, the NRC has been consulting with the interested Executive Branch agencies to develop further improvements in the export-import licensing process.

Licensing Actions

EXPORT SUMMARY

During fiscal year 1976, including the transition quarter, the NRC issued 338 export licenses and received 431 new export license applications. The major export licenses issued during this time are listed on the following three pages in three categories: Special Nuclear Material, Source Material, and Reactors.

Sixteen different nations received U.S. shipments of special nuclear material under major export license during the fiscal year, with 20 shipments going to West Germany and 17 to Japan. Five nations received source material under major license; five received reactors. During the fiscal year there was only one major licensing action involving the export of plutonium. This was the issuance on September 9, 1975 to the Westinghouse Electric Corp. of a license to export plutonium (in oxide form) to Italy for use as fuel in the Enrico Fermi reactor. The material exported (125.493 kg) was plutonium that had been generated in an Italian power reactor, extracted in Europe, imported to the United States for further processing into a form suitable for reactor fuel, and then shipped back to Italy.

In addition to the major licensing actions during the fiscal year, the NRC issued over 100 minor export licenses for special nuclear material, over 60 for source material, and over 65 for byproduct materials. Minor amendments were issued for three existing reactor export licenses.

India—Intervention and Public Hearing

The first petition for intervention and a hearing on an export license application ever submitted to the NRC or its predecessor, the Atomic Energy Commission, was received on March 2, 1976. Three environmental and public interest organizations sought to challenge applications for two licenses to export low enriched uranium fuel to India for use in the Tarapur Atomic Power Station, which is located north of Bombay and generates electrical power for the Indian States of Gujarat and Maharashtra.

Background. The two reactors at the Tarapur facility were supplied by the United States in the 1960's under the terms of the 1963 Agreement for Cooperation between the United States and India. Among other things, this agreement provides for the application of safe-

Nuclear Export Licenses

(Major Licensing Actions Taken by NRC—July 1, 1975 through September 30, 1976)

SPECIAL NUCLEAR MATERIAL

(One or more "effective kilograms" as defined in 10 CFR § 70.4(t))

Licensee	*Kilograms of Uranium*	*Enrichment %*	*Country of Destination*	*Date Issued*
Mitsubishi	15,364	3.3	Japan	7-2-75
Transnuclear	45.110	93.3	W. Germany	7-3-75
Transnuclear	38.110	93.3	Netherlands	7-25-75
Marubeni	15,347	2.79	Japan	8-8-75
Transnuclear	7,286.25	2.01	W. Germany	8-15-75
Transnuclear	32,614.26	3.2	W. Germany	8-15-75
Edlow International	22,153.23	3.55	Sweden	8-8-75
Westinghouse Electric	22,550	4.5	Italy	9-9-75
Mitsubishi	53,900	3.45	Japan	9-12-75
Edlow International	85,887.31	2.52	Sweden	9-17-75
Transnuclear	22,536.12	3.95	Belgium	9-19-75
Edlow International	12,250.95	2.71	India	9-23-75
General Electric	28,437	3.01	Japan	9-26-75
Mitsui	9,380	1.96	Japan	9-26-75
Edlow International	Additional < 334.133	2.71	India	10-3-75
Westinghouse Electric	82,360	3.25	S. Korea	10-4-75
U.S. Nuclear	46	93.3	Italy	10-8-75
Transnuclear	33.100	93.3	France	10-8-75
Transnuclear	20,863.80	3.3	Sweden	10-15-75
Transnuclear	7,136	1.43	France	10-15-75
Transnuclear	16.040	93.3	Netherlands	10-17-75
Transnuclear	10,683.15	3.55	Belgium	10-17-75
U.S. Nuclear	88	93.3	Canada	11-6-75
Transnuclear	179,633.7	3.35	W. Germany	11-13-75
Transnuclear	35.820	93.3	W. Germany	11-14-75
Transnuclear	3.263	93.3	Netherlands	11-26-75
Transnuclear	2.560	93.3	W. Germany	11-26-75
Transnuclear	6,718.425	3.25	W. Germany	11-26-75
Edlow International	125,334.920	4.05	W. Germany	12-17-75
Mitsubishi	17,579	2.65	Japan	12-22-75
Mitsubishi	31,738	3.30	Japan	12-22-75
Transnuclear	13,621.77	3.15	Switzerland	12-23-75
Transnuclear	48.120	93.3	W. Germany	12-30-75
General Electric	13,500	3.1	Japan	1-2-76
Transnuclear	148.37	93.3	France	1-7-76
Transnuclear	15.038	93.3	Sweden	1-8-76
Edlow International	4.5	93	Canada	1-15-76
Transnuclear	66.767	93.3	France	1-20-76
Transnuclear	83	93.3	W. Germany	1-28-76
General Electric	160,000	2.5	Japan	1-28-76
Mitsui	19,793	3.07	Japan	1-30-76
Mitsui	25,166	3.01	Japan	1-30-76
General Electric	2.176	70	Yugoslavia	2-2-76
Transnuclear	11,091.1	4.05	France	2-5-76
Transnuclear	11,260.02	3.65	Belgium	2-5-76
Transnuclear	12.840	3.35	Netherlands	2-5-76
Edlow International	76,642.32	3.15	Sweden	2-5-76

(Continued on page 142)

(Continued from page 141)

SPECIAL NUCLEAR MATERIAL

Licensee	*Kilograms of Uranium*	*Enrichment %*	*Country of Destination*	*Date Issued*
Transnuclear	25.070	93.3	Canada	2-5-76
Exxon Nuclear	5,160	2.80	W. Germany	2-13-76
Transnuclear	7,136	1.43	France	2-13-76
Transnuclear	23.760	93.3	Denmark	3-3-76
Edlow International	1.844	93	Japan	3-8-76
Transnuclear	87,164	3.26	W. Germany	3-8-76
Edlow International	22.35575	93.3	W. Germany	3-15-76
Transnuclear	15.040	93.3	W. Germany	3-15-76
Transnuclear	634.6	43.9	W. Germany	3-17-76
	70.175	73		
	68.17	61.7		
	34.085	50.4		
General Electric	Additional		Spain	3-24-76
	63,115	3.1		
Transnuclear	32,614	3.2	W. Germany	3-25-76
Transnuclear	38.100	93.3	Netherlands	3-31-76
U.S. Nuclear	Additional		Canada	4-1-76
	55	93.3		
Transnuclear	184,038.615	3.3	France	4-5-76
General Atomic	3.492	70	Mexico	4-8-76
Transnuclear	903.706	3.504	W. Germany	4-29-76
Transnuclear	18,800	3.35	W. Germany	4-30-76
General Electric	47,147	3.1	Italy	5-10-76
Marubeni	17,985	2.87	Japan	6-3-76
Mitsubishi	17,502	3.15	Japan	6-4-76
Edlow International	3,567	3.15	Japan	6-16-76
Edlow International	32,000	3.55	Sweden	6-29-76
Westinghouse Electric	146,362	3.15	Sweden	6-29-76
Transnuclear	34,575	3.13	W. Germany	6-29-76
Edlow International	9,165.6	2.71	India	7-2-76
Edlow International	84,905	3.55	Sweden	8-10-76
Edlow International	127,933.50	2.41	Sweden	8-16-76
Westinghouse Electric	15,219	4.5	United Kingdom	8-18-76
Mitsubishi	29,849	3.3	Japan	8-18-76
Mitsubishi	29,849	3.3	Japan	8-18-76
Transnuclear	3.0075	93.3	W. Germany	9-1-76
Edlow International	43,757	3.55	Sweden	9-1-76
Westinghouse	146,345	3.14	Spain	9-17-76

SOURCE MATERIAL

(10,000 kilograms or more of uranium or thorium)

Licensee	*Material*	*Country of Destination*	*Date Issued*
Edlow International	89,040 lbs uranium	W. Germany	8-27-75
Edlow International	356,160 lbs uranium	W. Germany	8-27-75
Edlow International	265,785 lbs uranium	Netherlands	8-29-75
Continental Oil	212,000 lbs uranium	Canada	2-20-76
Transnuclear	126,919 lbs uranium	W. Germany	2-20-76
Transnuclear	2,032,704 lbs uranium	Italy	4-8-76
Edlow International	203.520 lbs uranium	United Kingdom	4-20-76
Kawecki	240,502 lbs uranium and thorium	W. Germany	6-4-76
NL Industries	100,000 lbs uranium	United Kingdom	6-7-76
Transnuclear	89,066 lbs depleted uranium	W. Germany	7-7-76
Boeing Company	250.000 lbs depleted uranium	Condition 2	7-12-76
Maine Yankee	100,000 lbs uranium	Canada	9-30-76

REACTORS

Licensee	*Facility Description*	*Country of Destination*	*Date Issued*
Westinghouse Electric Pittsburgh, Pa.	2,783 MWt pressurized water reactor Statens Vattenfallsverk	Stockholm Sweden	10-21-75
Institute for Resource Mgt. Bethesda, Md.	Model AGN 201-109 research reactor Aerojet Nuclear Corporation Kyung Hee University	Seoul, S. Korea	11-18-75
General Electric Technical Services San Jose, Ca.	3,012 MWT boiling water reactor Kernkraftwerk Leibstadtag	Zurich, Switzerland	12-31-75
General Atomic San Diego, Ca.	250 KWt TRIGA Mark II research reactor Technical University	Istanbul, Turkey	3-24-76
General Electric San Jose, Ca.	Two pressurized water reactors each 2,696 MWt, ASCO II	Barcelona, Spain	7-22-76

guards to any nuclear materials supplied by the U.S. and requires that only U.S.-supplied fuel will be used in the Tarapur reactors.

The initial question to be decided by the Commission in the Tarapur proceeding was whether the petitioners had a right to intervene and to be afforded a hearing on the license applications. In this connection, the Commission reviewed extensive legal arguments submitted by the petitioners, the NRC staff, and the Executive Branch and, on March 17, 1976, held a preliminary hearing for oral presentations.

On May 7, the Commission issued an extensive opinion setting forth its unanimous view that the petitioners did not have standing to intervene:

> "The interests they claim to represent are those of the nation as a whole, which we, no less than the Congress and the Executive Branch, are sworn by oath to uphold. In these circumstances, the need for separate representation and for adjudication rather than political oversight is not established."

Two of the intervenors, the Natural Resources Defense Council and the Union of Concerned Scientists, sought judicial review of the Commission's decision (see Chapter 14).

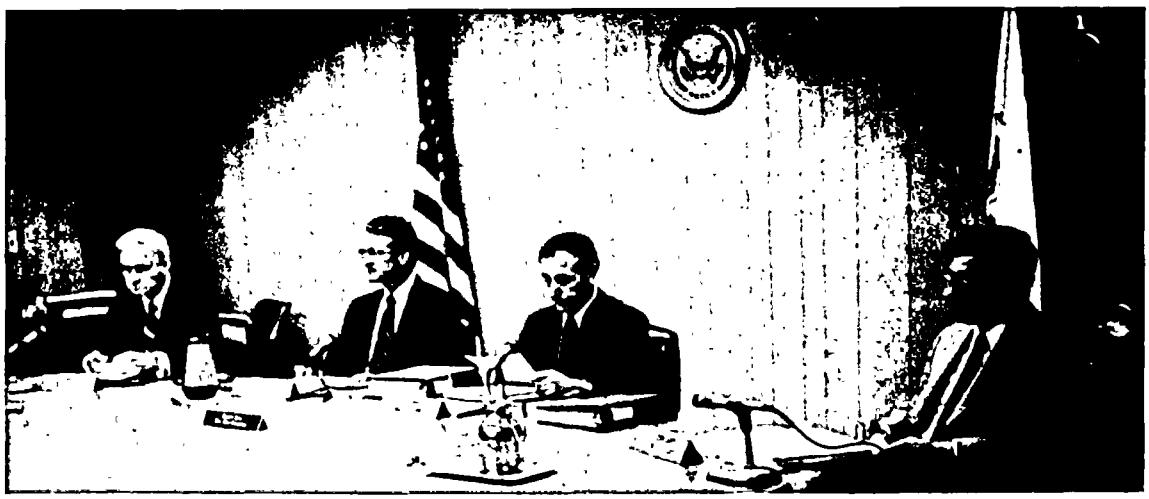
Although the Commission concluded that the petitioners were not entitled to intervene as a matter of right, it decided as a matter of discretion to hold a legislative-type public hearing on the issues presented by the two license applications. For the first time in the export licensing area, the Commission invited interested parties outside the government to participate in a public hearing and provide their views and information. In so deciding, the Commission considered that such a hearing could prove useful in determining the need for or value of public participation in export licensing processes:

> "Because of the absence of precedent for public hearings or other forms of citizen participation in export matters, not only in our own agency, but in many other fields having a foreign policy aspect, we believe that an experimental exploratory approach is best calculated to reveal whether broader participation can assist the Commission in performing its export licensing function, and what the practical consequences of such participation may be. The hearings will serve as a forum where the public can state its views on the issues raised by these nuclear export license applications before the agency of the U.S. Government which has ultimate licensing authority. The Commission already has extensive information gathering and analytical sources available to it under existing interagency arrangements. Nevertheless, the questions raised by petitioners, insofar as they are relevant to the license applications now before us, raise some of the very issues the Commission considers in making an informed national security determination."

Decision on Pending License. On May 20, prior to the Commission's hearing, agreement was reached among the NRC, the Department of Justice (representing the Department of State), and the petitioners that the petitioners would raise no objection to issuance of one of the pending Tarapur fuel licenses (amended to increase the amount of the export) in advance of the hearing, on the understanding that the issues common to both licenses would be considered in the hearing. In the Commission's Memorandum and Order of July 2, a majority of the Commission determined that all requisite statutory standards had been met and directed that the amended license application be granted. As noted below, Commissioner Gilinsky dissented from this licensing action.

The Majority View. The majority view of the Commission was that favorable action on the pending application was warranted because of India's urgent requirement for nuclear fuel to avoid possible interruption of the electrical power supply from the Tarapur facility, and because an undue adverse effect on U.S. foreign policy interests might otherwise ensue. The action was taken without prejudice to the questions of continued supply to India and the remaining application pending.

The Commission noted further that, "in view of the ongoing development of Indian reprocessing capacity at the Tarapur Atomic Power Station, the Commission intends in the forthcoming hearings to give careful consideration to the implications of the potential creation of national stockpiles of plutonium in India, and appropriate measures which might be taken in light of this possible development. In this connection we are mindful of the provisions of the U.S./India Agreement for Cooperation which specify that any reprocessing in India's facilities of special nuclear material utilized in the Tarapur Atomic Power Station would be subject to joint determination by the United States and India that safeguards in the Agreement for Cooperation may be effectively applied. . . . We note further that in exchanges of letters between the Governments of the United States and India it has been agreed 'that the special nuclear material that has been or is hereafter made available for, or used, or produced in the Tarapur Atomic Power Station . . . will be devoted exclusively to the needs of that Station unless our two Governments hereafter specifically agree that such material be used for other purposes.' . . . [T]he Agreement gives the United States the first option to repurchase 'any special nuclear material produced in the Tarapur Atomic Power Station which is in excess of



In July 1976, the NRC held its first public hearing to consider the issuance of an export license. The hearing, held before the Commissioners, concerned applications for export of uranium fuel to India for use in the two-reactor Tarapur atomic power station near Bombay. The Commissioners, seated left to right, are: Richard T. Kennedy; Edward A. Mason; Marcus A. Rowden, Chairman; and Victor Gilinsky.

the need of the Government of India for such material in its program for the peaceful uses of atomic energy. . . .' "

In reaching its decision, the Commission concluded "that it would be desirable for the Department of State to explore with the Government of India steps which would provide for the repurchase by the United States of the irradiated fuel discharged from the Tarapur Atomic Power Station or any special nuclear material recovered therefrom."

Dissenting Opinion. Commissioner Gilinsky dissented from the majority decision to issue the license, as follows:

"My principal objection to the issuance of this license stems from my lack of confidence that genuinely effective safeguards will be applied to the plutonium produced in U.S.-supplied Tarapur fuel. India has a facility for reprocessing this fuel almost ready to operate. My colleagues, while urging the State Department to explore repurchase of spent U.S.-supplied Tarapur fuel (or plutonium produced therefrom) nevertheless do not close the door to reprocessing of U.S. fuel in India. Such reprocessing might well take place under traditional IAEA [International Atomic Energy Agency] material accounting and inspection safeguards, which in my view are inadequate by themselves once plutonium is separated from spent reactor fuel. I believe this issue should have been faced directly, now, in the context of this license, and I would have withheld its approval until more positive assurances had been obtained. The need for effective safeguards over reprocessing and the subsequent storage of separated plutonium is particularly acute in this case given India's continuing nuclear explosives program and India's failure to renounce the use of such explosives as weapons through ratification of the NPT" (Nonproliferation Treaty).

Hearing. The hearing subsequently took place on July 20 and 21, 1976. Documents released under the Freedom of Information Act in connection with and in advance of the hearing totalled over two thousand pages. The hearing itself produced a transcript of over 300 pages of testimony from witnesses including a member of Congress, several former and current government officials, representatives of the academic community, and the representatives of the three petitioners. Information and views elicited at this hearing supplemented an already extensive Commission record on the subject of supplying nuclear fuel to the Tarapur facility. There had been numerous written briefings and other exchanges, both classified and unclassified, involving the Commission, NRC staff, and the Executive Branch.

At the close of the reporting period, the pending license application for the supply of nuclear fuel to India remained under consideration before the Commission, and consultation continued with the Executive Branch on the subjects of reprocessing controls, the possibility of repurchase of U.S.-supplied material from India after use in the Tarapur reactors, and other related aspects. On December 8, oral arguments were heard by the U.S. Court of Appeals for the District of Columbia on the intervenors' petition for review of the Commission's May 7 order.

Spanish Reactor Decision

Another export licensing matter which received unusual attention by the Commission involved an application by the Westinghouse Electric Corporation to export a pressurized water reactor to Asociacion Nuclear ASCO II for installation near Barcelona, Spain. The United States—through the former Atomic Energy Commission—had licensed the export of eight power reactors to Spain since 1965, all under terms of a United States-Spain Agreement for Cooperation and subject to the application of international safeguards. The ASCO II request was the first application to come before the NRC for the export of a power reactor to Spain.

Having received the views of the Executive Branch favoring issuance of a license, the Commission undertook analysis of the issues involved, starting in August 1975. In June 1976 the Commission reached its decision to issue the license, Commissioner Gilinsky dissenting.

Majority Views. The majority opinion noted that the proposed export would be undertaken under terms and conditions of the Agreement

for Cooperation between the two nations for the civil uses of nuclear energy. It stated further:

"The applicability of bilateral or IAEA safeguards to a nuclear export assures that the peaceful use assurances of the Spanish Government can be technically verified, and is therefore of crucial importance in reaching a decision on whether issuance of a license might contravene the common defense and security. The applicability of such safeguards in the instant matter and the means for their continuing improvement are factors giving substantial support to our decision."

The majority opinion also pointed out that the Agreement for Cooperation between the United States and Spain "evidences that the Spanish Government has forsworn development of atomic weapons with respect to U.S.-supplied technology and material, and non-U.S. supplied material irradiated in the ASCO II reactor."

In the safeguarding of fuel before and after use in the ASCO II reactor, the majority declared:

"With respect to U.S. fuel provided to Spain, U.S. rights would apply regardless of whether the fuel was used in ASCO II, in some other U.S.-supplied reactor, or in a reactor not of U.S. origin. The use of non-U.S. fuel in ASCO II, on the other hand, would take place in the context of an international safeguards regime. Spanish obligations under Article XI of the Agreement for Cooperation would assure that the use of non-U.S. fuel in ASCO II would trigger the application of continuing IAEA safeguards to that fuel, and to any plutonium produced from the irradiation of that fuel in the reactor. Finally, before any such fuel was reprocessed, an IAEA determination would have to be made that the reprocessing facility and the subsequent storage or use of the recovered plutonium would take place under conditions permitting adequate safeguards against diversion. The right of the United States (or, in the case of non-U.S. fuel, of the IAEA) to determine that adequate safeguards can be applied to plutonium *before* it occurs provides a mechanism to protect U.S. national security interests in this area." (Italics in original.)

Dissenting Opinion. Commissioner Gilinsky dissented from the favorable decision, stating, in part:

"I believe the United States must retain the authority to delay the separation of plutonium from the spent fuel until some equitable and secure alternative to national stockpiling of this dangerous material can be instituted. A search for such alternatives is now underway, both in our government and internationally. I have suggested a remedy, which is to place a condition on this license to ensure the retention—at least temporarily—of U.S. controls over the ASCO II fuel by requiring that U.S. fuel be used exclusively in the reactor."

And further:

"The danger in this developing situation arises from the fact that a secure system for safeguarding separated and stockpiled plutonium from sudden appropriation for military purposes is not yet at hand. The systems now in operation . . . are inadequate to provide, in the case of such appropriation, the early warning on which all existing safeguards are predicated."

The Commissioner noted that his concerns were underscored by the fact that Spain was not a party to the NPT and by the fact that Spain had existing contracts for the purchase of fuel from non-U.S. sources. The use of fuel from a source other than the United States was of particular concern to the Commissioner, "for if non-U.S. fuel is employed, safeguards will be administered only by the IAEA, and the U.S. will have no control over whether and in what circumstances plutonium will be separated from ASCO II's spent fuel." He noted that a requirement that U.S. fuel be used exclusively in the ASCO II reactor would involve "little or no cost to Spain," and he advocated that it be made a condition of the license.

Regarding the difference between the majority view and that of Commissioner Gilinsky, the majority opinion agreed that "it is desirable . . . to exercise the most stringent safeguards controls possible over fuel reprocessing" but found that, in this set of circumstances, "the considerable safeguards framework of existing agreements [are] an adequate basis for the subject export." The majority concluded

that the license condition proposed by Commissioner Gilinsky would not be an effective means to achieve safeguards objectives because ". . . the United States has already licensed eight power reactors for export to Spain, all of which may be fueled with non-U.S.-supplied uranium . . ." and "Spain has acquired reactors from other supplier countries, and will be able to do so in the future. Thus, even if we could assure that the transfer of ASCO II would be tied to the use of U.S.-supplied fuel, the end result would be without real effect as respects Spain."

Petitions on South African Exports

On May 10, 1976, license applications were filed with the NRC requesting authority to export two power reactors and low enriched fuel to South Africa. Eighteen days later, two separate petitions were filed with the Commission for leave to intervene in opposition to the proposed licenses. The first petition was filed on behalf of ten members of Congress, five organizations, and two private individuals; the second on behalf of three environmental and public interest orgaizations. The Commission subsequently dismissed both petitions in view of the fact that, on June 1, both license requests were formally withdrawn by the applicant, who noted that South Africa had withdrawn its letter of intent and that another supplier had been awarded the orders.

On July 2, fourteen members of Congress, three other persons, and four organizations joined in a petition to intervene against a pending license application to authorize the export of highly enriched uranium to fuel a U.S.-supplied research reactor in South Africa. At the end of the reporting period, the export license request was still under consideration by the Executive Branch, and the petition to intervene remained pending before the Commission.

NRC ROLE IN INTERAGENCY CONSULTATIONS

As noted in the beginning of this chapter, a basic concern of the NRC in conducting nuclear export licensing activities is that they be carried out in a manner which effectively serves this nation's interest in nuclear nonproliferation. To this end, the Commission has upgraded the agency's capacity for performing analyses in this area and has moved toward a more active role in interagency consultations on nuclear export and related matters.

On June 21, the Commission consolidated staff responsibility for nuclear export and import functions, including international safeguards policy and nonproliferation aspects, into a newly established Office of International Programs. The merger of NRC's international functions provides the basis for more comprehensive review of export-import licensing matters and their relationship to other international, nonproliferation, and export control issues. The Office draws on the resources of other NRC offices as necessary and particularly on the technical expertise of the Office of Nuclear Material Safety and Safeguards in safeguards and physical security matters.

In the spring of 1976, arrangements were made for NRC participation in meetings of the Interagency Operating Committee, when the agenda includes nuclear-related items of interest to the NRC, and for continuous staff-level consultations on applications received by the Commerce Department for the export of nuclear reactor components. Under the Export Administration Act, the Department of Commerce licenses nuclear reactor components which constitute substantially less than a production or utilization facility, as well as certain commodities (such as heavy water) which have nuclear applications. The Interagency Operating Committee acts on cases pending before the Department of Commerce which require formal interagency review. It also provides policy guidance as appropriate.

The Federal government's overall nuclear export activities involve much more than the licensing of nuclear facilities and materials by the NRC and the licensing of components and nuclear-related commodities by the Department of Commerce. Other aspects include the negotiation of agreements for cooperation with foreign countries and international organizations by ERDA and the State Department and ERDA's responsibilities in contracting for fuel

and enrichment services and in reviewing and approving proposed technology transfers, government-to-government transfers, and retransfers of U.S.-supplied materials abroad.

In assessing a legislative proposal which would have concentrated most of these responsibilities in the NRC, the Commission concluded that these functions were best left with the agencies that now conduct them and that existing arrangements for NRC's participation, on a consultative basis, in the interagency review of such matters were adequate.

In its broadest sense, an effective nuclear export program depends upon the development and implementation of effective nonproliferation and safeguards policies, and related foreign and defense policies as well. While the basic responsibility for framing these policies properly resides with the interested Executive Branch agencies, within the context of congressional oversight and policy guidelines, the NRC has a direct interest in nonproliferation and international nuclear safeguards. Pursuant to that interest, the Commission has provided its evaluation of proposed legislation in those areas and has consulted with Executive Branch agencies during the formulation of policies and strategies to further nonproliferation objectives and to strengthen international safeguards.

Presidential Statement

President Ford's nuclear policy statement of October 28 (see also Chapters 1 and 3) stressed the need to prevent proliferation of nuclear explosives capabilities abroad while preserving the benefits of peaceful uses of nuclear energy and reducing uncertainties that have delayed expanded use of nuclear energy in the United States.

The President announced specific guidelines for action concerning the framework of controls for U.S. nuclear export activities. These guidelines included the following:

- The United States will apply new criteria in judging whether to enter into new or expanded agreements for peaceful nuclear cooperation.
- The Secretary of State is to enter into negotiations to conform existing agreements between the United States and cooperating nations with established international guidelines and the new U.S. criteria.
- The Secretary of State is to intensify discussions with nuclear suppliers aimed at expanding common guidelines for cooperative agreements to conform with the new criteria.
- The Secretary of State is to work closely with the NRC to ensure appropriate emphasis on nonproliferation concerns in the nuclear export licensing process.

The President's statement also asked all nations to join with the United States in exercising maximum restraint in the transfer of reprocessing and enrichment technology and facilities, by avoiding such sensitive exports or commitments for a period of at least three years, and called for the development of means to establish international restraints over the accumulation of plutonium.

International Safeguards Activity

NRC's involvement in international safeguards activities goes beyond the review of specific applications to ensure that nuclear exports are subject to effective safeguards and controls. Other important aspects of NRC's involvement include its consultations and exchanges with foreign countries on nuclear materials accounting and physical protection measures, participation with U.S. Government agencies in the International Atomic Energy Agency's policy and technical studies and programs, participation in ERDA's physical security review visits to other countries, and performance of a special role in the implementation of the United States-IAEA Safeguards Agreement.

Key events and developments in the international sphere during fiscal year 1976 included:

(1) Several bilateral discussions with representatives of foreign nations concerning safeguards and physical protection activities. These exchanges provided valuable information in areas of mutual interest and insights into the views of representatives of other nations on safe-

guards and physical protection policies.

(2) Participation with the Department of State, ERDA, and the Arms Control and Disarmament Agency in developing a five-year program designed to strengthen IAEA safeguards. Over this period, the United States will supplement its present financial support of the IAEA program with additional support valued at $5 million.

(3) Regular participation of NRC technical experts in visits of U.S. physical security review teams, headed by ERDA, to other countries. These and other exchanges on foreign physical security programs not only contribute to U.S. efforts to strengthen physical security measures world-wide but also provide a necessary base for the review of license applications for the export of significant quantities of special nuclear material.

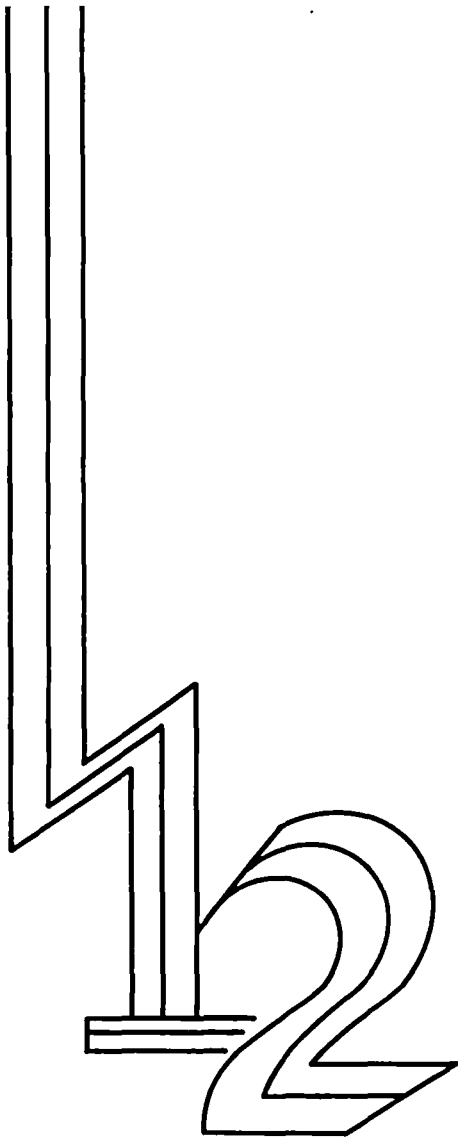
(4) Participation in the development and approval of the U.S.-IAEA Safeguards Agreement to implement the U.S. offer to accept IAEA safeguards on its nuclear activities (except for those which bear directly on national security) at the same time as those safeguards are being applied in non-nuclear-weapon-states under the Nonproliferation Treaty.

The United States first offered to take this step in 1967 during negotiations on the NPT, with the intention of coming to a formal agreement with the IAEA on safeguards procedures when NPT safeguards were being broadly applied in other industrial countries. The purpose of this offer was to demonstrate this country's conviction that IAEA safeguards under the NPT do not involve undue economic burden or risk of disclosure of proprietary information, and thereby assure other countries that they would not be placed at a commercial disadvantage by reason of their joining the treaty and agreeing to its safeguards requirements.

The final draft of the U.S.-IAEA Safeguards Agreement was reviewed and and concurred in by the interested agencies of the U.S. Government, including the NRC, in August 1976 and was subsequently approved at the September meeting of the IAEA Board of Governors. Facilities eligible for the application of IAEA safeguards will comprise both private and government facilities licensed by the NRC and license-exempt government installations. Several tasks, including the modification of NRC regulations to permit implementation of the agreement, must be completed before it can be brought into force.

As delineated above, the NRC is engaged in various efforts to strengthen nuclear safeguards and protection measures throughout the world. The NRC draws not only on its direct experience in international exchanges and cooperation but also, in important ways, on the technical expertise gained in discharging its statutory obligation to ensure that nuclear materials and facilities in the United States are protected from theft, diversion and sabotage.

Developing Regulatory Standards



Rules Basic to Regulation

The development of standards cuts across the range of the Nuclear Regulatory Commission's activities. Standards govern protection of the public and nuclear industry workers from radiation, safeguarding nuclear materials and plants, and protection of the quality of the environment. Many significant standards are discussed in other chapters of this annual report under topics to which they relate.

NRC standards are of two types: (a) regulations established by the Commission and published in Title 10, Chapter I, of the Code of Federal Regulations, which set forth requirements that must be met and (b) regulatory guides, developed to describe and make available to the public methods acceptable to the NRC staff for implementing specific parts of the Commission's regulations. In some cases, guides also delineate techniques used by the staff to evaluate specific problems or postulated accidents. In other cases, they provide guidance to applicants concerning information needed by the staff in its review of applications for permits and licenses. Many NRC guides refer to consensus standards (also called "national standards") which are developed by recognized national professional standards organizations, often with NRC participation.

During the past year there has been a marked increase in both the number and substance of public comments and input to the development of NRC standards. This public participation has been encouraged by mailing copies of draft regulatory guides to large numbers of individuals and organizations and in some instances by holding public meetings to obtain comments. Also, when a guide is issued, a staff analysis is placed in the Public Document Room concerning the need for the standard, the effectiveness of the standard compared to alternative ways of achieving the necessary level of safety, and the expected impact of the standard—for example, on other safety systems, costs, schedules, the regulatory process, labor market, etc. Regulations proposed or placed in effect during fiscal year 1976 are sum-

marized in Appendix 4. Regulatory guides issued during the same period are listed in Appendix 5.

NRC standards cover a wide range of technical subjects which are discussed below.

ADDRESSING CURRENT ISSUES

The following are current issues of high priority in the regulatory standards development program:

- *Transportation of Materials*

  Concern over the safe transport of radioactive materials has continued. NRC is developing standards dealing with shipment of radionuclides by air, barge, truck and other modes. A study is being conducted on the special problems of transportation through densely populated urban areas. A draft generic environmental impact statement dealing with the effects of the transportation of radioactive materials by air and other modes was issued in March 1976. This report, comments received on it, and the final environmental statement will form the bases for rulemaking.

- *Steam Generator Tube Integrity*

  Several pressurized water reactors have experienced corrosion and erosion of tubes in their steam generators. The NRC staff has developed guides for surveillance of steam generator tubes and for determining when degraded tubes are no longer acceptable and should be plugged. The staff is also working with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Subcommittee on Nuclear Inservice Inspection (Section XI) in this area. The latest edition of this Section added inservice inspection program requirements for steam generator tubing, as well as inspection methods. Plugging criteria are being developed for inclusion in future revisions. (See also Chapter 2.)

- *Fire Protection*

  The fire at the Browns Ferry nuclear plant in 1975 highlighted the need for improvements in standards to ensure fire safety. The NRC staff is developing basic fire protection standards and is participating with the American National Standards Institute (ANSI) to develop many of the needed, more detailed standards.

- *Plutonium Recycle to LWRs*

  In conjunction with the Commission's development and publication of the "Generic Environmental Statement—Mixed Oxides," a proposed regulation on plutonium recycle was issued for public comment.

- *Radioactive Waste Management*

  Under current NRC regulations, high-level liquid radioactive wastes from fuel reprocessing plants must be solidified and transferred to ERDA for storage or disposal. Pursuant to the Energy Reorganization Act of 1974, ERDA storage or disposal facilities and operations must be licensed by the NRC. Basic regulations setting forth performance, siting, repository design, and waste classification criteria are being developed to implement the regulatory requirements set forth in the Energy Reorganization Act.

- *Qualification Testing of Components*

  Reports from NRC inspectors in the field have indicated that some active components —particularly pumps and valves—have not functioned when called on in tests or during operation. The ASME Code principally deals with ensuring structural integrity and not the functioning of components. The staff has encouraged the American National Standards Institute (ANSI) to initiate development of standards to provide greater assurance that pumps and valves will operate when called on. As part of this effort, ANSI published a standard on functional specifications for nuclear valves. The major focus of this effort is on qualification testing.

- *Cost/Benefit of Reducing Exposures*

  Efforts leading to rulemaking have been initiated to define the health benefits of reducing radiation exposures of the general population from nuclear facility effluents. A cooperative effort with the Environmental Protection Agency to gather information during this proceeding will reduce duplication in soliciting public and industry input in this area, which is of interest to both agencies. The results of this proceeding will be used by NRC to improve the bases for conducting the cost-benefit analysis required by Appendix I to 10 CFR Part 50, which sets forth requirements for power reactor effluents and establishes as-low-as-reasonably-achievable

population doses. The efforts are long-term, and are not expected to be completed until fiscal year 1979.

- *Regional Siting*

  Standards for regional siting derive from institutional and technical considerations. They include such issues as emergency preparedness, regional geology, the assessment of alternative sites, and evaluation of environmental impacts. There is interest in these issues at local, State, and Federal levels of government. To improve the effectiveness and efficiency of treating the regional scale issues, programs have been initiated on a cost-shared basis through the Southern and Western Interstate Nuclear Boards. The aim of these programs is, first, to define relevant technical issues, and then, from the knowledge and experience gained, to develop mutually acceptable standards, criteria, regulations, and other tools of regulation.

- *Occupational Exposures at Licensed Facilities Other Than Reactors*

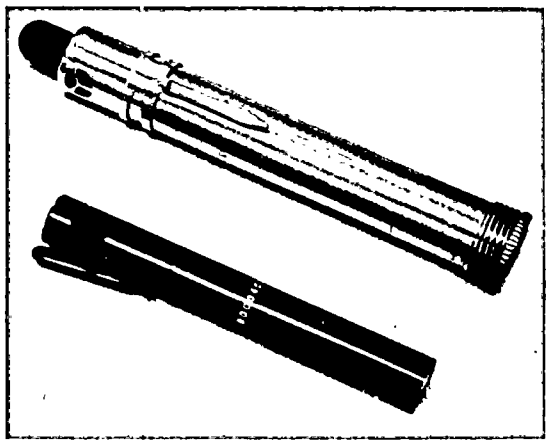
  A series of regulatory guides is being developed to establish actions that should be taken in the design and operation of licensed facilities to ensure that occupational radiational exposures are maintained as low as is reasonably achievable. Following successes in this area with nuclear power plants, the NRC staff is developing guides for fuel cycle facilities, such as uranium mills and fuel fabrication plants, and for other facilities such as radiopharmaceutical plants and medical and academic institutions.

- *Personnel Dosimetry Testing*

  A basic change in radiation protection regulations (10 CFR Part 20) is being developed to require all personnel dosimetry services to be tested periodically and to meet or exceed accuracy criteria now being established by an ANSI working group under the leadership of the Health Physics Society. This change, which would provide increased assurance of worker protection, is being developed in concert with the Bureau of Radiological Health of the Food and Drug Administration and the Energy Research and Development Administration.

- *Safeguards and Reactor Design*

  Security systems have been required for some time to protect nuclear power reactors against sabotage. To further assure such protection, studies have been made to determine whether design changes in future reactors can further reduce their inherent resistance to sabotage. The studies consider design changes in the context of existing physical security systems and the relation of these changes to safety, operability, maintenance, and reliability.



Pictured are two types of direct-reading dosimeters which may be used by workers entering areas where there is a possibility of higher than normal amounts of radioactivity. The smaller device can be read by the wearer by looking into the glass tube at a scale which shows accumulated radiation. The larger instrument, a "chirper," contains an ionization chamber to measure local radiation and indicates the amount by the frequency of a flashing light and a chirping sound.

- *Guard Training and Performance*

  Studies indicating the need to upgrade training and qualifications of licensees' guards for performing their duties in protecting nuclear materials and facilities have prompted initiation of an NRC program to provide more specific criteria in regulations for this area.

POWER REACTOR STANDARDS

Standards efforts for nuclear power plants during fiscal year 1976 were directed primarily to protecting the health and safety of the public and secondarily to reducing the regulatory burden. In a number of instances, the guidance

provided is based on national standards developed through the sponsorship of national technical societies under the broad direction and coordination of the American National Standards Institute (ANSI) (see later discussion). NRC staff personnel participate as members of the committees and working groups developing national standards.

Protection Against Fire

Detailed fire protection guidelines for nuclear power plants were issued in Regulatory Guide 1.120, published in June 1976. The guide describes how to implement NRC's requirement that the probability and effects of fire be minimized through fire prevention, detection and suppression. It also provides guidelines for designing fire safety features into nuclear power plants.

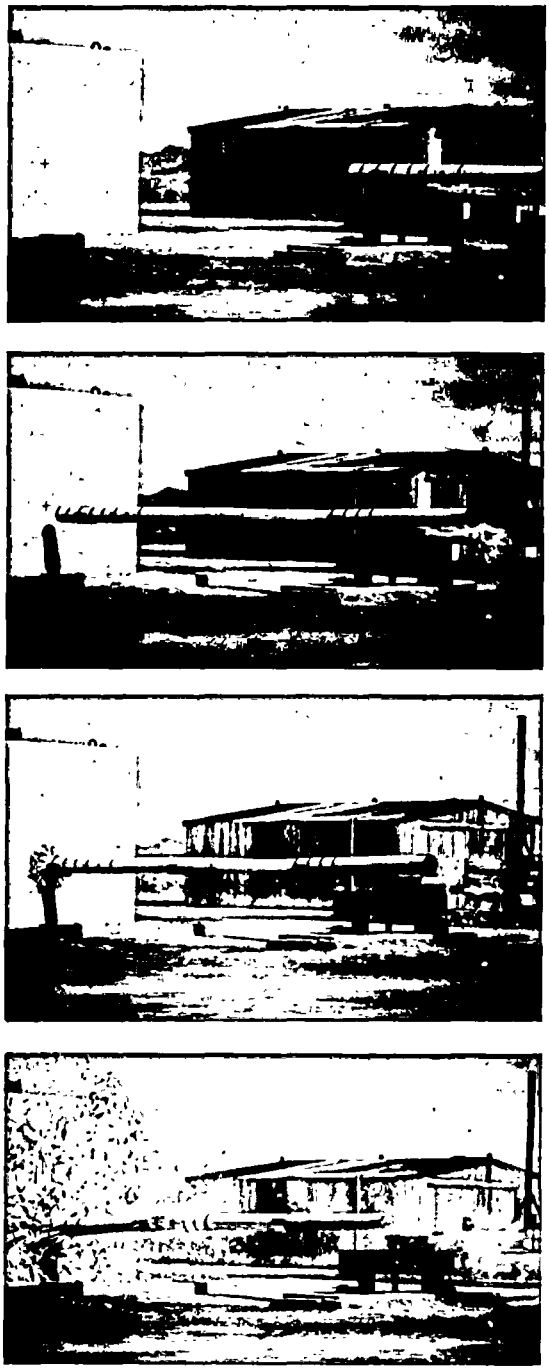
ANSI work in fire protection includes a projected generic fire protection standard for nuclear power plants and the identification, through steering committees, of requirements for additional ANSI fire protection standards.

A program was started at Sandia Laboratories that will provide the technical bases for needed fire protection guidance.

Protection Against Missiles

Missiles generated by turbine failure—usually pieces of the turbine blades—may have sufficient energy to penetrate several feet of reinforced concrete. Thus, they have an obvious potential for damaging essential safety systems. Guide No. 1.115, issued in March 1976, provides design criteria for mitigating the effects of low-trajectory turbine missiles.

Another guide, on possible tornado-generated missiles, expected to be issued in early 1977, outlines design criteria for protection. Wind tunnel tests to estimate the aerodynamic behavior of typical missiles that might be generated in a tornado were conducted during the year through contractual arrangements with the National Bureau of Standards and Sandia Laboratories.



Tests to determine how secure nuclear power plant walls are from the effects of tornado-driven missiles were performed by Sandia Laboratories at the Tonopah Test Range in Nevada. In the test shown here, a wood utility pole was propelled at a speed of about 150 mph into a reinformed concrete wall. There was no damage to the impacted wall surface and only minor cracking appeared on the rear surface. These tests were sponsored by the Electric Power Research Institute.

Seismic Design

Improving the methodology for ensuring that nuclear power plant structures, systems, and components will withstand earthquake motion continues to be an important NRC standards effort. Guide No. 1.92 was issued in February 1976 to describe acceptable methods for combining modal responses and the three components of earthquake motion in the dynamic analysis of nuclear power plant structures and systems. Guide No. 1.122, issued in September 1976, described ways to determine the vibratory motion transmitted to floor-supported equipment and components.

Lawrence Livermore Laboratory, in California, is examining several aspects of seismic design which will form the technical basis for future NRC guides. These include design criteria for spent fuel storage facilities, a method of seismic analysis for fuel reprocessing and fabrication plants, methods for modeling soil-structure interaction effects, and the advisability of seismic scram systems.

Accident Analysis

Conservative methods for estimating consequences of a postulated accident are described in Guide No. 1.98, issued in March 1976. It presents acceptable models for use in calculating the offsite radiological consequences of a radioactive offgas cleanup system failure in a boiling water reactor.

Reactor Containment

Containment design. In October 1976, the Commission published proposed "Standards for Combustible Gas Control Systems in Light-Water-Cooled Power Reactors" as an addition to the basic nuclear power reactor licensing regulations contained in 10 CFR Part 50. The effect of this proposed regulation would be to significantly reduce the number of plants that are required to inert containment atmosphere in order to prevent the possibility of hydrogen explosions under certain accident conditions. This proposed change results from taking account of increased conservatism in the revised emergency core cooling system requirements.

Guide No. 1.96, concerning the design of main steam isolation valve leakage control systems for boiling water reactor nuclear power plants, was revised in June 1976. These leakage control systems are designed to lower the offsite radiological dose caused by possible leakage of the main steam isolation valves in the event of a loss-of-coolant accident.

Guide No. 1.52, revised and issued in July 1976 after substantial public comment, describes the design, testing, and maintenance criteria for air filtration and adsorption units of atmosphere cleanup systems in light-water-cooled nuclear power plants. This guide applies only to engineered-safety-feature atmosphere cleanup systems designed to reduce the amount of radioactive material released to the environment following a postulated design basis accident.

Containment construction and inspection. Prestressed concrete construction is commonly used for reactor containment buildings. Inspection for possible corrosion of the highly loaded steel prestressing tendons is required to ensure integrity of the containment through the life of the plant. One of two methods of protecting the tendons against corrosion is usually employed: filling the tendon duct with grease (ungrouted), or filling it with cement grout.

Several guides relating to prestressed concrete containments were issued during fiscal year 1976. Revision 2 to Guide No. 1.35, on inservice inspection of ungrouted tendons in prestressed concrete containment structures, was issued in Jauary 1976. Guides No. 1.103 on post-tensioned prestressing systems for concrete reactor vessels and containments, and 1.107 concerning the qualifications for cement grouting for prestressing tendons in containment structures were issued for comment in November 1975. The public comments have been evaluated and revisions of both guides to reflect the comments will be issued in early fiscal year 1977.

The NRC staff is reviewing the 1975 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Division 2, Code for Concrete Reactor Vessels and Containments. The review will determine

its acceptability as a reference document in the licensing process.

System and Component Criteria

General design guidance. The Codes and Standards Rule (Section 50.55a of 10 CFR Part 50) was revised in February 1976 to relate the applicable edition and addenda of the ASME Boiler and Pressure Vessel Code to the docket date for a construction permit application rather than to the issuance date of the construction permit. This change permits applicants to make more accurate assessments of the code edition and addenda that will be in effect at the time components are ordered, thus facilitating procurement of long-lead components which are ordered well in advance of the construction permit date. The codes and standards rule was amended to incorporate by reference all editions of the ASME Boiler and Pressure Vessel Code through 1974, and all addenda through summer 1975.

Modifications to the ASME Code are often introduced through "code cases." NRC provides the industry with a timely indication of its approval of such code cases through the prompt revision and issuance of Guides No. 1.84, "Code Case Acceptability—ASME Section III Design and Fabrication", and 1.85 "Code Case Acceptability—ASME Section III Materials." Five revisions of each guide were issued during fiscal year 1976. Procedures provide for revision of the guides following each ASME Council meeting that approves new code cases.

A tornado design classification guide (Guide No. 1.117) was issued in June 1976 to describe an acceptable method for identifying structures, systems, and components of light-water-cooled reactors that should be designed to withstand the effects of a tornado, including tornado missiles, and remain functional.

Guidance on specific systems and components. Guidelines for the design, fabrication, and testing of overhead crane systems used for reactor refueling and spent fuel handling operations were published for comment in February 1976 as Guide No. 1.104. Comments are being evaluated for consideration in a future revision.

A revised guide on reactor coolant pump flywheel integrity (Revision 1 to Guide No. 1.14) was issued for comment in August 1975. The revision updates the analytical approach previously recommended to include more recent fracture analysis methods; the revision also reflects comments received concerning an earlier version.

Guide No. 1.68 describes acceptable methods for complying with NRC regulations on preoperational and initial startup testing programs for water-cooled power reactors. As part of an effort to provide more detailed guidance, the NRC issued Guide No. 1.68.1 in December 1975. The guide describes the type and nature of BWR feedwater and condensate preoperational and initial startup tests.

Electrical systems and components. The NRC is emphasizing development of standards and guides for post-accident monitoring systems. Regulatory Guide 1.97 is concerned with instrumentation to assess plant conditions during and following an accident.

NRC regulations require that electric power systems and components important to safety be designed to permit appropriate periodic inspection and testing. More detailed guidance issued during 1976 to specify acceptable methods for meeting these requirements covered testing of electric power and protection systems (Guide No. 1.118 published in June 1976), and testing of diesel generators used as onsite electrical power systems at nuclear power plants (Guide No. 1.108 published in August 1976).

Other guides issued during the fiscal year concerned electrical systems for components, including instrument spans and setpoints (Guide No. 1.105, November 1975), thermal overload protection for electric motors on motor-operated valves (Guide No. 1.106, November 1975) and a revision of the criteria for safety-related electric power systems for nuclear power plants (Guide No. 1.32, March 1976).

Qualification Testing

Emphasis is being placed on developing standards and guides for design verification by qualification testing and analysis. Standards

for qualification testing are being emphasized in two areas: active mechanical components and electrical components.

In the mechanical area, the staff is working closely with two national standards groups that are developing standards for qualification tests to make sure that safety-related pumps and valves will operate in their appropriate environments when called upon. The NRC staff is currently reviewing an ANSI standard on functional specifications for self-operated and power-operated safety-related valves for applications in nuclear power plants (ANSI N278.1-1975) to determine whether NRC will endorse it.

In the electrical area, Sandia Laboratories initiated tests for NRC to determine possible synergistic effects on electric equipment under accident conditions. Work continued at Sandia under NRC sponsorship on fire testing of electrical cable trays to determine the adequacy of prescribed separations. Results of these programs will form the basis for future NRC actions.

Radiological source terms used in qualifying safety-related equipment for accident conditions are being updated in a forthcoming revision of Guide No. 1.89 on the qualification of such equipment for nuclear power plants.

Quality Assurance

Quality assurance requirements for the design, construction, and operation of safety-related structures, systems, and components of nuclear power plants are established in 10 CFR Part 50 (Appendix B) of NRC regulations. During the past year, NRC issued new and revised guidance concerning the implementation of these requirements. This included Guide No. 1.116 on quality assurance requirements for installation, inspection, and testing of mechanical equipment and systems, published in June 1976; a revision of Guide No. 1.88 on collection, storage, and maintenance of nuclear power plant quality assurance records, issued in December 1975; and a revision of Guide No. 1.64 on quality assurance requirements for the design of nuclear power plants, published in June 1976.

Reporting Defects/Noncompliance

The Energy Reorganization Act of 1974 included Section 206, "Noncompliance," which requires certain individuals who become aware of either a defect that could create a substantial safety hazard or a failure to comply with an applicable rule, regulation, etc., relating to substantial safety hazards to report the matter to the NRC.

To implement that section, the Commission published in March 1975 a proposed new Part 21, titled "Reporting of Defects and Noncompliance," and proposed amendments to some parts of Title 10, Chapter I. The proposed part is intended to provide the Commission with a new source of information in its attempt to anticipate problems and would be applicable to licensees and a large number of their suppliers. Failure of a director or responsible officer of such an organization to notify the NRC of such a matter would make him subject to a civil penalty.

Since this proposed new part was published, over 140 letters of comment have been received. The Commission at year-end was considering a summary of public comments received, alternative proposals for modifying the proposed Part 21, and information on existing Federal statutes and regulations that are similar to the proposed rule.

Inservice Inspection and Surveillance

The Codes and Standards rule was revised in February 1976 to require that any new inservice inspection and testing requirements (Section XI of the ASME Boiler and Pressure Vessel Code) that become effective during the service lifetime of a facility be periodically adopted to the degree practicable, within limitations of design and access.

Revision 1 to the guide (No. 1.83) on inservice inspection of pressurized water reactor steam generator tubes, issued in July 1975 to reflect public comments, provides recommendations for eddy-current inspections of PWR steam generator tubes.

A guide concerning bases for plugging degraded pressurized water reactor steam gen-

A Combustion Engineering, Inc. employee ultrasonically tests a nozzle weld during the manufacture of a reactor vessel. C-E ultrasonically tests all nuclear vessel welds in accordance with ASME Boiler and Pressure Vessel Code Section XI. Ultrasonic testing detects minute flaws that may be repaired prior to shipment and service.

erator tubes was issued in August 1976 for comment (Guide No. 1.121). It provides guidelines for determining when degraded PWR steam generator tubes are no longer acceptable for service.

Guide No. 1.119, issued in July 1976 for comment, recommends a surveillance program for evaluating the inservice performance of new fuel assembly designs.

Guidance on the effects of residual elements on predicted radiation damage to reactor vessel materials was issued for public comment in July 1975 (Guide No. 1.99). The guide sets forth a common basis for predicting neutron radiation damage to reactor vessel steel. Public comments are being evaluated for reflection in a future revision of the guide.

Safety Analysis Report Format

Revision 2 to Guide No. 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," was issued in September 1975. Comments received from the public are being evaluated for consideration in a future update of the guide.

SAFEGUARDS STANDARDS

During the year, the NRC continued rulemaking actions to improve the protection of nuclear power plants from sabotage and to strengthen security over access to special nuclear material (SNM) through a graded personnel clearance program.

Reactor Sabotage Protection

Late in 1976 the NRC was nearing completion of action on a regulation setting forth requirements for a nuclear power reactor security system. The regulation, which was expected to be published in effective form in early 1977, was the result of year-long efforts in evaluating public comments on the proposed amendment that specified requirements for the protection of nuclear power reactors from sabotage. Detailed analyses were performed on the various major components proposed to be required for reactor security systems to ensure that the requirements being imposed were cost-effective.

The specific protection requirements include such measures as a physical security organization; controlled access to and within the nuclear power reactor by using qualified and trained guards; and establishment of other security provisions covering communications, alarm stations, liaison with local law enforcement authorities, and visitor controls. Other requirements include monitored isolation zones around such physical barriers as fences, and bullet-

resistant construction for central alarm stations and power reactor control rooms.

Personnel Clearance for Access to SNM

Late in 1976 the NRC was nearing completion of action on a proposed rule to establish a graduated clearance program based on a level of investigation keyed to the kind of access to special nuclear material involved in specific job functions.

In drafting the proposed amendment, NRC staff performed analyses and studied alternative approaches to assuring personnel reliability such as background investigations and medical examinations. The level of investigation, criteria for denying access authorization, and extent of coverage from a functional or job-related standpoint were also considered.

SITING STANDARDS

The nuclear plant site standards program is structured into three areas; site designation, site safety, and environmental standards.

Site Designation

In the site designation standards area, the staff began a review of reactor siting policy and practice and continued work on implementing NRC's "early site review" and regional siting concepts (see Chapter 2). In November 1975, Guide No. 1.101 on emergency planning for nuclear power plants was issued. At year-end, a guide was in preparation on emergency planning for research reactors.

Site Safety

Significant progress was made during 1976 in improving standards on protection of nuclear power plants against flooding. A guide on flood protection was first published in October 1975, and a revision reflecting public comments received on the guide (No. 1.102) was issued in September 1976. Guidance on the ultimate heat sink for nuclear power plants was issued as a second revision in January 1976 (Guide No. 1.27). Revised Guide No. 1.59, on the design basis floods for nuclear power plants, was issued in April 1976.

New programs comparable in scope to hydrologic activities were initiated in meteorology and soil mechanics standards. Progress also was made by year-end in developing revisions to clarify regulations concerning seismic hazards.

Environment

Environmental standards are concerned both with the control of radioactive effluents from nuclear facilities and with nonradiological environmental effects. In the latter category are such issues as environmentally based technical specifications for the operation of nuclear facilities, form and content of environmental reports submitted to NRC in connection with license applications, and performance standards for protection of the aquatic and terrestrial environment from the effects of NRC-licensed activities.

This program also involves NRC interaction with the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the Environmental Protection Agency, and the National Academy of Sciences in matters concerning environmental and radiation protection standards.

In the spring of 1976, NRC published five regulatory guides to implement Appendix I to 10 CFR Part 50 (Guide Nos. 1.109-1.113). The guides concern protection of the public against the hazard of low-level radioactive emissions from nuclear power reactors (see Chapter 4). Well-attended and productive public meetings were conducted by NRC to receive comments on two of these five guides.

Coordination with EPA. The Environmental Protection Agency exercises the functions of developing guidance for all Federal agencies on protection against radiation and developing generally applicable environmental radiation standards. The NRC has the responsibility to implement this guidance and enforce the general environmental radiation standards for

NRC-licensed activities. These interrelated activities require close coordination between the two agencies.

The NRC staff reviewed EPA's proposed environmental radiation standards for the uranium fuel cycle and light-water-cooled nuclear power reactors and testified at EPA's public hearings on the subject in March 1976. NRC staff comments and subsequent discussions with EPA staff resulted in revisions in the proposed standards that would achieve the same level of environmental protection without unnecessary regulatory burdens on the NRC, which must implement the standards.

The NRC staff also provided technical input to EPA staff in their development of standards in the following areas: thermal and chemical effluent limitations for power plants, nonradioactive effluent limitations for uranium mines and mills, radioactivity in drinking water, and water quality criteria. In addition, NRC staff supported EPA in its development of documents describing Federal radiation protection activities and the radiological state of the environment.

Agreements between NRC and EPA on implementing provisions of the Federal Water Pollution Control Act affecting NRC-licensed nuclear power plants are described in Chapter 4 under "Interagency Coordination."

FUEL PLANT STANDARDS

During the period of this report seven guides on special technical considerations relating to nuclear fuels and materials facilities were issued. The guides covered emergency water supply systems, fire protection, and ventilation systems design for fuel reprocessing plants; nondestructive examination of tubular products for use in fuel reprocessing, plutonium processing, and fuel fabrication plants; avoidance of corrosion in austenitic stainless steel components of fuel reprocessing plants; standard format and content for plutonium processing and fuel fabrication plant license applications; and the validation of calculational methods for nuclear criticality safety. (Titles of fuels and materials facilities guides are listed under Division 3 of Appendix 5.)

Proposed regulations covering the health, safety, and environmental aspects of possible wide-scale use of mixed oxides of plutonium and uranium to fuel nuclear power reactors have been prepared and issued for public comment. The proposed regulations would (1) extend existing criteria for emergency core cooling systems to light water reactors fueled with mixed oxide fuel; (2) authorize amendments to licenses for the use of the composition of mixed oxide fuel covered in the "Generic Environmental Statement on Use of Mixed Oxide Fuel in Light Water Reactors" (GESMO), without the preparation of additional environmental statements; (3) modify regulations covering environmental effects of the nuclear fuel cycle to include the effects of mixed oxide fuel cycle activities; and (4) permit the Commission to impose additional standards for the use of the composition of mixed oxide fuel not covered in GESMO. (The status of the Commission's proceeding toward a decision on the mixed oxide fuel question is discussed in Chapter 3.)

Among other standards and guides being developed at the end of the fiscal year were proposed rulemaking for the enrichment of uranium and guidance for preparation of license applications related to such installations; and guides on emergency planning, protective systems and design basis floods for fuel reprocessing plants.

In the waste management area, technical studies were underway at the Battelle-Pacific Northwest Laboratory to develop decontamination and decommissioning criteria for light water reactors and for fuel cycle facilities, with initial reports scheduled for completion in early 1977. These will assist in developing decommissioning regulations and regulatory guides.

Due to the delay in construction and operation of fuel reprocessing plants and their spent fuel receiving and storage areas, a need is developing for facilities to store increasing inventories of spent fuel off the reactor site. (See Chapter 3.) A proposed rule for licensing of these interim storage facilities, and guides on license application, facility siting, design requirements and plant protection were nearing completion at year-end.

The NRC increased emphasis on standards and guides related to design objectives for spent fuel handling facilities and equipment—both

at the reactor and at other fuel storage facilities —and quality assurance guidance at fuel cycle facilities through participation in development of ANSI standards.

TRANSPORTATION AND PRODUCT STANDARDS

Transportation

The NRC devoted substantial standards development effort during 1976 to a comprehensive program for protecting public health and safety in the transport of nuclear materials. Developments in this area are described in Chapter 3.

Consumer Products

Some petitions for rulemaking filed with the Commission are concerned with exempting from licensing and regulatory requirements a device, commodity, or other consumer product containing radioactive byproduct material [as defined in 10 CFR Section 20.3 (a)(3)]. Early in these rulemaking proceedings, the NRC evaluates information from the petitioner and other sources and prepares an environmental impact statement that accompanies the petition through, and is considered in, the Commission's decision-making process.

To assist petitioners in developing environmental information, the NRC issued for comment in October 1975 a regulatory guide on the preparation of an environmental report to support a rulemaking petition seeking an exemption for a radionuclide-containing product (Regulatory Guide 6.7). The guide was reissued in revised form in June 1976.

In October 1975, the NRC issued its first draft environmental impact statement for a consumer product. The statement concerned a proposed rule to exempt spark-gap irradiators containing cobalt-60 for use in spark-ignited fuel-oil burners. Placement of the irradiator near the spark gap eliminates spark delay that is considered to be a contributory factor in some explosions in spark-ignited oil-burning equipment. The final environmental statement was being prepared at the end of fiscal year 1976.

In June 1976, the NRC issued a second draft statement regarding consumer products. It concerned a proposed rule to exempt from licensing thorium in personnel neutron dosimeters worn on the human body. Thorium is an essential ingredient for recording fission track damage in an adjacent plastic foil from which the neutron exposures can be estimated. The final environmental statement was still in preparation at the end of the fiscal year.

OCCUPATIONAL HEALTH STANDARDS

Petition on "Hot Particles"

On April 12, 1976, the NRC published in the *Federal Register* a comprehensive analysis of what have been called "hot particles" of plutonium. Small particles of an alpha-emitting radionuclide such as plutonium, when deposited in the lung, can cause extremely large radiation doses to the tissue cells immediately surrounding the particles. Despite the large doses, however, experiments with animals have indicated that cancer is not likely to develop unless large volumes of tissue are irradiated, as would be the case with uniformly distributed radioactive material in the lung. In addition, clinical studies have established that workers exposed to airborne plutonium particles immediately following World War II have not developed lung cancer. The NRC analysis concluded that radionuclides in the form of particles are not more hazardous, and may be less hazardous, than the same quantity of radionuclides distributed uniformly in the lung.

The analysis was performed as the result of a petition from the Natural Resources Defense Council. The petition requested the NRC to establish special standards for plutonium and other alpha emitters in "hot particle" form, the standards to be a factor of 115,000 lower than present standards for these radionuclides in insoluble form. The Commission denied the petition.

The question raised by the petition was reviewed by the National Council on Radiation

Protection and Measurements (NCRP) and the National Academy of Sciences (NAS). The NCRP published its findings in NCRP Report No. 46, "Alpha-Emitting Particles in Lungs," which concluded that "particulate plutonium in the lung is no greater hazard than the same amount of plutonium more uniformly distributed throughout the lung." The NAS report was published in October 1976, and reached similar conclusions.

Personnel Monitoring Reports

Since 1969, four categories of licensees have been required to report annually the results of their personnel monitoring for radiation exposures. The four categories (nuclear reactors, industrial radiographers, nuclear fuel processors and reprocessors, and certain manufactures or processors of large quantities of byproduct material) are believed to include those licensees whose operations have the greatest potential for significant occupational radiation exposures.

On May 30, 1975, the NRC published a proposed amendment to its regulation that would require *all* licensees to file an annual statistical summary report. The data gathered would be used to identify situations for further study. This would enable the NRC to develop guidance on keeping occupational radiation exposures "as low as is reasonably achievable." The NRC believes the information it would receive from all licensees is needed for evaluating the risk of exposure associated with related activities.

However, a number of comments received on the proposed rulemaking questioned the value of the data requested and the burden of reporting by licensees. Consequently, the NRC asked all licensees to submit a voluntary, one-time report of their personnel monitoring data for 1975. These reports will provide NRC with a better basis for assessing the value of the data and will determine whether or not the licensees currently required to report actually conduct operations having the greatest potential for significant radiation exposure. The NRC will evaluate the reports before deciding on a requirement for reporting from all licensees.

Respiratory Protection

The NRC adopted a rule change in August 1976 that (1) eliminates separate licensing actions for approval of respirator use, (2) relaxes the requirements for reporting overexposures to radioactive materials taken into the body by replacing the former weekly reporting limits with quarterly limits that are consistent with basic radiation protection standards, and (3) establishes requirements for precautionary procedures, including a weekly basis for exposure control and the use of engineering controls, to limit exposures to airborne radioactive materials.

The rule is expected to strengthen safety requirements and result in significant savings by eliminating unnecessary reports from licensees. A regulatory guide (No. 8.15) and a supplemental manual of technical support information (NUREG-0041) were published in October 1976 to provide licensees with the necessary guidance on practices for respiratory protection that are acceptable to the NRC. The rule change became effective in December.

High-Intensity Radiation

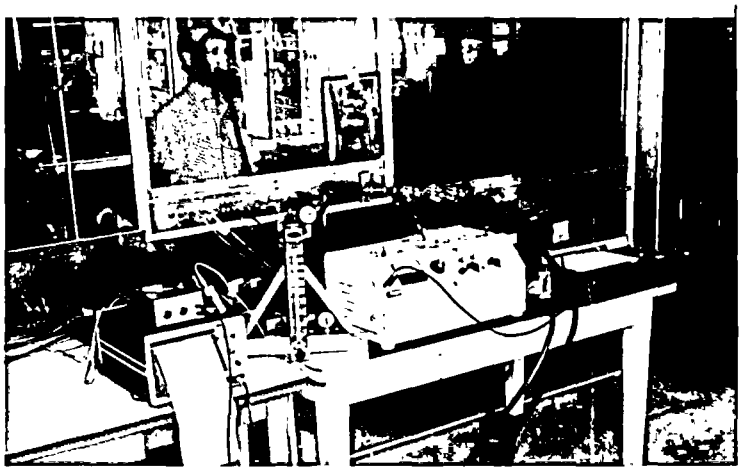
In May 1976, the NRC published a proposed rule change to upgrade requirements for protection against radiation from high-intensity sources, such as those used in some irradiators, that could be immediately lethal to people who might accidentally be exposed to them.

The proposed rule would require automatically functioning entry controls and warning devices as well as procedural controls to reduce the likelihood of exposures to these sources. Potentially affected licensees were provided information on costs and need for the additional controls.

At the end of the fiscal year, the NRC staff's evaluation of comments received indicated the need for additional review of technical problems before an effective rule can be issued.

Monitoring of Radiographers

An amendment to NRC regulations on personnel monitoring, placed in effect in May 1976,



In order to develop necessary guidance for licensees, the NRC supports the testing of various types of respirators designed to complement other safety measures taken by licensees to keep employees' exposures to airborne radioactivity as low as is reasonably achievable. As part of the testing program, respirators are tested on different facial types. Above, a male panel member in the test chamber at the Los Alamos Scientific Laboratory is preparing for a series of tests to determine the ability of a test air-line respirator to provide protection under simulated conditions of use in a contaminated atmosphere. At right, two types of air-supplied respirators are checked out by a female panel member before she enters a test chamber.

permits radiographers to use thermo-luminescent dosimeters as substitutes for film badges to record cumulative individual exposure to radiation. The amendment requires daily exposure records to be obtained with dosimeters that are readable without the use of accessory equipment.

Dosimetry Requirements for Criticality Accidents

In July 1976, the NRC issued a rule change to enable rapid screening of personnel who might have been exposed to radiation during a criticality (nuclear chain reaction) accident. It requires people who work near fissionable materials that could form a critical mass to wear a device such as an indium strip. This would enable quick identification of exposed workers should a criticality accident occur. Use of a dosimeter to measure the neutron dose is not required on the basis of an analysis which indicated that neutron dosimetry would cost more than the value of the dose information for attending physicians.

NATIONAL STANDARDS PROGRAM

The national standards program is conducted under the aegis of the American National Standards Institute (ANSI). It 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 so that efforts are concentrated on developing standards that can be most useful in protecting the public health and safety.

NRC participation in the national standards development program is based on the need for national standards to define acceptable ways of implementing the NRC's basic safety regulations.

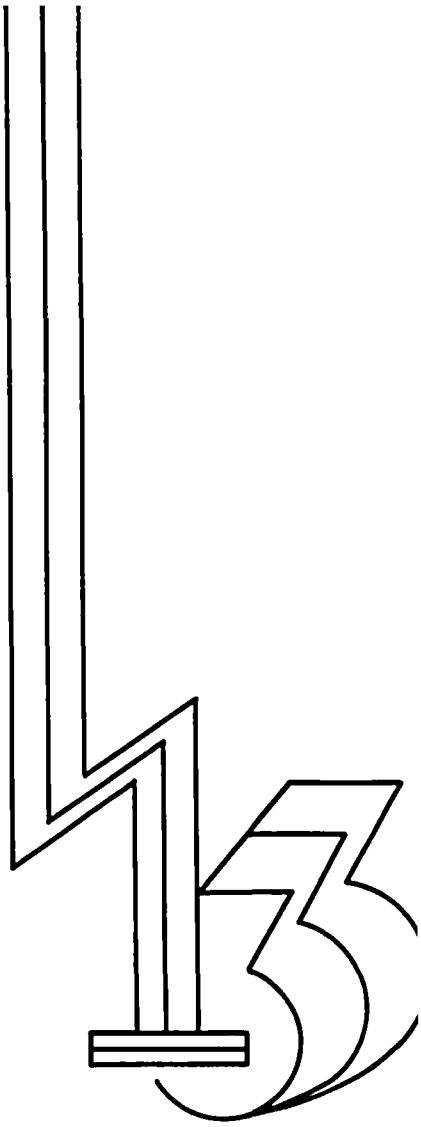
The actual drafting of standards is done by experts, most of whom are members of the pertinent technical and professional societies. Approximately 200 NRC staff members participate in the development of nuclear standards, mostly as members of standards working groups organized under technical and professional societies. The main societies with which the NRC Office of Standards Development interacts are listed in the accompanying table.

During the past year, ANSI has taken steps to improve its standards development procedure. At the urging of the NRC staff and other users of nuclear standards, the Institute is emphasizing clarity and specificity in the drafting of standards to make them more auditable and enforceable. This will increase the usefulness of national standards in the regulatory process. Such standards are used in the regulatory process only after independent review for suitability by the NRC staff.

MAJOR SOCIETIES PARTICIPATING IN NUCLEAR STANDARDS DEVELOPMENT

American Board of Health Physics
American Concrete Institute
American Industrial Hygiene Association
American Institute of Chemical Engineers
American National Standards Institute
American Nuclear Society
American Public Health Association
American Society of Mechanical Engineers
American Society for Nondestructive Testing
American Society for Quality Control
American Society for Testing and Materials
Association of Neutron Radiographers
Conference of Radiation Control Program Directors
Health Physics Society
Institute of Electrical and Electronics Engineers
Institute of Nuclear Materials Management
Instrument Society of America
National Academy of Sciences—National Research Council
National Council on Radiation Protection and Measurements
National Fire Protection Association
National Institute for Occupational Safety and Health
Nuclear Energy Liability Insurance Association
Society for Nuclear Medicine

Confirmatory Research



NRC Tests Producing Results

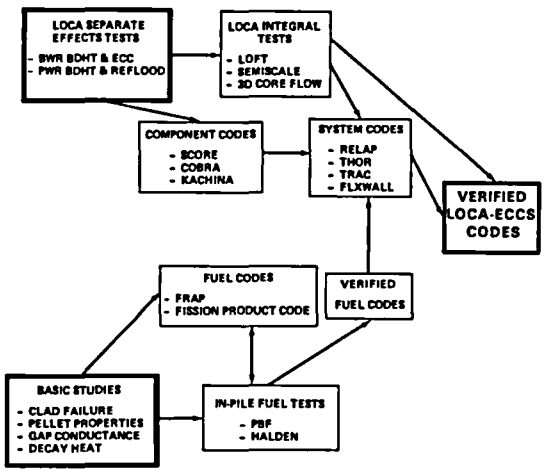
During 1976, the NRC's major testing facilities for water reactor safety research—comprising the largest part of the agency's confirmatory assessment program—started to generate significant data. The test data, combined with previous data, confirm NRC's expectations as to the ability of the emergency system of a light-water-cooled power reactor to cool the nuclear core if required by loss of the normal coolant.

Substantial progress also was made in other areas of regulatory research—in advanced reactor work, including experimental tests and computer code development related to postulated accidents in liquid metal cooled fast breeder reactors; in the development of a coordinated program for fuel cycle, health and environmental research; in safeguards research, which focused on developing an analytical framework for projects on the evaluation and design of physical protection, material control and transport protection subsystems; and in reactor operational safety matters including initial tests related to fire protection for nuclear power plants.

This chapter presents a summary of the principal results of the confirmatory research program followed by a more extensive discussion of technical details. Included at the end of this chapter is a selected list of reports useful for obtaining complete descriptions of programs and results.

SUMMARY OF WATER REACTOR SAFETY TESTS

At the end of fiscal year 1976, the Loss-of-Fluid Test facility (LOFT) had completed four tests; Semiscale, a nonnuclear electrically heated test loop (a closed circuit of pipe in which materials and components may be tested under different conditions of temperature, pressure, etc.), four series of tests; and the Power Burst Facility (PBF), nine tests. All these tests were



RESEARCH PLAN FOR CONFIRMED LWR LOCA ANALYSIS METHODS

performed at the Energy Research and Development Administration's Idaho National Engineering Laboratory (INEL). Five tests were completed at the Thermal Hydraulic Test Facility (THTF) at the Oak Ridge National Laboratory (ORNL) in Tennessee. Testing also was continuing at two industrial nonnuclear test loops: the Full Length Emergency Cooling Heat Transfer facility (FLECHT) at Pittsburgh, Pa., and the two-loop test apparatus at San Jose, California. (Detailed descriptions of these test facilities will be found in Chapter 8 of the NRC's 1975 Annual Report.)

The separate effects tests, integral system tests, basic fuel studies and "in-pile" tests (those performed inside a reactor) are all systematically planned to develop and verify computer codes which can be used to better quantify the safety margins of nuclear power plants. The key to success of such a research program lies in cooperation between analysis and experimentation; that is, the experimental results should satisfy the needs of analysts and code developers, and the code calculations should accurately predict the experimental behavior.

The Semiscale Loop, a model of the LOFT reactor system, has been very successful in simulating LOFT constant-temperature simulated pipe-break experiments. The rapid formation of steam and ejection of water after a pipe break is called a "blowdown." Data from selected tests in Semiscale match data from similar LOFT tests showing that the power to volume ratio is a good scaling criterion for blowdown of both systems.

Experiments in Semiscale also indicated the importance of the unheated rods in a fuel bundle in promoting cooling water mixing. Better mixing of the coolant delays the time it takes to reach the point of possible overheating of the fuel cladding, and the delay allows more time for the replacement coolant to reach the critical area and prevent damage. The presence of three unheated rods in a test section of 40 rods changes the time delay of reaching this overheating point from 0.5 second to 3 seconds. In a PWR the control rod guide thimbles, containing no fuel, behave as unheated rods.

The 26 Semiscale runs in fiscal year 1976 improved the understanding of loop blowdown behavior. Semiscale is expected to continue to yield valuable information for refining the understanding of the loss-of-coolant accident response of large water reactors.

The LOFT facility performed well during initial nonnuclear tests. Computer code predictions compared well with LOFT data. Repeatability of the LOFT results was excellent, indicating that the plant and the data acquisition system perform in a consistent manner to assure the reliability of the data. The LOFT emergency core cooling water injected in the reactor inlet pipe was delivered rapidly to the core inlet region. The nuclear core was not installed for this test. No hot wall delay effect was observed. It had been postulated that the steam which is formed when the replacement cooling water enters the reactor vessel and hits the core barrel could increase the time for the water to get to the core.

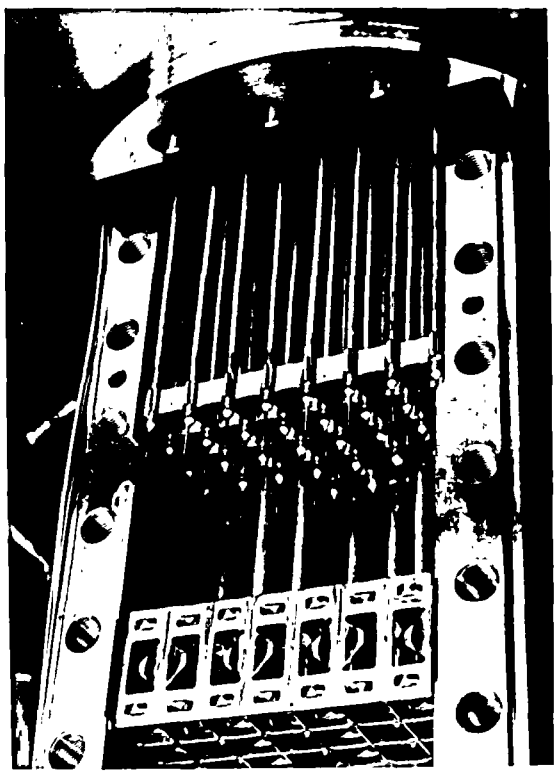
Although LOFT was designed to test loss-of-coolant accidents in a PWR, important suppression tank data was obtained for evaluating BWR containment analysis techniques.

THTF tests. Five tests have been successfully performed in the Thermal Hydraulic Test Facility at the Oak Ridge National Laboratory. The 49 rods in the test section were all electrically heated in early tests to represent a fully heated fuel rod bundle. The simulation of control rod thimbles (representative of a reactor core) will be incorporated by using unheated rods in the future tests.

FLECHT data. The low flooding rate data appear to be consistent with the older FLECHT

data for higher flooding rates. A method for calculating the steam quality under transient conditions above the steam/water quench front, using improved instrumentation, was developed. A calculational method of describing the motion of a fluid layer through the bundle was used to predict the bundle coolant mass inventory during reflood. The study of reflood phenomena is important in gaining an understanding or reactor core cooling following a loss-of-coolant accident (LOCA).

BWR blowdown tests. Boiling water reactor blowdown data were obtained from the two-loop test apparatus (TLTA) of the General Electric Co. Calculated results using a conservative evaluation computer model compared favorably with the data. Comparison of data with realistic best-estimate calculations was reported. The heat transfer data from the TLTA will be compared with existing published heat transfer correlations in a code verification program at INEL.



Close-up view of partially assembled Thermal Hydraulic Test Facility heater rod bundle showing grid spacer and subchannel thermocouples.

ECC bypass test. An emergency core cooling bypass test was performed in a 1/15 scale clear plastic model of a reactor vessel at Battelle Columbus Laboratories in Ohio and a movie was made of the fluid action. The test objective was to visualize the circumstances which may cause some of the emergency cooling water to bypass the core. This proved to be very enlightening in understanding the flow of steam/water mixtures in the downcomer section of a reactor vessel.

Fuel safety. The results of fuel safety research in fiscal year 1976 all indicate that conservatism exists in assumptions used in current safety assessments. These findings are:

- The fission product decay heat as measured is well below values (120 percent of American Nuclear Society standard curve) presently used in reactor safety calculations. Less heat means lower cladding temperatures.
- The rate of zirconium fuel cladding oxidation with steam is less than represented in the correlation presently used in reactor safety calculations.
- The rate of oxygen diffusion in zirconium is less than indicated by data presently used.
- The swelling of fuel cladding when tested with simulated fuel rods under more realistic conditions is less than that indicated by previous data. Less swelling means less flow blockage. German data on measured ballooning and circumferential burst strain are in substantial agreement with U.S. results. In addition, the ductility and elongation of fuel cladding decrease during irradiation. The ductility does not recover during the heatup that occurs in a LOCA. This means that there will be even less ballooning.
- In power-cooling mismatch tests at PBF, no rods failed during nuclear operation even though the maximum time in film boiling was 11 minutes. During film boiling the rate of transfer of heat from the fuel is significantly reduced. The tests also showed that there are no more severe failure modes for irradiated fuel than for unirradiated fuel, and that there is no strong indication of transient gas release

from irradiated fuel.

- The preliminary results of molten core-concrete interaction tests at Sandia Laboratories (New Mexico) show that the overall erosion rates for both limestone concrete and basaltic concrete are less than 1 centimeter per minute. This means that the risk of containment break and the resulting consequences are reduced considerably.

Code Development

The large quantity of data generated in the past year has enabled the development of various computer codes for reactor safety analysis to proceed at top speed. Use of the newly available data is substantially improving the existing component and system codes:

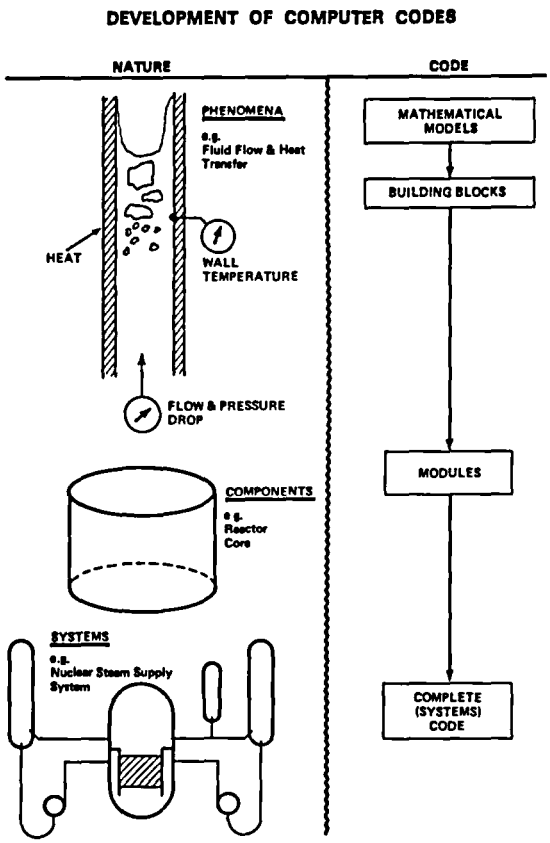
First, two versions of the reactor fuel code FRAP were verified at the Idaho Nuclear Engineering Laboratory. The steady-state version was shown to be most applicable to analysis of moderate operating conditions associated with core average rods. The transient version was shown to provide reasonable predictions of the limited data available on transient thermal and deformation behavior.

Second, the fifth modification of the reactor safety analysis system code RELAP-4 was completed at INEL in fiscal year 1976. It predicts Semiscale and LOFT results with reasonably good accuracy. More detailed new codes such as TRAC and THOR and improved versions of existing codes are being developed at other laboratories.

Third, a comparison of the results from the COBRA and SCORE codes, which perform detailed calculations of the nuclear core hydraulic phenomena, shows that both codes give similar water flow patterns at about 0.3 seconds after the beginning of saturated blowdown. The importance of this finding is twofold:

(1) An agreement between two independent codes implies some validity of the code predictions, even without data verification.

(2) During the early part of the blowdown, the flow velocity in the steam-filled region of the middle of the core is mostly radial, because of the difference in voiding between neighboring channels. This lateral velocity strongly affects time to reach critical heat flux. Verification by intercomparison of codes is necessary when phenomena occur so fast that they can hardly be measured in an experiment.



This parallel view shows the basis on which a computer code is formulated. Verification (i.e., being convinced that one can predict a measured outcome) at each level of development is necessary in order to arrive at a code which can be used with confidence to calculate behavior in large systems.

SUMMARY OF ADVANCED REACTOR WORK

Sodium-Cooled Reactors

Testing was completed in 1976 at the Oak Ridge National Laboratory on a method used to vaporize uranium dioxide in a manner that

simulates the formation of the fuel aerosol source during a hypothesized Liquid Metal-cooled Fast Breeder Reactor (LMFBR) accident. This method was used to determine the particle size distribution of the aerosol source and to establish the aerosol yield that can be obtained.

The initial power excursion tests in which an LMFBR fuel pin is melted and partially vaporized under sodium were performed in the Annular Core Pulse Reactor (ACPR) at Sandia Laboratories. The purpose of these experiments is to investigate the consequences of a power excursion in an LMFBR.

The KACHINA computer code was developed for use in the analysis of postulated core disruptive accidents in fast breeder reactors. In addition, the code was adapted to perform reactor core calculations in light water reactors.

Gas-Cooled Reactors

The initial versions of six computer codes for safety analysis of high-temperature gas-cooled reactors were completed. These provide a firm basis for the development of detailed codes at such time as the gas-cooled reactors may return to commercial use.

Tests of graphite samples in a newly completed loop that simulates conditions in gas-cooled reactors indicated that the corrosion rate of certain cheaper grades of graphite being considered for structural use in the reactor may be greater than is desirable.

FUEL CYCLE AND ENVIRONMENTAL RESULTS

The fuel cycle, health and environmental confirmatory research plan was developed into a coherent and coordinated program responsive to the expressed needs of NRC operating offices. Research projects that achieved substantial progress during fiscal year 1976 include:

- Reexamination and extension of the dosimetry model used in the calculations required by NRC regulations for "as low as reasonably achievable" (ALARA) releases of radioactive effluents;
- Assessments of radiation source terms associated with occupational exposure of PWR workers;
- Generalization to a psuedo-three dimensional basis of hydrological transport models for thermal effluents from light water reactors;
- Calculations of electricity demand forecasts broken down by States and user type;
- Post-licensing case studies of the socio-economic impact of two nuclear power plants in the northeast (Pilgrim and Millstone);
- Verification of source terms for ALARA analysis of pressurized water reactor operation; and
- Impact testing of existing plutonium shipping containers.

SAFEGUARDS RESEARCH SUMMARY

Safeguards research in fiscal year 1976 focused on defining an analytical framework for the program in terms of the NRC regulatory functions, the concept of societal risk and the functional elements of safeguards systems. This analytical framework served as the basis for defining and initiating safeguards research projects on the evaluation and design of physical protection, material control and transport protection subsystems.

Additional research projects, defined in coordination with appropriate NRC offices, were initiated to investigate: the susceptibility of safeguards systems to white-collar crime; the impact on regulatory effectiveness of the structure and language of regulations; the regulatory priorities implied by the potential consequences of malevolent acts; alternative concepts for safeguards systems in various types of plants; and the information system requirements of the decision-making structure associated with safeguards implementations.

The Water Reactor Safety Research Program

SYSTEMS ENGINEERING

Integral Systems Tests

Integral systems studies for PWR LOCAs are being conducted in the nonnuclear Semiscale facility and in the LOFT facility, which does not yet have a nuclear core installed. The LOFT studies will be expanded in 1979 to include experiments with a nuclear core. These facilities and experiments are described below.

The Loss-of-Fluid Test (LOFT). The Loss-of-Fluid-Test facility is a 55-megawatt thermal (MWt) pressurized water test reactor at ERDA's Idaho National Engineering Laboratory. The facility is designed to accommodate study of nuclear, thermal-hydraulic, and structural phenomena occurring during a postulated loss-of-coolant accident (LOCA) in a PWR.

The major objective of the LOFT test program is to provide data to evaluate and improve the analytical methods now used to predict the LOCA response of a large PWR. Thus, LOFT has been designed to perform a number of loss-of-coolant experiments and provide measurements of system response. These measurements are compared with pre-test predictions to check the capability of computer codes. The first nonnuclear test in LOFT was run on March 4, 1976.

The LOFT coolant system has one active, heat-dissipating, operating loop which models the three normal (unbroken) loops of a four-loop plant, and a blowdown loop which contains special quick-opening valves to simulate pipe-break conditions. The blowdown loop discharges into a suppression tank designed to provide back-pressure conditions typical of current PWR containments.

The emergency core cooling system (ECCS) components and emergency coolant injection configurations of LOFT are similar to those used in large PWRs, and are designed to provide flow rates scaled to a large PWR. Three systems are provided for emergency coolant injection: (1) high-pressure injection pumps which can produce a small flow of high-pressure coolant for small breaks; (2) intermediate-pressure gas-driven water-filled accumulators which can inject a large volume of water into the reactor system; and (3) low-pressure injection pumps to provide large volumes of water for core cooling after a major primary system pipe rupture. The primary coolant system and ECCS are extensively instrumented, and ECCS injection points and flow rates are easily varied for experimental purposes.

The first core in LOFT will be 5.5 feet long and 2 feet in diameter, and will contain 1,300 PWR-type fuel rods. Should data be desired on full-length reactor cores, the LOFT reactor is designed to accommodate cores up to 12 feet in length. The system has more than 500 instruments to measure temperatures, flows, pressures, and coolant levels inside and outside the reactor vessel. The core fuel rods are instrumented with high temperature thermocouples designed and fabricated specifically for LOFT.

The LOFT facility is now in the final stages of construction. All system acceptance testing has been completed, as has steady-state flow testing at reduced temperature and pressure. Steady-state flow testing (referred to as hot functional tests) at a water temperature of 540°F and water pressure of 2,250 pounds per square inch (psi) has been completed to confirm normal operating design conditions.

Four nonnuclear tests were conducted in LOFT during fiscal year 1976. The first test simulated the equivalent of a 50 percent break in the hot outlet pipe of a PWR operating at 1,360 psi. The RELAP computer code, based on conservative assumptions, indicated that all of the water in the lower plenum of LOFT would be blown out during the test. The test results showed that the plenum had a considerable amount of water in it at the end of blowdown and that the system filled rapidly with emergency cooling water. Thus the test showed more favorable cooling than the calculation.

The second LOFT test simulated the equivalent of a complete break ("double-ended guillotine break") in the cold leg (reactor inlet pipe) of a PWR operating at 2,250 psi (full pressure). One of the key items of interest in this test was the amount of delay in ECC water delivery which might be caused by the hot walls of the

downcomer. This delaying effect had been a source of concern when the former AEC published the ECCS Acceptance Criteria (10 CFR § 50.46). The test results showed that the delay was insignificant.

The third and fourth tests were also run with a complete break and from full pressure but this time the emergency coolant was injected directly into the lower plenum (an alternate ECCS concept). The fourth test was basically a repeat of the third test because in the third test an inadvertent pretest closure of the ECCS accumulator valve prevented the delivery of the ECC water, although the system was properly activated. Nevertheless, both the high and low pressure pumps delivered emergency coolant when called upon. Thus, the third test provided useful information on degraded ECCS performance. The fourth test, which went according to plan, showed that the vessel was half-filled in 40 seconds—less time than the conservative computer codes predicted.

Some general conclusions may be drawn from these nonnuclear tests:

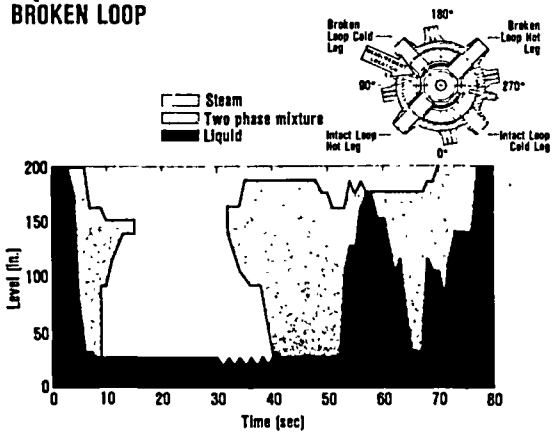
(1) The LOFT data either agree with pretest computer predictions or show less severe accident behavior than predicted.

(2) Comparisons of the LOFT performance with the much smaller Semiscale system performance indicate that effects of size are consistent with the computer modeling techniques used. This in turn gives added confidence in the modeling of the larger commercial nuclear plants.

(3) Very little emergency cooling water bypassed the core and no significant hot wall delay was found in the LOFT experiments.

The Semiscale Facility. The Semiscale facility is so-named because it is a scaled model of LOFT. It is a thermal-hydraulic test loop model of a pressurized water reactor in which the nuclear core is simulated using electrically heated rods. Semiscale is designed to provide thermal-hydraulic data to aid in development of computer models to describe loss-of-coolant accidents and to provide similar data to be used in LOFT test planning and instrument development. Semiscale consists of a pressure vessel (analogous to the reactor vessel), inlet and outlet water lines, pressurizer, steam generator and containment simulation system.

LOFT LOSS OF COOLANT EXPERIMENT L1-1 LIQUID LEVEL IN REACTOR VESSEL UNDER BROKEN LOOP

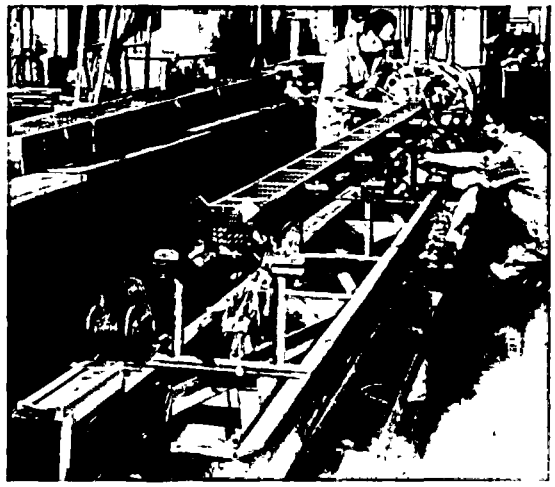


Knowledge of the location and amount of water or water-steam (two phase) mixture as a function of time is one of the more important pieces of information needed for verification of thermal-hydraulic calculations. The effects of emergency cooling water injection (which started at 29 seconds) can be seen as recovery of two phase mixture between 30 and 40 seconds. Other measurement locations showed liquid level recovery at earlier than the 50 seconds shown here.

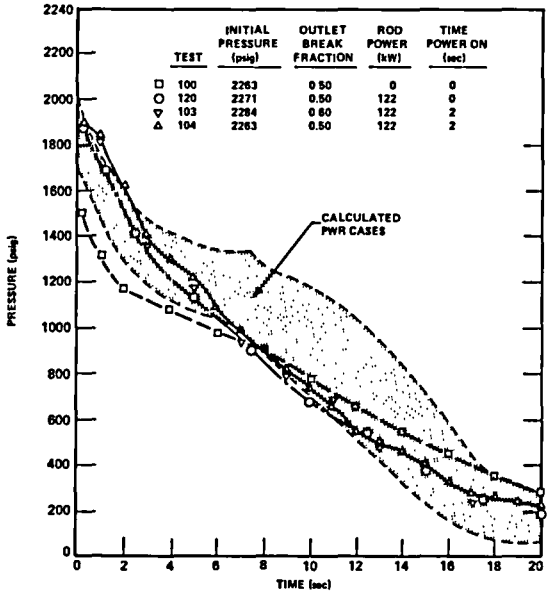
Semiscale has become a "production facility" because of its rapid generation of LOCA data. In fiscal year 1976, the Semiscale program completed:

- The LOFT isothermal counterpart test series, thereby enabling a scaling comparison to be made with the larger LOFT facility;
- The blowdown heat transfer test series which permitted the improvement of computer codes; and
- Twelve reflood heat transfer tests, which led to the development of a reflood predictive method for Semiscale and LOFT.

The Semiscale facility has provided the first integral system data on the various phases of a LOCA and has confirmed the capability of the available safety analysis codes to calculate the coupled thermal and hydraulic response of a complex system in a rapid transient. Improvements have been made in the codes as a result of these tests, and the improvements have led to closer agreements between succeeding pretest predictions and subsequently developed test data.



Overall view of a partially assembled test bundle for use in the Thermal Hydraulic Test Facility. The 49 electrically-heated rods are assembled in a rectangular shroud box connected to top flanges.



The assumed break location and depressurization rate in a hypothetical loss-of-coolant accident affect the calculation of cladding heatup. A wide range of experimental depressurization rates—including those assumed for all pressurized water reactors—is available at the Thermal Hydraulic Test Facility (at the Oak Ridge National Laboratory) for use in studying heatup of core rod simulators during depressurization.

Separate Effects Tests

Separate effects studies for PWRs generally conform to three sequential phases of a postulated LOCA: (1) the blowdown phase in which the pressurized coolant water is suddenly changed to a mixture of water and steam as the result of depressurization and is discharged from a break in a coolant-pipe, (2) the steam-water mixing phase during which steam leaves the pipe-break and the emergency coolant enters the reactor vessel, and (3) the reflooding phase in which emergency coolant reaches and cools the reactor core in place of the lost primary coolant.

Thermal Hydraulic Test Facility. During the past year, the facility checkout and operational testing of the first electrically-heated bundle in the Thermal Hydraulic Test Facility (THTF) were completed. The THTF, which is located at the Oak Ridge National Laboratory (ORNL), is a nonnuclear mockup (with a 7x7 array of 12-foot-long electrically heated rods) of a 15x15 PWR assembly, and is designed to simulate the blowdown phase of a postulated LOCA. Toward the end of the year problems were encountered with the electrical power supply, which could delay tests in fiscal year 1977.

Five blowdown tests were conducted in THTF covering the range from 25 percent to 100 percent of the reference 49-rod bundle power level (about 6 MWt). The tests were designed to assess the effects of pipe break location and size on the time needed to reach CHF (critical heat flux), the point at which the cladding can become overheated. The test data have been compared with the pretest predictions made with the RELAP computer code. The agreement was found to be good, giving added assurance that the analytical models can predict blowdown behavior in a full-length system.

Two Loop Test Apparatus. Depressurization heat transfer experiments applicable to BWRs are conducted under a program sponsored jointly by NRC, GE and the Electric Power Research Institute (EPRI). Separate effects and system response to a postulated LOCA during early depressurization are investigated. The test facility contains internal jet pumps, a

steam separator and an electrically heated, 49-rod bundle representative of a BWR fuel assembly. The test apparatus volume, flow paths, and initial operating pressure and temperatures are modeled on normal operating behavior and predicted LOCA behavior for BWRs.

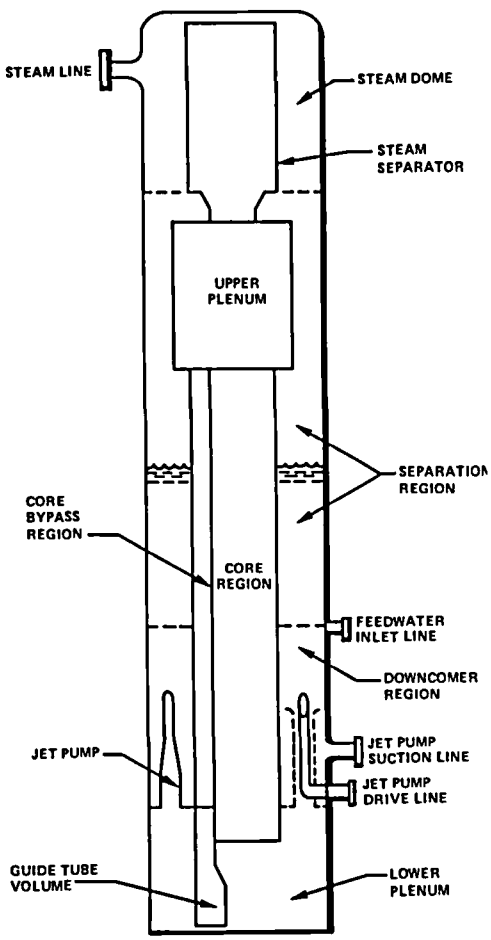
The final report (see Item 8 in report list at end of this chapter) indicated that the current BWR LOCA evaluation method, when applied to the test apparatus, showed a substantial margin in the prediction of the system blowdown performance and in the prediction of the peak cladding temperature.

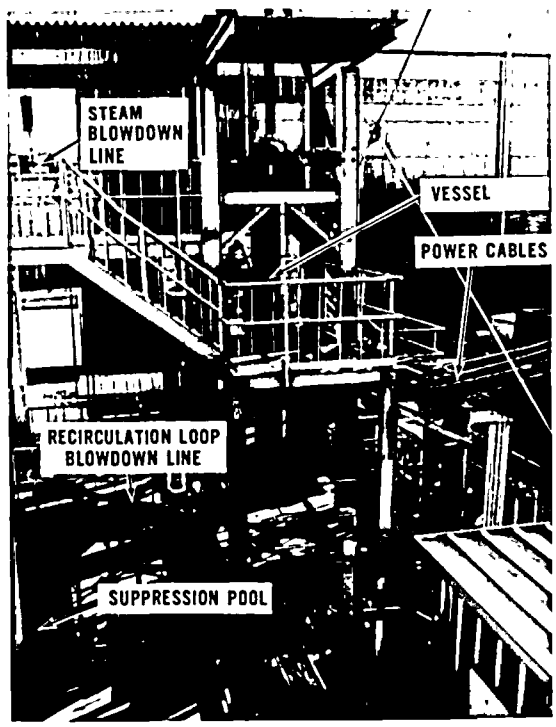
Pump Tests. The Electric Power Research Institute co-sponsored a two-phase (steam-water) pump test at Combustion Engineering Co.'s facilities in Windsor, Conn. The 1/5 scale pump data are needed to develop pump models for the loss-of-coolant accident analysis. The CE/EPRI Program is scheduled to initiate 4-quadrant, two-phase flow tests in the Spring of 1977. MPR (Washington, D.C.) is under NRC contract to compile a pump data bank and to assist in analysis.

Containment Tests. A research program for studying the mechanical effects of steam injection on the BWR Mark I torus-type containment has been initiated at Lawrence Livermore Laboratory (LLL) in California. These tests will complement the research programs being conducted in West Germany and in Sweden (Marviken Project). Experimental results will be available in fiscal year 1977.

Steam-water Mixing Tests. Separate effects tests on steam-water mixing phenomena and on ECC water penetration into the downcomer

TWO-LOOP TEST APPARATUS





At left is a diagram of the Two-Loop Test Apparatus Vessel used in the jointly funded (NRC, EPRI & GE) BWR blowdown heat transfer program. The sizing of all subsystem volumes was made on a 1 to 560 scale. A full sized, full power, electrically heated 49-rod bundle was used in the test. A photo of the whole Apparatus is above.

were conducted for NRC at the Battelle-Columbus Laboratories (BCL) and at Creare, Inc., in Hanover, New Hampshire. The tests were conducted with 1/15-scale models of PWR-like pressure vessels and were directed at assessing the degree of ECC bypass (failure to reach the lower core region) and lower plenum filling under conditions predicted for part of a LOCA. Basically, these tests are to provide data on the following topics:

Steam-water mixing. In the blowdown phase of the postulated LOCA, hot steam escaping from the vessel mixing with cool ECC water influences the motion of the cooling water entering the vessel.

ECC bypass. During the blowdown phase it may be possible for steam to block the incoming ECC water and cause this water to bypass the reactor core and flow out of the reactor.

Downcomer penetration. This refers to the amount of ECC water that penetrates through the downcomer (the space between the nuclear core barrel and the pressure vessel) and reaches the lower core region (lower plenum).

Hold-up. During the blowdown phase, ECC water may not reach the lower core region, but may remain for a while in upper parts of the reactor vessel rather than being bypassed. After the blowdown ends, this water would be available to run down and fill the lower plenum.

The fiscal year 1976 testing expanded the steady-state data base and provided initial transient results. The studies indicated that: (1) increasing the system pressure tends to retard the amount of ECC water penetration while (2) lowering the ECC water temperature tends to increase the amount of penetration. Preliminary indications show that the circumference of the downcomer (rather than its gap thickness) is the controlling dimension; however, it must be emphasized that this finding is based on 1/15-scale data. Larger scale tests in LOFT indicate that increasing the gap size will increase the penetration rate of the ECC water.

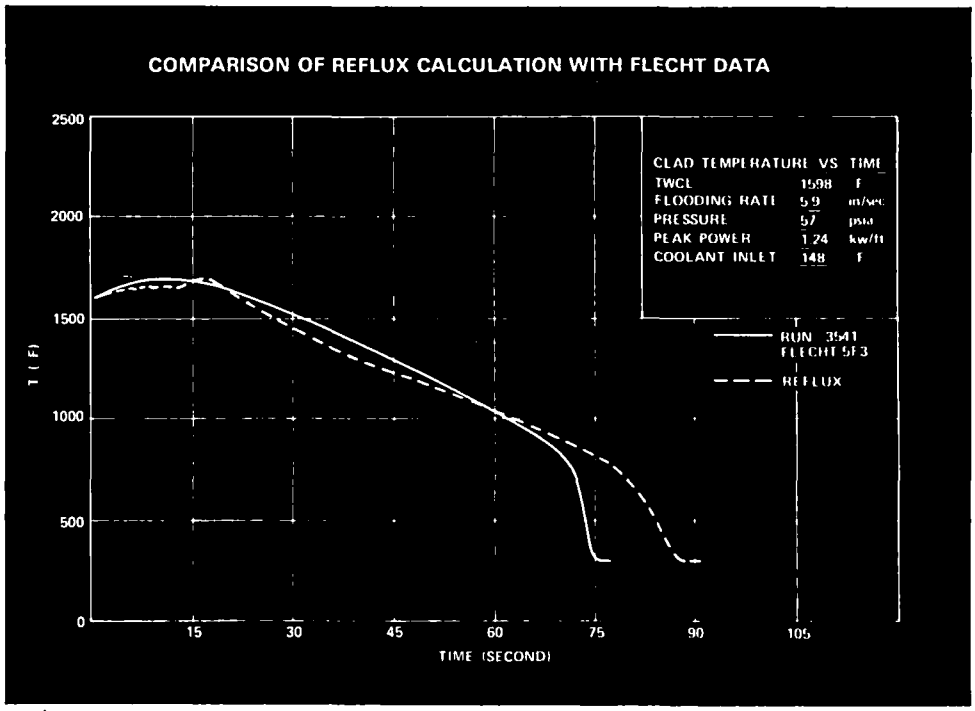
In addition, the applicability of small-scale experimental results to full-scale PWRs was addressed both analytically and experimentally, i.e., by testing at other sizes to verify scaling laws. Preliminary design of a 2/15 scale facility at BCL was undertaken with plans for testing in fiscal year 1977. A feasibility study was conducted to investigate the possibility of building a larger scale ECC bypass test facility to replace the cancelled Plenum Filling Experiment (PFE).

Cancellation of Plenum Fill Experiment (PFE). The PFE, which had been the major experimental program concerning ECC bypass and steam-water mixing phenomena, was cancelled after NRC had determined that the desired results could not be achieved with the existing program.

The PFE program, as originally proposed, was to have used two existing vessels, 1/5 and 4/5 of the actual size PWR vessels, and an existing, but decommissioned, steam plant, with experiments starting in mid-1974. The original estimate of the total cost of the program was about $2 million. Since initiation of the program by the former AEC in 1973, the projected total cost had risen to about $36 million with the start of testing delayed until May 1979.

In addition, NRC found that new boilers would be required to provide the necessary steam, and that the larger vessel would have to be replaced since it could not withstand the pressures required for the experiments. The NRC is considering the pros and cons of a facility in the range of ⅓ to ½ scale that could be built by fiscal year 1981.

Reflooding Experiments. To investigate performance of nuclear reactor fuel rods during the reflood phase of a postulated LOCA, the Full Length Emergency Cooling Heat Transfer (FLECHT) facilities are being utilized under joint sponsorship by NRC, EPRI and Westinghouse. The facilities are similar to those used in the initial FLECHT studies conducted several years ago by the AEC, but employ improved techniques to measure the coolant distribution below, inside, and above the 12-foot length, 100-rod bundle. The rods are heated electrically. Two heat distribution profiles are used to represent different stages of reactor core lifetimes. One has the heat generation peaked near the center and the other has the heat generation peaked near the top. Additional tests with the center-peaked bundle were completed during the past year to study the effects of low reflood rates, and tests with the top-peaked bundle were initiated in July 1976 after completion of a redesigned rod bundle housing.



The computer code REFLUX was written at the Massachusetts Institute of Technology to provide a physically based calculational method for prediction of reflood heat transfer in a PWR LOCA, and was based on FLECHT data.

Correlations are being developed to describe the heat transfer during the reflood phase of a LOCA. These correlations will be incorporated into computer codes to provide a more realistic (that is, less conservative) picture of what occurs as the ECC water moves into the core.

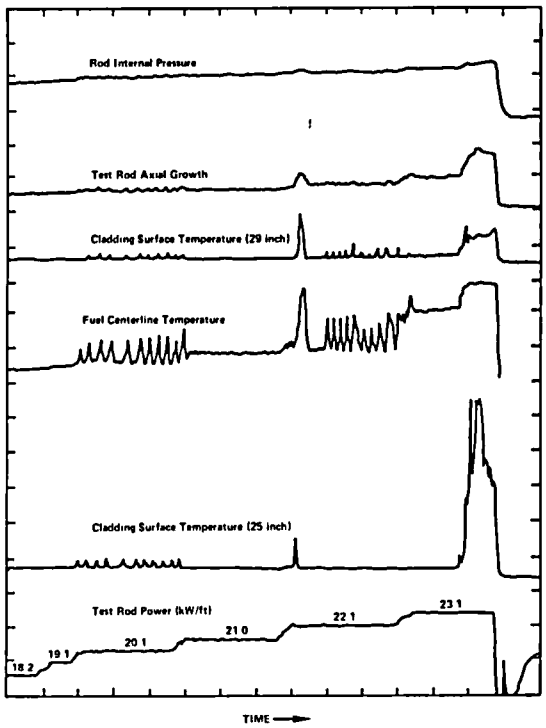
FUEL BEHAVIOR

The escape of radioactivity from nuclear power plants is prevented in part, by barriers designed into the structural and operational features of the plants. One such barrier is the cladding around the nuclear fuel pellets. An important goal of reactor safety research is to improve the understanding of the response of fuel element pellets and cladding to a postulated nuclear accident. The research programs in this area involve laboratory studies and in-pile tests, i.e., experiments conducted in an operating nuclear reactor. These activities provide data for the development of analytical computer codes, which in turn are verified by comparing predictions with results of additional experiments.

Power Burst Facility Tests

In-pile testing is conducted in the Power Burst Facility (PBF), a 40-MWt test reactor for fuel damage studies at INEL. Plans for PBF include tests characterized by type of postulated accident, i.e., flow blockage, power/cooling mismatch, and power excursion. A nuclear-fueled driver core provides neutrons to heat up test fuel rods placed in a centrally located in-pile tube.

By the end of fiscal year 1976, nine experiments had been conducted in PBF, utilizing a total of 20 highly instrumented fuel rods. Eight of these rods had been previously irradiated. The experiments were of three types: gap conductance, which measures how much heat is transferred across the gap between the fuel and cladding; flow coastdown, which measures the rod behavior as the coolant water flow decreases; and power ramp, which measures the rod behavior as the power level is increased.



Fuel rod peak power, cladding surface temperature, fuel temperature and other measurements are shown for a PBF experiment. At a power of 23 Kw/ft (the maximum in a reactor might be 16), the fuel cladding showed a large sustained temperature increase at 25 inches from the bottom of the 3-foot long fuel rod, thus indicating a change from nucleate boiling heat transfer (good) to film boiling heat transfer (poor). Although PWR design and operation (e.g., maximum linear power limits) are expected to preclude this behavior, it is desirable to know the extent to which fuel rods can withstand temperature excursions.

In some of the flow coastdown and power ramp tests the center of the uranium dioxide fuel pellets reached the melting temperature (about 5,000°F). Some cladding collapse onto the fuel pellets was observed, as well as some chemical attack on the cladding by the water and fuel.

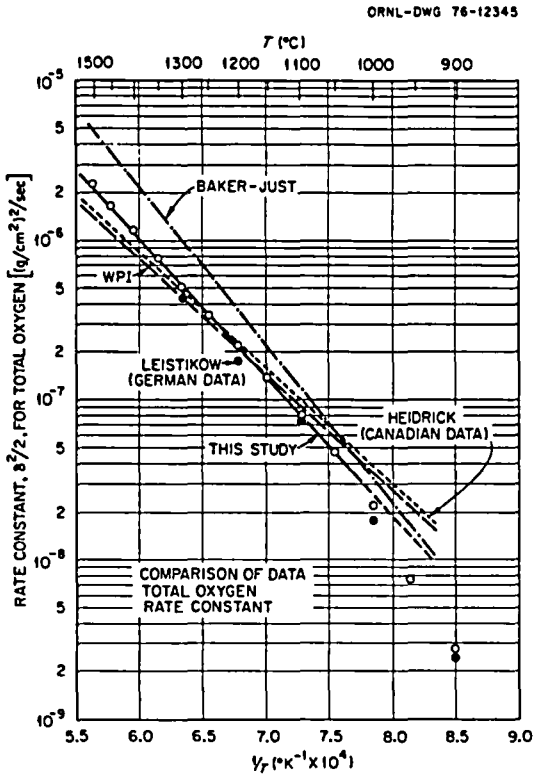
Interestingly enough, despite the presence of molten fuel and severe mechanical interactions, none of the tests caused the fuel rod cladding to fail at power. The results of these tests have led investigators to conclude that propagation of the failure from one rod to another, under conditions similar to those of these tests, is unlikely.

Dr. Edward A. Mason (left), USNRC Commissioner, and Dr. Eiji Munakate, President, Japan Atomic Energy Research Institute, sign an agreement between the two organizations in Tokyo on March 9, 1976. The agreement provides for research participation and technical exchange in the U.S. Power Burst Facility program and Japan's Nuclear Safety Research Reactor program.

Other Highlights in the Fuel Behavior Program. The experimental data on the oxidation rate of zircaloy fuel rod cladding are being assembled in final form. The results to date show that the oxidation rate of zircaloy at high temperature (about 2,200°F or 1,200°C) is only one-half to two-thirds the rate used in conservative licensing evaluation calculations. Since the oxidation of zircaloy in the steam produced in a LOCA could add additional heat to raise the cladding temperature (and further weaken the cladding) and lead to the production of hydrogen (which could burn), this reduced oxidation rate indicates a conservatism in the licensing models.

Since oxygen-contaminated zircaloy may be brittle, it might not withstand either the forces calculated to occur during a LOCA or the thermal shock caused by the quenching action of the cooler ECC water. Thus it is necessary to understand the way in which oxygen diffuses into the cladding. The latest experimental results show that the rate of diffusion of oxygen into zircaloy is only half of the value used in licensing evaluation calculations.

The mechanical behavior of zircaloy is being studied. Recent burst tests of zircaloy cladding have shown less deformation (also referred to as ballooning or circumferential strain) than was observed in previous tests sponsored by the



Comparison of zircaloy oxidation rate measurements with the Baker-Just line which is used in NRC licensing calculations. The NRC-sponsored data (open circles) agree well with data from foreign programs and an Electric Power Research Institute sponsored program (WPI line). Zircaloy is the material used in nuclear fuel rod cladding.

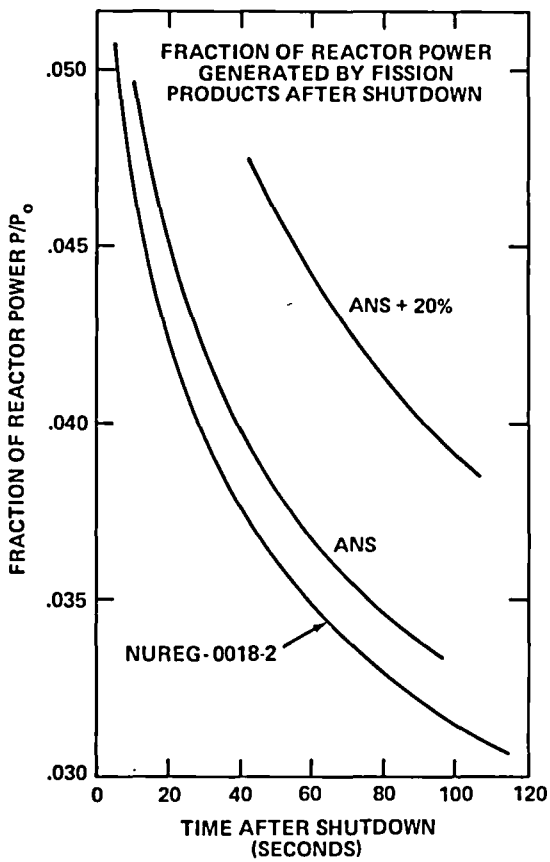
former AEC. The previous tests were conducted in an inert (rather than steam) atmosphere with unrealistic internal gas volume and axial constraint conditions. This means there will be less likelihood of the cladding ballooning out to block the flow of cooling water in a LOCA.

One of the energy sources which could raise the temperature of the cladding during an accident is the stored heat in the fuel. Experimental data obtained from irradiation of fuel assemblies in the Norwegian Halden reactor suggest that the fuel centerline temperature is lower than predicted by licensing evaluation methods.

The NRC's ECCS Acceptance Criteria (Appendix K of 10 CFR Part 50) require the decay heat, which is the source of heat available in a LOCA, to be calculated on the basis of an American Nuclear Society standard with a 20 percent uncertainty factor added. NRC-sponsored experiments at ORNL and LASL and analysis at Oregon State University indicate an average uncertainty of 5.9 percent.

The computer codes FRAP-T (Fuel Rod Analysis Program—Transient) and FRAP-S (Fuel Rod Analysis Program—Steady State) are being revised to incorporate the recent experimental results.

In addition to fuel rod damage studies, NRC is sponsoring research on phenomena associated with hypothetical fuel meltdown accidents. This research has been promptd by the *Reactor Safety Study* which noted that the only way to release potentially large amounts of radioactiv-



Best estimate decay heat calculations reported by Oregon State University (NUREG-0018-2) are compared to the American Nuclear Society Standard curve and the present NRC licensing criteria (ANS+20%). Integral experimental data from ORNL and LASL confirm the new calculations.

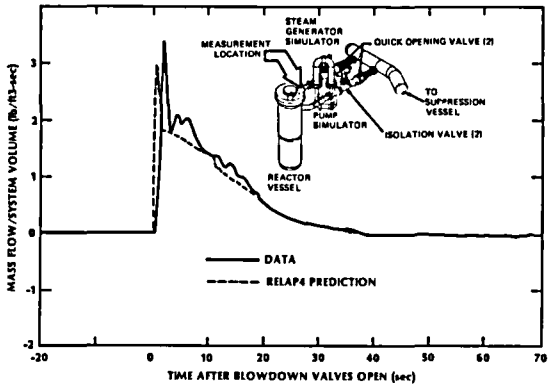
ity would be to melt the fuel in the reactor core. The meltdown studies address such subjects as molten fuel interactions, fission product release and steam explosion phenomena. Some preliminary observations and conclusions from experiments on molten material in the presence of concrete (similar to that used in reactor containment structures) indicate the principal thermal erosion mechanism is quiescent melting of the concrete matrix with little effect from thermal shock (see item 13 in report list at end of this chapter).

ANALYSIS DEVELOPMENT

As noted early in this discussion, computer codes form the basis of nearly all research methodologies employed by NRC.

Complex digital computer codes can be used to compute the time and space dependence of important factors during total or partial accident sequences, and effects which might occur if an accident ever took place. The credibility of using such codes in reactor safety assessment is based on the success achieved in using the codes to predict results of safety research experiments and on the validity of the scaling concept.

L1-2 MASS FLOW/SYSTEM VOLUME
IN BLOWDOWN LOOP COLD LEG



The primary objective of the LOFT tests is to provide experimental data to validate the thermal-hydraulic codes such as RELAP-4 used in analyzing hypothetical transients in large pressurized water reactors. The comparison above illustrates RELAP-4's capability to predict the transient mass flows in the operating loop cold leg of LOFT for a simulated double ended cold leg break.

Code development and application have a high priority in the NRC research program.

This code development effort follows a multi-path approach. While existing codes are being improved, advanced component and system codes are being developed.

Improvements of Existing Codes

The improvement of existing codes continues to have a high priority. System codes (such as RELAP-4) and component codes (such as COBRA and KACHINA) are involved.

RELAP-4. This code, developed at INEL, has two versions: The "evaluation model" version (used by the NRC staff in its licensing activities) provides conservative analysis through incorporation of NRC's ECCS Acceptance Criteria. The "best estimate" version, on the other hand, incorporates realistic (not necessarily conservative) mathematical descriptions of the system, and is useful for code verification (by comparing code predictions and test data).

Improvements to RELAP-4, developed over the past year, were concerned with modeling of particular two-phase flow processes as well as with computational efficiency. These improvements have been tested by using THTF, Semiscale and LOFT data.

COBRA-IV. This code, developed at Pacific Northwest Laboratories, is a multi-dimensional numerical simulation of a reactor core. The principal effort during the past year was directed at developing COBRA into a working tool for multi-dimensional PWR reflood analyses. This effort produced the COBRA-IV/ACE code which now has the necessary numerical capability to address fluid flow during reflood. Improvements in heat transfer and the quench front propagation have not yet been completed.

KACHINA. This code was developed at Los Alamos Scientific Laboratory (LASL) to analyze multidimensional effects in transient two-phase flow in simple multi-dimensional geometrics. During the past year, it has been modified to include the capability to simulate thermal-hydraulic processes which take place in a PWR downcomer during ECC water injection. This new version of KACHINA, called

K-TIF, is being run presently to analyze data obtained from ECC bypass experiments conducted at various laboratories, such as BCL and Creare, Inc.

Advanced Systems Code for LOCA

The development work is continuing on two advanced systems codes for describing a LOCA. This development work was prompted by some known deficiencies in the present system code (RELAP-4) which cannot account for the effects of thermal nonequilibrium and unequal velocities between the steam and water phases. The most elaborate advanced LOCA code, named TRAC, is being developed at LASL for "best estimate" analyses in which the flow processes inside the reactor vessel will be described multi-dimensionally. Brookhaven National Laboratory is developing a somewhat simpler but faster running advanced code, named THOR, which will subsequently be cast into a conservative form for replacement of the present evaluation model. Both codes make use of advanced modeling and numerical techniques to describe complex phenomena. Both THOR and TRAC codes are modular in form (each module describes a particular component of the reactor or a particular process) in order to permit easy updating and improvement.

To date, numerical techniques for both codes have been established and the modeling of several components (such as reactor core, pumps, pressurizer, steam generator and break flow) has been completed.

In order to establish the capability of advanced LOCA codes even before all modules have been assembled to describe the entire reactor system, computer runs are being made using individual modules. The results obtained from these computations are in the process of being compared to available experimental data. Thus, each module is tested separately for modeling accuracy and computational efficiency before being incorporated in the system code.

Advanced Containment Code

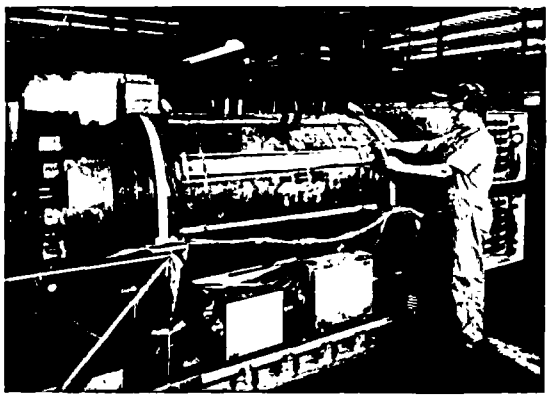
Two new code development programs have been initiated this year to analyze containment phenomena. The INEL is developing a containment code (called BEACON) which will be applicable to both BWR and PWR containment systems, whereas Lawrence Livermore Laboratory is developing a variety of codes for analysis of pressure suppression pool dynamics in BWR containment. All new containment codes are multi-dimensional (where needed) and use advanced numerical and modeling techniques.

METALLURGY AND MATERIALS

NRC-sponsored metallurgy and materials research is related to the integrity of the primary system pressure boundaries (vessels, components and piping) in LWRs. These heavy-walled vessels, components and pipes must remain intact at all times, since failure could lead to a loss of coolant accident. The ability of the steel vessel, components and piping to retain integrity throughout operating and accident conditions is governed by (1) the material properties and the response of the steel to the reactor environment, and (2) the size and orientation of any flaws that may exist in the vessel, components or piping. NRC research activities in these two areas during 1976 are discussed below.

Material Properties and Environmental Response

The research approach is to formulate analytical procedures for prediction of the behavior of reactor vessels, components or piping under operating and postulated accident conditions. Experiments are then performed to test both the steel and the structures to be sure that the predictions give the correct answers. Studies are conducted to provide a better understanding of the conditions under which cracks initiate and arrest, how they may grow under fatigue loading, how reactor neutron radiation affects the properties of steel, and the consequences to vessel integrity from different stresses. The influence of flaws of different sizes is given much importance, and the



A closeup view of the Heavy Section Steel Technology (HSST) program intermediate test vessel (ITV) number 7A. Before the test, a section of the 6" thick wall (to the left of his hands) was intentionally flawed 5.2" deep. The 8-ton ITV was then pressurized with nitrogen (pneumatic loading) rather than with water (hydraulic loading) as in previous tests.

experimental work is conducted at carefully selected and controlled temperatures and stress levels.

Size and Orientation of Flaws

This task area deals with the behavior of reactor components containing flaws when the components are subjected to stresses typical of operational or postulated accident conditions. Reactor performance under such conditions is predicted by a procedure called analytical fracture mechanics. Experiments are conducted in which stresses are applied to materials containing flaws of differing severity, and the results are used to validate predicted or measured fracture toughness of the material and resulting component performance.

Structural Integrity of Pressure Vessels

A central activity has been the pressurization-to-failure of deliberately flawed, 6-inch thick steel pressure vessels under hydraulic loading, at the Oak Ridge National Laboratory. The vessels were made of A533-B and A508-C1.2 steel; some vessels also contained nozzles. Overpressures two to three times design pressure were required at both low and high test temperatures to cause the vessels to either leak or break, despite the presence of large flaws. These results have validated the failure-analysis procedures for application to reactor pressure vessels.

An intermediate size pressure vessel tested by ORNL in 1976, under pneumatic (gas) rather than hydraulic (liquid) loading conditions, confirmed the prediction that the sustained pneumatic load would not continue to open up a very large flaw once the flaw had grown completely through the vessel wall. In fact, the deliberately flawed vessel sustained more than twice its design pressure before the forced failure occurred. This pressure level is more than 50 percent greater than the highest pressure level that might occur in a reactor pressure vessel under the maximum postulated accident conditions. Two more intermediate test vessels will be tested in fiscal year 1977, both tests designed to evaluate the structural integrity of weld repairs made in pressure vessels, according to American Society of Mechanical Engineers (ASME) recommendations.

A different kind of stress is applied to a reactor vessel under conditions of a postulated loss-of-coolant accident followed by emergency core cooling system operation. This is a thermal stress which would arise from the injection of cold ECCS water into the hot reactor pressure vessel.

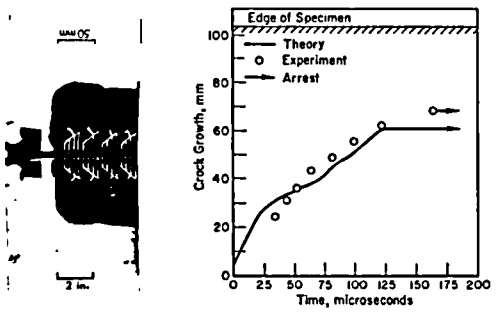
Three thermal shock tests were completed in fiscal year 1976 at ORNL using 21-inch diameter test cylinders, in order to verify predicted crack initiation and propagation behavior. In two cases, crack initiation at the deliberately placed flaws was predicted and occurred. In the other case, it was predicted that the crack would not initiate, and this was confirmed by the experiment. Further validation of the analytical predictive method for thermal shock analysis will be obtained in fiscal year 1977 by additional tests.

Complementary studies are being conducted at the Naval Research Laboratory (NRL) to characterize more fully the specific aspects of bending and resistance to crack propagation of steel cylinders under thermal shock loading conditions.

Crack Arrest

If an applied stress is enough to cause a crack to grow rapidly, arrest of that crack becomes a safety consideration. NRC and the Electric Power Research Institute are coordinating their programs to study crack arrest. Priority has been assigned to development of a theory to characterize the dynamic propagation and arrest of a crack that will be applicable to test specimens of different geometries and to reactor pressure vessels and piping lines. Testing is being performed at Battelle Columbus Laboratories (BCL) on reactor pressure vessel steels, using several specimen geometries. At the University of Maryland the same specimen geometries are under test, but the materials are plastic. The Maryland approach provides the unique advantage that both dynamic stresses and the running crack can be observed and photographed for later analysis. At BCL in 1976, computer analyses were developed to describe several important specimen types, and experimental data were obtained on crack speed and energy distribution throughout specimens. Good correlations are now being achieved between computer analysis predictions and experimental results of crack arrest test specimens, which will greatly aid the establishment of a standardized specimen and test procedure in fiscal year 1977.

Following the standardization efforts, a bank of data will be developed on the crack arrest properties of reactor pressure steels in both unirradiated and irradiated states.



(a) Single Edge Notch Test Piece with Timing Circuit

(b) Comparison of Theory with Experiment

Research to verify crack arrest theory for nuclear pressure vessels is being conducted at Battelle Columbus Laboratories. A fast running crack was produced in the laboratory specimen of commercial steel shown at left. The data points at right show the change in the crack length measured during the experiment (note that a microsecond = 1/1,000,000 second). The solid line in (b) gives the result of a computer calculation employing crack arrest theory. The crack traveled at a speed of 0.7 mm per microsecond—over 1500 miles per hour—and stopped close to the predicted location.

Radiation Embrittlement

The most significant effect of neutron irradiation of steel is a reduction of the fracture toughness, i.e., a reduced capability to remain structurally adequate under stress in the presence of a flaw. During 1976, the NRL performed irradiations of different steels with varying amounts of residual elements, which were suspected of being influential in promoting greater radiation damage to pressure vessel steels. These tests will be completed in 1977.

Fracture Toughness

The ability of a material to remain structurally adequate in the presence of flaws and applied stresses is termed fracture toughness. To assure the conservatism of ASME reference fracture toughness criteria for reactor pressure vessel steels, and to verify the procedure for its use under irradiation, very large, highly irradiated specimens of reactor pressure vessel steel must be used for the test program.

The second major irradiation of 4-inch thick fracture toughness specimens was conducted in 1976 at ORNL at the Bulk Shielding Reactor. The materials being examined are from three separate welds whose post-irradiation fracture toughness properties are expected to be severely degraded by neutron irradiation. The test results, to be obtained by the Hanford Engineering Development Laboratory in 1977, are expected to greatly improve NRC's ability to evaluate the actual toughness that can be expected in service from such materials. Because of the importance of fracture toughness in irradiated materials, a third irradiation of very large specimens of similar materials is also planned for 1977.

Crack Growth

Existing flaws in materials can grow under repetitive or cyclic loads associated with normal plant operation. Thus, an important reason for the study of flaws or crack growth is that the increased severity of the larger flaw or crack might cause component failure or leak. An important objective is to assure that the ASME code criteria related to crack growth are sufficiently conservative.

Testing programs at the Naval Research Laboratory, General Electric, and Westinghouse are directed toward obtaining a better understanding of the growth of cracks under loadings and environmental states experienced during normal plant service. The environmental conditions addressed include neutron irradiation; high temperature; high pressure, water or steam; high average stresses; and loading rates similar to those encountered in service. Accordingly, NRC is directing a coordinated program in cyclic crack growth rate evaluation. A test program to establish the critical parameters affecting crack growth rates was started in 1976 and will be completed in 1977. Larger scale testing will get underway in 1977.

Non-destructive Examination

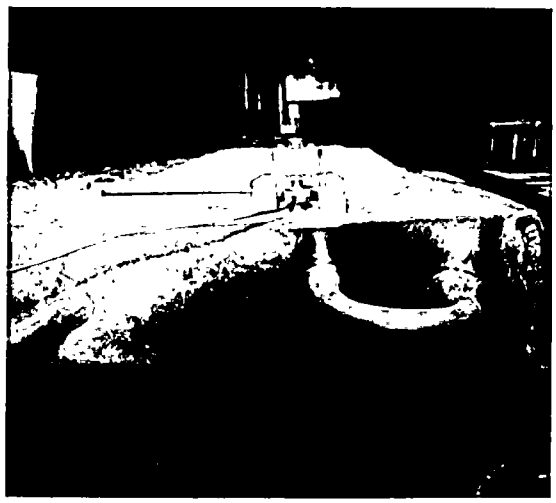
This task area is aimed at improving the methods used for finding flaws in steel pressure vessels or in piping and for evaluating the significance of those flaws depending upon their size, location and orientation in the component. The technique used most often for inservice inspection is ultrasonic testing (UT). The capability of UT to detect smaller flaws with better definition is being actively studied. Regarding fabrication inspection, the detection and location of cracks that form during the welding process are being studied with great success, using acoustic emission generated by the cracking process.

Ultrasonic Testing

This procedure depends on very high frequency sound waves bouncing off flaws deep within a material, much the same way that radar is used to locate and track aircraft. The ultrasonic echoes can be analyzed to locate flaws and estimate their size and shape.

In research conducted for NRC at the University of Michigan during 1976, an ultrasonic transducer (which sends and receives the signals) was moved over the piece to be inspected in a series of many small, discrete steps. The echoes were all stored, analyzed and processed on a computer which then synthesized the information from all the locations into a graphical representation of the flaws contained in the inspected part. This single transducer, coupled with the data processing, simulated an array of many separate transducers. The resulting representation of the flaw has sufficient accuracy in location, depth, length and orientation that it can be used to meet the requirements for flaw evaluation set forth in the ASME Boiler and Pressure Vessel Code, Section XI on Inservice Inspection.

In addition to improving the two-dimensional flaw representation into three dimensions, work in fiscal year 1977 will be directed toward transferring this laboratory technology into field application for eventual routine use in reactor plant inservice inspection.



Acoustic emission monitoring equipment is used for real-time, in-process nondestructive examination of piping welds. Results of tests by General American Research Division, GATX Corp., show that acoustic emission monitoring is very effective at detecting cracking type flaws during the welding process.

Weld Flaw Detection

As weld metal cools and solidifies, it shrinks. If the welding conditions and machine settings are not correct, the weld puddle may crack as it shrinks. There is no guarantee that subsequent weld beads will close these cracks. As weld cracks form, they emit sound waves—acoustic emission—which can be used to warn the welder of improper welding procedures, as well as to locate the cracks precisely. Thus, cracks can be found and repaired while they are accessible—not covered by subsequent weld beads.

Techniques for acoustic emission monitoring of welding are being developed for NRC by GARD, Inc. (Niles, Illinois). GARD demonstrated that acoustic emission monitoring can find flaws during welding of heavy section steel plate. A further major effort in 1976 has been the construction of a prototype weld monitor and its placement in a nuclear piping welding shop for collection of data on weld flaw monitoring during routine production welding. Excellent correlations are being developed between acoustic mission flaw indications and the flaws themselves, as uncovered by other non-destructive techniques or by weld-repair grinding techniques.

The goal for the end of fiscal year 1977 is to build and prove acoustic emission monitors for use in fabrication shops, and to document (for the ASME code) the ability of acoustic emission to equal or better the performance of conventional techniques for nondestructive examination of nuclear components.

Detection of Sensitization

The heat input during welding of stainless steel piping must be carefully controlled because excessive time at elevated temperatures can sensitize the steel microstructure; this could result in stress corrosion cracking in highly stressed pipes in the presence of oxygenated water. Once a weld is made, normal visual examination cannot reveal if sensitization has resulted from the welding process. The microstructural changes, however, also cause a change in the electrochemical properties of the steel, and this can be detected by nondestructive techniques. Research employing this technique is being conducted by the General Electric Co. for NRC, and during 1976 good correlations have been developed between measurements of electrochemical parameters and sensitization. The results are already being incorporated into material selection and preproduction qualification tests.

Continuing work in fiscal year 1977 is directed toward verification of the laboratory results for realistic field inspections and development of specifications for field inspection test units.

Steam Generator Tube Integrity

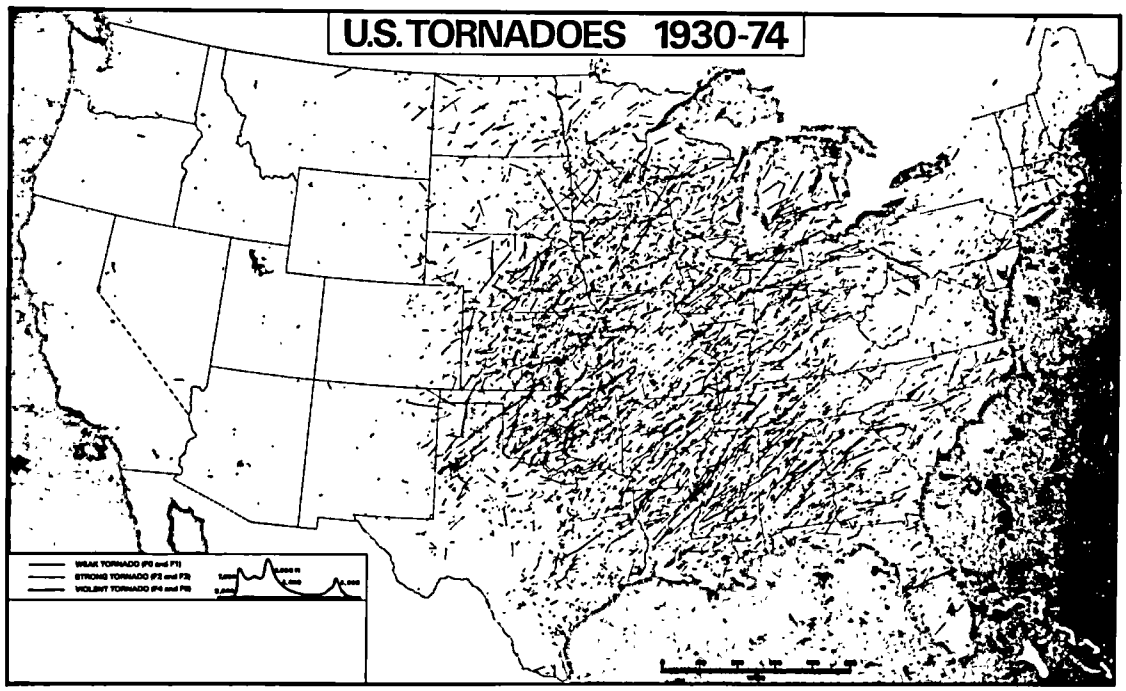
As mentioned in Chapter 2, NRC initiated a program at Battelle Pacific Northwest Laboratory to (1) carry out a selected number of burst and collapse tests on baseline and artificially defected tubes representative of the tubes presently installed in PWR steam generators; and (2) develop criteria to be applied to the evaluation of remaining life of tubes in which flaws are found during inservice inspections of PWR steam generators.

SITE SAFETY RESEARCH

Potential effects on nuclear facilities of earthquakes, tornadoes, floods, and other natural phenomena are considered by NRC in the licensing process. Research in safety related aspects of siting focuses on the characteristics and distribution of severe natural phenomena in the U.S., and upon the engineering methods which are used to mitigate the effects. The information developed is used by the NRC in the evaluation of sites during the licensing process and to provide bases for improving siting guides and criteria.

Much of the research is done in cooperation with other government agencies including the U.S. Geological Survey, National Oceanic and Atmospheric Administration, and the National Science Foundation. General scientific guidance is provided by the National Academy of Sciences. Cooperative studies also are conducted

In a study sponsored by NRC's Office of Nuclear Regulatory Research, the National Oceanic and Atmospheric Administration and the Colorado State University penetrated waterspouts off Florida with instrumented North American T-28 aircraft, to measure wind velocities in the waterspouts with laser beams. The study was one of NRC's projects to determine the characteristics of severe weather phenomena in connection with the siting and safety design of nuclear power plants. (Photo by Libbi McLaughlin, Key West, Fla.)



The paths of 19,189 tornadoes which occurrred in the United States between 1930 and 1974 have been plotted on the above map by T. T. Fugita, University of Chicago. The research was conducted under NRC contract and grants from other agencies.

with many State agencies, especially State geological surveys. The non-governmental contractors are mainly universities, but industrial research firms also provide special capabilities and practical studies in their areas of expertise. During the past year, the State cooperative programs have increased significantly.

The cooperative governmental programs have noteworthy benefits. A wide range of professional talent is available for application to NRC research requirements; other studies which are conducted by the cooperating agency in related areas also benefit. Effectively, this means that results of greater depth can be obtained at lower costs. Close coordination of efforts ensures that NRC mission-oriented requirements are met and that duplication of effort is avoided.

Emphasis on earthquake studies in the Eastern U.S., where the number of prospective sites is greater, has continued. Microearthquake detection networks are now installed in the Charleston, S.C.; New Madrid, Mo.; and Anna, Ohio areas to study the activity, in those regions with historic occurrence of large earthquakes, which influence seismic design. The Northeastern U.S. Seismic Network is operating for similar reasons, but covering the larger area encompassed by those States. A bulletin of events is published quarterly by the University of Connecticut Marine Sciences Institute for use by the different investigators and the earth sciences community. More specialized networks are being installed in other areas to study the cause and possible localizing features of earthquakes and to provide information on the state of stress in the crust. The ultimate goal of these studies is to provide a stronger basis for the assignment of earthquake intensity to different siting regions for design purposes.

Emphasis in the meteorological studies continues on development of measurement capabilities for wind speed and other parameters of tornadoes. These will be applied to calibrate intensity scales based on damage assessment of specific tornadoes, for which a large statistical data base exists. The statistical data are being compiled and evaluated concurrently, so that the final products will define the distribution of tornado intensities in more reliable and quantitative terms for the U.S. and will improve estimates of maximum wind speeds and pressure changes to be used by nuclear facility designers.

Field tests are conducted to verify and compare mathematical models used to describe atmospheric turbulence and dispersion over different types of terrain and under different meteorological conditions. Wind tunnel simulations of some of the field tests have been conducted to determine the relationships between field, mathematical, and physical model results.

Studies at the University of Florida of flooding resulting from hurricanes at coastal regions continue, and a tsunami (tidal wave) atlas of the U.S. coasts is nearing completion by Tetra Tech, Inc. These will assist in evaluating flood potential at specific coastal sites.

Engineering studies continue on the response of foundation materials to earthquake motions and loading, and on the response of concrete structures. These studies are intended to confirm evaluations and criteria used in seismic design (see item 26 in report list at end of this chapter).

OPERATIONAL SAFETY

NRC has expanded its research into reactor operational safety matters; specifically, fire protection and qualification testing evaluation. The programs were initiated to evaluate the currently utilized standards and guides in these areas.

During fiscal year 1976, a fire protection research plan was written based on the general recommendations of NUREG-0050, "Recommendations Related to Browns Ferry Fire," and reflecting the specific needs of NRC user offices (NRR, SD, IE). Research addressing the confirmation of the effectiveness of cable tray separation criteria to assure prevention of the spread of a fire between electrical cables of redundant safety systems is currently underway and research addressing the effectiveness of protective coatings, fire breaks, fire barriers and penetration fire stops will be initiated in fiscal year 1977.

The qualification testing evaluation research was started in fiscal year 1976 combining separate research programs already underway by NRC. The current research program is aimed

at evaluation of the Class I equipment qualification testing curently used to verify the performance of safety equipment during and following a loss-of-coolant accident. Specifically, questions of aging, nuclear source definition resulting from the accident and evaluation of synergistic effects of combined radiation and steam environment testing are all being studied.

An overall qualification testing evaluation research plan will be prepared in fiscal year 1977 covering all aspects of the loss-of-coolant-accident issue. Other areas of qualification testing evaluation will be included in the program as they are identified.

FOURTH WATER REACTOR SAFETY RESEARCH MEETING

The NRC Division of Reactor Safety Research held its Fourth Water Reactor Safety Research Information Meeting on September 27-30, 1976 at the National Bureau of Standards, Gaithersburg, Md. More than 70 papers were presented describing the latest results and significant research achievements in: (1) loss-of-coolant accident studies, (2) metallurgy and materials, (3) fuel behavior research, and (4) analysis development.

In addition to the review of NRC-sponsored water reactor safety research, the meeting included presentations on several foreign reactor safety programs as well as one session on research sponsored by the Electric Power Research Institute (EPRI). A wealth of technical data and experimental results were reported with emphasis on the manner in which the data are applied to validate computer codes for obtaining a better understanding of nuclear reactor safety. More than 635 persons participated in the four-day meeting, including 126 foreign visitors from 14 different countries. Summaries of papers presented at the meeting are available for review at NRC's Public Document Room in Washington, D.C.

Advanced Reactor Safety

Two types of advanced reactors—the liquid-metal-cooled fast breeder reactor (LMFBR), and the high-temperature gas-cooled reactor (HTGR)—are the focus of this program.

The fast reactor program aims at providing confirmatory data to assist in the licensing process on a schedule commensurate with ERDA's program for LMFBR commercialization.

The gas-cooled program centers on generic issues of HTGR safety, pending the outcome of ERDA-industry development efforts.

Fast Reactors

The current licensing action for LMFBRs concerns ERDA's Clinch River Breeder Reactor (CRBR). While most of the NRC's LMFBR research program will produce results further out in time, some work in 1976 has been performed which aids in NRC's review of the CRBR. This work is chiefly in the areas of severe accident analyses and radiological source assessments.

Most of the work has a long-term pay-off, although results obtained in 1977 may be of use to the CRBR review. The program is divided into five areas:

Analysis: Computer codes and mathematical models are created to enable one to predict how a plant would behave under a wide variety of extreme conditions. This effort, when properly verified by experiment, avoids the need for a repetitious series of costly and destructive tests. It is the backbone of the safety research effort.

Safety Test Facility Studies: The need for new facilities to conduct special reactor safety tests is studied to determine the facility specifications. These specifications are transmitted to the Energy Research and Development Administration for incorporation into their construction plans. These studies also consider special equipment needs and the details of the safety tests.

Aerosol Release and Transport: The assessment of the dose rate following an hypothesized accident requires knowledge of how much radioactive material is suspended within the containment, and how that concentration changes with time as material settles out. In LMFBR the radioactive material (fuel and sodium coolant) is expected to form an aerosol

—a suspension of very fine particles—which is transported throughout the containment. How much gets where and when is the question. The answers are found by a series of simulation experiments, which are intermediate size tests to establish scale effects and various proof tests. The data from these tests are used to modify and, finally, validate the use of a predictive code, the HAARM series. Data from this program have already been used in the CRBR licensing review.

Material Interactions: In the course of an accident, materials such as fuel or cladding can be overheated and, when they come into contact with sodium or concrete, interact to produce vapors and new chemical compounds. The expanding vapors are a potential cause of damage. This program provides confirmatory data to assess that potential.

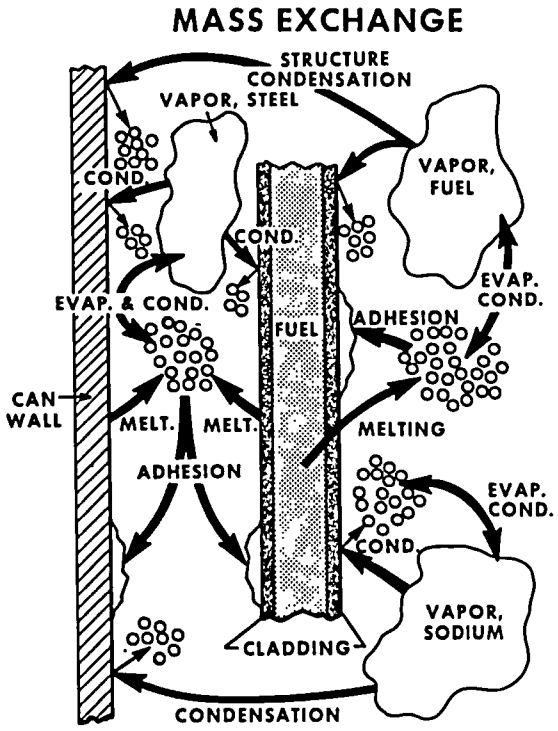
System Integrity: A key safety concern is the threat to containment integrity by the post-accident core debris. This threat includes the fission product decay heat, and the potential chemical attack of the hot core debris and sodium reactor coolant upon the plant structure. Another concern is the integrity of plant components, such as the containment, piping, and heat exchangers at LMFBR operating temperatures and under unexpected accident loads. This program element provides basic data for use in evaluating these effects.

Highlights of the LMFBR research program accomplishments in fiscal year 1976 are:

Analysis. The trial version of a code to study hypothetical core disruptive accident (HCDA) energetics—the SN-method, Implicit, Multifield, Multiphase, Eulerian Recriticality (SIMMER) code—was completed at Los Alamos Scientific Laboratory (LASL) in 1976. SIMMER has been exported to Brookhaven National Laboratory (BNL) for NRC testing and will be released for more general use in 1977. SIMMER was developed to treat the complex series of events that might occur if an LMFBR core were subjected to an accident which resulted in the expulsion of sodium and/or fuel melting. The phenomena evaluated by the SIMMER calculations are illustrated at right.

The DARE code, along with models for the CRBR, was completed by the University of Arizona in 1976. DARE is a system simulation code to study transients and accidents in power reactors. For some problems, additional work is required on steam generator models. At BNL, model development and programming was started on a benchmark systems code to study accidents and transients in LMFBRs. Work was started at Argonne National Laboratory (ANL) on a code to study natural circulation and heat transfer in an LMFBR core using a three-dimensional model.

Safety Test Facilities. The study of LMFBR safety test facility needs, conducted for the NRC by LASL, focused upon identifying key safety issues and defining the functional specifications of facilities needed to resolve these issues. These functional specifications were provided to ERDA so that they could be incorporated into their Safety Research Experiment Facilities (SAREF) program to insure that SAREF can accommodate ERDA developmental research and NRC confirmatory research in common facilities.



Pictorial diagram of the phenomena calculated by the SIMMER code for a hypothetical LMFBR accident.

A joint project with ERDA to upgrade the performance of the Annular Core Pulse Reactor (ACPR) at Sandia Laboratory has been started. This is the only test reactor in which experiments to assess the consequences of a postulated core disruptive accident can be conducted on a real time scale (1 to 2 msec period). When completed in two years, the upgrading will more than double the pulsed neutron fluence capability of the reactor and will include a system for measuring the motion of fuel during experiments. The new techniques developed to measure fuel motion are expected to prove valuable in other new facilities in the SAREF program.

Aerosol Release and Transport. Final testing was completed at ORNL on a method used to vaporize uranium dioxide in a manner which simulates the formation of the fuel aerosol source from a hypothesized accident. This method was used to initiate tests in a small vessel (in the absence of sodium coolant) to determine the upper bound on the quantity of aerosol source material and the size distribution of the basic particles which form the aerosol source. Time sequence photographs of the fuel vaporization and photomicrographs of aerosol particles so generated are shown at right and on the next page.

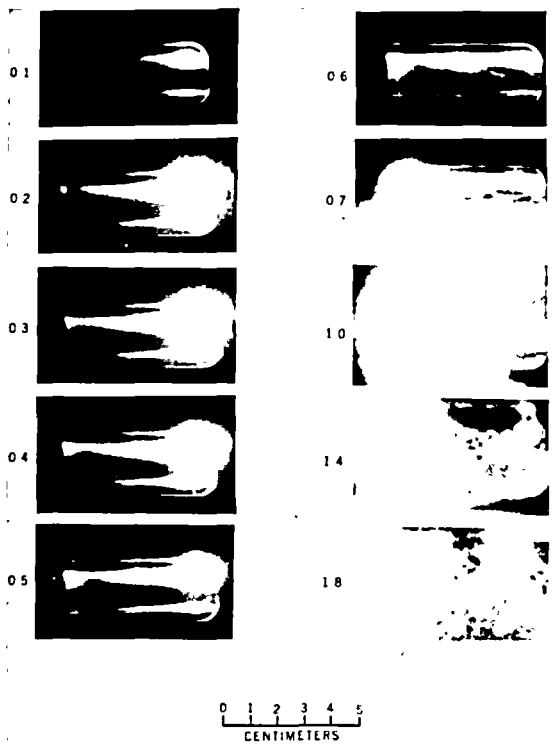
Tests were also conducted at ORNL in a small vessel to calibrate sampling instruments used for characterizing fuel aerosol behavior when agglomerates of suspended particles form and settle out during tests planned for the Nuclear Safety Pilot Plant (NSPP). The reactivation of the NSPP was completed in preparation for these latter tests, which are aimed at verifying the HAARM aerosol codes over a range of postulated accident conditions.

A series of laboratory measurements were started at Battelle Memorial Institute (BMI) to obtain data on properties of sodium oxide aerosol agglomerates which are important for describing the aerosol settling rate in the HAARM codes. These data, as well as similar data for fuel aerosols, will result in major improvements in the predictive capability for radiological source assessment of the HAARM code for use in the CRBR licensing review.

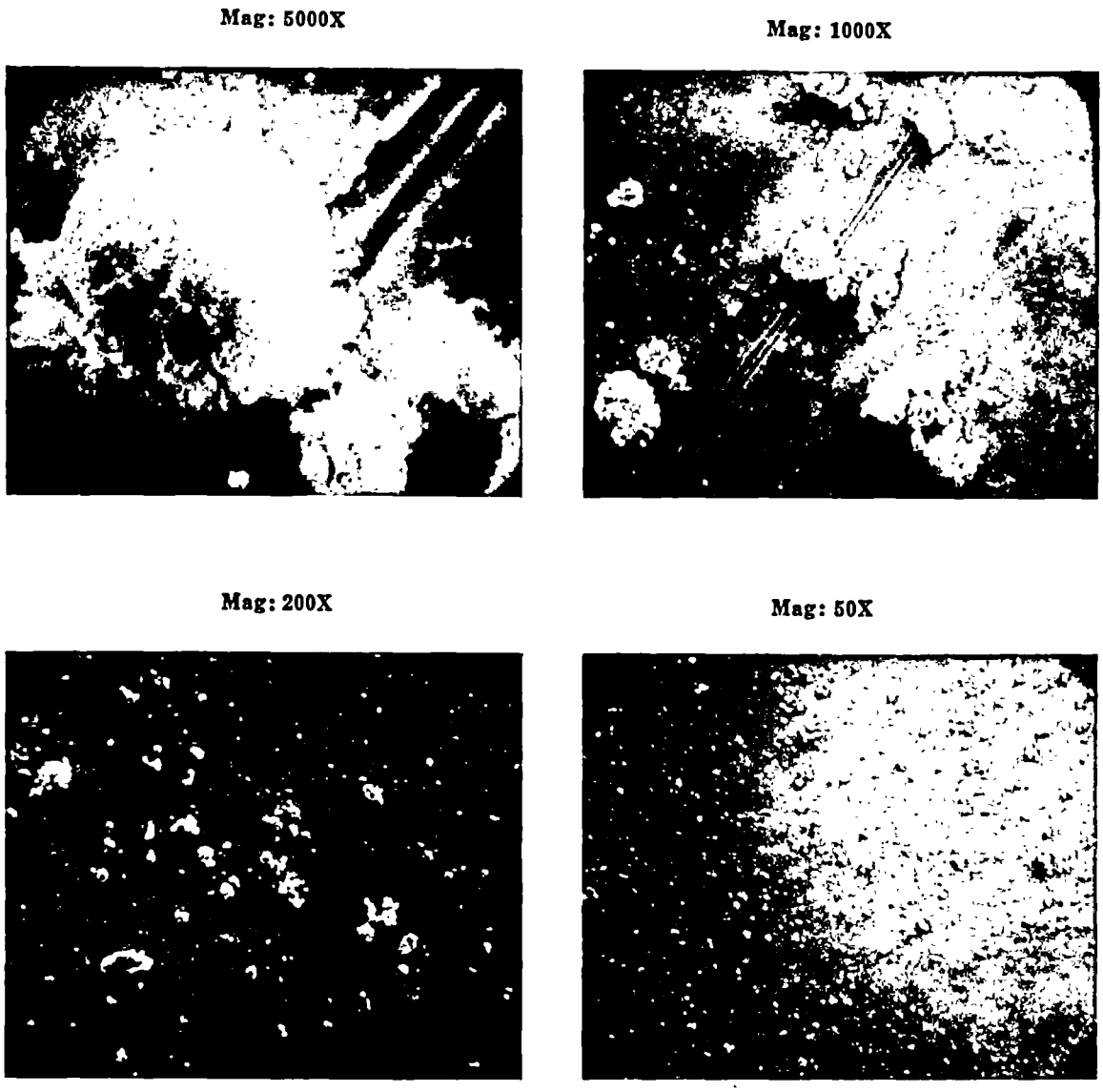
Material Interactions. The initial power excursion tests in which an LMFBR fuel pin is melted and partially vaporized under sodium were performed in the Annular Core Pulse Reactor (ACPR) at Sandia Laboratories. The purpose of these experiments is to determine the consequences of a postulated meltdown power excursion in an LMFBR.

These ACPR experiments are the first in the world to be performed in the real thousandth-of-a-second time scale of such a postulated accident. The initial test yielded a relatively small damage potential. There was no significant vaporization of sodium by the molten fuel, which would have a high damage potential were it to occur. Although further experiments are needed before definitive conclusions can be drawn, the present results are of considerable significance to CRBR licensing evaluation.

If the amount of sodium vaporization is not significant in a postulated LMFBR meltdown power excursion, the potential damage produced by the expansion of fuel vapor only would be small, but such pressures are the source



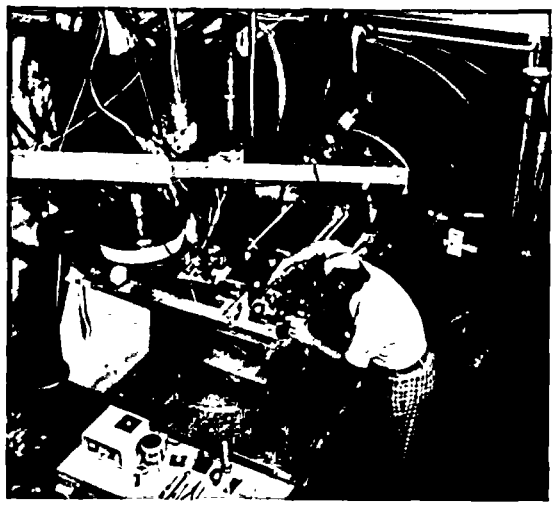
A typical time sequence of the vaporization of a UO_2 fuel sample using the capacitor discharge vaporization. Times shown are in milliseconds from the discharge of the capacitors.



Photomicrographs of UO_2 aerosol particles at the Oak Ridge National Laboratory. Four different magnifications are shown.

of disassembly and hence shutdown. No measurements had been made previously on the pressures generated by vaporized fuel at the very high temperatures (5,000°C) relevant to the analysis of LMFBR accidents. Measurements have now been made of the vapor pressure of uranium dioxide fuel at temperatures up to 7,000°C. These were made by pulse heating a thin slice of uranium dioxide by passing through it an intense current of high energy electrons in the Relativistic Electron Beam Accelerator (REBA) at Sandia Laboratories. The experimental arrangement is shown below. The results of this experiment are directly applicable to CRBR licensing evaluations.

System Integrity. Planning and construction of equipment have been completed for performing unique experiments on post-accident core-debris behavior. In these small-scale experiments, fission heating of core debris by reactor neutrons simulates post-accident low-power heating of debris by fission-product decay. A



Relativistic Electron Beam Accelerator at Sandia Laboratories as used in UO_2 vapor pressure measurements at temperatures up to 7000° C.

major part of the experimental preparation has been construction of a helium loop to remove the generated heat. The initial experiment being conducted early in fiscal year 1977 will determine the depths of particulate debris beds that can be cooled under a pool of sodium. These results will be directly applicable to CRBR licensing.

Basic out-of-pile experiments are underway at BNL on the thermal and hydrodynamic characteristics of boiling pools (as distinguished from debris beds) with internal heat generation. The results of these experiments apply to licensing evaluations in the areas of post-accident heat removal and transition-phase analysis.

A new program, started at mid-year at Sandia Laboratories, will furnish information for evaluating the inherent capability of the reactor plant to contain post-accident core debris. The immediate goal of this work is to furnish information for the licensing review of the CRBR. The experiments being performed include separate pours of several hundred pounds of molten stainless steel, sodium, or lesser quantities of molten fuel upon CRBR-specified concrete—either bare, or protected by a stainless steel "cell-liner."

Another program started at mid-year involves studies of the response of materials to the high-temperature environment during normal operation of LMFBR plants. A series of creep-fatigue interaction tests is being started both at Sandia and at Cambridge University in the United Kingdom. The latter work will provide both specific data to meet NRC needs and prompt access to significant European research.

Gas-Cooled Reactors

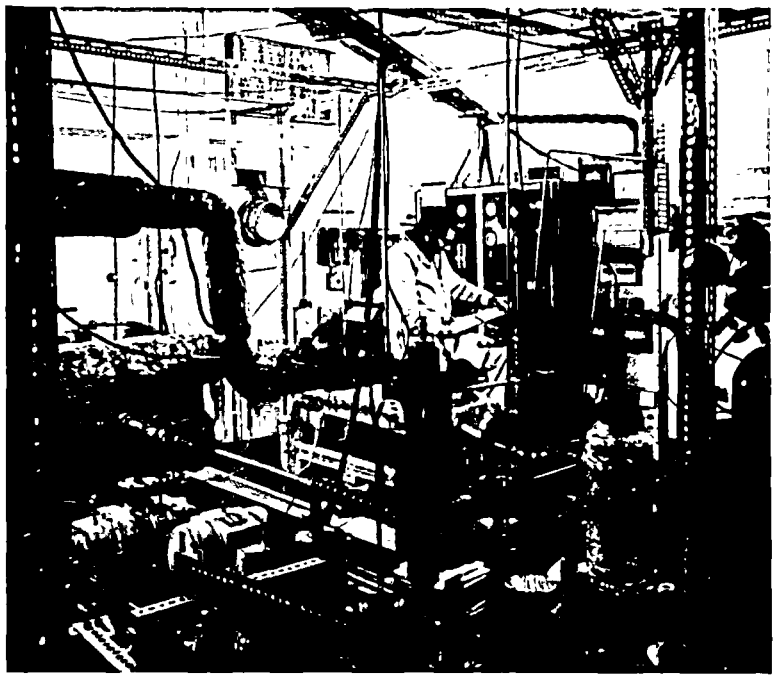
The 1976 program has emphasized gas-cooled reactor technology. The major elements of the program are:

Fission Product Release and Transport: The adsorption of fission products from the coolant onto primary system components, their interaction with the metal walls of these components and their release back into the coolant under normal and accident conditions are under investigation at LASL.

Primary Coolant Interactions: The interaction of impurities, such as water vapor, in the helium coolant with the graphite, fuel and other constituents of the primary system may have a significant effect on the material properties. A small high temperature test loop has been placed in operation at BNL in which tests of graphite and metallic samples have been conducted.

Structural Responses: Two areas have rereceived principal attention during 1976. These are the seismic response of an HTGR core and the response of prestressed concrete reactor vessels to static and dynamic loads. Computer codes providing one and two dimensional analysis of HTGR core seismic responses have been developed and released. Experiments to test the range of validity of the codes have been started. Extension of the NONSAP (Nonlinear Structural Analysis Program) code to handle large problems involving reinforced concrete with improved input and output routines has been completed.

High Temperature Materials Properties: High cycle fatigue failure of Incoloy-800 (a material used in HTGR steam generators) at high temperatures has been examined experimentally to develop a correlation with the low cycle fatigue data currently available.



High temperature test loop at Brookhaven National Laboratory used for exposure of graphite and steel to helium at temperatures up to 850°C (1562° F).

Analysis: The ability to predict the behavior of an HTGR system under transient conditions is a necessary prerequisite for predicting system response to various accident initiating events. The initial version of the CHAP program, which models large HTGR systems, has been completed. The code is structured as a modular system to facilitate adaptation to other reactor types.

Risk Assessment

Ways are being explored in which the probabilities and risk assessment techniques developed in the *Reactor Safety Study* (WASH-1400) can be implemented in the regulatory process and applied to help resolve both specific and generic technical issues. Several such issues, including those suggested by the ACRS and the Office of Nuclear Reactor Regulation have been identified.

The Office of Nuclear Regulatory Research has provided assistance to other offices of NRC in several areas; for example, in:

- Preparation of the environmental impact statement and assessment of the proposed reliability programs for the CRBR;
- Review of portions of the generic study of the potential liquid pathways for radioactive material to reach man from a land based plant comparable to a floating nuclear power plant;
- Review of the draft environmental impact statement on the transportation of radioactive materials; and
- Development, using statistical modeling, of improved testing schemes for diesel generators.

Additionally, a computer code has been developed for detailed analysis of nuclear power plant reliability data. The code may be used to calculate the sensitivity of system unavailability to variations in test-related characteristics and to design changes.

Several studies were concluded to provide information needed in risk assessment and licensing. These included: (1) one phase of a study to formulate a methodology, based on WASH-1400 techniques, to examine the risk to the public of reprocessing of nuclear fuels; (2) analysis of the effect of engineered safety features on the risk of hypothetical LMFBR accidents; and (3) an analysis of data on fires at nuclear power plants to be used in the development of a risk assessment.

To facilitate transfer of the techniques used in the *Reactor Safety Study* to NRC staff and

to contractor personnel, courses on "System Safety and Reliability Analysis" and "Human Factors Engineering" were conducted.

Safeguards Research

Nuclear materials safeguards are those activities which protect the public against death, injury, or property damage resulting from malevolent use of nuclear materials or sabotage of nuclear facilities. The main safeguards question arising in recent years has been directed to whether the risk of these societal consequences is "acceptable," that is, whether or not safeguards are effective enough. This question has two aspects—scope and level of protection. "Scope of protection" refers to the spectrum of possible adversaries, and malevolent acts to be protected against and target materials to be protected. "Level of protection" refers to the residual level of societal risk in the presence of current safeguards protection.

The main thrust of the safeguards research program has been to provide methods of assessing as quantitatively as possible the level of protection achieved by licensee safeguards systems. Although the safeguards issue, like the safety issue, can be expressed in terms of public risk, the socioeconomic elements of the safeguards problem make it unlikely that an adequate quantitative assessment of the absolute levels of societal risk can be made; however, a quantitative expression of safeguards effectiveness can be derived in terms of other relevant parameters. The goals of the research program related to the NRC regulatory function have therefore been expressed in terms of providing technical bases for improving the following capabilities:

(1) The capability for assessing the effectiveness and socioeconomic impact of safeguards policy options and alternative national strategies or procedures;

(2) The capability for predictive evaluation of the effectiveness of licensee safeguards proposals; and

(3) The capability for assessing the effectiveness of licensee safeguards as implemented.

During 1976, implementation of the safeguards research program formulated in 1975 was initiated. Individual projects are divided into three categories.

Projects in the first category are directed toward identifying measures of effectiveness for each of the safeguards subsystems and developing methods and models for evaluating them. Some work has already been done on these, but the first major results will be obtained in fiscal year 1977. Analytical methods will be developed to predict and evaluate the performance of safeguards subsystems for LWR plutonium recycle facilities. In fiscal year 1978 these models will be improved and translated into operational use, while work will begin on application to highly enriched uranium facilities, including enrichment plants, and high-level waste storage facilities.

Projects in the second category are in direct response to requirements of other NRC offices. Work in fiscal year 1977 will emphasize devices and techniques in support of inspection and the design of the integrated safeguards information system.

Projects in the third category are not yet firm in detail, as they will depend on research results as well as operational and policy developments in the coming months. However, work is planned on communications effectiveness in dealing with the industry, the public and the potential adversaries; on the parameters involved in national priorities; and on ways of increasing flexibility and responsiveness of the regulatory process.

Major projects were contracted through ERDA with Sandia Laboratories on physical protection and transportation evaluation and with Lawrence Livermore Laboratory on material control and accounting evaluation. In addition, studies to develop new concepts for safeguards systems and subsystems were initiated with private firms through competitive proposals.

During these first years of independent NRC existence, the safeguards research program is being pursued across a broad front and into new areas. The results of these early efforts will provide a basis for selection of promising techniques for intensive further development. The keynote of this relatively new program is

"performance related to objectives." Every effort is being made to clearly define the problems to be solved before funding the efforts and to keep in mind the ultimate research objective of transferring the results of safeguards research into operational tools useful to NRC.

Fuel Cycle, Health, and Environmental Research

The objectives of the NRC research programs in health and environmental impacts, fuel cycle and site safety include the development of data, methods and models to support the regulatory process involved in the agency's rulemaking, licensing, and inspection activities.

The research aims include:

- Identification of deficiencies in information concerning the potential impacts of the construction and operation of nuclear facilities on man and the environment;
- Development of technical information needed to ensure that actions taken for the protection of health, safety and environment are adequate, but that unwarranted requirements are not imposed;
- Production of improved methods, procedures and models for evaluating sites for nuclear power and fuel cycle facilities and for predicting and assessing the health, safety and environmental impacts of the installations; and
- Provision of results of the research in usable form to the appropriate NRC offices.

Health and Environmental Research

The major purposes of the nuclear regulatory process are to protect the public health and safety, and to preserve the quality of the environment. NRC health and environmental research programs address issues concerning the possible effects of radioactive materials, waste heat and chemical effluents from licensed nuclear activities. Assessment of the potential sources of radiation exposure associated with occupations in the nuclear industry is aimed at reducing exposure to levels as low as reasonably achievable.

Research to improve environmental measurement and monitoring technology is directed to continued refinement in the control of effluents from nuclear plants. While there is a great wealth of knowledge gained from past years of nuclear safety research, there is a continuing need to study important issues directed to present day applications of nuclear energy. These include studies of the potential health effects in large populations from long-term exposure to low levels of radiation; the potential for interactions between radioactive and chemical effluents from the nuclear industry and environmental systems; the possible effects of nuclear plant effluents in the presence of other industrial pollutants in the environment; and the methodology for predicting and assessing potential environmental impacts essential to selecting suitable sites for future energy producing nuclear plants.

There are four major ongoing topical areas of investigation:

Health effects studies presently address the epidemiology of radioiodine used in diagnostic medical procedures, measurement of radiation materials in uranium mill workers, the effectiveness of certain regulatory guidance for reducing radiation exposure to reactor workers and the reliability of respiratory equipment and measuring and monitoring devices used by the industry.

Environmental studies assess, confirm or improve the capability to predict where radioactive materials and other effluents go in the environment, what the effects might be, and what measures are appropriate to reducing impacts to as low as can be reasonably achieved, balancing all considerations of cost and benefit.

Socioeconomic and regional systems studies are directed to bettering the understanding and methods for measuring economic impacts on communities, institutions and populations of people.

Effluent monitoring and measuring studies are directed toward improving surveillance of licensee performance in response to regulations. These efforts are essential to enable effective inspection and enforcement of controls on nuclear plant operations.

Fuel Cycle Safety Research

Fuel cycle confirmatory research consists of three major programs: facility safety, waste management and transportation safety. In each of these, data are being developed which will provide NRC's licensing and standards setting groups with more precise estimates of plant performance, the characteristics of radioactive wastes and their potential interaction with the environment, and performance characteristics of systems used to transport radioactive materials.

Facility Safety. During 1976, an extensive program was started to confirm and refine the effluent release models used by the licensing staff in their review of nuclear power plants. Measurements were carried out in two operating reactors which characterized the sources and concentrations of radioactive materials throughout the entire reactor plant. This in-plant measurement program will be extended to other operating reactors to provide a comprehensive review of actual power plant radioactivity sources and releases under a variety of operating conditions.

In view of the growing need to provide for storage of spent reactor fuel, additional nuclear criticality studies have been undertaken to assure that spent fuel storage system designs will continue to provide adequate margins of safety. Criticality experiments are also being carried out to confirm the models used to analyze the safety of spent fuel shipping containers.

Waste Management. Research on waste management continues to represent a high priority NRC program. During 1976 a cooperative program was developed with the U.S. Geological Survey to reevaluate the capability of several licensed burial grounds to confine low-level radioactive wastes. Measurements are being made of the nature and extent of any migration of radioactive materials from the burial areas. Such information will be required in any assessment of the long term impact of such activities on man and the environment. In a related effort, studies are continuing on defining the characteristics of certain low-level wastes of the type being placed in commercial burial grounds. Two principal waste types are of particular concern: those arising from the operation of nuclear power plants, and those wastes generated in medical and academic institutions.

Experiments are also being conducted to characterize the potential interaction of waste materials with the environment. Leaching tests on solidified wastes using typical ground water and waste types are continuing as part of this program.

Transportation. NRC's transportation safety research program during 1976 was directed at experimentally determining the impact resistance capabilities of current packages used for the shipment of plutonium, and developing and verifying analytical procedures for predicting the performance of shipping containers and their radioactive contents when subjected to the normal and potential accident environments experienced in transit.

A series of tests of plutonium packages has included 25 impact tests of two typical packages. Impact velocity, package orientation, and target material were varied. One of the targets impacted is referred to as an "unyielding surface" —in this case, a three-inch steel plate backed up by a 15-foot thick reinforced concrete block. This surface is much "harder" than impact surfaces expected under typical accident conditions, but is used as a reference target against which certain licensed packages must demonstrate acceptable survivability. The test series indicated that, for the specific containers tested, the damage resulting from impacts against the steel-concrete surface could be approximately duplicated by a 33 percent increase in impact velocity onto concrete and a 133 percent velocity increase if the impact surface were hardened soil. A test involving impact into an earthen target was conducted at 760 ft/sec (518 mph) without any measurable loss of contents (see also Chapter 3).

The program has not only established the margins of safety in existing plutonium packages but will also allow NRC to relate the demonstrated performance to the specific accident environments associated with a variety of transport modes.

The development and verification of analytical procedures is necessary to predict with greater confidence the margins of safety which exist in the design of large, complex, and costly

shipping containers such as spent fuel shipping casks. For these packages, physical testing of each individual design, ultimately involving their damage or destruction, is not necessary or justified. NRC, therefore, has ongoing research efforts to establish analytical methods for evaluating the structural and thermal performance, and shielding and sub-criticality features of these casks and their critical components. Identification of the physical tests required to verify the capability of the analytical model procedures has been initiated.

REFERENCES

A selection of reports prepared for the Office of Nuclear Regulatory Research by its contractors is provided here to allow the interested readers to obtain further technical information concerning the programs presented in this chapter.

These reports are available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161, unless indicated otherwise.

1. Buchanan, J. R., *Bibliography of Reports on Research Sponsored by the Office of Nuclear Regulatory Research, November 1975-June 1976,* ORNL/NUREG/NSIC-130 (October 1976).

Water Reactor Research

2. Aerojet Nuclear Company, *Quarterly Technical Report on Water Reactor Safety Programs Sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research, January-March 1975,* ANCR-1254 (September 1975).
3. Aerojet Nuclear Company, *Quarterly Technical Progress Report on Water Reactor Safety Programs Sponsored by the Nuclear Regulatory Commission's Division of Reactor Safety Research, January-March 1976,* ANCR-NUREG-1315 (June 1976).
4. Larson, T. K., *Core Thermal Response during Semiscale Mod-1 Blowdown Heat Transfer Tests,* ANCR-NUREG-1285 (June 1976).
5. Kirchner, W. L., *"Reflood Heat Transfer in a Light Water Reactor,"* NUREG-0106 (August 1976).
6. Oak Ridge National Laboratory, *Project Description, ORNL PWR Blowdown Heat Transfer Separate-Effects Program-Thermal-Hydraulic Test Facility (THTF),* ORNL/NUREG/TM-2 (February 1976).
7. Berta, V. T., *Quick Look Report on LOFT Nonnuclear Experiment L1-2 and the Hot Wall Delay Experiment,* QLR-76-3 (May 1976). [Available from NRC Public Document Room].
8. Muralidharan, R., et al., *BWR Blowdown Heat Transfer Final Report,* GEAP-21214 (February 1976).
9. Cawood, G. W., et al., *Power-Cooling Mismatch Test PCM-2A Test Results Report,* ANCR-NUREG-1347 (September 1976).
10. Argonne National Laboratory, *Light Water Reactor Safety Research Program: Quarterly Program Report, January-March 1976,* ANL-76-49.
11. Bauer, A. A., Lowry, L. M. and Perrin, J. S., *Evaluating Strength and Ductility of Irradiated Zircaloy, Task 61, Quarterly Progress Report for January through March 1976,* BMI-NUREG-1948 (March 1976).
12. MacDonald, P.E., and Thompson, L. B., (ed.), *MATPRO, A Handbook of Materials Properties for Use in the Analysis of Light Water Reactor Fuel Rod Behavior,* TREE-NUREG-1005 (December 1976).
13. Sandia Laboratories, *Light Water Reactor Safety Research Program Quarterly Report, January-March 1976,* SAND/NUREG-76-6505 (August 1976).
14. Dickens, J. K., Love, T. A., McConnell, J. W. Emery, J. F., and Peelle, R. W., *Preliminary Fission Product Energy Release Measurements for Thermal Neutron Fission of ^{235}U,* ORNL/TM-5273 (March 1976).
15. Spinrad, B. I., *Evaluation of Fission Product After-Heat, Quarterly Report, October 1, 1975-December 31, 1975,* NUREG-0018-2 (March 1976).
16. Aerojet Nuclear Company, *RELAP 4/Mod 5 A Computer Program for Transient Thermal-Hydraulic Analysis of Nuclear Reactors and Related Systems,* ANCR-NUREG-1335 (3 volumes) (September

1976).

17. Wulff, W., et al., *Development of a Computer Code for Thermal Hydraulics of Reactors (THOR) Fifth Quarterly Report,* BNL-NUREG-50534 (July 1976).
18. Whitman, G. D., *Quarterly Progress Report on the Heavy-Section Steel Technology Program for April-June 1976,* ORNL/NUREG/TM-49 (October 1976).
19. Merkle, J. G., et al., *Test of 6 Inch Thick Pressure Vessels, Series 3: ITV-7,* ORNL/NUREG-1 (August 1976).

Advanced Reactor Research

20. Agrawal, A. K., et al., *SSC An Advanced Thermohydraulic Transient Code for LMFBRs, Quarterly Progress Report, April-June 1976,* BNL-NUREG-50543(September 1976).
21. Lathrop, K. D., *Reactor Safety and Technology Quarterly Progress Report, January-March 1976,* LAPR-NUREG-6317 (May 1976).
22. Fontana, M. H., et al., *LMFBR Aerosol Release and Transport Program Quarterly Progress Report for October-December 1975,* ORNL-NUREG-TM-9 (May 1976).
23. Sandia Laboratories, *Annular Core Pulse Reactor Upgrade Quarterly Report, October-December 1975,* SAND-76-0165 (April 1976).
24. Catton, I., *Post Accident Heat Removal for LMFBRs,* UCLA-ENG-7593 (November 1975).
25. Ball, S. J., *ORECA-1: A Digital Computer Code for Simulating the Dynamics of HTGR Cores for Emergency Cooling Analyses,* ORNL-TM-5159 (April 1976).

Site Safety Research

26. Shannon & Wilson, Inc. and Agbabian Assoc., *Geotechnical and Strong Motion Earthquake Data from U.S. Accelerograph Stations in California,* NUREG-0029 (September 1976).
27. Texas Tech University, *Proceedings of a Symposium on Tornadoes Assessment of Knowledge and Implications for Man, June 22-24, 1976.* [To be Published]

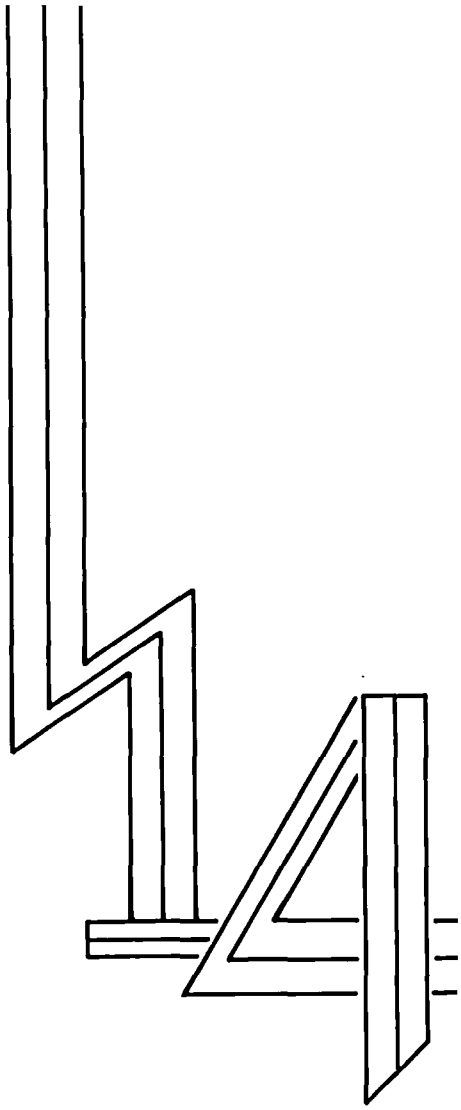
Fuel Cycle, Health and Environmental Research

28. Schuske, C. L. and Rothe, R. E., *Reference Critical Experiments Progress Report for Period July through September 1976,* RFP-NUREG-2582 (October 1976).
29. Mewhinney, J. A., et al., *Radiation Exposure and Risk Estimates for Inhaled Airborne Radioactive Pollutants Including Hot Particles, Progress Report for October 1975-November 1976,* Lovelace Biomedical and Environmental Research Institute, Inc. [To be Published]
30. McWhirter, M., et al., *Final Report on Special Tests of Plutonium Oxide Shipping Containers to FAA Flight Recorder Survivability Standards,* NUREG-SAND-75-0446 (September 1975).
31. Colombo, P. and Neilson, Jr., R. M., *Properties of Radioactive Wastes and Waste Containers Quarterly Progress Report April-June 1976,* BNL-NUREG-50571 (October 1976).

NRC Research Program Plan

32. *A Description of Current and Planned Reactor Safety Research Sponsored by NRC Division of Reactor Safety Research,* NUREG-75/058 (June 1975).

Addressing Public Concerns



Public Awareness and Participation

As the Government agency responsible for protecting the public interest in commercial nuclear facilities and activities and for assuring the safety of civilian nuclear operations, the NRC has, from its inception, followed a policy of openness in informing the public and responsiveness to public concerns. A number of events took place in fiscal year 1976 that had special impact in the public sphere. Among them were efforts in a number of the States to adopt measures which could restrict nuclear power development; there were resignations by employees of NRC and employees of the nuclear industry, accompanied by allegations of nuclear risks; U.S. nuclear export policies and activities and their relation to international efforts to control the proliferation of nuclear weapons came under close scrutiny; questions related to the environmental impact of nuclear waste management and fuel reprocessing brought about a temporary suspension in licensing nuclear power plants; and the physical security of nuclear reactors and materials continued to be a source of public concern.

These issues required an active effort on the part of the NRC to (1) identify and understand the nature of the concerns; (2) define those actions needed to address such concerns; and (3) inform the public of the Commission's judgment on those concerns and any actions taken or planned.

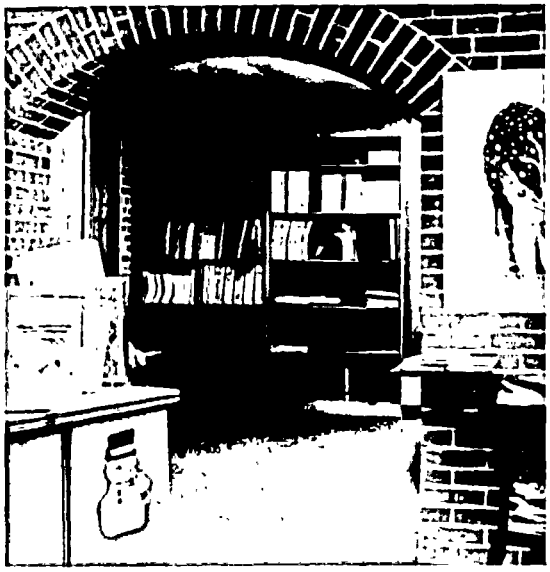
NRC's Communications Program

Information about the agency's activities is essential to meaningful public participation in, and understanding of, Commission actions. Public announcements are issued routinely on licensing hearings and prehearing conferences and licensing issuances; meetings and reports of the Advisory Committee on Reactor Safeguards; issuance and public availability of documents such as environmental impact statements; safety evaluations and special reports; regulatory guides; inspection-

and-enforcement bulletins and major enforcement actions; and proposed and effective changes in the regulations. Safety-related incidents involving licensed operations are also publicly announced. Notices in the *Federal Register* constitute another means of communicating information on many of these same actions. On matters of more than routine interest, members of the Commission and the senior staff may participate in press conferences and interviews.

The Commission's activities, and activities over which the Commission exercises jurisdiction, are often the subject of oral and written inquiries from the news media, the Congress and the general public. The Commission and the NRC staff members may also respond to public inquiry, as the occasion warrants, and to requests for information from the Congress and the White House. NRC staff members often meet with local officials and citizens to discuss NRC actions and decisions and to respond to questions.

Public document rooms are located throughout the Nation—usually near nuclear plant sites—to provide public access to detailed information on individual nuclear plants licensed to operate, under construction or under initial review, and on operations of the nuclear industry and the NRC generally. Information not of a proprietary or classified nature is available at these rooms and at the public document room maintained by NRC at 1717 H Street, N.W., Washington, D.C. This room contains, in addition to documents on licensed facilities and rulemaking proceedings, copies of research and topical reports, regulatory guides, judicial decisions, reports to the Congress, and many other special and periodic reports of interest to the public. More than 130 such document rooms are now open to the public. (See Appendix 3 for a complete



The NRC made special efforts during the year to work with the custodians of NRC material in local public document rooms to organize the documents on file and to assure that each case file is complete. Three of the local public document rooms are: the Salem (N.J.) Free Public Library, right; the Sedro Wooley (Wash.) Library, below; and the Stockton State College Library, Pomona, N.J., below right.

listing of public document rooms and their locations.)

Among the many documents published by the Commission are separate monthly reports on the operating and construction status of nuclear power plants. The Commission also publishes a quarterly report to the Congress on "Abnormal Occurrences," which are events at licensed nuclear facilities considered by NRC to be of potential or actual significance to public health and safety (see Chapter 8). These documents are available to the public on a subscription basis through the National Technical Information Service or the Government Printing Office.

Participation by the public in the NRC licensing process is provided for in a number of ways. Public comments are sought on environmental impact statements, as well as on proposed changes in regulations or regulatory guides. Public hearings are held on all applications for construction permits for nuclear facilities. An opportunity is offered for public hearings on applications for operating licenses, on proposed changes in construction permits and operating licenses involving significant safety considerations, and on petitions for rulemaking.

In fiscal year 1976, the Commission took the unprecedented step of holding a public hearing on an application for a license to export nuclear materials to a foreign country. It also announced the procedures for public hearings that are expected to lead to a Commission decision of whether to allow the wide-scale use of recycled plutonium in reactor fuel.

Freedom of Information/Privacy

A major phase of NRC's response to public concerns involves the release of documents pursuant to requests under the Freedom of Information Act (FOIA). The FOIA requires the NRC, like other government agencies, to make available on request, for public inspection and copying, any identifiable record in its possession, unless the record falls within one of the nine exemption categories set forth in the law. Exemption categories include, for example, information that is classified in the interest of national defense or foreign policy, trade secrets and commercial or financial information, certain investigatory files, and certain inter-agency and intra-agency memoranda of a "predecisional" nature.

Requests for documents under the FOIA increased substantially during 1976. In the nine months ending September 30, 1976, the NRC had received 370 FOIA requests, compared with only 49 requests for a similar period in 1975. Over 10,000 man-hours were expended in meeting 1976 requests through September, involving the retrieval and release of documents from all major NRC offices. While Federal agencies are permitted, under Exemption 5 of the FOIA, to withhold internal documents related to the decision-making process, the NRC has followed a liberal disclosure policy and has made available thousands of pages of documentation which might legally have been withheld. Copies of FOIA requests and the documents released as a result of such requests are placed in NRC's public document room in Washington, D.C. This procedure provides the general public with access to the same documents released to any individual.

The past year has also seen the NRC take major steps in implementing the Privacy Act of 1974, which became effective on September 27, 1975. Under the Act, individuals have the right to determine the existence of agency records about themselves, to seek access to those records, and to have corrected any records which are not accurate, relevant, timely or complete for agency purposes. NRC regulations implementing the Privacy Act and the descriptions of the systems of records covered by the Act were published in the *Federal Register* and are available in the public document room in Washington, D.C.

ISSUES OF SPECIAL CONCERN

Of the numerous events and questions related to nuclear power generation that arose in 1976, perhaps the most widely publicized were the resignations of three persons from positions in the nuclear industry and two NRC employees

and their allegations of unsafe conditions or practices. These actions were taken with the utmost seriousness by the NRC, as well as by the Congress, the industry and the public. The NRC sought to determine as swiftly as possible whether or not the allegations offered grounds for immediate corrective action at any licensed facility. Such grounds were not identified, but because safety issues of continuing importance and interest were involved, the matter was explored at length.

Engineers/Project Manager Resign

In February 1976, three nuclear engineers with the General Electric Co. resigned simultaneously from their posts, issuing public statements that their joint action was the result of a shared conviction that they could no longer be contributors to commercial nuclear power operations. (The General Electric Co. is a major vendor of nuclear steam supply systems for nuclear power plants.) All three men were engineers with substantial experience in the nuclear field and responsible positions with the company. At about the same time in early 1976 an employee of the NRC also resigned from his job as one of the project managers with the Office of Nuclear Reactor Regulation, giving as his reason his personal and professional concern with nuclear safety in general and with conditions at one facility in particular.

The Commission met with the three GE engineers, and the Chairman met with the former NRC employee and discussed his concerns directly with him. The three engineers also met later with the Advisory Committee on Reactor Safeguards and cooperated with that independent body in examining their safety concerns (see Chapter 2 under "Advisory Committee on Reactor Safeguards"). In mid-February and early March, the Joint Committee on Atomic Energy (JCAE) conducted a series of public hearings on the whole matter, with testimony from the four men, the Chairman and other officials of the NRC, members of the Advisory Committee on Reactors Safeguards, and representatives of the nuclear industry and of the nuclear scientific community. Extensive documentation was assembled for the JCAE by the NRC, dealing point-by-point with the issues and concerns cited by the four men.

While some of these issues had not previously been reviewed by the NRC staff or the Advisory Committee on Reactor Safeguards, neither was able to identify a specific safety problem in the statements and testimony of the four individuals which had not been previously considered and evaluated in the licensing process. The allegation by the former NRC employee that dissent within the agency was discouraged posed a different and disturbing question. No corroboration of the charge emerged from the ensuing investigation, and there was evidence that the former employee's dissents from licensing decisions had been considered and explored with him at length by supervisory staff. Chairman Anders issued a statement to the entire NRC staff reaffirming the right and obligation of any member of NRC to report any fact or convey any judgment on an unsafe situation in a licensed facility to his or her supervisors, or confidentially to the NRC Inspector and Auditor, or, if need be, directly to a Commissioner, with no prejudice to the individual's position or prospects with the agency.

The record on the allegations and NRC's responses to them and a transcript of the testimony of all parties before the JCAE may be found in the NRC public document rooms across the country (see Appendix 3 for addresses).

Consultant Recommends Licensing Suspension

On May 11, 1976, the NRC received a recommendation from one of its research consultants that all licensing of new nuclear power plants should be suspended and public hearings initiated to examine the adequacy of emergency core cooling systems, possible redesigns, and the reliance put upon large-scale calculations in evaluating complex systems. The consultant, a mathematician, was working with the Advanced Code Review Group of the NRC's Office of Nuclear Regulatory Research.

The Commission directed its technical staff to assess the recommendation. The staff concluded, on its first review, that there was no need for immediate action of the kind recommended because of (1) the very low probability of a large loss-of-coolant accident requiring emergency cooling; (2) the conservatism of assumptions underlying the analytical models in question; and (3) the fact that all of the consultant's express concerns had been previously studied and discussed at an extensive public rulemaking proceeding. The performance of emergency core cooling systems had been under intense scrutiny for at least 10 years by NRC and former AEC staff, the nuclear industry, and others. Public hearings held in 1971-73, involving more than 100 hearing days and tens of thousands of pages of written testimony and exhibits, covered the same questions as those put forward by the consultant, and resulted in the adoption of new and more conservative regulations for emergency core cooling systems. Confirmatory research carried out since then confirmed the conservatism of the analyses used for licensing evaluation. NRC promised further consideration of the views of this consultant and of other scientists who might share them, noting, however, that it could not subscribe to the consultant's requirement of "absolute certitude" in predicting the performance of safety systems.

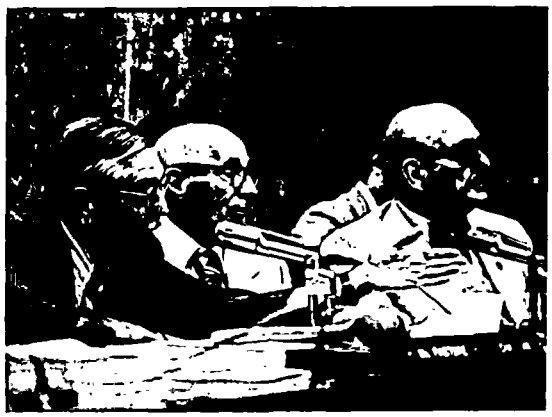
NRC Engineer Resigns

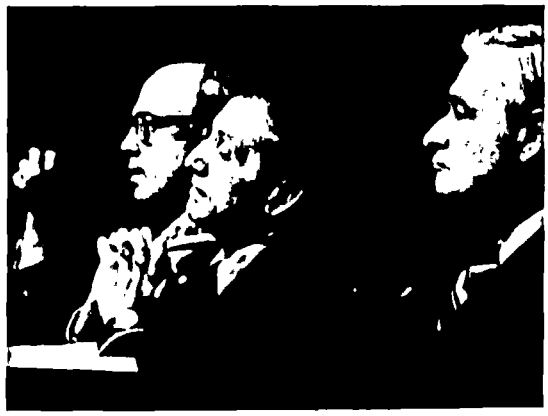
In late September 1976, an NRC engineer in the Reactor Systems Branch of the Division of Safety Systems—part of the Office of Nuclear Reactor Regulation—resigned from the agency. Three weeks later, in a letter to the Chairman of the Commission, the engineer asserted that the NRC had "covered up and brushed aside" significant safety questions which he had raised, and he called for the shutdown of all pressurized water reactors. In his letter, the engineer stated that there were others on the NRC staff who agreed with him on safety issues but did not speak out "for fear of harassment, reprisals or loss of their jobs."

Following the inquiry undertaken at his direction, Chairman Rowden responded to the engineer by letter, noting that the latter's charges were not specific enough to permit analysis and evaluation. The NRC staff confirmed that the engineer had expressed dissatisfaction with "the pace and nature" of staff actions to prevent over-pressurization in pressurized water reactors, and that his concerns had been considered, along with the contrasting views of many others, in deciding the proper course of action to deal with the problem. The Chairman of the NRC issued a statement to all NRC staff members reaffirming the agency's mission to protect the public in the uses of nuclear facilities and materials, declaring that "that is the reason for our existence—the reason NRC was established as a separate and independent nuclear regulatory agency." Chairman Rowden also reemphasized the belief of the Commission that "diversity of viewpoint is a strength of our regulatory process, not a weakness; and we must maintain an agency climate which encourages qualified staff to speak their best judgment in carrying out their job." Whether or not a staff member's judgment will prevail, the Chairman declared, as it cannot always be expected to do, it is the right and the duty of the staff member to apprise appropriate management personnel of "any situation which he or she considers to be unacceptable from the standpoint of protection of the public."

CONGRESSIONAL OVERSIGHT

Under Section 202 of the Atomic Energy Act of 1954, the NRC is required to keep the Joint Committee on Atomic Energy (JCAE) "fully and currently" informed of all its activities. Not only does this occur, but NRC Commissioners and staff are frequently involved in Joint Committee hearings and in hearings of other committees and subcommittees of the Congress. From July 1, 1975 through December 1976, NRC Commissioners and/or staff participated in 36 days of Congressional hearings conducted by either the full committee or subcommittees of nine Congressional committees. The following list shows the date of each hearing in which NRC participated, the committee or





Several sessions of a public hearing were held by the Joint Committee on Atomic Energy to consider how best to deal with the growing problem of nuclear explosives proliferation. JCAE members shown at a July 28, 1976 session (left photo) are Senator John O. Pastore, Rep. Melvin Price and Rep. John Young. Witnesses in right photo include NRC Chairman Marcus A. Rowden (center), and Commissioner Richard T. Kennedy (right). ERDA Deputy Administrator Robert W. Fri is at left. Other NRC witnesses included Commissioners Victor Gilinsky and Edward A. Mason.

subcommittee conducting it, and the subject of inquiry.

7/22/75—House Interior Committee, Subcommittee on Energy and the Environment (Nuclear Oversight: Nuclear Export Licensing);

7/29/75—Senate Committee on Appropriations (NRC appropriations—fiscal year 1976 and Transition Quarter);

9/16/75—JCAE (Browns Ferry Investigation);

9/23/75—JCAE, Subcommittee on Legislation (Price-Anderson Extension (H.R. 8631));

10/30/75—House Committee on International Relations, Subcommittee on International Security and Scientific Affairs (International Safeguards);

11/19/75—JCAE (Waste Management);

12/ 2/75—JCAE (Nuclear Fuel Assurance Act (S. 2035, H.R. 8401));

1/29/75—Senate Committee on Government
1/30/76 Operations (Revised Export Reorganization Act (S. 1439);

2/4/76—Senate Judiciary Committee, Subcommittee on Antitrust and Monopoly (Antitrust Review Functions of NRC);

2/17/76—JCAE (Review NRC's Fiscal Year 1977 Authorization (H.R. 12387, S. 3107));

2/18/76—JCAE (To Investigate Charges
2/23/76 Relating to Nuclear Reactor
2/24/76 Safety);

3/ 2/76

3/ 4/76

2/26/76—House Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment (Domestic Nuclear Safeguards);

3/ 9/76—House Committee on Appropriations, Subcommittee on Public Works (NRC Appropriations Request for Fiscal Year 1977);

3/11/76—Senate Committee on Appropriations, Subcommittee on Public Works (NRC Appropriations Request for Fiscal Year 1977);

3/12/76—House Committee on Government Operations, Subcommittee on Conservation, Energy and Natural Resources (Low-level Radioactive Waste);

3/19/76—JCAE (NRC Authorization for fiscal year 1977—Nuclear Materials Safety and Safeguards);

5/ 3/76—Senate Judiciary Committee, Subcommittee on Administrative Practice and Procedure (Administrative Reform);

5/12/76—JCAE (Waste Management);

5/25/76—House Committee on International Relations, Subcommittee on International Resources, Food and Energy (Proposed Export of Nuclear Power Reactors to South Africa);
5/27/76—Senate Committee on Foreign Relations, Subcommittee on African Affairs (Proposed Export of Nuclear Power Reactor to South Africa);
6/ 7/76—House Committee on International Relations, Subcommittee on International Security and Scientific Affairs (Export Administration Act Amendments of 1976);
6/11/76—House Committee on Interior and Insular Affairs, Subcommittee on Energy and Environment (Reactor Safety Study);
6/22/76—JCAE (Export Reorganization Act (S. 1439));
7/27/76—House Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment (Floating Nuclear Power Plants);
7/28/76—JCAE (Export Reorganization Act (S. 1439));
8/27/76—JCAE (Impact on Reactor Licensing of Two July 21, 1976 D.C. Court of Appeals Decisions);
8/31/76—JCAE (Proposed Nuclear Explosive Proliferation Control Act of 1976);
9/17/76—House Committee on Government Operations, Subcommittee on Conservation, Energy and Natural Resources (Impact on Reactor Licensing of Two Recent Decisions, Issued on July 21, 1976 by the United States Court of Appeals for the District of Columbia Circuit);
9/20/76—House Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment (GESMO Decision-Making Process);
9/28/76—House Committee on Interior and Insular Affairs, Subcommittee on Energy and the Environment (Public Funding of Intervenors in the GESMO Proceedings);
12/13/76—Senate Committee on Government Operations (Adequacy of Consideration of Dissident Staff Views in NRC Licensing Reviews).

FORMAL PUBLIC PARTICIPATION

Besides keeping the public informed through its communications program, the NRC also provides for active public participation in proceedings leading to licensing decisions. It is mandatory that public hearings on each application for a construction permit be conducted by an Atomic Safety and Licensing Board (see below). Notice of such a hearing is published well in advance in the *Federal Register* and posted in a public document room near the proposed construction site, together with a copy of the full application. Local newspapers also carry notice of the hearing. Interested persons or groups are invited to petition the Licensing Board for the right to participate in the hearing by: (1) submitting a written statement at the hearing; (2) making an oral presentation at the hearing; or (3) becoming an "intervenor" in the proceeding with full participatory rights, including cross-examination of other participants. Should the Licensing Board disallow a petition, appeal may be made to the Atomic Safety and Licensing Appeal Board (see below) by the petitioner. In some instances, the Commission may rule on a petition. Ultimately a petitioner may seek a ruling in the appropriate Federal Court of Appeals and the Supreme Court of the United States.

These same rights and procedures apply to hearings of a Licensing Board on an application for an operating license, with the difference that such hearings are not mandatory and need not take place unless requested by one or more interested parties.

To facilitate public participation, hearings of the Licensing Board are, with rare exceptions, held in communities near each proposed facility site. Intervenors involved in a hearing participate fully in prehearing conferences with other interested parties for the exchange of data and identification of issues in contention.

OPPORTUNITIES FOR FORMAL PUBLIC HEARINGS IN NRC PROCEEDINGS

Type of Proceeding	*Opportunity for Hearing*	*Purpose of Hearing*	*Criteria for Granting Hearing*	*Unit Deciding To Hold Hearing*
RULEMAKING Proceeding	Prior to issuance of final rule.	To determine whether a proposed rule should be adopted.	At the discretion of the Commission.	Commission (which may decide to hold informal or "hybrid" hearing).
MANUFACTURING LICENSE Proceeding*	Mandatory hearing prior to issuance of manufacturing license.	To determine whether a license authorizing the manufacture of a production or utilization facility of a particular design should be issued.	Mandatory hearing on safety and environmental issues.	Mandatory hearing before Licensing Board.
CONSTRUCTION PERMIT Proceeding*	Mandatory hearing prior to issuance of construction permit	To determine whether a particular production or utilization facility should be constructed at a particular site and, where indicated, to resolve adverse antitrust matters.	Mandatory hearing on safety and environmental issues; on antitrust matters, upon request by interested persons or Attorney General or at discretion of Commission.	Mandatory hearing before Licensing Board.
OPERATING LICENSE Proceeding*	Prior to issuance of operating license.	To determine whether a particular production or utilization facility should be permitted to operate; antitrust review where significant changes have occurred since previous antitrust review.	Request by any person whose interest may be affected by proceeding who raises genuine issue of material fact, and at discretion of Commission; in addition, in the case of antitrust review, there must be determination by the Commission that significant changes have occurred.	Commission, Appeal Board or Licensing Board, as appropriate.
MATERIALS LICENSE Proceeding	Either prior to or after issuance of materials license.	To determine whether a particular materials license should be issued or remain in effect.	Request by any person whose interest may be affected by proceeding and at discretion of Commission.	Commission, Appeal Board, Licensing Board or Administrative Law Judge, as appropriate.
SHOW CAUSE Proceeding (to modify, suspend or revoke a license or for other appropriate action).	Prior to issuance of final Commission Order.	To determine appropriate action to be taken.	Upon demand by person cited in Show Cause Order or by request of other persons whose interest may be affected, upon making requisite factual showing.	Commission

* An opportunity for hearing is also provided prior to issuance of amendments to manufacturing licenses, construction permits and operating licenses which involve significant hazards considerations. If there are no significant hazards considerations, opportunity for hearing may be provided after such amendments are issued.

Some sessions of the meetings of the Advisory Committee on Reactor Safeguards (see Chapter 2) are open to the public and public comment may be registered at these sessions. In order to further broaden public participation in the licensing process, the Commission announced in October 1976 that members of the general public were invited to submit nominations for positions on the Advisory Committee. Formerly, nominations for the 15-member panel came mainly from within the agency. Final selections are made by the Commission in consultation with the Advisory Committee. Normally Committee members possess a minimum of 25 years' experience in technical or scientific fields. Operating experience in power plants is desirable in a nominee, as is management experience and training in nuclear safety or in fields with similar safety considerations. Nominations may be sent to: Advisory Committee Management Officer, Secretary of the Commission, Nuclear Regulatory Commission, Washington, D.C. 20555.

Funding for Intervenors

In August 1975 the NRC initiated an informal rulemaking into the question of whether financial assistance should be provided for intervenors in NRC proceedings. In November 1976 the Commission issued an opinion which concluded the rulemaking. The opinion emphasized that, apart from the question of legal authority, funding participants in government proceedings raises fundamental social policy questions concerning the use of public money to support private viewpoints and thus is properly resolved by Congress, not an unelected regulatory agency. The Commission majority did not recommend that Congress fund participants in its ordinary licensing and rulemaking proceedings. The majority noted that the NRC regulatory staff, which has developed expertise over the past two decades, has the task of assuring, subject to Commission review, that no facility is licensed and no rule promulgated unless such action is fully consistent with the public health and safety. The staff is not monolithic; indeed Commission policy is designed to assure that all staff views are effectively made known. Moreover, the majority noted, the Commission's licensing process includes independent analysis by the Advisory Committee on Reactor Safeguards, expert licensing and appeal panels, federal, state and local bodies, and citizens' groups that utilize their own resources. Accordingly, the safety and environmental considerations raised by commercial nuclear power are well understood and diverse viewpoints are already represented in agency decisionmaking. The majority concluded that NRC's mission can be fully accomplished without funding participants in its proceedings. Finally, it noted the

At the direction of the Hearing Board designated to consider whether to permit the widescale use of plutonium oxide mixed with uranium oxide to fuel nuclear power plants (the GESMO proceeding), documents relating to the proceeding were separated from other public documents and were made available to participants and the public in a new "GESMO reading room." The reading room is located next to the NRC's Public Document Room at 1717 H Street, N.W., Washington, D.C.

potential for delay inherent in a funding program.

Commissioner Gilinsky, in a partial dissent from the November decision, stated that Congress should provide funds to intervenors for the whole range of NRC activities. His partial dissent emphasizes that external intervention has time and again provided the impetus for necessary Commission action, by creating an urgency or suggesting a perspective on issues which would otherwise have been lacking. Additionally, funding will, in his view, promote conditions favorable to staff effectiveness. While emphasizing that his conclusion in no way reflects discredit on the NRC staff, he goes on to note that funding during the public stage of Commission proceedings will, by assuring the sharp presentation of conflicting views, help keep the staff and the remainder of the agency on guard during earlier, less formal stages.

In the November decision, the Commission unanimously supported a Congressional funding program for one ongoing agency proceeding of special significance—the rulemaking concerning the generic environmental statement on mixed oxide fuel (GESMO). The majority noted that this proceeding was of "singular importance" because it involved every phase of the nuclear fuel cycle, concerned a wide range of domestic and international issues, and has attracted unprecedented attention from the Commission, Congress, the Executive Branch, the courts, and the public. The Commission recently transmitted to the Congress, with the approval of the Office of Management and Budget, a request that $200,000 be appropriated to fund participants in the GESMO proceedings. Moreover, the Commission, in advance of Congressional action, has instituted a program of providing qualified GESMO participants with free service of their filings, free transcripts, and free security clearances.

Adjudicatory Proceedings

The quasi-judicial and judicial stages of NRC licensing and regulating procedures concern and engage the public closely, often as petitioners and initiators of appeal and review proceedings. Following are accounts of the adjudicatory activity during the report period by the Atomic Safety and Licensing Boards; the Atomic Safety and Licensing Appeal Boards; the Commission; and NRC as a party to Federal court actions.

ATOMIC SAFETY AND LICENSING BOARDS

Public participation in the licensing process reaches fruition in proceedings conducted by Atomic Safety and Licensing Boards, for it is here that members of the public may place its concerns, information, and conclusions on the record before an independent tribunal.

It is a requirement of the Atomic Energy Act of 1954 that no construction permit for a nuclear power plant and related facilities may be issued until a public hearing has been held on the application. This hearing is conducted before a Licensing Board authorized to issue a decision on the application (known as an "Initial Decision") which, subject to the NRC's review and appellate procedures discussed below, usually becomes the final NRC decision. Although a notice of hearing inviting public participation is published shortly after receipt of a construction permit application, the hearing itself takes place only after completion of the NRC staff's safety or environmental review. Ample notice of the proceeding is given to the public, State and local agencies, and other interested groups.

Additionally, the Atomic Energy Act requires that, before a nuclear power plant or related facility may be licensed to operate, or before certain license amendments may be issued, an application be filed and an opportunity for hearing be provided. Thus, members of the public, State and local agencies, and other interested groups can cause a hearing to be held at this stage of the licensing process, within certain legal requirements. Public participation is also invited in proceedings instituted by the NRC staff.

The Atomic Energy Act also requires that, for certain licensees and under certain circumstances, a determination be made by NRC as to whether the activities licensed by it would create or maintain a situation inconsistent with

the antitrust laws, and that the NRC take appropriate action should this determination be affirmative. While the procedures laid down by the Act for this review are more complex than those outlined for other reviews, a similar opportunity to trigger a hearing is provided.

Each of the Boards that conduct these hearings consists of three members drawn from the Atomic Safety and Licensing Board Panel—a body of legal, technical, environmental, and other experts appointed by the Commission. As of September 30, 1976, the Panel included 19 full-time and 46 part-time members. Of these 65 members, 22 are lawyers, 19 environmentalists, 13 engineers, 8 physicists, 2 economists and 1 chemist. (See Appendix 2 for names of members.) All members are chosen for their recognized experience, achievement, and independence. Assignments to a given Licensing Board are based on the kinds of issues involved in the application to be considered. Separate hearings may be conducted on the technical aspects of an application and on environmental questions, and separate Initial Decisions covering these matters may be issued. Antitrust problems in an application are heard and decided by a Board of three antitrust experts.

The increasing procedural complexity of the licensing process is reflected in the number of Initial Decisions which may be issued as a prerequisite to construction and ultimate operation of a nuclear power plant. In order to permit an early start on construction activities, the NRC has authorized the issuance of a so-called Limited Work Authorization (LWA); but only after the Licensing Board has issued a favorable Initial Decision covering environmental and site suitability matters. During the period of this report, Licensing Boards issued nine such decisions, involving 20 nuclear units.

Similarly, certain structural work may be undertaken pursuant to a further Limited Work Authorization (LWA-2), if it is approved by a Licensing Board. Five such decisions were rendered during the report period, covering 10 units.

Finally, the remainder of the plant may be constructed only after the Licensing Board has made favorable findings in regard to radiological health and safety matters. Seven such decisions were issued during the report period two of which, at the option of the applicants, covered environmental and site suitability matters as well. These decisions involved 16 units.

At the operating license stage, should a hearing be necessary, several Initial Decisions may be issued before full power operation is approved. In appropriate circumstances, Licensing Boards may authorize fuel loading and low power testing prior to final resolution of the environmental and safety issues before them. Two such decisions were issued with respect to one unit during the period of the report, followed by an Initial Decision authorizing full power operation.

During a period in which utilities have sometimes found it appropriate to defer addition of new generating capacity for which they have sought NRC licensing, certain proceedings before Licensing Boards have been affected. The boards, in such cases, are authorized to issue Initial Decisions on and make findings on matters not likely to change with the passing of time—particularly site suitability. While these decisions do not authorize any construction activities and are subject to later revision, they do furnish some advantage by providing for early review of certain issues. One such decision was issued during this period, and in another proceeding evidentiary hearings were held.

This last proceeding—concerning the *Douglas Point* Generating Station in Maryland —is of particular interest because it marks the first instance in which joint hearings were conducted with a State regulatory body. In the Douglas Point hearing, the board sat with a member and hearing examiner from the Public Service Commission of Maryland, as well as a representative from the county commissioners of the county in which the plant is proposed to be located. A single record was compiled, which the hearing board and the Public Service Commission will utilize in making their individual decisions.

Other decisions of interest include one which imposed civil penalties on a licensee for material false statements made during the licensing process; one which approved a license amendment permitting operation of Browns Ferry Units 1 & 2 upon satisfactoy completion of the

work required to restore the plant following the March 22, 1975 fire; and one which disposed of all issues raised in the *River Bend* proceeding but did not authorize a construction permit because of the court of appeals decision in *NRDC v. NRC,* discussed below.

Antitrust considerations were dealt with in two Initial Decisions during this period, one of which constituted the first full-scale review of such matters, and the other constituted board approval of a settlement agreement reached by the parties. Two other full-scale antitrust hearings were completed during this period (an Initial Decision on one of these, the consolidated Davis Besse/Perry proceeding, was issued January 7, 1977).

ATOMIC SAFETY AND LICENSING APPEAL BOARDS

Since 1969, three-member appeal boards have been utilized—first by the Atomic Energy Commission and later by the Nuclear Regulatory Commission—to exercise the Commission's authority and perform its review functions in facility licensing proceedings. Beginning in 1972, members of boards for individual proceedings have been selected from an Atomic Safety and Licensing Appeal Panel. The Chairman of the Panel (or, in his absence, the Vice Chairman) makes such selections. (See Appendix 2 for current membership of the Panel.)

Appeal Boards review initial decisions of Licensing Boards either upon exceptions filed by a party or parties or on their own initiative. Certain Licensing Board orders respecting intervention are also appealable. In addition, in limited circumstances, questions may be certified or rulings may be referred by a Licensing Board to an Appeal Board at any point during a licensing proceeding. The Appeal Board for a proceeding is the highest administrative level within the Nuclear Regulatory Commission at which a party may seek review as a matter of right; however, the Commission may review an Appeal Board action on its own initiative. Ordinarily the decision of an Appeal Board represents the final order of the Nuclear Regulatory Commission and is subject to review in the Federal courts.

From July 1, 1975 through September 30, 1976 (fiscal year 1976), Appeal Boards completed or undertook review of 289 matters. Published decisions in that period (numbered ALAB-280 through ALAB-349) appear in the NRC's monthly publication, *Nuclear Regulatory Commission Issuances.* During this period, NRC produced the first two bound hard-back volumes of these issuances—with Volume 1 encompassing reprints of the January-June 1975 issuances, and Volume 2 covering the July-December issuances. Continuing the practice started in January 1975, the opinions published during the period under review included brief summaries of the rulings, headnotes of significant legal issues, and references to important technical issues. This reference material (which also appears with respect to published Commission and Licensing Board decisions) was prepared under the direction of the Appeal Panel Staff.

Opinions rendered by Appeal Boards in this period reflected the growing complexity of nuclear reactor licensing proceedings. A number of them merit specific mention.

In the area of the public health and safety, two Appeal Boards devoted considerable effort to an endeavor not usually undertaken by such boards—the conduct of evidentiary hearings. In the *Prairie Island* (Minnesota) proceeding, the Appeal Board examined in depth the matter of the integrity of the reactors' steam generator tubes. Following its review of a Licensing Board's consideration of this subject, it held three days of evidentiary hearings and thereafter rendered a decision covering both the questions raised about tubes in the Prairie Island plant, and generic questions relevant to all such tubes. The other Appeal Board, on direction of the Commission, held hearings (which lasted 35 days) on seismic issues raised in connection with the *Indian Point* (New York) facility. A decision will be rendered in fiscal year 1977.

One of the more widely publicized Appeal Board decisions involved alleged material false statements made by the applicant/licensee concerning seismic and geologic conditions at

the site of its *North Anna* (Virginia) facility. The Appeal Board found that four of the applicant's statements were materially false and held that civil penalties and other sanctions should be imposed.

During fiscal year 1976, several important environmental questions were presented to various Appeal Boards. In two opinions in the *Wolf Creek* (Kansas) proceeding, an Appeal Board considered the extent to which off-site construction activities could be undertaken by an applicant prior to the completion of the environmental review of a facility. Requirements for the consideration of alternatives to a proposed facility were reviewed in opinions in the *St. Lucie* (Florida) and *Clinton* (Illinois) proceedings. The latter case also gave rise to an in-depth review of the appropriate method for evaluating the environmental impact of the removal from agricultural production of high quality farmland. In the *River Bend* (Louisiana) proceeding, an Appeal Board considered the means for ascertaining whether a sufficient supply of uranium will be available to fuel a proposed reactor. And in the *Seabrook* (New Hampshire) proceeding, the Appeal Board considered on three occasions (through December 1976) whether the previously issued construction permits should be suspended pending further review of various environmental questions.

Noteworthy among the antitrust issues considered by Appeal Boards was the scope and extent of the statutory exemptions from mandatory pre-licensing antitrust review. An Appeal Board ruled that the "grandfather clause" in the Atomic Energy Act (which exempts existing nuclear facilities from certain regulations adopted after they were licensed) did not waive such review for the operating license for the *Davis-Besse* (Ohio) reactor. In the same proceeding, that Appeal Board spelled out the standards which should be applied in determining whether an attorney for a party should be disqualified, for alleged conflict-of-interest reasons, from representing its client in the proceeding.

By far the most numerous of the issues confronted by Appeal Boards during fiscal year 1976 were those which were procedural in nature. Many were of general significance to licensing proceedings. Reflecting the fact that persons with ever more remote interests in a given facility are attempting to participate in hearings on its application, Appeal Boards issued a series of opinions on different aspects of the question of these persons' standing to so participate. Appeal Boards also rendered a number of opinions which delineated in some detail the requirements for appellate consideration of issues at an interlocutory stage of a proceeding. In the *Wolf Creek* proceeding, the Appeal Board issued three opinions outlining the standards for determining whether information requested upon discovery should be accorded proprietary treatment. And the appellate rights of "interested States" were outlined in a decision issued in the *River Bend* proceeding.

COMMISSION REVIEW

During fiscal year 1976, the Commission continued its practice of reviewing adjudicatory decisions of the Atomic Safety and Licensing Appeal Boards only on its own motion. Under this governing rule, no party to an adjudicatory proceeding has the right to call for Commission review. However, the Commission has been actively considering revision of this rule. Under a revised procedure, parties to adjudicatory proceedings would have a right to seek Commission review of Appeal Board decisions, and the Commission would have discretion to grant review in cases presenting important legal or policy issues. It was anticipated at the close of fiscal year 1976 that the Commission would soon issue a revised procedure for public comment, and that some form of discretionary review would probably be provided for in early 1977.

In the first six months of fiscal year 1976, the Commission rendered four significant adjudicatory decisions. Three of these involved petitions addressed directly to the Commission, resulting in: (1) a review of a staff-level denial of a request by a public-interest group that a show-cause order be issued to management of the *Indian Point* facilities in New York regarding geologic and seismic questions; (2) a determi-

nation that the *Big Rock Point* reactor (Michigan) could not be authorized to use substantial additional amounts of mixed oxide fuel without the preparation of an environmental impact statement; and (3) the granting of limited exemptions for the *Catawba* reactors (South Carolina) from aspects of the emergency core cooling system criteria. The fourth decision involved a modification of an Appeal Board's decision disapproving a stipulation of the parties that would have resolved a dispute over cooling towers for Unit 2 of the *Indian Point* station. The Commission approved the stipulation of the parties, determined that the staff's environmental review of the cooling tower issue had been adequate, and approved issuance of the operating license. (These decisions are described in greater detail in the NRC's 1975 Annual Report.)

During the remainder of fiscal year 1976, the Commission rendered five significant adjudicatory decisions, three in the context of licensing construction or operation of domestic commercial reactors, and two in the export context.

Diablo Canyon. In February 1976, in the *Diablo Canyon* (California) operating license proceeding, an intervenors' group—the San Luis Obispo Mothers for Peace—challenged the proposed issuance of a materials license that would have authorized the storage of fuel bundles at the *Diablo Canyon* facility in advance of issuance of an operating license. The Licensing Board had found that issuance of such a license would have met applicable safety requirements. The intervenor group sought to appeal that decision, but the Commission's rules, as presently structured, do not provide for an automatic appeal from a denial of a materials license under Part 70 of the Commission's rules. In these circumstances, the Commission designated a special Appeal Board to hear the intervenor group's appeal. Subsequently, that Board heard the appeal and rendered a decision, finding that issuance of the materials license in question would be consistent with applicable safety standards.

Big Rock Point. In May 1976, the Commission granted a limited exemption from aspects of the emergency core cooling system requirements with respect to the *Big Rock Point* (Michigan) nuclear reactor. The exemption was granted on the basis of several conditions recommended by the staff for inclusion as amendments in the operating license which were designed to compensate for the reactor's failure to comply with otherwise applicable requirements. Commissioner Gilinsky dissented from this decision, expressing the view that although the staff's recommended conditions would adequately protect public health and safety, notice requirements relating to significant amendments to operating licenses had not been met in that case.

Clinch River Breeder. In August, the Commission rendered a major opinion in the construction permit proceeding for the proposed *Clinch River* (Tennessee) liquid metal fast breeder reactor facility. Under Section 202(1) of the Energy Reorganization Act of 1974, the Commission is required to conduct licensing proceedings for demonstration liquid metal fast breeder reactors proposed by the Energy Research and Development Administration. ERDA had already prepared an extensive environmental impact statement covering its program for the development of liquid metal fast breeder reactors in response to an earlier court of appeals decision interpreting the National Environmental Policy Act to require such a statement. Intervenor groups in the *Clinch River* proceeding contended that many of the issues that had been fully explored in the ERDA programmatic statement also had to be explored in the *Clinch River* proceeding. The applicants for the *Clinch River* construction permit, which included ERDA, the Tennessee Valley Authority, and a specially organized consortium called Project Management Corporation, argued that duplicative review was unnecessary and that the separate impact statement being prepared in connection with licensing of the *Clinch River* facility need only address local impacts associated with its construction and operation. The Commission rendered a lengthy decision, concluding that the Commission's environmental review must embrace not only analysis of local impacts, but also alternatives to the proposed action. However, the Commission also determined that, in the circumstances of that case, it would not consider the issue of need for and timing of

a demonstration project for the liquid metal fast breeder reactor. It reasoned that a review of need and timing questions would conflict with the assignment of responsibilities by Congress under the Energy Reorganization Act, under which ERDA was assigned primary responsibility for long-range research and development projects. The Commission also took into account the fact that Congress had repeatedly addressed questions of need and timing for a demonstration project.

Export Decisions. The Commission rendered two major decisions in the export area. The first involved applications to authorize the export of special nuclear material to India as fuel for the Tarapur reactors. Intervenor groups sought leave to intervene as a matter of right under Section 189 of the Atomic Energy Act and a hearing accompanied by full adjudicatory rights. The Commission decided that the petitioners did not have standing to intervene as a matter of right; the Commission went on to determine, however, that it would hold a legislative-type hearing on the question of whether its program of shipping reactor fuel to India pursuant to an agreement for cooperation should be continued. This hearing, held as a matter of Commission discretion in a legislative format, took place in July. A court challenge to the Commission's rulings in this case was pending at the close of the fiscal year, as was Commission action on the license.

The second major decision in the export area involved applications for the export of a pressurized water reactor to Spain, pursuant to an agreement for cooperation between the United States and that country. In acting upon such a license, the Commission is required to make a number of determinations, including whether the export would be inimical to the common defense and security of the United States. A majority of the Commission determined that the export in question would not be inimical to common defense and security, and issuance of the license was authorized. Commissioner Gilinsky dissented, contending that the term of the proposed license did not include adequate controls over the plutonium that would be produced by the reactor. These two exports decisions are treated in greater detail in Chapter 11.

JUDICIAL REVIEW

Judicial decisions involving the Nuclear Regulatory Commission were issued in the following significant cases during fiscal year 1976.

Northern Indiana Public Service Company v. Porter County Chapter of the Izaak Walton League of America, Inc., 423 U.S. 12 (1975). The Supreme Court, on November 11, 1975, reversed a Seventh Circuit decision setting aside the construction permit for the Bailly reactor (Indiana) proposed to be built on the south shore of Lake Michigan. The Supreme Court held that the Seventh Circuit had erroneously rejected the Commission's interpretation of its own regulations governing "population center distance" in nuclear power plant siting. The case was remanded for consideration of the remaining questions concerning issuance of the construction permit. On remand, the Seventh Circuit, in its decision of April 13, affirmed the Commission's grant of a permit to the Northern Indiana Public Service Co. to construct a nuclear plant at the Bailly site.

Train v. Colorado Public Interest Research Group, Inc., 48 L.Ed.2d 434 (1976). Although the NRC was not party to the case, the Supreme Court's June 1, 1976 decision in that case is noteworthy in that it reaffirms NRC's exclusive authority to regulate radioactive waste materials discharged by NRC-licensed facilities. Respondents unsuccessfully contended that such materials were included within the Federal Water Pollution Prevention and Control Act's (FWPCA) definition of "pollutant" and therefore were subject to regulation by the Environmental Protection Agency (EPA) and by individual States under EPA's FWPCA permit program. The Court held that EPA had correctly disclaimed any authority under the FWPCA to regulate the discharges, which are subject to NRC regulation under the Atomic Energy Act.

Natural Resources Defense Council, Inc., v. NRC (D.C. Cir. Nos. 74-1385 and 74-1586). The Court of Appeals for the District of Columbia Circuit, by its July 21, 1976, decision in this consolidated case, set aside the waste management and reprocessing portions of the Commission's uranium fuel cycle rule

(Table S-3). That rule had assigned numerical values to the environmental effects of the uranium fuel cycle attributable to the licensing of a nuclear power plant and was intended, for purposes of making an environmental assessment under the National Environmental Policy Act (NEPA), to quantify the incremental environmental impact of licensing an additional reactor insofar as the fuel cycle was concerned. Without Table S-3 in place, the Commission's analysis of the environmental effects of the proposed Vermont Yankee plant was found to be inadequate, and the Vermont Yankee oprating license was remanded to the Commission for further consideration pending an adequate assessment of the fuel cycle issues. (See Chapters 2 and 5.)

Aeschliman v. NRC (D.C. Cir. Nos. 73-1776 and 73-1867). On review of the construction permits issued for Consumer Power Company's Midland facility, the Court of Appeals for the District of Columbia Circuit disapproved the Commission's treatment of energy conservation issues, ruling that the Commission had placed too stringent an evidentiary burden on groups seeking Commission consideration of energy conservation issues. The court also held that

Ben Rusche, Director of Nuclear Reactor Regulation, responds to a question from a reporter at a press conference in October 1976 on a proposed interim rule on waste management and fuel reprocessing aspects of the light water reactor fuel cycle. Issuance of proposed interim rule, along with an environmental survey, were steps toward resuming licensing after a court decision in July set aside a previous rule. Next to Mr. Rusche is Dr. William P. Bishop, head of the task force that prepared the environmental survey.

Advisory Committee on Reactor Safeguards (ACRS) reports must be sufficiently explicit to inform the public of all identified hazards of reactor operation and that Licensing Boards have the obligation to return cryptic reports to the ACRS for further elaboration. This consolidated case, treated by the Court as a companion case to the above-mentioned *Natural Resources Defense Council, Inc. v. NRC* case, was remanded to the Commission for the purpose of restriking the NEPA cost-benefit balance, including an assessment of unaddressed fuel cycle issues. A number of utilities have asked the Supreme Court to review these D.C. Circuit decisions. On August 13, and again on November 5, 1976, the Commission issued policy statements informing the public of how the Commission intends to conduct its licensing activities in the interim, pending resolution of the legal questions raised by the decisions.

Natural Resources Defense Council, Inc. v. NRC (2d. Cir. Nos. 75-4276 and 75-4278). In another consolidated case, New York State and citizen groups sought review of the Commission's November 14, 1975, *Federal Register* notice which set forth procedures for hearings on the Generic Environmental Statement on Mixed-Oxide Fuel (GESMO) and outlined agency standards for licensing activities related to the use of mixed-oxide fuel prior to a Commission decision on wide-scale use of plutonium recycle. On May 26, 1976, the Court of Appeals for the Second Circuit issued its decision upholding in full both the GESMO hearing procedures and associated individual licensing procedures. However, interim licensing, except that for "experimental and feasibility purposes," was forbidden. This prohibition covers all separations, conversion, fuel fabrication, imports and loading of mixed-oxide fuel in reactors unless it can be shown that the action is not related to commercial plutonium recycle. Current uses of mixed-oxide fuel remain unaffected. Allied-General Nuclear Services has sought Supreme Court review of the Second Circuit's decision.

Other litigation developments during this fiscal year include 13 cases concluded and 15 cases initiated. Five other cases remained pending at year-end.

Cases Concluded

North Anna Environmental Coalition v. NRC, 533 F.2d 655 (D.C. Cir. 1976). On March 3, 1976, the Court of Appeals for the District of Columbia Circuit affirmed the Commission's determination that "non-capable" geologic faults underlying Virginia Electric and Power Company's North Anna Power Station did not pose an undue risk to public health and safety. The court also upheld the Commission's interpretation of its Seismic and Geologic Siting Criteria for Nuclear Power Plants.

Aeschliman v. NRC (E.D. Mich. No. 3202). Plaintiffs sought a declaratory judgment that NRC's environmental impact statement for Consumer Power Company's Midland facility was deficient and an injunction against construction activities until such time as an adequate EIS was issued. In dismissing the suit, on May 17, the District Court for the Eastern District of Michigan held that the complaint was in essence an appeal from an interlocutory order which was subsequently merged in a final order of the NRC, review of which is possible only in the Courts of Appeals. The court further noted that plaintiffs had an adequate remedy at law which they actively pursued in the Court of Appeals for the District of Columbia Circuit in the *Aeschliman* case discussed above.

Citizens for Safe Power, Inc. v. NRC, 524 F.2d 1291 (D.C. Cir. 1975). On December 22, the Court of Appeals for the District of Columbia Circuit affirmed the Commission's issuance of an operating license for the Maine Yankee facility. The license had been challenged on the theory that the Atomic Energy Act required the Commission to make formal findings weighing the residual risks of reactor operation. In rejecting that contention, the court held that where a facility complies with NRC safety and health regulations, and the residual risks of operation have been weighed under NEPA, no discretely formalized weighing of residual risks is required by the Atomic Energy Act. The court also rejected petitioners' contention that the environmental impact statement was inadequate in failing to consider the alternatives of less than full-term operation.

Environmental Coalition on Nuclear Power v. NRC (3d Cir. No. 75-1421). The Commission's issuance of construction permits for the Limerick Generating Station was challenged on the grounds that NRC's NEPA review was incomplete because it erroneously assumed that the Limerick station would depend on natural river flow to obtain cooling water and also failed to adequately analyze that operating mode. In its brief, the Commission argued that the operation of Limerick station was, on the basis of natural river flow, environmentally and economically sound. On November 12, the Court of Appeals for the Third Circuit issued its order denying the petition for review.

Hudson River Fisherman's Association, Inc. v. NRC (2d Cir. No. 75-4212). Petitioners challenged an Appeal Board order interpreting —and approving as interpreted—a stipulation which they had executed jointly with the other parties to NRC's adjudicatory hearing concerning issuance of an operating license for Unit 3 of the Indian Point Nuclear Generating Station. Finding that a Commission Order, approving the stipulation and vacating other portions of the Appeal Board decision, had rendered the Appeal Board decision moot, the Court of Appeals for the Second Circuit, on December 5, dismissed the suit at petitioner's request.

York Committee for a Safe Environment v. NRC, 527 F.2d 812 (D.C. Cir. 1976). The Court of Appeals for the District of Columbia Circuit, rejecting numerous other objections raised by petitioners to the grant of an operating license for the Peach Bottom Atomic Power Station, Unit 2 (Pennsylvania), remanded the case to the Commission for an individualized analysis of the cost and benefits of reducing routine radioiodine releases in accordance with the Commission's "as low as reasonably achievable" regulations. Noting that the current level of emissions is low, the court found that the public interest did not require suspension of the operating license during the pendency of the remand. On January 26, the Commission ordered a Licensing Board to supervise the cost/benefit analysis.

City of Cleveland, Ohio v. NRC (D.C. Cir. No. 75-2115). Petitioners sought review of a Commission decision which held that the

appointment of a Special Master, made with the parties' agreement, to decide certain discovery matters did not violate an AEC Manual prohibition against delegation of the Licensing Board's authority. Government respondents argued that the court lacked jurisdiction to review the decision since it did not constitute a final order in the proceeding. On August 6, 1976, the Court of Appeals for the District of Columbia Circuit issued its order dismissing the petition for review.

Environmentalists, Inc. v. NRC (4th Cir. No. 75-2377). A citizens group sought to overturn the Commission's decision refusing to enjoin hearings for the Barnwell reprocessing facility (South Carolina), pending a Commission decision on plutonium recycle. The Court of Appeals for the Fourth Circuit, on June 15, 1976, dismissed the petition for review on stipulation of the parties in light of the Second Circuit's decision in the *NRDC v. NRC* case discussed above.

Gadler v. NRC (D.C. Cir. No. 76-1001). A private party appealed the Commission's order denying him intervention in the Prairie Island (Minnesota) operating license proceeding. On March 4, 1976, the Court of Appeals for the District of Columbia Circuit granted the NRC's motion to dismiss the petition as untimely.

Sands Point Harbor, Inc. v. NRC (D.N.J. No. 75-2110). Local property owners requested the District Court for the District of New Jersey to enjoin operation of the Oyster Creek reactor and construction of the Forked River reactor, alleging that these activities damaged their property, primarily through shipworm infestation. NRC moved to dismiss the complaint for failure to exhaust administrative remedies. Plaintiffs thereafter decided to seek intervention in the Oyster Creeek operating license proceeding and, on March 18, 1976, voluntarily withdrew their complaint without prejudice.

Golden v. Public Service Company of Indiana, Inc. (S.D. Ind. No. 76-49-C). Plaintiff filed suit in the District Court for the Southern District of Indiana, seeking to bar the Commission from granting the applicant's request for an exemption permitting early site-related activities at the proposed Marble Hill Nuclear Generating Station. After his complaint was filed, the exemption request was denied, rendering the case moot. On July 6, 1976, the court granted plaintiff's motion to dismiss his complaint.

Save Needed Environmental Levels League v. Southern California Edison Company (C.D. Cal. No. 75-1543). The NRC is one of 34 named defendants in this case. The defendants are alleged to have violated NEPA, as well as various antitrust and security laws, in regard to the proposed Palo Verde Nuclear Facility near Buckeye, Arizona. On September 17, 1976, the district court dismissed the complaint for improper venue.

Lloyd Harbor Study Group v. NRC (D.C. Cir. No. 73-2266). Issuance of a construction permit for the proposed Shoreham facility (New York) was challenged on the grounds that the Commission's NEPA review was deficient in that it reserved for generic treatment the question of incremental impact of the uranium fuel cycle and failed to consider the consequences of a class 9 accident. On November 9, the court of appeals remanded the case to the Commission for further consideration in light of the court's decision in the *NRDC v. NRC* uranium fuel cycle case discussed earlier.

Cases Initiated

United States of America v. City of New York (S.D.N.Y. No. 76-273). Government plaintiffs, NRC, ERDA and DOT (Department of Transportation), seek a judgment declaring a New York City Health Code provision dealing with the transportation of nuclear materials through the city to be inconsistent with the federal statutory scheme governing the transportation of hazardous materials. The government's request for a preliminary injunction against enforcement of the Health Code provision was denied on January 30, 1976, the court finding that no irreparable injury would occur pending a decision on the merits of the case.

Natural Resources Defense Council, Inc. v. NRC (D.C. Cir. No. 76-1525). Petitioners seek

review of the Commission's May 7, 1976, order denying petitioner's motion for leave to intervene in the proceeding involving the export of low-enriched uranium fuel to India for use at the Tarapur Atomic Power Station. The basis for the Commission's decision was that petitioners lacked standing. The State Department has intervened and filed a motion to dismiss, on which the court must now rule.

Culpeper League for Environmental Protection v. NRC (D.C. Cir. Nos. 76-1484 and 76-1532). Petitioners in this consolidated case challenge a Commission decision concerning the routing of high-voltage transmission lines from the Virginia Electric & Power Company's North Anna Power Station. They contend that an alternate route is preferable from an environmental standpoint. The case is now being briefed.

Union of Concerned Scientists v. NRC (D.D.C. No. 76-0370). This Freedom of Information Act suit seeks to compel disclosure of all notes and memoranda submitted by Dr. Hanauer, Technical Advisor to L. Manning Muntzing during Mr. Muntzing's tenure as Director of Regulation at the AEC. NRC has filed a motion for summary judgment, appending an extensive affidavit in support of its claim that the requested documents fall within exemption 5 of the FOIA.

Westinghouse Electric Corporation v. NRC (3rd Cir. No. 76-1611). Westinghouse challenges as unconstitutional an amendment to the Commission's rules of practice relating to the treatment of proprietary information submitted to the NRC. These rules set forth criteria for determining whether submitted information is, in fact, proprietary and reassert NRC's authority to publicly disclose proprietary information when in the public interest. The case is awaiting oral argument.

Audubon Society of New Hampshire v. United States (1st Cir. 76-1347). Two environmental groups seek review of an Appeal Board order declining to stay the issuance of construction permits for Seabrook Station (New Hampshire). Petitioners seek a stay of construction until the Appeal Board can pass upon exceptions taken to the Licensing Board's initial decision.

Hodder v. NRC (D.D.C. Cir. No. 76-17-9). Petitioners seek review of the partial initial decision authorizing issuance of a Limited Work Authorization for Florida Power & Light Company's proposed St. Lucie Plant, Unit 2. They claim NEPA's requirement of full consideration of alternatives has not been satisfied. This contention had been dismissed by the Licensing Board, but the Appeal Board, finding the record to be insufficient, remanded the case to the Licensing Board for further hearing while refusing to revoke the LWA. On October 21, the court of appeals denied petitioners' motion for injunctive relief and summary reversal of the decision authorizing the LWA, but stayed construction under the LWA pending further consideration of alternative sites.

Natural Resources Defense Council, Inc. v. NRC (D.D.C. No. 76-0592). Petitioner seeks pursuant to the Freedom of Information Act all documents prepared by the Commission or its staff in developing the November 14, 1975 *Federal Register* notice on mixed-oxide fuel. The Commission had denied petitioner's request for these documents after determining that they are intra-agency documents which are exempt from disclosure. The case has been briefed and awaits action by the court.

Natural Resources Defense Council, Inc., et al. v. Robert C. Seamans, Jr., et al. (D.D.C., No. 76-1691). On September 9, 1976, NRDC and other environmental groups sued ERDA and NRC, seeking to block construction of the waste tanks projected for the Hanford and Savannah River facilities. The complaint urges that ERDA has failed to comply with NEPA by not issuing an environmental impact statement for the waste tank construction, and that ERDA failed to obtain licenses from NRC under Section 202(4) of the Energy Reorganization Act. The request for relief is directed principally against ERDA rather than NRC in that injunctions are sought barring ERDA from constructing the tanks. NRC is named as a defendant because plaintiffs seek a declaratory judgment that NRC has licensing authority in this matter.

New England Coalition on Nuclear Pollution v. NRC, et al. (1st Cir. No. 76-1469). On October 6, 1976, the NECNP petitioned the First Circuit for review of the Commission's

October 5 order directing review of ALAB-349, the Appeal Board's decision suspending the Seabrook construction permits. NECNP claims that the Commission's direction of review was illegal for failure to state reasons, and that the Commission's stay rule does not comport with judicial standards. The Commission's motion to dismiss the petition for review was pending before the court of appeals as of November 30, 1976.

Natural Resources Defense Council, et al. v. NRC (D.C. Cir. No. 76-1966). On October 22, 1976, NRDC and East Tennessee Energy Group petitioned the court of appeals to review the Commission's August 27 Clinch River opinion. NRDC claims that the limitations imposed on the environmental analysis of the proposed Clinch River Breeder Reactor violate NEPA. The Commission's motion to dismiss the petition for review was pending before the court of appeals as of November 30, 1976.

New England Coalition on Nuclear Pollution v. NRC (1st Cir. No. 76-1525). On November 18, 1976, the New England Coalition on Nuclear Pollution petitioned the First Circuit to review the Commission's November 5 decision overturning the Appeal Board's stay of construction at the Seabrook facility (ALAB-349). The Commission decided that a halt to construction was inappropriate in light of the conclusions in its Task Force Report on the Environmental Survey of the Reprocessing and Waste Management Portions of the light-water-reactor fuel cycle.

Virginia Electric and Power Co. v. NRC (4th Cir. No. 76-2275) and *North Anna Environmental Coalition v. NRC* (4th Cir. No. 76-2331). On November 12, 1976 the Commission imposed a fine of $32,500 on the Virginia Electric and Power Co. for making false statements to the NRC concerning seismic conditions at the utility's proposed plant site at North Anna, Va. The utility petitioned the Fourth Circuit to review the Commission's decision, and the North Anna Environmental Coalition petitioned the same court to find that the utility's construction permit should have been revoked. NRC is seeking consolidation of the cases.

Cases Pending

Carolina Environmental Study Group v. NRC (W.D.N.C. No. 73-139). Citizen groups challenge the Commission's grant of a construction permit to Duke Power Company for its McGuire facility (North Carolina). Plaintiffs alleged that the Commission's NEPA review was inadequate and that the limitation of liability in the Price-Anderson Act is unconstitutional. All issues, except that relating to the constitutionality of the Price-Anderson provision, were dismissed by the court in June 1975. An evidentiary hearing, on questions of standing, ripeness and justiciability was held in September 1976. The district court's decision was pending as of November 30, 1976.

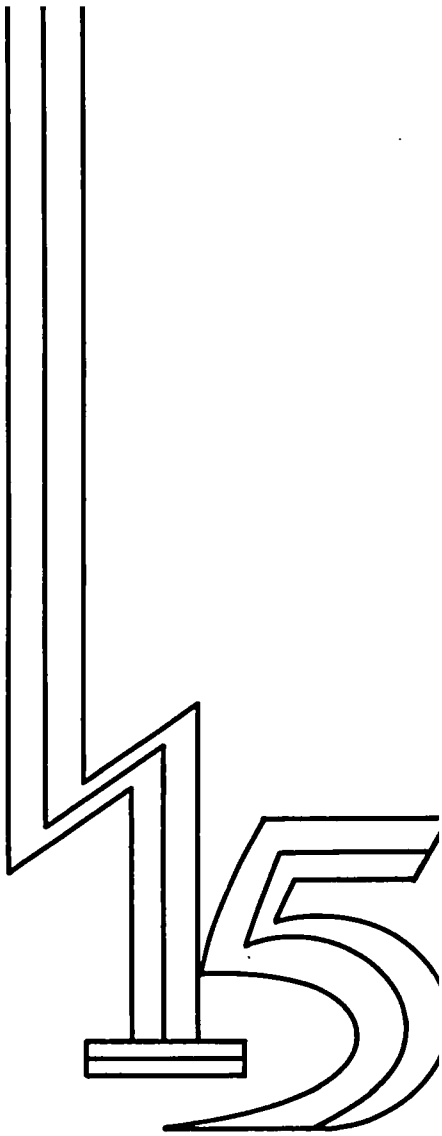
State of New York v. NRC (2nd Cir. Nos. 75-6115, 76-6022 and 76-6081). Three decisions issued by the District Court for the Southern District of New York during this fiscal year have been appealed by the State of New York to the Court of Appeals for the Second Circuit. The first, dated September 9, 1975, denied the State's request for a preliminary injunction against the air transportation of special nuclear materials. Injunctive relief had been sought based on the alleged failure of several agencies, including the NRC, to satisfy the requirements of NEPA in not preparing an environmental impact statement on air transportation. The second decision, dated December 23, dismissed defendants Civil Aeronautics Board and United States Customs Service from the case. The third decision, dated May 7, 1976, denied New York's motion for summary judgment that the Federal agencies had violated NEPA, and declined to rule on the State's motion for a preliminary injunction against air transportation of plutonium and the commercial air transport of enriched uranium. New York's appeals from the three decisions were consolidated for oral argument, which was heard on July 21. The case is now under consideration by the Second Circuit.

West Michigan Environmental Action Council, Inc. v. NRC (W.D. Mich. No. G-58-73). Citizen group plaintiffs seek an injunction against increased use of mixed-oxide fuel in Consumer Power Co.'s Big Rock power reactor.

A June 1974 court opinion placed the case in abeyance, and on August 11, 1975, the Commission issued an order requiring an environmental report from Consumers Power Co. before the amount of plutonium loaded in the Big Rock Plant (Michigan) reactor may be increased. Until the company submits such a report, there would appear to be no occasion for the litigation to go forward.

Sierra Club v. NRC (D.D.C. No. 1867-73). Four environmental groups charge the NRC (originally AEC) and its Commissioners, and other Federal entities and their officials, with a series of alleged failures to comply with NEPA. Specifically, plaintiffs contend that the defendants have a "nuclear power export program" and that each of them must prepare an impact statement on the program as a whole and on each individual action taken in furtherance of the program. A final programmatic environmental impact statement regarding the nuclear export program was issued by the Energy Research and Development Administration in March 1976. The suit remains pending.

Management and Administrative Matters



Besides the activities undertaken to meet NRC's statutory mission, set forth in the preceding chapters of this report, there are many important administrative operations carried out in support of that mission. This chapter provides basic data on NRC personnel and funding and describes some management and administrative programs of interest.

At the close of fiscal year 1976, the NRC—Commission and staff—comprised a total of 2,289 authorized full-time employees, an increase of 28.5 percent over the 1,782 employees transferred from the regulatory staff of the former Atomic Energy Commission to NRC at its inception in January 1975. The substantial increase was the product of intensive national recruitment of scientific, technical and administrative talent. Of the 2,289 total, about two-thirds were employed in the NRC's program offices, more than one-fifth in the Office of the Executive Director for Operations and administrative staff offices, and one-tenth on the staffs of the Commission and the licensing and advisory boards and panels.

More than two-thirds of the total NRC staff hold bachelors' or advanced college degrees, including one-fifth with masters' degrees, and almost one-tenth with doctorates. More than one-half of the staff are scientists and engineers.

NRC RESOURCES
PERSONNEL (Technical Disciplines)

Biology & Radiobiology	Metallurgy	Engineering:
Chemistry	Meteorology	Chemical
Ecology & Radioecology	Oceanography	Civil
Geology	Physics	Electrical
Hydrology	Rad. Health Physics	Instrumentation
Limnology	Seismology	Mechanical
Mathematics		Nuclear
		Systems

NRC RESOURCES— PERSONNEL AND FUNDING

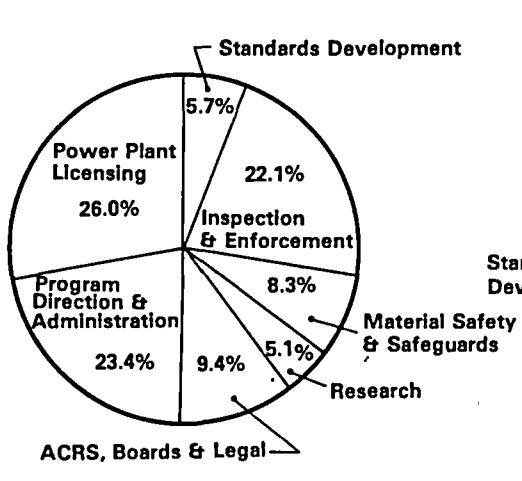
The charts below indicate the relative apportionment of authorized personnel and appropriated funds to the various NRC activities during fiscal year 1976. (The pie-charts pertain to the 12-month period of July 1, 1976, through June 30, 1976, omitting the transition quarter, thus permitting ready comparison between fiscal year 1976 and the fiscal year 1977 projections also shown.) The balance sheet on the following pages shows NRC assets and liabilities for June 30, 1975 and September 30, 1976. The statement of operations shows the cost of NRC operations for fiscal year 1975 and fiscal year 1976, including the transition quarter. The factors involved in calculating NRC equity as of September 30, 1976 are also shown.

These data are prepared by the NRC Office of the Controller, whose major functions for the reporting period included the preparation and forwarding to the Office of Management and Budget of NRC budgets for fiscal years 1977 and 1978; the development of the initial NRC Five-Year Plan; the establishment of the NRC accounting system; and the formulation of the financial and budgetary agreements between the Energy Research and Development Administration and NRC for the performance of reimbursable work.

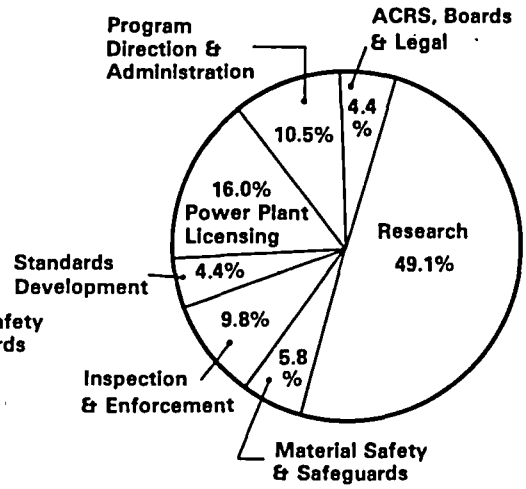
NRC License Fees

The NRC is authorized to collect fees for its licensing services under Title V of the Independent Offices Appropriations Act of 1952 (65 Stat. 290; 31 U.S.C. 483a). Since 1968, when fee collections began, through the reporting period, a total of $66.4 million has been collected in fees, $15.4 million of that total in fiscal year 1976. Such fees are assessed for specific nuclear materials and facility licenses,

NRC RESOURCES
FY 1976



PERSONNEL — 2289
(Authorized thru Transition Quarter)



FUNDS — $222 MILLION
(Transition Quarter $67 Million Not Included)

and, until mid-1974, fees were imposed on an annual basis.

Because of a Supreme Court decision in 1974, the NRC has suspended the collection of annual fees and has refunded $5.5 million of annual fees previously collected. The NRC has proposed legislation to the Congress which would provide specific authority for NRC to collect annual fees from licensees and would continue the one-time fees for specific licensing services. The Commission also has under consideration a revision to the NRC license fee schedule which would establish fees for: (1) applications from vendors and architect-engineer firms for review of standardized reference designs; (2) applications from utilities which incorporate standardized reference designs and duplicate plants; (3) review by NRC of proposed sites for nuclear plants; (4) license amendments and health and safety inspections; and (5) other special projects requested of NRC by applicants.

INSPECTION AND AUDIT

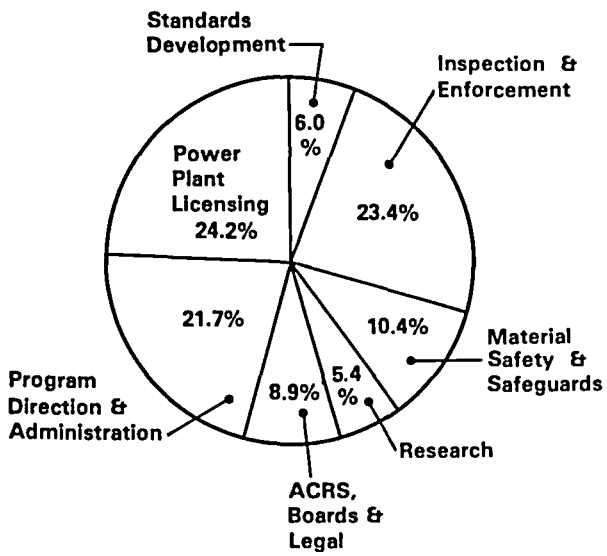
The NRC's Office of Inspector and Auditor (OIA) carries out the agency's internal audit and investigative activity. OIA's audits, investigations and inspections provide the Commission with an independent review and appraisal of all NRC operations to assure that responsibilities at all organizational levels are discharged with effectiveness and efficiency; to ascertain and verify facts relevant to any aspect of NRC operations; and to assure the maintenance of the highest standards of integrity of all NRC organizations, programs and activities.

The following are some of the more important investigations and audits conducted by OIA during fiscal year 1976.

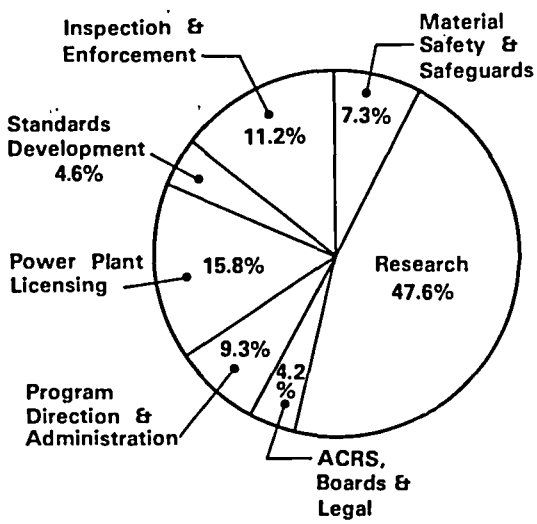
Project Manager's Resignation. As related in Chapter 14 of this report—under "Issues of Special Concern"—one of the NRC's Project Managers resigned from the agency in January

NRC RESOURCES

FY 1977



PERSONNEL — 2529 (Authorized)



FUNDS — $256 MILLION

Fiscal Year 1976—NRC Financial Statements
Balance Sheet
(in thousands)

ASSETS	September 30, 1976	June 30, 1975
Cash:		
Appropriated Funds in U.S. Treasury	$ 91,782	$ 48,482
Other*	5,482	944
	97,264	49,426
Accounts Receivable:		
Federal Agencies	42	21
Other	71	8
Miscellaneous Receipts	602	214
	715	243
Plant:		
Completed Plant and Equipment	11,668	4,500
Less—Accumulated Depreciation	1,161	780
	10,507	3,720
Advances and Prepayments:		
Federal Agencies	50	167
Other	486	522
	536	689
Total Assets	$109,022	$ 54,078

LIABILITIES AND NRC EQUITY	September 30, 1976	June 30, 1975
Liabilities:		
Funds held for Others—Note 1	$ 5,483	$ 944
Accounts Payable and Accrued Expenses:		
Federal Agencies	8,464	5,674
Other	26,215	17,398
Accrued annual leave of NRC employees	4,005	3,555
Total Liabilities	44,167	27,571
NRC Equity: July 1, 1975, Balance	26,507	
Additions:		
Funds Appropriated—net	269,548	101,704
Non-reimbursable transfers from ERDA	99	
	296,154	101,704
Deductions:		
Net Cost of Operations	211,512	70,609
Non-reimbursable transfers from AEC		3,351
Funds returned to U.S. Treasury	19,787	1,237
	231,299	75,197
Total NRC Equity	64,855	26,507
Total Liabilities and NRC Equity	$109,022	$ 54,078

* Includes $5,001,005.79 of funds received under cooperative research agreements involving NRC, ERDA, the Federal Republic of Germany, and the Japan Atomic Energy Research Institute.

Fiscal Year 1975/1976 Statement of Operations
(in thousands)

	Fiscal Year 1976 (July 1, 1975, thru September 30, 1976)	Fiscal Year 1975 (January 19, 1975, thru June 30, 1975)
Personnel Compensation	$ 70,177	$ 20,312
Personnel Benefits	6,226	2,107
Benefits for former personnel		14
Program Support	132,243	39,491
Administrative Support	14,641	5,621
Travel of Persons	4,641	1,348
Refunds to Licensees	2,754	2,785
Reimbursable Work	120	7
Increase in annual leave accrual	450	794
Depreciation expense	398	92
Equipment write-offs and adjustments	155	56
Total Cost of Operations	231,805	72,627
Less Revenues:		
Reimbursable work for other agencies*	119	7
Fees*		
Licenses	15,358	193
License Indemnities	4,752	1,632
Miscellaneous Services	64	185
Total Revenues	20,293	2,017
Net Cost of Operations	$211,512	$ 70,610

U.S. Government Investment in the Nuclear Regulatory Commission
(from January 19, 1975 through September 30, 1976—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)	226,248
	279,040
Unexpended Balance of Appropriated Funds in U.S. Treasury, September 30, 1976	91,782
Transfer of Refunds Receivable from Atomic Energy Commission, January 19, 1975	429
Total Funds Appropriated	371,251
Less:	
Funds returned to U.S. Treasury*	21,024
Assets and Liabilities transferred from Other Federal Agencies without Reimbursement	3,251
Net Cost of Operations from January 19, 1975, through September 30, 1976	282,121
Total Deductions	306,396
NRC Equity at September 30, 1976, as shown on Balance Sheet	$ 64,855

* These funds are deposited in the U.S. Treasury and are not available for NRC use.

1976, alleging that certain unsafe conditions were permitted to exist at NRC-licensed nuclear power plants and also that dissent within the NRC on safety-related issues was discouraged and ultimately suppressed. At the Commission's request, the latter charge was investigated by OIA.

Waste Burial Facility Inspected. An unauthorized removal of radioactive waste material and items of equipment from a waste burial site near Beatty, Nev., was reported to the NRC in February 1976 (see "Unauthorized Removal of Waste," in Chapter 8). In connection with this incident, certain allegations arose concerning the conduct of past inspections by AEC and NRC inspectors at this facility. OIA investigated these allegations while the Office of Inspection and Enforcement investigated the removal of the materials. Subsequently OIA reported its findings on the conduct of prior inspections to the Office of Inspection and Enforcement. It referred the question of possible criminal violations in the removal of the radioactive materials to the U.S. Department of Justice.

Browns Ferry Fire. One of the several separate inquiries following upon the March 1975 fire at the Browns Ferry Nuclear Power Plant in Alabama (see "Browns Ferry Restart," in Chapter 8) was OIA's investigation of past AEC and NRC inspections in those areas subsequently involved in the fire. The results of this review and recommendations of OIA were conveyed to the Commission.

Investigation of Employees' Complaints. At the request of the Director of NRC's Office of Nuclear Reactor Regulation (NRR), OIA gathered information concerning certain management problems raised by members of the Electrical Instrumentation and Control Systems Branch of NRR and issued a report to the Commission and to the Director of NRR. The Senate Committee on Government Operations held hearings in December 1976 on the same matter.

Faulty Inspection Claim. Allegations that faulty inspection procedures were employed by NRC inspectors at the proposed site for the North Anna nuclear power plant in Virginia were investigated by OIA at the direction of the Commission. No improprieties in the manner in which NRC staff conducted inspections at the site or any improper conduct on the part of NRC inspectors were found.

Materials Licensing Program. Following issuance in January 1976 of an audit report on NRC's materials licensing program by OIA, improvements were made in the administrative processing of applications for materials licenses and in the guidance provided these kinds of applicants.

Export Licensing Program. OIA also issued an audit report during fiscal year 1976 recommending improvements in the processing of applications for the export of nuclear materials, with respect to both internal procedures and to the interaction between NRC and the Executive Branch. Effective implementation of the recommendations was under study at the close of the reporting period.

Research Activities. Pursuant to recommendations of an OIA audit report on interrelationships between NRC and the Energy Research and Development Administration (ERDA) in the conduct of NRC-sponsored research projects at ERDA facilities, a joint NRC-ERDA task force was formed during fiscal year 1976 to resolve current and anticipated problems.

Materials Inspection Program. An audit was conducted and a draft report issued by OIA on NRC's materials inspection program. The audit centered upon the management and implementation of the program at NRC headquarters and the five regional offices.

PROCUREMENT ACTIVITIES

The NRC awards contracts to secure technical assistance in virtually every major area of the agency's activity—nuclear health and safety; antitrust; the licensing and regulatory process; safeguards; fuel cycle and the environment; international and state programs; and guides, standards and codes related to the foregoing. Confirmatory research in various areas is also carried out under contract with the NRC; this research is distinct from that undertaken for the NRC in the National Laboratories of the ERDA, which is administered by the Office of

Nuclear Regulatory Research (see Chapter 13). During fiscal year 1976, contract purchases of all kinds totaled about $25 million. Projections for fiscal year 1977 indicate that about $35 million in goods and services will be acquired through the procurement process.

NATIONAL EMERGENCY PLANS

In March of 1976, the NRC was asked to address itself to the matter of national emergency and preparedness by the Federal Preparedness Agency (FPA). The FPA, which is part of the General Services Administration, has the task of coordinating the preparedness of Federal agencies to contribute to the mobilization of human, natural and industrial resources, and to assure continuity in Federal government operations during a national emergency, including an attack on the United States.

The NRC undertook to define its emergency preparedness functions, in response to the FPA, with special attention to four aspects of emergency planning:

(1) Determination of which NRC functions should continue without interruption during a national emergency for as long as possible;

(2) Development of organizational, physical facility and procedural arrangements, including the identification and storage of vital records, needed to continue those essential functions;

(3) Drawing up procedures for continuing

During 1976 the Office of EEO sponsored a series of EEO Awareness seminars for NRC managers and supervisors. The seminars were conducted by Mr. Robert Scruggs and Ms. Joan Dendinger from the National Oceanic and Atmospheric Administration's EEO Training Unit.

Commissioner Marcus Rowden presented NRC's Distinguished Woman Award to Dr. Mary Jane Oestmann (right), Environmental Project Manager, at an October 1975 ceremony in observance of International Women's Year. The Under Secretary General of the United Nations, Dr. Davidson Nicol (center) of Sierra Leone, was the keynote speaker. At left is Ruth Anderson, NRC's Federal Women's Program Coordinator.

or, in the alternative, resuming licensing and regulatory functions supplementary to those deemed essential during emergency conditions; and

(4) Preparation of plans for carrying out functions proposed for assignment to NRC under Executive Order 11490, which assigns special emergency preparedness functions to Federal departments and agencies.

EQUAL EMPLOYMENT OPPORTUNITY

With the formation of the NRC in 1975, an Office of Equal Employment Opportunity (EEO) was created within the agency to assure that minority and women employees were accorded the same opportunities for advancement as others and to take positive steps to increase the number of such employees on the NRC staff. Prior to 1975 these functions were carried out on a parti-time basis through the Office of Administration.

EEO has mounted an intensive effort to increase the proportion of minority and women employees throughout the agency and, especially, at grade levels of GS-12 and above, where current levels are low. EEO endeavors to identify mid-level and senior-level engineers and scientists from among women and minorities in government and private industry and to recruit them for the NRC staff. The qualifications of minority and women employees of NRC are periodically reviewed by the Office to ascertain their eligibility for promotion and to encourage it wherever justified. An intensive recruitment of minority and women college graduates is also underway to broaden the personnel base from which both may accede to higher grade levels over time. As of June 1976, minority employees constituted 10.8 percent of the total NRC staff and women made up 28.4 percent of the total. EEO has adopted the goal of increasing minority employment to 12 percent of total strength in fiscal year 1977 and, over the period 1978-1982, to raise minority employment to 16 percent of total staff.

Federal Women's Program

The NRC Federal Women's Program seeks to assure equal employment opportunity specifically for women and to encourage women both to compete in Federal employment and to participate in training programs leading to advancement. The NRC Federal Women's Program Coordinator implements these objectives by recruiting women; encouraging placement of women in jobs related to NRC's major funtions with greater prospects for advancement; motivating women employees to improve their knowledge of NRC goals and their skills for contributing to their attainment; and providing continued training for women as their careers advance within the NRC.

Appendix 1

NRC Organization

(As of September 30, 1976)

COMMISSIONERS

Marcus A. Rowden, Chairman
Edward A. Mason
Victor Gilinsky
Richard T. Kennedy

The Commission Staff

General Counsel, Peter L. Strauss
Office of Policy Evaluation, Benjamin Huberman, Director
Office of Public Affairs, John A. Harris, Director
Office of Congressional Affairs, Carlton C. Kammerer, Director
Office of Inspector and Auditor, Thomas J. McTiernan, Director
Secretary of the Commission, Samuel J. Chilk

Other Offices

Advisory Committee on Reactor Safeguards, Dade W. Moeller, Chairman
Atomic Safety & Licensing Board Panel, James R. Yore, Acting Chairman
Atomic Safety & Licensing Appeal Panel, Alan S. Rosenthal, Chairman

EXECUTIVE DIRECTOR FOR OPERATIONS

Executive Director for Operations, Lee V. Gossick
Assistant Executive Director for Operations, William J. Dircks
Technical Advisor, Stephen H. Hanauer

Program Offices

Office of Nuclear Reactor Regulation, Ben C. Rusche, Director
Office of Nuclear Material Safety and Safeguards, Kenneth R. Chapman, Director
Office of Nuclear Regulatory Research, Saul Levine, Acting Director
Office of Standards Development, Robert B. Minogue, Director
Office of Inspection and Enforcement, Ernst Volgenau, Director

Staff Offices

Office of Administration, Daniel J. Donoghue, Director
Executive Legal Director, Howard K. Shapar
Controller, Learned W. Barry, Acting
Office of Equal Employment Opportunity, Edward E. Tucker, Director
Office of Planning and Analysis, Barrett J. Riordan, Director
Office of International Programs, James R. Shea, Director
Office of State Programs, Robert G. Ryan, Director
Office of Management Information and Program Control, William G. McDonald, Director
Office of Special Studies, Seymour H. Smiley, Director

Regional Offices

Region I Philadelphia, Pa., James P. O'Reilly, Director
Region II Atlanta, Ga., Norman C. Moseley, Director
Region III Chicago, Ill., James G. Keppler, Director
Region IV Dallas, Texas, E. Morris Howard, Director
Region V San Francisco, Calif., Robert H. Engelken, Director

The Energy Reorganization Act of 1974 specified that, below the Commission level, there would be an Executive Director for Operations, and three regulatory or "line" offices: the Offices of Nuclear Reactor Regulation, Nuclear Material Safety and Safeguards, and Nuclear Regulatory Research. During the transition phase of the organization's development, NRC determined that two additional program offices were needed to perform functions not specifically mandated by the legislation (See organization chart in Chapter 1.)

The Executive Director for Operations directs and coordinates the Commission's operational and administrative activities and the development of policy options for Commission consideration.

The Office of Nuclear Reactor Regulation performs licensing functions associated with nuclear power plants. NRR reviews applications for construction permits and operating licenses for power, test and research reactors, and is responsible for the issuance of licenses for operators and senior operators at licensed facilities. NRR also is responsible for the detailed technical safety, environmental, and safeguards evaluation of both applications and the operating facilities themselves, as well as for review of generic safety issues associated with reactor safety, containment safety, site safety, and engineering.

The Office of Nuclear Material Safety and Safeguards is responsible for ensuring public health and safety, and protection of national security and environmental values in the licensing and regulation of facilities and materials associated with the processing, transport, and handling of nuclear materials. NMSS reviews and assesses safeguards against potential threats, thefts, and sabotage, and works closely with other NRC organizations in coordinating safety and and safeguards programs and in recommending research, standards, and policy options necessary for their successful operation.

The Office of Nuclear Regulatory Research plans and supervises research programs necessary to the confirmatory assessment of the safety of both water reactors and advanced reactors. Research programs cover such areas as materials behavior, computer code development and verification, safeguards, health effects associated with the nuclear fuel cycle, environmental impact of nuclear power, waste treatment and disposal, and transportation of radioactive materials.

The Office of Standards Development develops regulations, guides, and other standards needed for regulation of facilities and materials with respect to radiological health and safety and environmental protection, for materials and plant protection, and for antitrust review. The Office also coordinates NRC participation in national and international standards activities.

The Office of Inspection and Enforcement inspects licensees to determine if operations are conducted in compliance with license provisions and Commission regulations and to identify conditions that may adversely affect the protection of nuclear materials and facilities, the environment, or the health and safety of the public; inspects applicants and their facilities to provide a basis for recommending issuance or denial of licenses; investigates accidents, incidents, and allegations of improper actions that involve nuclear material and facilities; and enforces NRC regulations and license provisions. IE, on behalf of NRC, manages and directs the Commission's five regional offices, located as follows: Region I, Philadelphia, Pa.; Region II, Atlanta, Ga.; Region III, Chicago, Ill.; Region IV, Dallas, Texas; and Region V, San Francisco, Calif.

The Commission Staff

The Office of the Secretary develops policies and procedures and provides secretariat services for the conduct of Commission business and implementation of Commission decisions, including the scheduling of Commission business and recording of meetings. The office also plans and administers the Commission Paper system, the Correspondence and Records Facility, the official docket, the historical program, the Public Document Room in Washington, D.C., and provides administrative and logistical support for Commission offices located in Washington, D.C.

The Office of the General Counsel directs matters of law and legal policy and advises the Commission in connection with its quasi-judicial responsibilities and in the development of substantive policy matters; represents the Commission in matters relating to litigation, and in court proceedings affecting NRC programs. The office also reviews and prepares appropriate decisions on Appeal Board decisions and rulings, petitions seeking direct Commission action, and rulemaking proceedings involving hearings; reviews the legal aspects of legislation pending in the Congress which would affect the Commission's activities; and assists in drafting legislation proposed by the Commission and testimony provided to Congress.

The Office of Policy Evaluation plans and manages activities involved in performance of an independent review of positions developed by the NRC staff which require policy determinations by the Commission. The Office also conducts analyses and projects which are either self-generated or requested by the Commission.

Office of the 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. Refers criminal matters to the Department of Justice and maintains liaison with law enforcement agencies.

The Office of Public Affairs plans and administers NRC's program to inform the public of Commission policies, programs and activities and keeps NRC management informed of public affairs activities of in-

terest to the Commission.

The Office of Congressional Affairs provides advice and assistance to the Commission and senior staff on congressional matters, coordinates NRC's congressional relations activities, and maintains liaison for the Commission with congressional committees and members of Congress.

Support Staff

The Office of Administration directs the agency's programs for organization and personnel management; security and classification; document control; facilities and materials license fees; contracting and procurement; rules, proceedings and document services; data processing; and other administrative housekeeping and special services.

The Office of the Controller develops and maintains the Commission's financial management program, including policies, procedures, and standards of accounting, budgeting, pricing, contract finance, automatic data processing equipment acquisition, and accounting for capitalized property. Prepares reports necessary to the financial integrity, efficiency, and management of NRC direct and contract operations and to safeguarding of NRC funds. Administers financial functions for the agency and maintains liaison with the General Accounting Office, Office of Management and Budget, and other agencies, congressional committees, and industry. The Controller also performs resource planning functions and prepares the NRC Five-Year Plan.

The Office of the Executive Legal Director provides legal advice and services to the Executive Director for Operations and staff, including representation in administrative proceedings involving the licensing of nuclear facilities and materials, and the enforcement of license conditions and regulations; counseling with respect to safeguards matters, contracts, security, patents, administration, research, personnel, and the development of regulations to implement applicable Federal statutes.

The Office of Equal Employment Opportunity develops and recommends overall policy providing for equal employment opportunity, recommends improvements or corrections to achieve this goal, and monitors the agency's affirmative action program.

The Office of International Programs plans and implements programs of international cooperation; coordinates NRC export-import policies, issuing licenses as directed by the Commission; and establishes regulatory relationships with foreign nations and international organizations.

The Office of Management Information and Program Control provides integrated information and control systems for schedules, manpower, budget, and program performance by line offices; administers agency-wide manpower reporting system and performance appraisal reports; and analyzes and reports on the operating experience of licensed facilities.

The Office of Planning and Analysis performs program assessment and management studies; conducts analyses to determine NRC progress in achieving objectives; develops and implements Commission policiy on value/impact analyses; and identifies new agency policy objectives.

The Office of State Programs administers activities pertaining to regulatory relationships with State governments and organizations and interstate bodies; directs the NRC Agreement State program; and provides Federal agency leadership in assisting State and local governments in radiological emergency response planning.

The Office of Special Studies conducted the Congressionally mandated Nuclear Energy Center Site Survey. (The Office was disbanded on October 1, 1976.)

Other Offices

Advisory Committee on Reactor Safeguards, a statutory group of 15 scientists and engineers, reviews and reports its recommendations on applications for construction and operation of major nuclear facilities and advises the Commission on safety matters referred to it, and on the adequacy of proposed reactor safety standards.

Atomic Safety and Licensing Board Panel: Three-member licensing boards drawn from the Panel —made up of lawyers and others with expertise in various technical fields—conduct public hearings and make such intermediate or final decisions as the Commission may authorize in proceedings to grant, suspend, revoke, or amend NRC licenses or authorizations.

Atomic Safety and Licensing Appeal Panel: Three-member appeal boards selected from the Panel exercise the authority and perform the review functions which would otherwise be carried out by the Commission in licensing proceedings. ASLB decisions are subject to appeal, and the decision of the appeal board ordinarily represents the final order of the Commission in a licensing matter.

Appendix 2

NRC Committees and Boards

Advisory Committee on Reactor Safeguards

The ACRS was made a statutory committee in 1957 by Section 29 of the Atomic Energy Act of 1954, as amended. The committee reviews safety studies and facility license applications referred to it in accordance with the Atomic Energy Act and the Energy Reorganization Act and makes reports thereon which are made part of the public record of the proceeding. The committee provides advice with respect to the hazards of new or existing nuclear facilities and the adequacy of related safety standards. The committee also performs such other additional duties as the Commission may request. The members are appointed for four-year terms by the Commission. The committee annually designates its own chairman and vice chairman. As of September 30, 1976, the members were:

Dr. DADE W. MOELLER, *Chairman,* Professor of Engineering in Environmental Health, Head of Environmental Health Sciences Dept. and Associate Director, the Kresge Center for Environmental Health, School of Public Health, Harvard University, Boston, Mass.

MYER BENDER, *Vice Chairman,* Manager of Engineering, Oak Ridge National Laboratory, Oak Ridge, Tenn.

JOHN H. ARNOLD, Consultant, Air Products and Chemicals, Inc., Allentown, Pa.

Dr. SPENCER H. BUSH, Senior Staff Consultant, Battelle Memorial Institute, Pacific Northwest Laboratory, Richland, Wash.

Dr. MAX W. CARBON, Professor and Chairman of Nuclear Engineering Department, University of Wisconsin, Madison, Wis.

JESSE EBERSOLE, Retired Head Nuclear Engineer, Division of Engineering Design, Tennessee Valley Authority, Knoxville, Tenn.

HAROLD ETHERINGTON, Retired Consulting Engineer (Mechanical Reactor Engineering), Jupiter, Fla.

Dr. HERBERT S. ISBIN, Professor, Chemical Engineering, University of Minnesota, Minneapolis, Minn.

Prof. WILLIAM KERR, Professor, Nuclear Engineering, University of Michigan, Ann Arbor, Mich.

Dr. STEPHEN LAWROSKI, Senior Engineer, Chemical Engineering Division, Argonne National Laboratory, Argonne, Ill.

Dr. J. CARSON MARK, Retired Division Leader, Los Alamos Scientific Laboratory, Los Alamos, N.M.

Dr. DAVID OKRENT, Professor, School of Engineering and Applied Science, University of California, Los Angeles, Calif.

Dr. MILTON S. PLESSET, Professor, Department of Engineering Science, California Institute of Technology, Pasadena, Calif.

Dr. CHESTER P. SIESS, Professor and Head of Civil Engineering, University of Illinois, Urbana, Ill.

Atomic Safety and Licensing Board Panel

Section 191 of the Atomic Energy Act of 1954 authorizes the Commission to establish one or more atomic safety and licensing boards, each comprised of three members, one of whom is to be qualified in the conduct of administrative proceedings and two of whom will have such technical or other qualifications as the Commission deems appropriate to the issues to be decided. The boards conduct such hearings as the Commission may direct and make such intermediate or final decisions as it may authorize in proceedings with respect to granting, suspending, revoking, or amending licenses or authorizations. The Atomic Safety and Licensing Board Panel (ASLBP) office—with a permanent chairman who coordinates and supervises the ASLBP activities—serves as spokesman for the panel, and makes policy recommendations to the Commission concerning conduct of hearings and hearing procedures. Pursuant to subsection 201(g)(1) of the Energy Reorganization Act of 1974, the functions performed by the Licensing Boards were specifically transferred to the Nuclear Regulatory Commission. As of September 30, 1976, the ASLBP was composed of the following members and professional staff:

JAMES R. YORE, *Acting Chairman, ASLBP;* Attorney, U.S. Nuclear Regulatory Commission, Bethesda, Md.*

Dr. GEORGE C. ANDERSON, Department of Oceanography, University of Washington, Seattle, Wash.

ELIZABETH S. BOWERS, ASLBP Attorney, Bethesda, Md.*

JOHN H. BREBBIA, Attorney with Law Firm of Alston, Miller & Gaines, Washington, D.C.

R. B. BRIGGS, Senior Research Engineer, Oak Ridge National Laboratory, Oak Ridge, Tenn.

GLENN O. BRIGHT, ASLBP Engineer, Bethesda, Md.*

Dr. A. DIXON CALLIHAN, Retired Union Carbide Corp. Physicist, Oak Ridge, Tenn.

Dr. E. LEONARD CHEATUM, Director of Institute of Natural Resources, University of Georgia, Athens, Ga.

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* Denotes full-time ASLBP members and staff.

HUGH K. CLARK, Retired E. I. duPont de Nemours & Co. Attorney, Kennedyville, Md.
Dr. RICHARD F. COLE, ASLBP Environmental Scientist, Bethesda, Md.*
FREDERIC J. COUFAL, ASLBP Attorney, Bethesda, Md.*
Dr. FREDERICK P. COWAN, Retired Brookhaven National Laboratory Physicist, Stuart, Fla.
Dr. FRANKLIN C. DAIBER, Department of Biological Sciences, University of Delaware, Newark, Del.
VALENTINE B. DEALE, Attorney at Law, Washington, D.C.
RALPH S. DECKER, Retired U.S. Atomic Energy Commission Engineer, Cambridge, Md.
Dr. DONALD P. DE SYLVA, Assoc. Prof. of Marine Science, Rosentiel School of Marine and Atmospheric Science, University of Miami, Miami, Fla.
MICHAEL A. DUGGAN, College of Business Administration, University of Texas, Austin, Texas
Dr. KENNETH G. ELZINGA, Department of Economics, University of Virginia, Charlottesville, Va.
Dr. GEORGE A. FERGUSON, Professor of Nuclear Engineering, Howard University, Washington, D.C.
Dr. HARRY FOREMAN, Director of Center for Population Studies, University of Minnesota, Minneapolis, Minn.
JOHN H. FRYE, III, ASLBP Legal Assistant, Bethesda, Md.*
JOHN M. FRYSIAK, ASLBP Attorney, Bethesda, Md.*
MICHAEL GLASER, Partner in Law Firm of Glaser and Fletcher, Washington, D.C.
ANDREW C. GOODHOPE, Retired Federal Trade Commission Administrative Law Judge, Wheaton, Md.
Dr. DAVID B. HALL, Los Alamos Scientific Laboratory, Los Alamos, N.M.
Dr. CADET HAND, Director, Bodega Marine Laboratory, University of California, Bodega Bay, Calif.
DANIEL M. HEAD, ASLBP Attorney, Bethesda, Md.*
Dr. DAVID L. HETRICK, Professor of Nuclear Engineering, Tucson, Ariz.
ERNEST E. HILL, Engineer, Lawrence Livermore Laboratory, University of California, Livermore, Calif.
Dr. ROBERT L. HOLTON, School of Oceanography, Oregon State University, Corvallis, Ore.
Dr. FRANK F. HOOPER, Chairman of Resource Ecology Program, School of Natural Resources, University of Michigan, Ann Arbor, Mich.
SAMUEL W. JENSCH, Administrative Law Judge, U.S. Nuclear Regulatory Commission, Bethesda, Md.*
ELIZABETH B. JOHNSON, Engineer, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Dr. WALTER H. JORDAN, Retired Senior Research Advisor & Physicist, Oak Ridge National Laboratory, Oak Ridge, Tenn.
LESTER KORNBLITH, JR., ASLBP Engineer, Bethesda, Md.*
Dr. JAMES C. LAMB, III, Department of Environmental Sciences & Engineering, University of North Carolina, Chapel Hill, N.C.
MARGARET M. LAURENCE, Partner in Law Firm of Laurence, Laurence and Neilan, Arlington, Va.
ROBERT M. LAZO, ASLBP Attorney, Bethesda, Md.*
Dr. J. V. LEEDS, JR., Professor of Environmental and Electrical Engineering, Rice University, Houston, Texas
GUSTAVE A. LINENBERGER, ASLBP Physicist, Bethesda, Md.*
Dr. LINDA W. LITTLE, Assoc. Professor, Department of Environmental Sciences & Engineering, University of North Carolina, Chapel Hill, N.C.
Dr. STANLEY LIVINGSTON, Retired Associate Director, AEC National Accelerator Laboratory, Santa Fe, N.M.
Dr. EMMETH A. LUEBKE, ASLBP Physicist, Bethesda, Md.*
EDWARD LUTON, ASLBP Attorney, Bethesda, Md.*
Dr. JOHN R. LYMAN, Retired Professor of Oceanography, University of North Carolina, Chapel Hill, N.C.
Dr. MARVIN M. MANN, ASLBP Technical Advisor, Bethesda, Md.*
Dr. WILLIAM E. MARTIN, Senior Ecologist, Battelle Memorial Institute, Columbus, Ohio
Dr. KENNETH A. MCCOLLOM, Associate Dean, College of Engineering, Oklahoma State University, Stillwater, Okla.
GARY L. MILHOLLIN, Associate Professor, University of Wisconsin Law School, Madison, Wis.
MARSHALL E. MILLER, ASLBP Attorney, Bethesda, Md.*
Dr. OSCAR H. PARIS, ASLBP Environmental Scientist, Bethesda, Md.*
Dr. HUGH PAXTON, Los Alamos Scientific Laboratory, Los Alamos, N.M.
Dr. THOMAS H. PIGFORD, Professor of Nuclear Engineering, University of California, Berkeley, Calif.
Dr. PAUL W. PURDOM, Chairman, Department of Civil Engineering, Drexel University, Philadelphia, Pa.
Dr. FORREST J. REMICK, Director of Institute of Science and Engineering, Pennsylvania State University, University Park, Pa.
DOUGLAS V. RIGLER, Partner in Law Firm of Foley, Lardner, Hollabough & Jacobs, Washington, D.C.
Dr. ERNEST O. SALO, Professor, Fisheries Research Institute-WH-10, College of Fisheries, University of Washington, Seattle, Wash.
DAVID R. SCHINK, Department of Oceanography, Texas A & M University, College Station, Texas
CARL W. SCHWARZ, Partner in Law Firm of Metzger, Noble, Schwarz & Kempler, Washington, D.C.
FREDERICK J. SHON, ASLBP Physicist, Bethesda, Md.*
IVAN W. SMITH, ASLBP Attorney, Bethesda, Md.*
Dr. MARTIN J. STEINDLER, Chemist, Argonne National Laboratory, Argonne, Ill.
Dr. QUENTIN J. STOBER, Research Assoc. Prof., Fisheries Research Institute, University of Washington, Seattle, Wash.
JOSEPH F. TUBRIDY, Attorney at Law, Washington, D.C.
JOHN F. WOLF, Attorney in Law Firm of Lamensdorf, Leonard & Moore, Washington, D.C.

* Denotes full-time ASLBP members and staff.

SHELDON J. WOLFE, ASLBP Attorney, Bethesda, Md.*

Atomic Safety and Licensing Appeal Panel

An Atomic Safety and Licensing Appeal Board, established effective September 18, 1969, was delegated the authority to perform the review functions which would otherwise be performed by the 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.

In view of the increase in the number of proceedings subject to administrative appellate review, the Atomic Safety and Licensing Appeal Panel was established on October 25, 1972, from whose membership three-member Appeal Boards could be designated for each proceeding in which the Commission had delegated its authority to an Appeal Board. At the same time, the 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 (or, in his absence, the Vice-Chairman) designates a three-member Appeal Board for each proceeding. The Commission retains review authority, exercised solely on its own motion, of decisions and actions of Appeals Boards. The Appeal Panel on September 30, 1976, was composed of the following full-time members and professional staff:

ALAN S. ROSENTHAL, *Appeal Panel Chairman,* U.S. Nuclear Regulatory Commission, Bethesda, Md.

Dr. JOHN H. BUCK, *Appeal Panel Vice-Chairman,* U.S. Nuclear Regulatory Commission, Bethesda, Md.

MICHAEL C. FARRAR, Appeal Panel Member, U.S. Nuclear Regulatory Commission, Bethesda, Md.

RICHARD S. SALZMAN, Appeal Panel Member, U.S. Nuclear Regulatory Commission, Bethesda, Md.

JEROME E. SHARFMAN, Appeal Panel Member, U.S. Nuclear Regulatory Commission, Bethesda, Md.

CHARLES BECHHOEFER, Counsel, Appeal Panel, U.S. Nuclear Regulatory Commission, Bethesda, Md.

CARDIS L. ALLEN, Technical Advisor, Appeal Panel, U.S. Nuclear Regulatory Commission, Bethesda, Md.

PAUL GAUKLER, Legal Intern, Appeal Panel, U.S. Nuclear Regulatory Commission, Bethesda, Md.

In addition to the permanent members, also available to serve as Appeal Board members for specific proceedings are:

Dr. LAWRENCE R. QUARLES, Dean Emeritus, School of Engineering and Applied Science, University of Virginia, Charlottesville, Va.

Dr. W. REED JOHNSON, Professor of Nuclear Engineering, University of Virginia, Charlottesville, Va.

Advisory Committee on Medical Uses of Isotopes

The Advisory Committee on Medical Uses of Isotopes was established in July 1958. The ACMI, composed of qualified physicians and scientists, considers medical questions referred to it by the NRC staff, and renders expert opinion regarding medical use of radioisotopes. The ACMI also advises the NRC staff, as requested, on matters of policy. Members are employed under yearly personal service contracts. The Director, Division of Fuel Cycle and Material Safety serves as Committee Chairman. As of September 30, 1976, the members were:

RICHARD E. CUNNINGHAM, *Acting Chairman, ACMI,* Acting Director, Division of Fuel Cycle and Material Safety, U.S. Nuclear Regulatory Commission, Bethesda, Md.

FRANK H. DE LAND, Chief, Nuclear Medicine Department, Veterans Administration Hospital, Lexington, Ky.

Dr. DAVID E. KUHL, Associate Director of the Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, Calif.

Dr. JAMES L. QUINN, III, Director, Nuclear Medicine Department, Northwestern Memorial Hospitals, Chicago, Ill.

Dr. HENRY N. WAGNER, JR., Professor of Radiology and Radiological Science, Johns Hopkins Medical Institution, Baltimore, Md.

Dr. EDWARD W. WEBSTER, Director, Department of Radiation Physics, Massachusetts General Hospital, Boston, Mass.

Dr. JOSEPH B. WORKMAN, Associate Professor of Radiology, Duke University Medical Center, Durham, N.C.

* Denotes full-time ASLBP members and staff.

Appendix 3

Public Document Rooms

Most documents originated by NRC, or submitted to it for consideration, are placed in the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C., for public inspection. In addition, documents relating to licensing proceedings or licensed operation of specific facilities are made available in local public document rooms established in the vicinity of each proposed or existing nuclear facility. The locations of these local PDRs of May 3, 1977, and the name of the facility for which documents are retained, are listed below.

ALABAMA

- Mrs. Maude S. Miller
  Athens Public Library
  South and Forrest
  Athens, Ala. 35611
  Browns Ferry nuclear plant
- Mr. Wayne Love
  G.S. Houston Memorial Library
  212 W. Verdeshaw Street
  Dothan, Ala. 36301
  Farley nuclear plant
- Mrs. Joanne Wyatt
  Clanton Public Library
  100 First Street
  Clanton, Ala. 35045
  Barton nuclear plant
- Mrs. Blanks
  Scottsboro Public Library
  1002 South Broad Street
  Scottsboro, Ala. 35768
  Bellefonte nuclear plant

ARIZONA

- Mrs. Mary Carlson
  Phoenix Public Library
  Science and Industry Section
  12 East McDowell Road
  Phoenix, Ariz. 85004
  Palo Verde nuclear plant

ARKANSAS

- Mr. Vaughn
  Arkansas Polytechnic College
  Russelville, Ark. 72801
  Arkansas Nuclear One

CALIFORNIA

- Mrs. Inez Pettijohn
  Kern County Library
  1315 Truxtun Avenue
  Bakersfield, Calif. 93301
  San Joaquin nuclear plant
- Mrs. Alice Rosenberger
  Palo Verde Valley District Library
  125 West Chanslorway
  Blythe, Calif. 92255
  Mr. James Werner
  San Diego County Law Library
  1105 Front Street
  San Diego, Calif. 92101
  Sundesert nuclear plant
- Mrs. Lucille A. Martel
  Mission Viejo Branch Library
  24851 Chrisanta Drive
  Mission Viejo, Calif. 92676
  San Onofre nuclear plant
- Mrs. Patricia Clark
  San Luis Obispo County Library
  888 Morro Street
  San Luis Obispo, Calif. 93406
  Diablo Canyon nuclear plant
- Mrs. Judy Klapprott
  Humboldt County Library
  636 F Street
  Eureka, Calif. 95501
  Humboldt Bay nuclear plant
- Mrs. Dorothy Harvey
  Business & Municipal Dept.
  Sacramento City-County Library
  828 I Street
  Sacramento, Calif. 95814
  Rancho Seco nuclear plant
- Mr. Andrew La Mance
  Stanislaus County Free Library
  1500 I Street
  Modesto, Calif. 95345
  Stanislaus nuclear plant

COLORADO

- Miss Ester Fromm
  Greeley Public Library
  City Complex Building
  Greeley, Colo. 80631
  Fort St. Vrain nuclear plant

CONNECTICUT

- Mrs. Liskov
  Waterford Public Library
  Rope Ferry Rd. Route 156
  Waterford, Conn. 06385
  Millstone nuclear plant
- Mr. William Van Beynum
  Russell Library
  119 Broad Street
  Middletown, Conn. 06457
  Haddam Neck nuclear plant

DELAWARE

- Mrs. L. J. Brown
  Newark Free Library
  Elkton Rd. and Delaware Ave.
  Newark, Del. 19711
  Summit nuclear plant

FLORIDA

- Ms. Sally Litton
  Jacksonville Public Library
  122 North Ocean Street
  Jacksonville, Fla. 32204
  Offshore Power Systems manufacturing facility
- Mrs. R. Scott
  Indian River Junior College Library
  3209 Virginia Avenue
  Ft. Pierce, Fla. 33450
  St. Lucie nuclear plant

Note: Due to changes in the location of local PDRs, an updated listing may be obtained by writing to the Local Public Document Room Coordinator, Division of Rules and Records, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

- Miss Elizabeth Peeler
  Environmental and Urban Affairs Library
  Florida International Univ.
  Miami, Fla. 33199
  Turkey Point nuclear plant
- Mrs. Bonsall
  Crystal River Public Library
  668 N.W. First
  Crystal River, Fla. 32639
  Crystal River nuclear plant

GEORGIA

- Mrs. J. W. Borom
  Burke County Library
  4th Street
  Waynesboro, Ga. 30530
  Vogtle nuclear plant
- Ms. Charlotte Brobston
  Appling County Public Library
  Parker Street
  Baxley, Ga. 31513
  Hatch nuclear plant

ILLINOIS

- Miss Elizabeth Cummings
  Illinois Valley Community College
  Rural Route #1
  Oglesby, Ill. 16348
  LaSalle nuclear plant
- Mrs. Pam Wilson
  Morris Public Library
  604 Liberty Street
  Morris, Ill. 60451
  Dresden nuclear plant
  Midwest fuel recovery plant
- Mrs. Marie Hoschied
  Moline Public Library
  504 - 17th Street
  Moline, Ill. 61265
  Quad-Cities nuclear plant
- Mrs. Liz Bishoff
  Waukegan Public Library
  128 N. County Street
  Waukegan, Ill. 60085
  Zion nuclear plant
- Mrs. M. Evans
  Vespasian Warner Public Library
  120 West Johnson Street
  Clinton, Ill. 61727
  Clinton nuclear plant
- Mrs. Penny O'Roarke
  Byron Public Library
  Third and Washington Street
  Byron, Ill. 61010
  Byron nuclear plant
- Mr. Thomas Carter
  Wilmington Township Public Library
  201 S. Kankakee Street
  Wilmington, Ill. 60481
  Braidwood nuclear plant
- Mrs. Martin Ginie
  Savanna Township Public Library
  326 Third Street
  Savanna, Ill. 61074
  Carroll nuclear plant

INDIANA

- Mr. David Palmer
  West Chester Township Public Library
  125 South Second Street
  Chesterton, Ind. 46304
  Bailly nuclear plant
- Mr. Don C. Johnson
  Madison-Jefferson County Public Library
  420 West Main Street
  Madison, Ind. 47250
  Marble Hill nuclear plant

IOWA

- Miss Kay Burke
  Reference Service
  Cedar Rapids Public Library
  428 Third Avenue S.E.
  Cedar Rapids, Iowa 52401
  Duane Arnold nuclear plant

KANSAS

- Mrs. Florine Applegate
  Coffey County Courthouse
  Burlington, Kan. 66839
  Wolf Creek nuclear plant

LOUISIANA

- Mrs. Lucy Carriger
  Business & Science Division
  New Orleans Public Library
  219 Loyola Avenue
  New Orleans, La. 70140
  Offshore Power Systems manufacturing facility
- Mr. Ken Owen
  University of New Orleans Library
  Louisiana Collection, Lakefront
  New Orleans, La. 70122
  Waterford nuclear plant
- Miss Janie Videtto
  Audubon Library,
  West Feliciana Branch
  Ferdinand Street
  St. Francisville, La. 70775
  Mr. Jimmie Hoover
  Government Documents Dept.
  Louisiana State University
  Baton Rouge, La. 70803
  River Bend nuclear plant

MAINE

- Mrs. Barbara Shelton
  Wiscasset Public Library
  High Street
  Wiscasset, Maine 04578
  Maine Yankee nuclear plant

MARYLAND

- Mrs. Elizabeth Hart
  Charles County Library
  Garrett and Charles Streets
  La Plata, Md. 20646
  Douglas Point nuclear plant
- Mrs. Marie Barrett
  Calvert County Library
  Prince Frederick, Md. 20678
  Calvert Cliffs nuclear plant
- Mrs. Pamela R. Schott
  Harford Community College
  401 Thomas Run Road
  Bel Air, Md. 21014
  Perrymen nuclear plant

MASSACHUSETTS

- Miss Lucille Bolton
  Greenfield Public Library
  402 Main Street
  Greenfield, Mass. 01581
  Yankee Rowe nuclear plant
- Mr. Mark Titus
  Plymouth Public Library
  North Street
  Plymouth, Mass. 02360
  Pilgrim nuclear plant
- Ms. Sue SanSoucie
  The Carnegie Library
  Avenue A
  Turner Falls, Mass. 01376
  Montague nuclear plant

MICHIGAN

- Mrs. Diana Shamp
  Kalamazoo Public Library
  Reference Department
  315 South Rose Street
  Kalamazoo, Mich. 49006
  Palisades nuclear plant
- Mrs. Katherine Thomson
  St. Clair County Library
  210 McMorran Blvd.
  Port Huron, Mich. 48060
  Greenwood nuclear plant
- Mrs. M. B. Wallick
  Charlevoix Public Library
  107 Clinton Street
  Charlevoix, Mich. 49720
  Big Rock Point nuclear plant

- Mrs. Alma FitzGibbon
  Grace Dow Memorial Library
  1710 W. St. Andrews Road
  Midland, Mich. 48640
  Midland nuclear plant
- Ms. Ann Stobbe
  Maude Preston Palenske Memorial Library
  500 Market Street
  St. Joseph, Mich. 49085
  D. C. Cook nuclear plant
- Mrs. Marcia Learned
  Monroe County Library System
  Reference Department
  3700 South Custer Road
  Monroe, Mich. 48161
  Fermi nuclear plant

MINNESOTA

- Mrs. Copeland
  Environmental Conservation Library
  Minneapolis Public Library
  300 Nicollet Mall
  Minneapolis, Minn. 55401
  Monticello nuclear plant
  Prairie Island nuclear plant

MISSOURI

- Mrs. Freida Mittwede
  Fulton City Library
  709 Market Street
  Fulton, Mo. 65251

  Mrs. Ranata Rotkowicz
  Olin Library,
  Washington University
  Skinker & Lindell Blvd.
  St. Louis, Mo. 63130
  Callaway nuclear plant

MISSISSIPPI

- Mrs. Stella Jennings
  Clairborne County
  Chancery Clerk
  Clairborne County Courthouse
  Port Gibson, Miss. 39150
  Grand Gulf nuclear plant
- Mr. William McMullin
  Corinth Public Library
  1023 Fillmore Street
  Corinth, Miss. 38834
  Yellow Creek nuclear plant

NEBRASKA

- Mrs. Leona Hansen
  Blair Public Library
  1665 Lincoln Street
  Blair, Neb. 68008
  Ft. Calhoun 1 nuclear plant
- Mr. Frank Gibson
  Omaha Public Library
  1823 Harney Street
  Omaha, Neb. 68102
  Ft. Calhoun 2 nuclear plant
- Mr. Loy Mowery
  Auburn Public Library
  118 - 15th Street
  Auburn, Neb. 68305
  Cooper nuclear plant

NEW HAMPSHIRE

- Miss Pamela Gjettum
  Exeter Public Library
  Front Street
  Exeter, N.H. 03883
  Seabrook nuclear plant

NEW JERSEY

- Mr. Arthur Flandreu
  Stockton State College Library
  Pomona, N.J. 08240
  Offshore Power Systems manufacturing facility
  Atlantic nuclear plant
- Miss Elizabeth Fogg
  Salem Free Public Library
  112 West Broadway
  Salem, N.J. 08079
  Salem nuclear plant
  Hope Creek nuclear plant
- Mrs. Gail Colure
  Ocean County Library
  Brick Township Branch
  Brick Town, N.J. 08723
  Oyster Creek nuclear plant
  Forked River nuclear plant

NEW YORK

- Mr. Patrick Lozitto
  Oswego County Office Building
  46 E. Bridge Street
  Oswego, N.Y. 13126
  Nine Mile Point nuclear plant
  Sterling nuclear plant
  FitzPatrick nuclear plant
- Mrs. June Rogoff
  Rochester Public Library
  Business & Social Science Div.
  115 South Avenue
  Rochester, N.Y. 14604
  Ginna nuclear plant
- Mrs. Kay Winter
  Hendrick Hudson Free Library
  31 Albany Post Road
  Montrose, N.Y. 10548
  Indian Point nuclear plant
- Mr. Richard Lusak
  Comsewogue Public Library
  170 Terryville Road
  Port Jefferson, N.Y. 11776
  Shoreham nuclear plant
- Mrs. E. Overton
  Riverhead Free Library
  330 Court Street
  Riverhead, N.Y. 11901
  Jamesport nuclear plant
- Mrs. Dorothy Augustine
  Catskill Public Library
  1 Franklin Street
  Catskill, N.Y. 12414
  Greene County nuclear plant
- Mr. Stanley Zukowzki
  Buffalo & Erie County Public Library
  Lafayette Square
  Buffalo, N.Y. 14203

  Ms. Marsha Russell
  Town of Concord Public Library
  23 North Buffalo Street
  Springville, N.Y. 14141

  Mrs. Walter Baumann
  Memorial Library of Little Valley
  Main Street
  Little Valley, N.Y. 14755
  NFS fuel processing plant and UF_6 facility

NORTH CAROLINA

- Mrs. Ruth Osborne
  Public Library of Charlotte & Mecklenburg County
  310 North Tryon Street
  Charlotte, N.C. 28202
  McGuire nuclear plant
- Mr. Roy Dicks
  Wake County Public Library
  104 Fayetteville Street
  Raleigh, N.C. 27601
  Shearon Harris nuclear plant
- Mr. David G. Ferguson
  Davie County Public Library
  416 N. Main Street
  Mocksville, N.C. 27028
  Perkins nuclear plant
- Mr. Phillip Barton
  Southport-Brunswick Co. Library
  109 W. Moore Street
  Southport, N.C. 28461
  Brunswick nuclear plant
- Mrs. Charlotte Ellis
  Franklin County Library
  1026 Justice Street
  Louisburg, N.C. 27549
  Gulf Youngsville fuel fabrication facility

OHIO

- Mrs. Betty Waltman
  Perry Public Library
  3753 Main Street
  Perry, Ohio 44081
  Perry nuclear plant

- Miss Diana Conner
  Clermont County Library
  Third and Broadway Streets
  Batavia, Ohio 45103
  Zimmer nuclear plant
- Mr. Donald Fought
  Ida Rupp Public Library
  310 Madison Street
  Port Clinton, Ohio 43452
  Davis-Besse nuclear plant
- Mrs. Esther Schedley
  Berlin Township Public Library
  4 East Main Street
  Berlin Heights, Ohio 44814
  Erie nuclear plant

OKLAHOMA

- Mrs. Linda Hill
  Tulsa City-County Library
  400 Civic Center
  Tulsa, Okla. 74102
  Black Fox nuclear plant
- Mrs. O. J. Grosclaude
  Sallisaw City Library
  111 North Elm
  Sallisaw, Okla. 74955
  Sequoyah UF_6 facility
- Ms. Hazel Nicholson
  Guthrie Public Library
  402 East Oklahoma Street
  Guthrie, Okla. 73044
  Cimarron Pu fabrication plant
  & uranium fuel facility

OREGON

- Mr. H. B. Allen
  City Hall, Records Office
  Arlington, Ore. 97812
  Pebble Springs nuclear plant
- Mr. Zimmer
  Columbia County Courthouse
  Law Library Circuit Court Rm.
  St. Helens, Ore. 97501
  Trojan nuclear plant

PENNSYLVANIA

- Mrs. Louise Heimann
  Beaver Area Memorial Library
  100 College Avenue
  Beaver, Pa. 15009
  Beaver Valley nuclear plant
- Osterhout Free Library
  Reference Department
  71 South Franklin Street
  Wilkes-Barre, Pa. 18701
  Susquehanna nuclear plant
- Mrs. Phyllis I. Doutrich
  Martin Memorial Library
  159 E. Market Street
  York, Pa. 17401
  Peach Bottom nuclear plant
- Mr. John Geschwindt
  Government Publications
  Section
  State Library of Pennsylvania
  Commonwealth and Walnut
  Streets
  Education Bldg.
  Harrisburg, Pa. 17126
  Three Mile Island
  nuclear plant
- Mr. Robert N. Case
  Lancaster County Library
  125 North Duke Street
  Lancaster, Pa. 17602
  Fulton nuclear plant
- Mrs. Gordon Bauerle
  Pottstown Public Library
  500 High Street
  Pottstown, Pa. 19464
  Limerick nuclear plant
- Mrs. Helen Speer
  Apollo Memorial Library
  219 North Pennsylvania Ave.
  Apollo, Pa. 15613
  Apollo UF_6 and Pu facilities
- Mr. Anthony Martin
  Carnegie Library of Pittsburgh
  4400 Forbes Avenue
  Pittsburgh, Pa. 15213
  Cheswick Fuel Development
  Labs.
- Mr. F. E. Virostek
  B. F. Jones Memorial Library
  663 Franklin Avenue
  Aliquippa, Pa. 15001
  Shippingport Light Water
  Breeder Reactor

RHODE ISLAND

- Mrs. Ann Crawford
  Cross Mill Public Library
  Old Post Road
  Charlestown, R.I. 02831

  Mrs. Ann Shaw
  University of Rhode Island
  University Library
  Government Publications Office
  Kingston, R.I. 02881

  Mr. Philip Newbury
  New England Power Company
  P.O. Box 600
  Charleston, R.I. 02813
  New England nuclear plant

SOUTH CAROLINA

- Mr. Joe E. Garcia
  York County Library
  325 South Oakland Avenue
  Rockhill, S.C. 29730
  Catawba nuclear plant
- Reference Department
  Richland County Public Library
  1400 Sumpter Street
  Columbia, S.C. 29201
  Summer nuclear plant
- Miss Louise Marcum
  Oconee County Library
  201 S. Spring Street
  Walhalla, S.C. 29691
  Oconee nuclear plant
- Mrs. Allene Reep
  Hartsville Memorial Library
  Home & Fifth Avenue
  Hartsville, S.C. 29550
  H. B. Robinson nuclear plant
- Mr. David Lyon
  Cherokee County Library
  300 E. Rutledge Avenue
  Gaffney, S.C. 29340
  Cherokee nuclear plant
- Mr. Fred Bodiford,
  County Supervisor
  County Office Bldg. Room 105
  P.O. Box 443
  Barnwell, S.C. 29812
  Barnwell fuel plant
  UF_6 facility
  Barnwell fuel storage station
- Mr. Carl Stone
  Anderson County Library
  202 East Greenville Street
  Anderson, S.C. 29621
  Recycle fuel plant

TENNESSEE

- Mrs. A. A. Louderdale
  Fred A. Vought Library
  311 White Oak Street
  Hartsville, Tenn. 37174
  Hartsville nuclear plant
- Ms. Dorothy Dismuke
  Oak Ridge Public Library
  Civic Center
  Oak Ridge, Tenn. 37830

  Mrs. Patricia Rugg
  Lawson McGhee Public Library
  500 W. Church Street
  Knoxville, Tenn. 37902
  Clinch River breeder plant
  Exxon Nuclear Fuel
  Recovery Center
  Fuel Fabrication Facility

- Mr. Wally Keasler
  Chattanooga-Hamilton County
  Bicentennial Library
  1001 Broad Street
  Chattanooga, Tenn. 37402
  Sequoyah nuclear plant
  Watts Bar nuclear plant
- Mr. T. Cal Hendrix
  Kingsport Public Library
  Broad & New Streets
  Kingsport, Tenn. 37660
  Phipps Bend nuclear plant

TEXAS

- Mrs. Tim Whitworth
  Somerville County
  Public Library
  On the Square
  P.O. Box 417
  Glen Rose, Texas 76403
  Comanche Peak nuclear plant
- Mrs. Dorothy Kenebrew
  Newton County Library
  P.O. Box 657
  Newton, Texas 77034
  Blue Hills nuclear plant
- Honorable Hert Huebner
  Judge, Matagorda County
  Matagorda County Courthouse
  Bay City, Texas 77414
  South Texas nuclear plant
- Mrs. Kroesche
  Sealy Public Library
  415 Main Street
  Sealy, Texas 77474
  Allens Creek nuclear plant

VERMONT

- Mrs. June Bryant
  Brooks Memorial Library
  224 Main Street
  Brattleboro, Vt. 05301
  Vermont Yankee
  nuclear plant

VIRGINIA

- Ms. Sandra Peterson
  Swem Library
  College of William & Mary
  Williamsburg, Va. 23185
  Surry nuclear plant
- Mr. Edward Kube
  Louisa County Courthouse
  P.O. Box 27
  Louisa, Va. 23093

  Mr. Gregory Johnson
  Alderman Library
  Manuscripts Department
  University of Virginia
  Charlottesville, Va. 22901
  North Anna nuclear plant

WASHINGTON

- Miss D. E. Roberts
  Richland Public Library
  Swift and Northgate Streets
  Richland, Wash. 99352
  WPPSS 1, 2, & 4
  nuclear plants
  Exxon fuel plant
- Mrs. D. Stendal
  Sedro Wooley Library
  802 Ball Avenue
  Sedro Wooley, Wash. 98294
  Skagit nuclear plant
- Mrs. Linda Hansford
  W. H. Abel Memorial Library
  125 Main Street, South
  Montesano, Wash. 98563
  WPPSS 3 & 5 nuclear plants

WISCONSIN

- Mrs. June Radloff
  LaCrosse Public Library
  800 Main Street
  LaCrosse, Wis. 54601
  LaCrosse nuclear plant
- Mr. Arthur M. Fish
  Document Dept., Library
  University of Wisconsin
  Stevens Point
  Stevens Point, Wis. 54481
  Point Beach nuclear plant
  Wood nuclear plant
- Mrs. M. Gates
  Dwight-Foster Public Library
  102 E. Milwaukee Avenue
  Fort Atkinson, Wis. 53538

  Ms. Ann Waidelich
  Municipal Reference Service of
  the Madison Public Library
  Room 103B
  City County Building
  Madison, Wis. 53709
  Koshkonong nuclear plant
- Miss Sue Grosshuech
  Kewaunee Public Library
  822 Juneau Street
  Kewaunee, Wis. 54216
  Kewaunee nuclear plant
- Mr. John Jax
  University of Wisconsin
  Stout Library
  Menomonie, Wis. 54751
  Tyrone nuclear plant
- Mrs. Frances Wendtland
  Mead Public Library
  710 North Eighth Street
  Sheboygan, Wis. 53081
  Haven nuclear plant

WYOMING

- Mrs. Carroll Highfill
  Converse County Library
  Douglas, Wyo. 82633
  Highland uranium mill
- Mrs. Margaret Baker
  Carbon County Public Library
  Court House
  Rawlins, Wyo. 82301
  Shirley Basin uranium mill

PUERTO RICO

- Mrs. Rosario Cabrera
  Public Library, City Hall
  José de Diego Avenue
  P.O. Box 1086
  Arecibo, P.R. 00612

  Mrs. Amalia Ruiz De Porras
  Etien Totti Public Library
  College of Engineers,
  Architects & Surveyors
  Urb Roosevelt Development
  Hato Rey, P.R. 00918
  North Coast nuclear plant

Appendix 4

Regulations

The regulations of the Nuclear Regulatory Commission are contained in Title 10, Chapter I, of the Code of Federal Regulations. Effective and proposed regulations concerning licensed activities, and certain policy statements relating thereto, which were published in the *Federal Register* during fiscal year 1976 are set forth below.

REGULATIONS AND AMENDMENTS PUT INTO EFFECT

Amendments of Table S-3 and Summary Table S-4—Part 51

On July 28, 1975, amendments to Part 51 were published, effective immediately, which correct a typographical error in Table S-3 and Summary Table S-4 and revise footnote 1 of Summary Table S-4 to reflect the availability of NUREG-75/038.

Measurement Control Program for Special Nuclear Materials Control and Accounting —Part 70

On August 11, 1975, amendments to Part 70 were published, effective September 11, 1975, which specify criteria for a measurement control program which would be required to be established and maintained by each licensee which is authorized to possess, at any one time and place, more than one effective kilogram of special nuclear material in unsealed form.

Petition for Temporary Reduction of Licensing Fees—Part 170

On August 11, 1975, NRC published an order denying petitioners' (Cincinnati Gas and Electric Company, et al.) request to limit fees to be charged in the future to the amounts specified in their petition of May 1974 with respect to "application fees, construction permits, and operating licenses" until such time as the matter is finally resolved by court or legislative actions. NRC granted petitioners' request to consolidate into Docket PRM-170-2 the Commission-initiated rulemaking proceeding regarding the proposed amendments of 10 CFR Part 170.

Application of Cost-Benefit Analysis Requirements of Appendix I to Certain Nuclear Power Plants—Part 50

On September 4, 1975, amendments to Part 50 were published, effective immediately, which provide persons who have filed applications for construction permits for light-water-cooled nuclear power reactors which were docketed on or after January 2, 1971, and prior to June 4, 1976, the option of dispensing with the cost-benefit analysis required by paragraph II.D. of Appendix I if the proposed or installed radwaste systems and equipment satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed by the regulatory staff in the rulemaking proceeding on Appendix I.

Miscellaneous Amendments to Chapter —Parts 20, 37, and 73

On September 15, 1975, amendments to Parts 20, 37, and 73 were published, effective immediately, which correct the definition of "calendar quarter," change certain telephone listings and other pertinent information regarding the Commission's Regional Offices, and revoke Part 37.

Privacy Act Regulations—Part 9

On September 26, 1975, amendments to Part 9 were published, effective September 27, 1975, which implement the provisions of the Privacy Act of 1974, Public Law 93-579, including, in particular, those provisions of the Privacy Act which require the promulgation of agency rules.

Clarifying and Corrective Amendments to Chapter—Parts 0, 20, 30, and 70

On October 31, 1975, amendments to Parts 0, 20, 30, and 70 were published, effective immediately, clarifying the definition of "random error" in Part 70 and making minor corrections and editorial changes in Parts 0 and 20. Part 30 was amended to require that Form NRC-313 be filed in duplicate.

An Occupational Exposure Limit for Radon-222 and Its Use When Uranium Ore Dust is Present —Part 20

On October 31, 1975, amendments to Part 20 were published, effective January 29, 1976, lowering the limit on occupational exposure to airborne randon-222 and its daughters to one-third of that currently permitted and changing the uranium ore dust provision to require consideration of radon-222 and its short-lived daughters in addition to uranium.

Atomic Safety and Licensing Board Alternates —Part 2

On November 7, 1975, amendments to Part 2 were published, effective immediately, which specify procedures for and delegate specific authority to the Chairman of the Atomic Safety and Licensing Board Panel in designating alternate Atomic Safety and Licensing Board members at all stages of the hearing process.

Advance Notice of Certain Shipments of Special Nuclear Material—Part 73

On November 13, 1975, amendments to Part 73 were published, effective December 15, 1975, requiring that advance notice of shipments involving certain quantities of special nuclear material be provided to the NRC and that the NRC be notified upon arrival of such shipments.

Mixed Oxide Fuel; Scope, Procedures and Schedule for Generic Environmental Impact Statement and Criteria for Interim Licensing Actions

On November 14, 1975, the Commission published its conclusions, reached in light of extensive public comment, on the subject of procedures for decisions relating to wide-scale use of mixed oxide fuel in light-water nuclear power reactors.

Effluent Monitoring and Reporting Requirements —Parts 40 and 70

On November 17, 1975, amendments to Parts 40 and 70 were published, effective December 17, 1975, which specify reporting requirements regarding results of monitoring for radionuclides in gaseous and liquid effluents released to unrestricted areas from uranium milling, uranium hexafluoride production, and other licensed fuel cycle activities in which special nuclear material is used.

Change of Terminology for "As Low As Practicable" Limits—Parts 20 and 50

On December 19, 1975, amendments to Parts 20 and 50 were published, effective January 19, 1976, which substitute the currently accepted phrasing "as low as is reasonably achievable" for the older, less precise terminology "as low as practicable" where it appears in the regulations.

Subpart B, Privacy Act Regulations, Exemptions —Part 9

On February 5, 1976, amendments to Part 9 were published, effective immediately, which exempt from certain requirements of the Privacy Act portions of certain NRC systems of records to prevent access to records that contain information specifically authorized under E.O. 11652 to be kept secret in the interest of national defense and foreign policy and to protect the identity of confidants who provide information under a promise of confidentiality.

Codes and Standards for Nuclear Power Plants and Technical Information—Part 50

On February 12, 1976, amendments to Part 50 were published, effective March 15, 1976, which modify the basis for establishing which revisions of referenced codes and standards should be applied to the construction and operation of certain components of water-cooled nuclear power plants.

Group Licensing for Certain Medical Uses —Part 35

On February 23, 1976, an amendment to Part 35 was published, effective immediately, which added a new drug to the group of licensed uses of by-product material.

Treatment of Trade Secrets and Confidential or Privileged Commercial or Financial Information —Part 2

On March 22, 1976, an amendment to Part 2 was published, effective April 21, 1976, which revised Section 2.790 "Public inspections, exemptions, requests for withholding."

Construction Permit or Operating License; Initial Treatment of Application—Parts 2, 50, and 51

On April 15, 1976, amendments to Parts 2, 50, and 51 were published, effective May 17, 1976, which

are procedural changes pertaining to the initial treatment of an application for a construction permit or facility operating license.

Miscellaneous Changes to Chapter—Parts 20, 30, 31, 32, 35, 40, 50, 55, 70, 73, 140, and 150

On April 19, 1976, amendments to Parts 20, 30, 31, 32, 35, 40, 50, 55, 70, 73, 140, and 150 were published, effective immediately, which change the address to which various reports and copies thereof should be sent by licensees and which specify particular offices to which reports should be addressed rather than a general directive to send reports to the Commission.

Group Licensing for Certain Medical Uses —Part 35

On April 19, 1976, an amendment to Part 35 was published, effective immediately, which added a new drug to the group of licensed uses of byproduct material.

Preservation of Records—Parts 20, 30, 31, 32, 34, 40, 50, 55, 70, and 150

On May 3, 1976, amendments to Parts 20, 30, 31, 32, 34, 40, 50, 55, 70, and 150 were published, effective June 2, 1976, which prescribe time periods for applicant and licensee retention of certain records, and provide that if a retention period is not otherwise provided, such records shall be maintained by the licensee or applicant until the Commission authorizes their disposition.

Personnel Monitoring of Radiographers—Part 34

On May 6, 1976, an amendment to Part 34 was published, effective August 4, 1976, which allows radiographers and their assistants to use either film badges or thermoluminescent dosimeters to record exposures. The amendment also requires that direct-reading pocket dosimeters be used instead of pocket dosimeters or pocket chambers that require a separate device for reading.

Amendments of Privacy Act and Freedom of Information Act Regulations—Part 9

On May 20, 1976, amendments to Part 9 were published, effective immediately, which suggest legends be used on envelopes and letters indicating a Privacy Act or Freedom of Information Act request and which increase the time for filing appeals from denials of access to records and denials of correction of records.

Clarifying and Corrective Amendments—Parts 40 and 70

On May 27, 1976, amendments to Parts 40 and 70 were published, effective immediately, which amend the language of Sections 40.65 and 70.59 to avoid a possible ambiguity as to the time submission of reports are due. These amendments also add a specific provision regarding the submission of copies of reports and make an editorial change.

Codes and Standards for Nuclear Power Plants —Part 50

On June 14, 1976, amendments to Part 50 were published, effective immediately, that clarify the intent of the prefatory language of Section 50.55a and Section 50.55a(g).

Number of Copies of Amendments to Safety Analysis Report—Part 50

On July 29, 1976, an amendment to Part 50 was published, effective immediately, which increases the number of copies of amendments to the safety analysis report which must be submitted to the staff from 40 to 60 copies.

Criticality Accident Protection Requirements —Part 70

On July 29, 1976, amendments to Part 70 were published, effective September 27, 1976, requiring a "screening" device, such as an indium strip, be used where special nuclear material is handled, used, or stored.

Group Licensing for Certain Medical Uses —Part 35

On August 16, 1976, an amendment to Part 35 was published, effective immediately, which added a new drug to the group of licensed uses of byproduct material.

Environmental Effects of the Uranium Fuel Cycle; General Statement of Policy

On August 16, 1976, the Commission issued a policy statement to indicate how it intends to conduct its licensing activities pending resolution of several legal questions raised by two recent decisions of the U.S. Court of Appeals for the District of Columbia Circuit (*Natural Resources Defense Council, et al. v. NRC* and *Aeschliman, et al. v. NRC*).

Mixed Oxide Fuel (GESMO)

On September 2, 1976, the Commission announced the availability of the health, safety, and environmental portion of the Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light-Water-Cooled Reactors (identified as report number NUREG-0002).

REGULATIONS AND AMENDMENTS PROPOSED

Limits for Special Nuclear Material Unaccounted For—Part 70

On July 17, 1975, proposed amendments to Part 70 were published for comment which provide for explicit limits for material balance uncertainty and provide requirements for prompt action when an excessive MUF occurs.

Financial Assistance to Participants in Commission Proceedings; Policies Concerning Requests—Part 2

On August 25, 1975, NRC published a notice that it is considering the possibility of amendments to Part 2 that would specify the Commission's policy concerning requests for financial assistance to participants in Commission proceedings. Comments were invited by October 9, 1975.

Persons Using Spark Gap Irradiators Containing Cobalt-60; Proposed Exemption—Part 30

On October 24, 1975, a proposed amendment was published for comment which would exempt from licensing and regulatory requirements the receipt, possession, use, transfer, export, ownership, and acquisition of spark gap irradiators containing not more than one microcurie of cobalt-60 per spark gap irradiator for use in electrically ignited fuel oil burners.

Packaging and Transportation of Special Nuclear Material by Air; Continuation of Shipments During Pendency of Rule Making Proceeding —Parts 71 and 73

On February 9, 1976, the NRC published its conclusion that the air transportation of special nuclear material, other than plutonium, under currently effective regulations needs not, and should not, be suspended or otherwise limited during the period that the rulemaking proceeding is being conducted.

Draft Environmental Statement on Transportation of Radioactive Material by Air and Other Modes —Parts 71 and 73

On March 29, 1976, the NRC announced the availability of the environmental statement prepared in connection with the advance notice of proposed rulemaking, which was published on June 2, 1975.

Early Site Reviews and Limited Work Authorizations—Parts 2 and 50

On April 22, 1976, proposed amendments were published for comment which would encourage and provide for early review of site suitability issues associated with nuclear power reactors and other large utilization and production facilities, and extend the so-called "limited work authorization" concept to include production facilities such as commercial isotopic enrichment plants and fuel reprocessing plants, and testing reactors.

Caution Signs, Labels, Signals, and Controls —Part 20

On May 3, 1976, a proposed amendment was published for comment which would:

a. require entry controls that function automatically to prevent individuals from inadvertently entering certain areas where potentially life-threatening radiation levels exist and that cause the radiation levels to be reduced to a much safer level before anyone could enter the area deliberately;
b. require appropriate alarm signals and additional control devices to reduce the radiation from such large sources to the safer level, if the entry controls should fail or if physical radiation barriers should fail (e.g., loss of shielding liquid from a viewing port);
c. require use of administrative controls and devices to assure that the area is clear of personnel before such a large radiation source is used; and
d. require the testing of control devices prior to operation of certain sources of potentially life-threatening radiation.

The amendment would apply to licensees who use certain large radiation sources.

Persons Using Thorium in Personnel Neutron Dosimeters; Proposed Exemption—Part 40

On June 24, 1976, proposed amendments were published for comment which would exempt from the regulatory requirements of Part 40 and the licensing requirements of section 62 of the Atomic Energy Act of 1954, as amended, the receipt, possession, use, transfer, or import of personnel neutron dosimeters by

adding this product as a new category in Section 40.13(c)(1).

Privacy Act Regulations—Part 9

On August 19, 1976, a proposed amendment was published for comment which would exempt from certain requirements of the Privacy Act portions of the NRC Systems of Records NRC-1 "Appointment and Promotion Certificate Records—NRC."

Reporting of Material Accounting Data—Part 70

On August 23, 1976, proposed amendments were published for comment which would require the reporting of the results of each ending physical inventory and associated material accounting and measurement error data.

Use of Mixed Uranium-Plutonium Oxide Fuels in Light-Water Nuclear Power Reactors —Parts 50 and 51

On September 20, 1976, proposed amendments were published for comment related to certain differential health and safety and environmental effects that may be associated with the wide-scale use of mixed oxide fuels in light-water nuclear power reactors assuming that such wide-scale use is ultimately approved by the Commission.

Implementation of Legislation Amending the Price-Anderson Act—Part 140

On September 20, 1976, proposed amendments were published for comment which would implement legislation that modifies and extends for ten years (to August 1, 1987) the present Price-Anderson Act.

Codes and Standards for Nuclear Power Plants —Part 50

On September 30, 1976, proposed amendments were published for comment which would incorporate new addenda to specified published industry codes in Section 50.55a.

Appendix 5

Regulatory Guides

Regulatory guides describe and make available to the public methods acceptable to the NRC staff for 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 provide guidance to applicants concerning information needed by the staff in its review of applications for permits and licenses. Comments and suggestions for improvements in guides are encouraged at all times, and guides will be revised as appropriate, to accommodate comments and to reflect new information or experience. Regulatory guides may also be withdrawn when they are superseded by the Commission's regulations, when equivalent recommendations have been incorporated in applicable approved codes and standards, or when changes in methods and techniques have made them obsolete.

When guides are issued, revised, or withdrawn, a notice is placed in the *Federal Register* and a public announcement is made. Single copies of guides may be obtained by writing to the Director, Division of Document Control, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. The following guides were issued or revised (or withdrawn as noted) during the period July 1, 1975 to September 30, 1976.

Division 1—Power Reactor Guides

1.8 Personnel Selection and Training (Revision 1)

1.13 Spent Fuel Storage Facility Design Basis (Revision 1)

1.14 Reactor Coolant Pump Flywheel Integrity (Revision 1)

1.16 Reporting of Operating Information—Appendix A Technical Specifications (Revision 4)

1.20 Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing (Revision 2)

1.26 Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants (Revision 3)

1.27 Ultimate Heat Sink for Nuclear Power Plants (Revision 2)

1.29 Seismic Design Classification (Revision 2)

1.32 Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants (Revision 1)

1.35 Inservice Inspection of Ungrouted Tendons in Prestressed Concrete Containment Structures (Revision 2)

1.42 WITHDRAWN—Interim Licensing Policy on as Low as Practicable for Gaseous Radioiodine Releases from Light-Water-Cooled Nuclear Power Reactors (Revision 1)

1.51 WITHDRAWN—Inservice Inspection of ASME Code Class 2 and 3 Nuclear Power Plant Components

1.52 Design, Testing, and Maintenance Criteria for Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants (Revision 1)

1.59 Design Basis Floods for Nuclear Power Plants (Revision 1)

1.64 Quality Assurance Requirements for the Design of Nuclear Power Plants (Revision 2)

1.68.1 Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants

1.70 Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition) (Revision 2)

1.79 Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactor Steam Generator Tubes (Revision 1)

1.83 Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes (Revision 1)

1.84 Code Case Acceptability—ASME Section III Design and Fabrication (Revisions 3, 4, 5, 6, 7)

1.85 Code Case Acceptability—ASME Section III Materials (Revisions 3, 4, 5, 6, 7)

1.88 Collection, Storage and Maintenance of Nuclear Power Plant Quality Assurance Records (Revision 1)

1.92 Combining Modal Responses and Spatial Components in Seismic Response Analysis (Revision 1)

1.94 Quality Assurance Requirements for Installation, Inspection, and Testing of Structural Concrete and Structural Steel During the Construction Phase of Nuclear Power Plants (Revision 1)

1.96 Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants (Revision 1)

1.97 Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident
1.98 Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor
1.99 Effects of Residual Elements on Predicted Radiation Damage to Reactor Vessel Materials
1.100 Seismic Qualification of Electric Equipment for Nuclear Power Plants
1.101 Emergency Planning for Nuclear Power Plants
1.102 Flood Protection for Nuclear Power Plants (Initial Publication and Revision 1)
1.103 Post-Tensioned Prestressing Systems for Concrete Reactor Vessels and Containments
1.104 Overhead Crane Handling Systems for Nuclear Power Plants
1.105 Instrument Spans and Setpoints
1.106 Thermal Overload Protection for Electric Motors on Motor-Operated Valves
1.107 Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures
1.108 Periodic Testing of Diesel Generators Used as Onsite Electric Power Systems at Nuclear Power Plants
1.109 Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I
1.110 Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors
1.111 Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors
1.112 Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors
1.113 Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I
1.114 Guidance on Being Operator at the Controls of a Nuclear Power Plant
1.115 Protection Against Low-Trajectory Turbine Missiles
1.116 Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems
1.117 Tornado Design Classification
1.118 Periodic Testing of Electric Power and Protection Systems
1.119 Surveillance Program for New Fuel Assembly Design
1.120 Fire Protection Guidelines for Nuclear Power Plants
1.121 Bases for Plugging Degraded PWR Steam Generator Tubes
1.122 Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components

Division 2—Research and Test Reactor Guides

2.3 Quality Verification for Plate-Type Uranium-Aluminum Fuel Elements for Use in Research Reactors (Initial Publication and Revision 1)
2.4 Review of Experiments for Research Reactors

Division 3—Fuels and Materials Facilities Guides

3.31 Emergency Water Supply Systems for Fuel Reprocessing Plants
3.32 General Design Guide for Ventilation Systems for Fuel Reprocessing Plants
3.36 Nondestructive Examination of Tubular Products for Use in Fuel Reprocessing Plants and in Plutonium Processing and Fuel Fabrication Plants
3.37 Guidance for Avoiding Intergranular Corrosion and Stress Corrosion in Austenitic Stainless Steel Components of Fuel Reprocessing Plants
3.38 General Fire Protection Guide for Fuel Reprocessing Plants
3.39 Standard Format and Content of License Applications for Plutonium Processing and Fuel Fabrication Plants
3.41 Validation of Calculational Methods for Nuclear Criticality Safety

Division 4—Environmental and Siting Guides

4.2 Preparation of Environmental Reports for Nuclear Power Stations (Revision 2)
4.7 General Site Suitability Criteria for Nuclear Power Stations (Revision 1)
4.8 Environmental Technical Specifications for Nuclear Power Plants
4.9 Preparation of Environmental Reports for Commercial Uranium Enrichment Facilities (Revision 1)
4.10 Irreversible and Irretrievable Commitments of Material Resources (Revision 1)
4.11 Terrestrial Environmental Studies for Nuclear Power Plants

Division 5—Materials and Plant Protection Guides

5.44 Perimeter Intrusion Alarm Systems (Revision 1)
5.52 Standard Format and Content for the Physical Protection Section of a License Application (For Facilities Other than Nuclear Power Plants) (Revision 1)
5.53 Qualification, Calibration, and Error Estimation Methods for Nondestructive Assay
5.57 Shipping and Receiving Control of Special Nuclear Material

Division 6—Product Guides

6.7 Preparation of an Environmental Report to Support a Rule Making Petition Seeking an Exemption for a Radionuclide-Containing Product (Initial Publication and Revision 1)

Division 7—Transportation Guides

None.

Division 8—Occupational Health Guides

8.8 Information Relevant to Maintaining Occupational Radiation Exposure As Low As Is Reasonably Achievable (Nuclear Power Reactors) (Revision 1)

8.10 Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable (Revision 1)

8.13 Instruction Concerning Prenatal Radiation Exposure (Revision 1)

8.14 Personnel Neutron Dosimeters

Division 9—Antitrust Guides

9.2 Information Needed by the NRC Staff in Connection with Its Antitrust Review of Construction Permit Applications for Nuclear Power Plants (Revision 1)

Division 10—General Guides

10.1 Compilation of Reporting Requirements for Persons Subject to NRC Regulations (Revisions 1 and 2)

10.2 Guidance to Academic Institutions Applying for Specific Byproduct Material Licenses

10.3 Guide for the Preparation of Applications for Special Nuclear Material Licenses of Less Than Critical Mass Quantities

10.4 Guide for the Preparation of Applications for Licenses to Process Source Material

10.5 Guide for the Preparation of Applications for Type A Licenses of Broad Scope for Byproduct Material

10.6 Guide for the Preparation of Applications for Use of Sealed Sources and Devices for the Performance of Industrial Radiography

Appendix 6

Nuclear Electric Generating Units In Operation, Under Construction, Or Planned

(As of September 30, 1976)

The following listing includes 237 nuclear power reactor electrical generating units which were in operation, under NRC review for construction permits, and ordered or announced by utilities in the United States at the end of September 1976, representing a total capacity of approximately 237,000 MWe. TYPE is indicated by: BWR—boiling water reactor, PWR—pressurized water reactor, HTGR—high temperature gas-cooled reactor, and LMFBR—liquid metal cooled fast breeder reactor. STATUS is indicated by: OL—has operating license, CP—has construction permit, UR—under review for construction permit, A/O—announced or ordered by the utility but application for construction not yet docketed by the NRC for review. The dates for operation are either actual or those scheduled by the utilities.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
ALABAMA						
Clanton	Alan R. Barton Nuclear Plant: Unit 1	1,159	BWR	UR	Alabama Power Co.	Indef.
Clanton	Alan R. Barton Nuclear Plant: Unit 2	1,159	BWR	UR	Alabama Power Co.	Indef.
Decatur	Browns Ferry Nuclear Power Plant: Unit 1	1,065	BWR	OL	Tennessee Valley Authority	1974
Decatur	Browns Ferry Nuclear Power Plant: Unit 2	1,065	BWR	OL	Tennessee Valley Authority	1974
Decatur	Browns Ferry Nuclear Power Plant: Unit 3	1,065	BWR	OL	Tennessee Valley Authority	1976
Dothan	Joseph M. Farley Nuclear Plant: Unit 1	829	PWR	CP	Alabama Power Co.	1977
Dothan	Joseph M. Farley Nuclear Plant: Unit 2	829	PWR	CP	Alabama Power Co.	1978
Scottsboro	Bellefonte Nuclear Plant: Unit 1	1,213	PWR	CP	Tennessee Valley Authority	1980
Scottsboro	Bellefonte Nuclear Plant: Unit 2	1,213	PWR	CP	Tennessee Valley Authority	1981
ARIZONA						
Winterburg	Palo Verde Nuclear Generating Station: Unit 1	1,238	PWR	CP	Arizona Public Service Co.	1982
Winterburg	Palo Verde Nuclear Generating Station: Unit 2	1,238	PWR	CP	Arizona Public Service Co.	1984
Winterburg	Palo Verde Nuclear Generating Station: Unit 3	1,238	PWR	CP	Arizona Public Service Co.	1986

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
ARKANSAS						
Russelville	Arkansas Nuclear One: Unit 1	850	PWR	OL	Arkansas Power & Light Co.	1974
Russelville	Arkansas Nuclear One: Unit 2	912	PWR	CP	Arkansas Power & Light Co.	1977
CALIFORNIA						
Eureka	Humboldt Bay Power Plant: Unit 3	65	BWR	OL	Pacific Gas & Electric Co.	1963
San Clemente	San Onofre Nuclear Generating Station: Unit 1	450	PWR	OL	So. Calif. Ed. & San Diego Gas & Electric Co.	1968
San Clemente	San Onofre Nuclear Generating Station: Unit 2	1,100	PWR	CP	So. Calif. Ed. & San Diego Gas & Electric Co.	1980
San Clemente	San Onofre Nuclear Generating Station: Unit 3	1,100	PWR	CP	So. Calif. Ed. & San Diego Gas & Electric Co.	1981
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 1	1,084	PWR	CP	Pacific Gas & Electric Co.	1976
Diablo Canyon	Diablo Canyon Nuclear Power Plant: Unit 2	1,106	PWR	CP	Pacific Gas & Electric Co.	1977
Clay Station	Rancho Seco Nuclear Generating Station: Unit 1	913	PWR	OL	Sacramento Municipal Utility District	1975
*	Stanislaus: Unit 1	1,200	BWR	A/O	Pacific Gas & Electric Co.	Indef.
*	Stanislaus: Unit 2	1,200	BWR	A/O	Pacific Gas & Electric Co.	Indef.
*	San Joaquin Nuclear Project 1	1,300	—	A/O	L.A. Dept. of Water, PG&E, SCE, SDG&E, CDWR	1983
*	San Joaquin Nuclear Project 2	1,300	—	A/O	L.A. Dept. of Water, PG&E, SCE, SDG&E, CDWR	1984
*	San Joaquin Nuclear Project 3	1,300	—	A/O	L.A. Dept. of Water, PG&E, SCE, SDG&E, CDWR	1986
*	San Joaquin Nuclear Project 4	1,300	—	A/O	L.A. Dept. of Water, PG&E, SCE, SDG&E, CDWR	1987
*	Eastern Desert 1	1,100	—	A/O	Southern Calif. Ed.	Indef.
*	Eastern Desert 2	1,100	—	A/O	Southern Calif. Ed.	Indef.
Clay Station	Rancho Seco Nuclear Generating Station: Unit 2	1,100	—	A/O	Sacramento Municipal Utility District	1984

* Site not selected.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
*	Sundesert 1	950	PWR	A/O	San Diego Gas & Electric Co.	1985
*	Sundesert 2	950	PWR	A/O	San Diego Gas & Electric Co.	1987
COLORADO						
Platteville	Fort St. Vrain Nuclear Generating Station	330	HTGR	OL	Public Service Co. of Colorado	1975
CONNECTICUT						
Haddam Neck	Haddam Neck Generating Station	575	PWR	OL	Conn. Yankee Atomic Power Co.	1968
Waterford	Millstone Nuclear Power Station: Unit 1	690	BWR	OL	Northeast Nuclear Energy Co.	1971
Waterford	Millstone Nuclear Power Station: Unit 2	828	PWR	OL	Northeast Nuclear Energy Co.	1975
Waterford	Millstone Nuclear Power Station: Unit 3	1,156	PWR	CP	Northeast Nuclear Energy Co.	1982
DELAWARE						
Summit	Summit Power Station: Unit 1	770	—	UR+	Delmarva Power & Light Co.	—
Summit	Summit Power Station: Unit 2	770	—	UR+	Delmarva Power & Light Co.	—
FLORIDA						
Florida City	Turkey Point Station: Unit 3	745	PWR	OL	Florida Power & Light Co.	1972
Florida City	Turkey Point Station: Unit 4	745	PWR	OL	Florida Power & Light Co.	1973
Red Level	Crystal River Plant: Unit 3	825	PWR	CP	Florida Power Corp.	1976
Ft. Pierce	St. Lucie Plant: Unit 1	810	PWR	OL	Florida Power & Light Co.	1976
Ft. Pierce	St. Lucie Plant: Unit 2	810	PWR	UR+	Florida Power & Light Co.	1980
South Dade	South Dade 1	1,100	PWR	A/O	Florida Power & Light Co.	1983
South Dade	South Dade 2	1,100	PWR	A/O	Florida Power & Light Co.	1984
GEORGIA						
Baxley	Edwin I. Hatch Plant: Unit 1	786	BWR	OL	Georgia Power Co.	1975

* Site not selected.
+ Limited work authorization issued.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Baxley	Edwin I. Hatch Plant: Unit 2	795	BWR	CP	Georgia Power Co.	1978
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 1	1,113	PWR	CP	Georgia Power Co.	—
Waynesboro	Alvin W. Vogtle, Jr. Plant: Unit 2	1,113	PWR	CP	Georgia Power Co.	—
ILLINOIS						
Morris	Dresden Nuclear Power Station: Unit 1	200	BWR	OL	Commonwealth Edison Co.	1960
Morris	Dresden Nuclear Power Station: Unit 2	809	BWR	OL	Commonwealth Edison Co.	1970
Morris	Dresden Nuclear Power Station: Unit 3	809	BWR	OL	Commonwealth Edison Co.	1971
Zion	Zion Nuclear Plant: Unit 1	1,050	PWR	OL	Commonwealth Edison Co.	1973
Zion	Zion Nuclear Plant: Unit 2	1,050	PWR	OL	Commonwealth Edison Co.	1974
Cordova	Quad-Cities Station: Unit 1	809	BWR	OL	Comm. Ed. Co.-Iowa-Ill. Gas & Electric Co.	1972
Cordova	Quad-Cities Station: Unit 2	809	BWR	OL	Comm. Ed. Co.-Iowa-Ill. Gas & Electric Co.	1972
Seneca	LaSalle County Nuclear Station: Unit 1	1,078	BWR	CP	Commonwealth Edison Co.	1979
Seneca	LaSalle County Nuclear Station: Unit 2	1,078	BWR	CP	Commonwealth Edison Co.	1980
Byron	Byron Station: Unit 1	1,120	PWR	CP	Commonwealth Edison Co.	1980
Byron	Byron Station: Unit 2	1,120	PWR	CP	Commonwealth Edison Co.	1982
Braidwood	Braidwood: Unit 1	1,120	PWR	CP	Commonwealth Edison Co.	1981
Braidwood	Braidwood: Unit 2	1,120	PWR	CP	Commonwealth Edison Co.	1982
Clinton	Clinton Nuclear Power Plant: Unit 1	933	BWR	CP	Illinois Power Co.	1981
Clinton	Clinton Nuclear Power Plant: Unit 2	933	BWR	CP	Illinois Power Co.	1984
Savannah	Carroll County Station: Unit 1	1,120	—	A/O	Commonwealth Edison Co.	1984
Savannah	Carroll County Station: Unit 2	1,120	—	A/O	Commonwealth Edison Co.	1985

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
INDIANA						
Westchester Town	Bailly Generating Station	645	BWR	CP	Northern Indiana Public Service Co.	1980
Madison	Marble Hill: Unit 1	1,130	PWR	UR	Public Service of Indiana	1982
Madison	Marble Hill: Unit 2	1,130	PWR	UR	Public Service of Indiana	1984
IOWA						
Pala	Duane Arnold Energy Center: Unit 1	538	BWR	OL	Iowa Elec. Light & Power Co.	1974
*	Iowa Power Unit 1	1,200	BWR	A/O	Iowa Po. & Lt. Co.	—
KANSAS						
Burlington	Wolf Creek	1,150	PWR	UR	Kansas Gas & Electric Co.	1982
LOUISIANA						
Taft	Waterford Steam Electric Station: Unit 3	1,113	PWR	CP	Louisiana Power & Light Co.	1981
St. Francisville	River Bend Station: Unit 1	934	BWR	UR+	Gulf States Utilities Co.	1981
St. Francisville	River Bend Station: Unit 2	934	BWR	UR+	Gulf States Utilities Co.	1983
MAINE						
Wiscasset	Maine Yankee Atomic Power Plant	790	PWR	OL	Maine Yankee Atomic Power Co.	1972
Sears Island	Central Maine	1,150	PWR	A/O	Central Maine	Indef.
MARYLAND						
Lusby	Calvert Cliffs Nuclear Power Plant: Unit 1	845	PWR	OL	Baltimore Gas & Electric Co.	1975
Lusby	Calvert Cliffs Nuclear Power Plant: Unit 2	845	PWR	OL#	Baltimore Gas & Electric Co.	1976
Douglas Point	Douglas Point Generating Station: Unit 1	1,178	BWR	UR	Potomac Electric Power Co.	1985
Douglas Point	Douglas Point Generating Station: Unit 2	1,178	BWR	UR	Potomac Electric Power Co.	1987
MASSACHUSETTS						
Rowe	Yankee Nuclear Power Station	175	PWR	OL	Yankee Atomic Electric Co.	1961

* Site not selected.
+ Limited work authorization issued.
# Limited to 1% power operation.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Plymouth	Pilgrim Station: Unit 1	655	BWR	OL	Boston Edison Co.	1972
Plymouth	Pilgrim Station: Unit 2	1,180	PWR	UR	Boston Edison Co.	1982
Turners Falls	Montague: Unit 1	1,150	BWR	UR	Northeast Nuclear Energy Co.	1986
Turners Falls	Montague: Unit 2	1,150	BWR	UR	Northeast Nuclear Energy Co.	1988
IICHIGAN						
Big Rock Point	Big Rock Point Nuclear Plant	72	BWR	OL	Consumers Power Co.	1965
South Haven	Palisades Nuclear Power Station	821	PWR	OL	Consumers Power Co.	1971
Lagoona Beach	Enrico Fermi Atomic Power Plant: Unit 2	1,093	BWR	CP	Detroit Edison Co.	1980
Bridgman	Donald C. Cook Plant: Unit 1	1,090	PWR	OL	Indiana & Michigan Electric Co.	1976
Bridgman	Donald C. Cook Plant: Unit 2	1,060	PWR	CP	Indiana & Michigan Electric Co.	1977
Midland	Midland Nuclear Power Plant: Unit 1	460	PWR	CP	Consumers Power Co.	1982
Midland	Midland Nuclear Power Plant: Unit 2	811	PWR	CP	Consumers Power Co.	1981
St. Clair County	Greenwood Energy Center: Unit 2	1,200	PWR	UR	Detroit Edison Co.	1984
St. Clair County	Greenwood Energy Center: Unit 3	1,200	PWR	UR	Detroit Edison Co.	1986
MINNESOTA						
Monticello	Monticello Nuclear Generating Plant	545	BWR	OL	Northern States Power Co.	1971
Red Wing	Prairie Island Nuclear Generating Plant: Unit 1	530	PWR	OL	Northern States Power Co.	1973
Red Wing	Prairie Island Nuclear Generating Plant: Unit 2	530	PWR	OL	Northern States Power Co.	1975
MISSOURI						
Fulton	Callaway Plant: Unit 1	1,120	PWR	CP	Union Elec. Co.	1981
Fulton	Callaway Plant: Unit 2	1,120	PWR	CP	Union Elec. Co.	1983
MISSISSIPPI						
Port Gibson	Grand Gulf Nuclear Station: Unit 1	1,250	BWR	CP	Mississippi Power & Light Co.	1979
Port Gibson	Grand Gulf Nuclear Station: Unit 2	1,250	BWR	CP	Mississippi Power & Light Co.	1983
Yellow Creek	Yellow Creek: Unit 1	1,285	PWR	UR	Tennessee Valley Authority	1985

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Yellow Creek	Yellow Creek: Unit 2	1,285	PWR	UR	Tennessee Valley Authority	1986
NEBRASKA						
Fort Calhoun	Fort Calhoun Station: Unit 1	457	PWR	OL	Omaha Public Power District	1973
Fort Calhoun	Fort Calhoun Station: Unit 2	1,136	PWR	UR	Omaha Public Power District	1984
Brownville	Cooper Nuclear Station	778	BWR	OL	Nebraska Public Power District	1974
*	NPPD-2	1,100	—	A/O	Nebraska Public Power District	1986
NEW HAMPSHIRE						
Seabrook	Seabrook Nuclear Station: Unit 1	1,200	PWR	CP	Public Service of N.H.	1981
Seabrook	Seabrook Nuclear Station: Unit 2	1,200	PWR	CP	Public Service of N.H.	1984
NEW JERSEY						
Toms River	Oyster Creek Nuclear Power Plant: Unit 1	650	BWR	OL	Jersey Central Power & Light Co.	1969
Forked River	Forked River Generating Station: Unit 1	1,070	PWR	CP	Jersey Central Power & Light Co.	1982
Salem	Salem Nuclear Generating Station: Unit 1	1,090	PWR	OL#	Public Service Elec. & Gas Co.	1976
Salem	Salem Nuclear Generating Station: Unit 2	1,115	PWR	CP	Public Service Elec. & Gas Co.	1979
Salem	Hope Creek Generating Station: Unit 1	1,067	BWR	CP	Public Service Elec. & Gas Co.	1983
Salem	Hope Creek Generating Station: Unit 2	1,067	BWR	CP	Public Service Elec. & Gas Co.	1984
Little Egg Inlet	Atlantic Generating Station: Unit 1	1,150	PWR	UR	Public Service Elec. & Gas Co.	1985
Little Egg Inlet	Atlantic Generating Station: Unit 2	1,150	PWR	UR	Public Service Elec. & Gas Co.	1987
*	Atlantic Generating Station: Unit 3	1,150	PWR	A/O	Public Service Elec. & Gas Co.	1990
*	Atlantic Generating Station: Unit 4	1,150	PWR	A/O	Public Service Elec. & Gas Co.	1992
NEW YORK						
Indian Point	Indian Point Station: Unit 1	265	PWR	OL	Consolidated Edison Co.	1962
Indian Point	Indian Point Station: Unit 2	873	PWR	OL	Consolidated Edison Co.	1973

* Site not selected.
# Limited to 1% power operation.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Indian Point	Indian Point Station: Unit 3	965	PWR	OL	Consolidated Edison Co.	1976
Scriba	Nine Mile Point Nuclear Station: Unit 1	610	BWR	OL	Niagara Mohawk Power Co.	1969
Scriba	Nine Mile Point Nuclear Station: Unit 2	1,100	BWR	CP	Niagara Mohawk Power Co.	1982
Ontario	R. E. Ginna Nuclear Power Plant: Unit 1	490	PWR	OL	Rochester Gas & Electric Co.	1970
Brookhaven	Shoreham Nuclear Power Station	819	BWR	CP	Long Island Lighting Co.	1979
Scriba	James A. FitzPatrick Nuclear Power Plant	821	BWR	OL	Power Authority of State of N.Y.	1975
Long Island	Jamesport: Unit 1	1,150	PWR	UR	Long Island Lighting Co.	1983
Long Island	Jamesport: Unit 2	1,150	PWR	UR	Long Island Lighting Co.	1985
*	Unnamed: Unit 1	1,200	—	A/O	N.Y. State Elec. & Gas Co.	Indef.
*	Unnamed: Unit 2	1,200	—	A/O	N.Y. State Elec. & Gas Co.	Indef.
Sterling	Sterling Power Project: Unit 1	1,150	PWR	UR	Rochester Gas & Electric Co.	1984
*	Greene County Nuclear Power Plant	1,191	PWR	UR	Power Authority of State of N.Y.	1984
*	Mid-Hudson East 1	1,300	—	A/O	Empire State Power Resources	1987
*	Mid-Hudson East 2	1,300	—	A/O	Empire State Power Resources	1989
*	Mid-Hudson West 1	1,300	—	A/O	Empire State Power Resources	1990
*	Shoreham West 1	1,300	—	A/O	Empire State Power Resources	1987
*	Shoreham West 2	1,300	—	A/O	Empire State Power Resources	1989
*	St. Lawrence 1	1,300	—	A/O	Empire State Power Resources	1988
*	St. Lawrence 2	1,300	—	A/O	Empire State Power Resources	1990
NORTH CAROLINA						
Southport	Brunswick Steam Electric Plant: Unit 2	821	BWR	OL	Carolina Power & Light Co.	1975
Southport	Brunswick Steam Electric Plant: Unit 1	821	BWR	OL#	Carolina Power & Light Co.	1976

* Site not selected.
# Limited to 1% power operation.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Cowans Ford Dam	Wm. B. McGuire Nuclear Station: Unit 1	1,180	PWR	CP	Duke Power Co.	1978
Cowans Ford Dam	Wm. B. McGuire Nuclear Station: Unit 2	1,180	PWR	CP	Duke Power Co.	1979
Bonsal	Shearon Harris Plant: Unit 1	900	PWR	UR‡	Carolina Power & Light Co.	1984
Bonsal	Shearon Harris Plant: Unit 2	900	PWR	UR‡	Carolina Power & Light Co.	1986
Bonsal	Shearon Harris Plant: Unit 3	900	PWR	UR‡	Carolina Power & Light Co.	1988
Bonsal	Shearon Harris Plant: Unit 4	900	PWR	UR‡	Carolina Power & Light Co.	1990
Davie Co.	Perkins Nuclear Station: Unit 1	1,280	PWR	UR	Duke Power Co.	1985
Davie Co.	Perkins Nuclear Station: Unit 2	1,280	PWR	UR	Duke Power Co.	1987
Davie Co.	Perkins Nuclear Station: Unit 3	1,280	PWR	UR	Duke Power Co.	1989
*	Carolina P&L: Unit 8	1,150	PWR	A/O	Carolina Power & Light Co.	—
*	Carolina P&L: Unit 9	1,150	PWR	A/O	Carolina Power & Light Co.	—
*	Carolina P&L: Unit 10	1,150	PWR	A/O	Carolina Power & Light Co.	—
OHIO						
Oak Harbor	Davis-Besse Nuclear Power Station: Unit 1	906	PWR	CP	Toledo Edison-Cleveland Elec. Illum. Co.	1976
Oak Harbor	Davis-Besse Nuclear Power Station: Unit 2	906	PWR	UR+	Toledo Edison-Cleveland Elec. Illum. Co.	1983
Oak Harbor	Davis-Besse Nuclear Power Station: Unit 3	906	PWR	UR+	Toledo Edison-Cleveland Elec. Illum. Co.	1985
Perry	Perry Nuclear Power Plant: Unit 1	1,205	BWR	UR+	Cleveland Elec. Illum. Co.	1980
Perry	Perry Nuclear Power Plant: Unit 2	1,205	BWR	UR+	Cleveland Elec. Illum. Co.	1982
Moscow	Wm. H. Zimmer Nuclear Power Station: Unit 1	810	BWR	CP	Cincinnati Gas & Electric Co.	1978
Moscow	Wm. H. Zimmer Nuclear Power Station: Unit 2	1,170	BWR	A/O	Cincinnati Gas & Electric Co.	—

*Site not selected.
‡ Exemption granted to allow some early work at site.
+ Limited work authorization issued.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Berlin Hgts.	Erie: Unit 1	1,100	PWR	A/O	Ohio Edison Co.	1982
Berlin Hgts.	Erie: Unit 2	1,100	PWR	A/O	Ohio Edison Co.	1984
OKLAHOMA						
Inola	Black Fox: Unit 1	1,150	BWR	UR	Public Service Co. of Oklahoma	1983
Inola	Black Fox: Unit 2	1,150	BWR	UR	Public Service Co. of Oklahoma	1985
OREGON						
Prescott	Trojan Nuclear Plant: Unit 1	1,130	PWR	OL	Portland General Electric Co.	1976
Arlington	Pebble Springs: Unit 1	1,260	PWR	UR	Portland General Electric Co.	1985
Arlington	Pebble Springs: Unit 2	1,260	PWR	UR	Portland General Electric Co.	1988
PENNSYLVANIA						
Peach Bottom	Peach Bottom Atomic Power Station: Unit 2	1,065	BWR	OL	Philadelphia Electric Co.	1974
Peach Bottom	Peach Bottom Atomic Power Station: Unit 3	1,065	BWR	OL	Philadelphia Electric Co.	1974
Pottstown	Limerick Generating Station: Unit 1	1,065	BWR	CP	Philadelphia Electric Co.	1983
Pottstown	Limerick Generating Station: Unit 2	1,065	BWR	CP	Philadelphia Electric Co.	1985
Shippingport	Shippingport Atomic Power Station: Unit 1	90	PWR	—∞	Duquesne Light Co. & ERDA	1957
Shippingport	Beaver Valley Power Station: Unit 1	852	PWR	OL	Duquesne Light Co. Ohio Edison Co.	1976
Shippingport	Beaver Valley Power Station: Unit 2	852	PWR	CP	Duquesne Light Co. Ohio Edison Co.	1982
Goldsboro	Three Mile Island Nuclear Station: Unit 1	792	PWR	OL	Metropolitan Edison Co.	1974
Goldsboro	Three Mile Island Nuclear Station: Unit 2	906	PWR	CP	Metropolitan Edison Co.	1978
Berwick	Susquehanna Steam Electric Station: Unit 1	1,050	BWR	CP	Pennsylvania Power & Light Co.	1980
Berwick	Susquehanna Steam Electric Station: Unit 2	1,050	BWR	CP	Pennsylvania Power & Light Co.	1982
Fulton	Fulton Generating Station: Unit 1	1,160	—	UR	Philadelphia Electric Co.	—
Fulton	Fulton Generating Station: Unit 2	1,160	—	UR	Philadelphia Electric Co.	—

∞ Operable but OL not required for Government-Owned facility.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
RHODE ISLAND						
No. Kingston	New England: Unit 1	1,150	PWR	UR	New England Power Co.	1984
No. Kingston	New England: Unit 2	1,150	PWR	UR	New England Power Co.	1986
SOUTH CAROLINA						
Hartsville	H. B. Robinson S.E. Plant: Unit 2	707	PWR	OL	Carolina Power & Light Co.	1971
Seneca	Oconee Nuclear Station: Unit 1	886	PWR	OL	Duke Power Co.	1973
Seneca	Oconee Nuclear Station: Unit 2	886	PWR	OL	Duke Power Co.	1974
Seneca	Oconee Nuclear Station: Unit 3	886	PWR	OL	Duke Power Co.	1974
Broad River	Virgil C. Summer Nuclear Station: Unit 1	900	PWR	CP	So. Carolina Elec. & Gas. Co.	1979
Lake Wylie	Catawba Nuclear Station: Unit 1	1,153	PWR	CP	Duke Power Co.	1981
Lake Wylie	Catawba Nuclear Station: Unit 2	1,153	PWR	CP	Duke Power Co.	1982
Cherokee County	Cherokee Nuclear Station: Unit 1	1,280	PWR	UR+	Duke Power Co.	1984
Cherokee County	Cherokee Nuclear Station: Unit 2	1,280	PWR	UR+	Duke Power Co.	1986
Cherokee County	Cherokee Nuclear Station: Unit 3	1,280	PWR	UR+	Duke Power Co.	1988
TENNESSEE						
Daisy	Sequoyah Nuclear Power Plant: Unit 1	1,148	PWR	CP	Tennessee Valley Authority	1978
Daisy	Sequoyah Nuclear Power Plant: Unit 2	1,148	PWR	CP	Tennessee Valley Authority	1979
Spring City	Watts Bar Nuclear Plant: Unit 1	1,177	PWR	CP	Tennessee Valley Authority	1979
Spring City	Watts Bar Nuclear Plant: Unit 2	1,177	PWR	CP	Tennessee Valley Authority	1980
Oak Ridge	Clinch River Breeder Reactor Plant	350	LMFBR	UR	U.S. Government	1984
Hartsville	TVA Plant 1: Unit 1	1,233	BWR	UR+	Tennessee Valley Authority	1982
Hartsville	TVA Plant 1: Unit 2	1,233	BWR	UR+	Tennessee Valley Authority	1983
Hartsville	TVA Plant 2: Unit 1	1,233	BWR	UR+	Tennessee Valley Authority	1982

+ Limited work authorization issued.

Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Hartsville	TVA Plant 2: Unit 2	1,233	BWR	UR+	Tennessee Valley Authority	1983
Phipps Bend	Phipps Bend: Unit 1	1,233	BWR	UR	Tennessee Valley Authority	1984
Phipps Bend	Phipps Bend: Unit 2	1,233	BWR	UR	Tennessee Valley Authority	1985
EXAS						
Glen Rose	Comanche Peak Steam Electric Station: Unit 1	1,150	PWR	CP	Texas P&L, Dallas P&L, Texas Elec. Service	1980
Glen Rose	Comanche Peak Steam Electric Station: Unit 2	1,150	PWR	CP	Texas P&L, Dallas P&L, Texas Elec. Service	1982
Jasper	Blue Hills Station: Unit 1	918	PWR	UR	Gulf States Utilities Co.	Indef.
Jasper	Blue Hills Station: Unit 2	918	PWR	UR	Gulf States Utilities Co.	Indef.
Wallis	Allens Creek: Unit 1	1,150	BWR	UR	Houston Lighting & Power Co.	Indef.
Wallis	Allens Creek: Unit 2	1,150	BWR	UR	Houston Lighting & Power Co.	Indef.
Bay City	South Texas Nuclear Project: Unit 1	1,250	PWR	CP	Houston Lighting & Power Co.	1980
Bay City	South Texas Nuclear Project: Unit 2	1,250	PWR	CP	Houston Lighting & Power Co.	1982
ERMONT						
Vernon	Vermont Yankee Generating Station	514	BWR	OL	Vermont Yankee Nuclear Power Corp.	1972
IRGINIA						
Gravel Neck	Surry Power Station: Unit 1	822	PWR	OL	Virginia Electric & Power Co.	1972
Gravel Neck	Surry Power Station: Unit 2	822	PWR	OL	Virginia Electric & Power Co.	1973
Gravel Neck	Surry Power Station: Unit 3	859	PWR	CP	Virginia Electric & Power Co.	1984
Gravel Neck	Surry Power Station: Unit 4	859	PWR	CP	Virginia Electric & Power Co.	1985
Mineral	North Anna Power Station: Unit 1	898	PWR	CP	Virginia Electric & Power Co.	1977
Mineral	North Anna Power Station: Unit 2	898	PWR	CP	Virginia Electric & Power Co.	1978
Mineral	North Anna Power Station: Unit 3	907	PWR	CP	Virginia Electric & Power Co.	1981

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Site	Plant Name	Capacity (Net MWe)	Type	Status	Utility	Scheduled Operation
Mineral	North Anna Power Station: Unit 4	907	PWR	CP	Virginia Electric & Power Co.	1981
WASHINGTON						
Richland	N-Reactor/WPPSS Steam	850	GR	—∞	Wash. Public Power Supply System	1966
Richland	WPPSS No. 1 (Hanford)	1,218	PWR	CP	Wash. Public Power Supply System	1981
Richland	WPPSS No. 2 (Hanford)	1,103	BWR	CP	Wash. Public Power Supply System	1979
Satsop	WPPSS No. 3	1,242	PWR	UR	Wash. Public Power Supply System	1981
Richland	WPPSS No. 4	1,218	PWR	UR+	Wash. Public Power Supply System	1982
Satsop	WPPSS No. 5	1,242	PWR	UR	Wash. Public Power Supply System	1983
Sedro Wooley	Skagit Nuclear Power Project: Unit 1	1,277	BWR	UR	Puget Sound Power & Light Co.	1983
Sedro Wooley	Skagit Nuclear Power Project: Unit 2	1,277	BWR	UR	Puget Sound Power & Light Co.	1986
WISCONSIN						
Genoa	Genoa Nuclear Generating Station (LaCrosse)	50	BWR	OL	Dairyland Power Coop.	1971
Two Creeks	Point Beach Nuclear Plant: Unit 1	497	PWR	OL	Wisconsin Michigan Power Co.	1970
Two Creeks	Point Beach Nuclear Plant: Unit 2	497	PWR	OL	Wisconsin Michigan Power Co.	1972
Carlton	Kewaunee Nuclear Power Plant: Unit 1	560	PWR	OL	Wisconsin Electric Power Co.	1974
Durand	Tyrone Energy Park: Unit 1	1,150	PWR	UR	Northern States Power Co.	1984
Ft. Atkinson	Koshkonong Nuclear Plant: Unit 1	900	PWR	UR	Wisconsin Electric Power Co.	1985
Ft. Atkinson	Koshkonong Nuclear Plant: Unit 2	900	PWR	UR	Wisconsin Electric Power Co.	1986
PUERTO RICO						
Arecibo	North Coast Nuclear Plant: Unit 1	583	PWR	UR	Puerto Rico Water Resources Authority	Indef.

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Index

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