NUREG-1355

The Status of Recommendations of the President's Commission on the Accident at Three Mile Island

A Ten-Year Review

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ABSTRACT

This report summarizes the status of actions taken by the U.S. Nuclear Regulatory Commission (NRC) in response to recommendations made by the Presidential Commission on the Accident at Three Mile Island in the 10 years since the accident occurred in March 1979. It also updates NRC's initial response to the Presidential Commission's recommendations contained in "NRC Views and Analysis of the Recommendations of the President's Commission of the Accident at Three Mile Island" (NUREG-0632), issued in November 1979. The status of ongoing initiatives for actions not yet complete is also reported for reference purposes. On the basis of its analysis of NRC and the industry, the Presidential Commission found many then-current practices inadequate and in need of improvement. As a result of its recommendations and of guidance from other studies, substantial changes have been made in the 10 years since the accident. This report reflects how, based on Presidential Commission recommendations and continued work, revised practices and standards are now being implemented by NRC and throughout the industry.

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EXECUTIVE SUMMARY

On March 28, 1979, the most serious accident at a U.S. commercial nuclear power plant occurred at Three Mile Island Unit 2 (TMI-2) in Pennsylvania. Two weeks after the accident, the President of the United States appointed a 12-member Presidential Commission to conduct a comprehensive investigation of the accident and to make "appropriate recommendations based upon the Commission's findings."

The U.S. Nuclear Regulatory Commission's (NRC) initial response to the Presidential Commission's recommendations was published in November 1979 as NUREG-0632, "NRC Views and Analysis of the Recommendations of the President's Commission on the Accident at Three Mile Island." This report, NUREG-1335, updates that initial response. It follows the sequence of recommendations in the Presidential Commission report and, where appropriate, reflects the commitments and agreements contained in NUREG-0632. The status of ongoing actions not yet complete are reported for reference purposes.

The Presidential Commission found many then-current NRC and industry practices inadequate and in need of improvement. As a result of their report and other TMI-2 studies, the NRC established a number of new programs and initiatives and modified others. The following highlights many of these actions in terms of the broad areas for improvement identified in the Presidential Commission recommendations.

A. NRC Organization and Management

The NRC has reorganized and adopted several new measures to strengthen its management accountability and to place higher priority attention on the safety of plant operations. The NRC has consolidated the majority of its staff in a single location in Rockville, Maryland, to enhance more efficient decision making and to bring the Commissioners and the staff elements responsible for operational safety into close proximity. NRC has restructured the licensing and inspection functions to reflect the shift in the nuclear industry from construction to operation; and established a separate Office of Enforcement to implement a strengthened enforcement policy.

The NRC has also initiated a number of new programs intended to ensure a improved oversight of licensee performance. These include the systematic assessment of licensee performance program, the diagnostic evaluation program, and the performance indicator program. The NRC inspection program has been expanded, particularly through the use of team inspections and by locating resident inspectors at each site. In addition, the Research program has been redirected to place greater emphasis on severe accidents and risk studies. These efforts have provided NRC management more detailed knowledge of plant operating characteristics and daily operational events.

B. Utility and Suppliers

The industry has established the Institute of Nuclear Power Operations, the Nuclear Safety Analysis Center, and the Nuclear Management and Resources Council to aid licensees to improve plant performance and safety. Both the NRC and the industry have placed a high priority on understanding the lessons of operational experience, particularly with regard to root causes, and communicating these lessons to all plants, both domestic and foreign. NRC has verified that responsibilities for plant operations and related plant procedures are clearly defined for both normal and emergency conditions.

C. Training of Operating Personnel

All licensees have extensively revised their training programs for licensed and non-licensed operators. National accreditation of these training programs is now accomplished under close NRC monitoring. A systems approach to training has been established to improve the effectiveness of training programs for plant personnel. NRC operator examinations now focus on a knowledge of plant operations, and the passing grade was increased. More stringent initial operator candidate screening and medical evaluations were instituted. Licensees were required to have a simulator facility and to provide comprehensive training in the diagnosis of and recovery from possible plant malfunctions and potential accident conditions.

D. Technical Assessment

Since the TMI-2 accident, control room instrumentation and layouts have been reviewed against needed capability to mitigate accidents, and plants have been modified as necessary. Inadequacies in plant design and hardware have been corrected. A Safety Parameter Display System has been provided for critical plant parameters to enhance operators' understanding of the plant's safety status. In-depth and comprehensive studies have been, and continue to be, conducted on severe accident and core melt phenomena, plant equipment performance and reliability, and human performance. Detailed risk assessment research activities and studies have characterized potential safety issues. NRC requirements for oral and written reports of operating events have been substantially revised, and a comprehensive operational experience assessment and feedback program has been established. Finally, the TMI-2 accident recovery program has been conducted in a deliberate manner with full documentation to aid in accident modeling and design studies for advanced reactors.

E. Worker and Public Health and Safety

In order to promote increased attention to public health and safety, the NRC has worked to achieve coordination of Federal radiation effects research; adequate training of state and local emergency response personnel; and upgrading of licensee, State, and local radiological emergency response capabilities. Federal radiation effects research and related matters are now coordinated through the Committee on Interagency Radiation Research and Policy Coordination. Licensees are required to provide training to emergency response personnel, and both NRC and the Federal Emergency Management Agency provide additional training directly to such personnel. Further, NRC emergency preparedness regulations have been extensively revised since the TMI-2 accident. Facility

modifications have been required; periodic emergency response drills are evaluated; and licensee emergency plans, facilities, training, and equipment are routinely inspected. All licensees now maintain radioprotective drugs for onsite emergency workers.

F. Emergency Planning and Response

Revised NRC rules and guidance have been issued to provide for improved capability for a wide range of accidents. State and local authorities have upgraded emergency plans, equipment, and training and participate with licensees in biennial response exercises. Public notification and information channels have been established and tested. Responsibilities and cooperative procedures with other agencies have been documented and demonstrated through two Federal Field Exercises involving licensee organizations and Federal, State, and local officials.

G. Public Right to Information

To disseminate prompt and accurate information about emergency conditions, a Joint Public Information Center will be established near the site of any future accident. These centers have the necessary facilities to support the media, and will be staffed by Federal, State, local, and utility representatives who can speak authoritatively about the emergency. Arrangements have been established for announcements over the Emergency Broadcast System to disseminate information. NRC ensures that the public is informed of events which are not emergencies through open meetings and widely disseminated documents, and on any release of radioactivity to the environment in excess of NRC limits. Media training is provided on nuclear safety and related subjects.

In summary, since the TMI-2 accident, significant modifications and improvements have been made in NRC's and the industry's organization and practices. Training, equipment, and maintenance at nuclear power plants have been upgraded. Emergency planning has been enhanced. Noteworthy progress has been achieved in improving the margin of safety inherent in commercial nuclear power reactors. There is now a heightened safety awareness within the NRC and the nuclear industry, and an improved understanding of the lessons of experience taught by this accident.

INTRODUCTION

On March 28, 1979, the most serious accident at a U.S. commercial nuclear power plant occurred at the Three Mile Island Unit 2 plant in Pennsylvania. Two weeks after the accident, the President of the United States appointed a 12-member Presidential Commission to conduct a comprehensive investigation of the accident and to make "appropriate recommendations based upon the Commission's findings." The resulting recommendations from the Presidential Commission formed the principal basis for the U.S. Nuclear Regulatory Commission's (NRC's) Three Mile Island Action Plan. As a result of work performed in response to the plan, licensed nuclear utilities were required to undertake a range of actions to implement the lessons learned from the accident at Three Mile Island.

This report updates the Agency's initial response to Presidential Commission recommendations contained in "NRC Views and Analysis of the Recommendations of the President's Commission on the Accident at Three Mile Island" (NUREG-0632) published in November 1979. It follows the sequence of recommendations in the Presidential Commission report. Each verbatim recommendation is followed by a summary of the current status of actions and commitments resulting from that recommendation. Where appropriate, the commitments and agreements contained in NUREG-0632 are reflected in this report. The status of ongoing initiatives for actions not yet complete are reported for reference purposes.

The Presidential Commission made recommendations in the following broad areas:

A. The Nuclear Regulatory Commission

This section included recommendations for statutory changes in the structure of the Nuclear Regulatory Commission and for policy changes in how the Agency fulfilled its primary mandate of assuring the safe operation of nuclear power reactors. This section also recommended Agency changes in rulemaking, in the adjudication of case-specific safety issues, and in the Agency's inspection and enforcement functions.

B. The Utility and Its Suppliers

This section recommended ways to improve the design, construction, and operation of nuclear power plants. These three components -- design, construction, and operation -- of necessity involved the human element. The recommendations focused on setting standards for doing things correctly, for detecting problem areas, and for correcting problems when they occur. Specifically, the recommendations included items on shifting attitudes, setting clear safety goals and standards, sharing operating experience, maintaining technical competence, assuring quality, emphasizing operator qualifications, and upgrading plant procedures.

C. Training of Operating Personnel

This section addressed several aspects of training. Several recommendations pertained to the accrediting of training institutions for reactor operators and

their supervisors and the role of the licensee and the regulatory Agency in assuring adequately trained operators. The recommendations reflected that operator training was an ongoing concern and that research was necessary to bring added understanding and realism to the dynamic simulation of nuclear power plant operations.

D. Technical Assessment

This section included recommendations for the type, arrangement, and display of the information in the control room to improve the ability of plant operators to prevent and cope with accidents. Another recommendation treated the inadequacies in specific instruments used to cope with the TMI accident. It also recommended that accident studies, including those for accidents that might result in melting of the core, be continued. A related recommendation was that, to the extent possible, data be obtained from the severely damaged TMI core for use in safety studies. The results of these studies were to be used to identify desirable changes to the design of plants. The Presidential Commission recognized the hazard to the public health and safety that remained at TMI and recommended continued close monitoring of the cleanup and recovery from the accident. It also recommended systematic evaluation of operating experience.

E. Worker and Public Health and Safety

This section reflected the concerns of the Presidential Commission regarding uncertainties in the scientific understanding of the health effects of ionizing radiation, the need for public health agency overview of NRC activities, and the shortcomings in State, local, and utility emergency preparedness.

F. Emergency Planning and Response

This section pertained to the review and approval of State emergency response plans, the assessment of the basis for evaluating State and local government plans, the coordination between utility and local officials, the upgrading of State plans, and the role of the Federal Emergency Management Agency (FEMA). It also included the use of accident scenarios in developing and activating emergency response plans, protection of the public from radiation at levels lower than called for in current plans, and the availability of funds for emergency response planning at the local level. Education of the public and the need for study of the benefits and impacts of mass evacuation were also addressed.

G. The Public's Right to Information

This section included recommendations that stressed the need for Federal and State agencies and utilities operating nuclear power plants to make adequate preparations for a systematic public information program. The Presidential Commission also stressed that the information must be presented in a form that is understandable, timely, and accurate.

This NRC update on the current status of the Presidential Commission recommendations is another step in NRC's overall effort to use the findings and recommendations made in the many studies of the accident at Three Mile Island. The entire range of follow-up activities were incorporated into the "NRC Action Plan Developed as a Result of the TMI-2 Accident" (NUREG-0660). Subsequent requirements developed for implementation by NRC licensees and holders of construction permits were compiled in "Clarification of TMI Action Plan Requirements" (NUREG-0737). Finally, the status of specific Action Plan initiatives continues to be monitored in NRC's periodical report, "A Prioritization of Safety Issues" (NUREG-0933).

RECOMMENDATIONS AND ACTIONS

A. RECOMMENDATIONS FOR NUCLEAR REGULATORY COMMISSION (NRC) ORGANIZATION AND MANAGEMENT

A.1 and A.1.a Reorganize NRC into the Executive Branch with a Single Administrator and Abolish the Five-Member Commission

Presidential Commission Recommendation

The Nuclear Regulatory Commission should be restructured as a new independent agency in the executive branch. The present five-member Commission should be abolished.

Status of Actions

The Presidential Commission concluded that the five-member Nuclear Regulatory Commission (NRC), as constituted, did not possess the organizational and management capabilities necessary for the effective pursuit of nuclear safety goals and recommended that it be abolished. In its stead, the Presidential Commission called for the establishment of a new Executive Branch Agency, headed by a single administrator, who would be appointed by and serve at the pleasure of the President.

Four of the five NRC Commissioners then serving indicated that they would not support single-administrator legislation. Instead, to strengthen Agency management, the Commissioners preferred enactment of modest legislation that, combined with Commission-initiated changes in the Agency's internal practices and procedures, would clarify the Chairman's authority. Following the issuance of the Presidential Commission Report, the President proposed a plan to Congress that would strengthen the Chairman's authority. When Congress did not disapprove this proposal, Reorganization Plan No. 1 of 1980 became law. In the years after enactment of this legislation, the Commission delegated additional authority to the Chairman and to the Executive Director for Operations.

In 1988 the Senate passed legislation that would establish a single-administrator agency. The House of Representatives did not act on this proposal. Single-administrator legislation is expected to be introduced this year in the 101st Congress. Three of the current NRC Commissioners support single-administrator legislation with certain qualifications; two do not support such legislation.

A.1.b Appoint a Single Administrator to Head the New Agency

Presidential Commission Recommendation

The new agency should be headed by a single administrator appointed by the President, subject to the advice and consent of the Senate, to serve a substantial term (not coterminous with that of the President) in order to provide an expectation of continuity, but at the pleasure of the President to allow removal when the President deems it necessary. The administrator should be a person from outside the present agency.

Status of Actions

Legislation to make NRC a single-administrator Agency is expected to be introduced in the current session of Congress. Three of the current NRC Commissioners support single-administrator legislation with certain qualifications; two do not support such legislation.

A.1.c Grant Substantial Discretionary Authority to the Administrator

Presidential Commission Recommendation

The administrator should have substantial discretionary authority over the internal organization and management of the new agency, and over personnel transfers from the existing NRC. Unlike the present NRC arrangement, the administrator and major staff components should be located in the same building or group of buildings.

Status of Actions

As noted previously, the President's Reorganization Plan of 1980 served to strengthen the authority of the NRC Chairman relative to the other Commissioners. For example, the Chairman is the official spokesman and principal executive officer of the Commission and directs and delegates various functions to the Executive Director for Operations (EDO), who reports to the Chairman on all matters. The Commission retains responsibility for policy formulation, rule-making, orders, and adjudication. The Chairman initiates personnel actions, subject to Commission approval, for heads of offices reporting directly to the Commission, including the EDO and the heads of the major program offices reporting to the EDO. The Chairman directs and delegates to the EDO responsibility for all administrative functions, distribution of business, preparation of reorganization proposals and budget estimates, allocation of funds, and personnel matters other than those affecting the major program offices and certain other offices reporting to the Commission. The Commission's emergency response functions were also transferred to its Chairman for defined emergencies.

The EDO position was also strengthened relative to the program staff. For example, all program offices and regional offices report to the EDO. The EDO is to be consulted regarding actions affecting the program and regional offices. The EDO is required to keep the Commission fully and currently informed through the Chairman.

Since its inception as an independent regulatory Agency, NRC has sought to consolidate its headquarters' staff in the Washington, D.C. area. Further emphasis was placed on this effort as a result of the TMI-2 accident. On the basis of past discussions between senior NRC and General Services Administration (GSA) officials, both agencies acknowledged the benefits of a consolidation and agreed to develop alternative options that would accommodate both short- and long-term housing solutions. In November 1986, GSA concluded negotiations with White Flint North Limited Partnership to purchase an 18-story building (One White Flint North, 11555 Rockville Pike, Rockville, Maryland) for NRC's consolidation. This building is now fully occupied and has provided major improvements in staffing efficiency.

The purchase contract for One White Flint North included an option to lease a second building of similar size to be constructed on an adjacent portion of the One White Flint North site. The Government has exercised this option and, following issuance of the necessary State and local permits, construction will begin, with initial occupancy now forecast for spring 1991. The completion of the second building at White Flint will provide, for the first time, for the total consolidation of all NRC headquarters' staff and Commission offices in one location.

A.1.d Improve Interagency Communications

Presidential Commission Recommendation

A major role of the administrator should be assuring that offices within the agency communicate sufficiently so that research, operating experience, and inspection and enforcement affect the overall performance of the agency.

Status of Actions

Although NRC has not been reconstituted as an Agency headed by a single administrator, the intent of this recommendation has been reflected in revisions to NRC's management structure and operations. These reorganizations were undertaken in large measure to strengthen and improve the performance of the NRC staff through the consolidation of headquarters' offices.

For example, in April 1987 a major restructuring of NRC headquarters' offices effectively consolidated NRC responsibilities for licensing and inspecting operating reactors in a single office; gathered NRC activities for non-reactors in a single office; raised the level of priority placed on the assessment of operating experience; integrated in a single office NRC resources being applied on generic safety issues and other research activities; placed enforcement functions in a new office; and created a new Office of Governmental and Public Affairs in place of previously separate Offices of Public Affairs, Congressional Affairs, State Programs, and International Programs.

In January 1989, in order to further assist the Executive Director for Operations (EDO), promote integration of staff activities, and to accommodate the heavy workload of the EDO Office, a second Deputy Executive Director was appointed. With this appointment, a second Deputy Executive Director position was filled after a vacancy of over two years. Consequently, at this time, one Deputy is responsible for the Office of Nuclear Reactor Regulation, Regional Offices (except non-reactor matters) and the Office of Research, and the newly appointed Deputy is responsible for the Offices of Nuclear Material Safety and Safeguards (NMSS), Investigations, Enforcement, Consolidation, Administration, and Information Resources Management.

A.2 Establish an Oversight Committee

Presidential Commission Recommendation

An oversight committee on nuclear reactor safety should be established. Its purpose would be to examine, on a continuing basis, the performance of the agency and of the nuclear industry in addressing and resolving important public safety issues associated with the construction and operation of nuclear power plants, and in exploring the overall risks of nuclear power.

The members of the committee, not to exceed 15 in number, should be appointed by the President and should include: persons conversant with public health, environmental protection, emergency planning, energy technology and policy, nuclear power generation, and nuclear safety; one or more state governors; and members of the general public.

The committee, assisted by its own staff, should report to the President and to Congress at least annually.

Status of Actions

The Commission considered the need for an independent board to investigate nuclear accidents before the TMI-2 accident occurred. In August 1978, the NRC Chairman responded to a series of questions on a nuclear accident board posed by Congress. After the TMI-2 accident, the President established a Nuclear Safety Oversight Committee by Executive Order 12202 in March 1980. This Committee, headed by Governor Bruce Babbitt of Arizona, issued a report on the state of nuclear reactor licensing on July 23, 1981. After issuance of the report, the Committee was abolished.

In 1984, Congress directed that NRC conduct a study of the need for and feasibility of an independent organization responsible for conducting investigations of significant safety events at NRC-licensed facilities. In response, NRC contracted with Brookhaven National Laboratory (BNL) to conduct the study. BNL's final report was submitted to NRC in February 1985.

BNL recommended the establishment of a statutory office of nuclear safety, headed by a director reporting directly to the Commission. However, the study stated that NRC investigations of operating events had been conducted in a "proficient and technically competent" manner. Although BNL suggested a number of improvements for investigating operating events, it was noted that, for the most part, these improvements could be implemented within NRC's then-present organizational structure. Many of the improvements recommended by BNL have been adopted as part of the NRC Incident Investigation Program. On the basis of the Commission's review of the BNL report and of other studies of the issue, the Commission believed that there were no major deficiencies in the NRC accident investigation program that would warrant formation of an independent Board or agency, and that the necessary independent oversight and assessment could be provided by NRC's Office for Analysis and Evaluation of Operational Data (AEOD). This Office was established in 1979 in response to the TMI-2 accident, is organizationally independent of the Offices of Nuclear Reactor Regulation and Nuclear Material Safety and Safeguards, and reports directly to the Executive Director for Operations.

The Commission continues to receive a substantial amount of external oversight. In addition to the oversight from numerous Congressional committees, NRC receives independent advice from a number of advisory committees, such as the Advisory Committee on Reactor Safeguards and the newly formed Advisory Committee on Nuclear Waste.

A.3 and A.3.a Retain the ACRS and Strengthen Its Role

Presidential Commission Recommendation

The Advisory Committee on Reactor Safeguards (ACRS) should be retained, in a strengthened role, to continue providing an independent technical check on safety matters. The members of the committee should continue to be part-time appointees; the Commission believes that the independence and high quality of the members might be compromised by making them full-time Federal employees. The Commission recommends the following changes:

The staff of ACRS should be strengthened to provide increased capacity for independent analysis. Special consideration should be given to improving ACRS' capabilities in the field of public health.

Status of Actions

The NRC endorsed a strengthened role for the ACRS in its response to the Presidential Commission Report. In this regard, the ACRS has been retained as an independent technical check on safety matters and continues to play an important role in its capacity as an advisory body reporting directly to the Commission. Further, the Committee is still composed of part-time appointees, and emphasis has continued on assuring the high quality of the membership.

The Committee has, at present, been limited to a maximum strength of 11 members from its previous maximum of 15 (established in the Atomic Energy Act). This change was associated with the establishment of a four-member independent advisory group to provide needed advice in the area of waste management. As a result of declining Agency resources, the size of the ACRS staff has declined since the early 1980's.

The ACRS' authority to conduct reviews of specific generic matters or nuclear safety-related items on its own initiative was codified in July 1978 in NRC's rules (10 CFR 1.20).

A.3.b Remove Requirements for ACRS Review of All License Applications

Presidential Commission Recommendation

The ACRS should not be required to review each license application. When ACRS chooses to review a license application, it should have the statutory right to intervene in hearings as a party. In particular, the ACRS should be authorized to raise any safety issue in licensing proceedings, to give reasons and arguments for its views, and to require formal response by the agency to any submission it makes. Any member of the ACRS should be authorized to appear and testify in hearings, but should be exempt from subpoena in any proceedings in which he has not previously appeared voluntarily or made an individual written submission.

Status of Actions

Both NRC and the ACRS agreed with the Presidential Commission recommendation that the ACRS should be relieved of the burden of reviewing every license application. Such a proposal was included in several legislative proposals

from NRC, but has since been dropped as being unnecessary because no new license applications are now being submitted. Neither the Committee nor the Commission was in favor of a formal litigating role for the ACRS in hearings in light of their view that such a role would detract from the independent collegial function of the ACRS. Thus, no such role has been established for the Committee.

A.3.c Permit ACRS Rulemaking Initiatives

Presidential Commission Recommendation

ACRS should have similar rights in rulemaking proceedings. In particular, it should have the power to initiate a rulemaking proceeding before the agency to resolve any generic safety issue it identifies.

Status of Actions

The ACRS, consistent with its charter under the Atomic Energy Act, reviews and comments on proposed significant safety-related rules and rule changes. Moreover, procedures are in place that provide for ACRS participation at early stages in the development of NRC rules, policy matters, and guidance by the staff.

NRC regulations provide that the ACRS may recommend rulemaking to the Commission and that the Commission will respond in writing within 90 days stating its intent to implement, study, or defer action. (Paragraph 2.809 was added to Part 2 of Title 10 of the Code of Federal Regulations by publication in the Federal Register on April 17, 1981.) If the Commission decides to reject the recommendation, or to defer action on it, the rule provides that the Commission will state its reasons for doing so.

A.4 Establish and Explain Safety-Cost Tradeoffs and Non-Safety Review Responsibilities

Presidential Commission Recommendation

Included in the agency's general substantive charge should be the requirement to establish and explain safety-cost trade-offs; where additional safety improvements are not clearly outweighed by cost considerations, there should be a presumption in favor of the safety change. Transfers of statutory jurisdiction from the NRC should be preceded by a review to identify and remove any unnecessary responsibilities that are not germane to safety. There should also be emphasis on the relationship of the new agency's safety activities to related activities of other agencies. (See recommendations E.2 and F.1.b.)

Status of Actions

NRC is in complete accord with the recommendation that there should be a presumption in safety-cost tradeoffs in favor of safety. NRC addressed the issue of safety-cost tradeoffs in its amended backfitting rule (10 CFR 50.109) which clarified when economic costs may be considered in backfitting requirements for nuclear power plants (53 Federal Register 20603, June 6, 1988). As noted in the background to the rule, the Atomic Energy Act clearly specifies that the Commission is to ensure that nuclear power plants provide

adequate protection to the health and safety of the public. In defining, redefining, or enforcing this statutory standard of adequate protection, the Commission may not and will not consider economic costs. But, the Commission is empowered under Section 161 of the Atomic Energy Act to impose additional safety requirements beyond those needed for adequate protection and to consider economic costs in so doing.

NRC's position on divestiture of its nonsafety responsibilities remains essentially unchanged from that provided in NUREG-0632. It still does not support such action. Divesting NRC of nonsafety responsibilities (it is assumed that domestic safeguards responsibilities would be retained) would require legislation by the U.S. Congress. In enacting the Nuclear Non-Proliferation Act of 1978, Congress expressed the firm belief that nuclear exports should be subjected to a thorough review by an independent agency. Furthermore, relieving NRC of its antitrust review responsibilities under the Atomic Energy Act and of its environmental obligations under the National Environmental Policy Act and other federal laws for environmental protection, could leave serious gaps in regulation at the Federal level.

Since the issuance of NUREG-0632, NRC has emphasized the relationship of its safety authorities with the related activities of other agencies. Numerous Memoranda of Understanding have been signed with agencies such as the Federal Emergency Management Agency, the Department of Labor, the Department of Energy, the Department of Justice, the Environmental Protection Agency, the Occupational Health and Safety Administration, and several States. In 1987 a major NRC reorganization resulted in the creation of the Office of Governmental and Public Affairs, which has increased the focus on planning and coordinating with other Federal and State entities whose interests are similar to those of NRC.

A.4.a Upgrade Operator and Supervisor Licensing Requirements

Presidential Commission Recommendation

The agency should be directed to upgrade its operator and supervisor licensing functions. These should include the accreditation of training institutions from which candidates for a license must graduate. Such institutions should be required to employ qualified instructors, to perform emergency and simulator training, and to include instruction in basic principles of reactor science, reactor safety, and the hazards of radiation. The agency should also set criteria for operator qualifications and background investigations, and strictly test license candidates for the particular power plant they will operate. The agency should periodically review and reaccredit all training programs and relicense individuals on the basis of current information on experience in reactor operations. (See recommendations C.1 and C.2)

Status of Actions

NRC agreed with this recommendation, and after the TMI-2 accident, initiated a number of actions to upgrade and strengthen operator licensing. As a result, nuclear facility training programs are now based on a "Systems Approach to Training" and each plant-specific operator training program is accredited by the Institute of Nuclear Power Operations (INPO). Each license candidate must complete the program as part of his/her eligibility to take an NRC license

examination. Instructors conducting the training of license candidates, prior to the training program accreditation, were examined and certified by NRC to assure their competence and qualifications. NRC Form 398, "Personal Qualifications Statement," was developed to permit a closer review of an applicant's training and experience for determining his/her eligibility to take an NRC license examination. The NRC also adopted the more stringent initial candidate screening and medical evaluations established by the industry. A "Knowledge and Abilities Catalog for Nuclear Plant Operators" was developed with major contributions from INPO to validate examination content and passing criteria to test plant operators on specific pressurized and boiling water reactors.

In addition, NRC revised criteria to upgrade reactor operator (RO) and senior reactor operator (SRO) training and licensing requirements. Eligibility requirements for the administration of an NRC examination were clarified and made more explicit in terms of experience and training requirements. Initial licensing training programs were modified to include the following: (1) practical application of heat transfer, fluid flow and thermodynamics; (2) use of installed plant equipment to control or mitigate accidents in which the core is severely damaged; and (3) increased emphasis on reactor and plant transients.

NRC expanded the scope and passing criteria for examinations for both RO and SRO licenses and imposed a time limit for completion of these examinations. Applicants for SRO licenses are required to pass an operating examination as well as a written examination. Also, all applicants are required to take a simulator examination in addition to the written and plant oral walkthrough tests.

The content of the requalification program was increased to require instruction in heat transfer, fluid flow, thermodynamics, and mitigation of degraded core accidents. Passing grades were raised to the same criteria for the issuance of a new license, and programs now require hands-on experience for specific reactivity control manipulations. Also, NRC periodically evaluates facility requalification programs and administers requalification examinations to current license holders.

Certification by the highest level of corporate management at that facility is required of all applicants for RO and SRO licenses as to the need for the license and the individual's eligibility and qualifications.

The regulatory upgrade of licensing requirements was initiated through a revision to 10 CFR Part 55 "Operators' Licenses." The regulation was amended to (1) clarify the regulation for issuing operator licenses; (2) revise the scope of written and operating tests to include simulation facility requirements; (3) codify NRC requalification examination administration; (4) describe the form and content for license applications; and (5) require administration of an NRC examination to current license holders prior to the renewal of a license.

"Operator Licensing Examiner Standards" (NUREG-1021) was developed to provide guidance to NRC examiners and establish the procedures for examining and licensing applicants for NRC license pursuant to 10 CFR Part 55. (Also see Sections C.1 and C.2 of this report.)

A.4.b Better Define Safety Versus Nonsafety Systems

Presidential Commission Recommendation

The agency should be directed to employ a broader definition of matters relating to safety that considers thoroughly the full range of safety matters, including, but not limited to, those now identified as "safety-related" items, which currently receive special attention.

Status of Actions

Following the accident at TMI-2, and in response to this recommendation, the staff has paid increased attention to nonsafety-related plant equipment. Consequently, improvements in the reliability of a number of nonsafety-related systems now provide greater assurance that a safe plant shutdown can be achieved. These improvements were made to systems not required for mitigation of large-break loss-of-coolant accidents, which had previously been the primary focus of staff attention when defining safety-related systems. There has been a reduction in the number of rapid plant shutdowns and challenges to safety systems.

Improvements and actions involving nonsafety equipment and systems since the TMI-2 accident include:

- Backup power provided to the pressurizer heaters and pilot-operated relief valves from an emergency diesel generator bus.

- Changes in containment building isolation design to maintain adequate cooling water flow to the reactor coolant pump (RCP) seals to improve pump availability throughout the course of an accident.

- An anticipated transient without scram (ATWS) rule instituted to reduce the probability and the consequences of a transient not followed by a rapid reactor shutdown. The rule, along with Generic Letter 83-28, has resulted in increased reliability of rapid shutdown systems and a diversity in mitigation capability.

- An anticipatory rapid shutdown (trip) capability added to cause the reactor to shut down on low main feedwater flow to reduce the challenge to pressurizer safety and relief valves. Previously, a reactor coolant system high-pressure trip would generally occur to provide this protection, whereupon safety relief valves would actuate.

- The request that all plants verify by test the reliability and design bases of the instrument air systems and the adequacy of air quality, training, and maintenance procedures. A similar request is being issued for the service water system.

- Balance-of-plant (BOP) inspections performed to determine possible impacts on personnel safety or on safety-related equipment. A procedure for these inspections has now been added to the NRC inspection manual.

- Rapid reactor shutdowns caused by nonsafety-related systems have been analyzed. It is expected that the BOP inspection procedure will be updated as a result of this study.

- The reassessment program for Babcock & Wilcox (B&W) reactors resulted in numerous recommendations for modifications of nonsafety-related systems, such as main feedwater, main turbine, turbine bypass, and instrument air. These recommendations were aimed at reducing the frequency of rapid shutdowns and of the complications associated with BOP system failures following such shutdowns. Many of these recommendations have already been implemented at the B&W plants.

Balance-of-plant equipment, normally not safety related, also continues to be assessed for risk significance as part of probabilistic risk assessments. Further, human factor programs focus on all aspects of human performance and not just on safety-related activities. Through revised regulatory criteria and substantially increased organizational emphasis, all aspects of plant design and human performance, safety- and nonsafety-related, have received increased scrutiny.

A.4.c Reevaluate Control Room and Overall Plant Design

Presidential Commission Recommendation

Other safety emphases should include:

(i) a systems engineering examination of overall plant design and performance, including interaction among major systems and increased attention to the possibility of multiple failures;

(ii) review and approval of control room design; the agency should consider the need for additional instrumentation and for changes in overall design to aid understanding of plant status, particularly for response to emergencies; (see Recommendation D.1) and

(iii) an increased safety research capacity with a broadly defined scope that includes issues relevant to public health. It is particularly necessary to coordinate research with the regulatory process in an effort to assure the maximum application of scientific knowledge in the nuclear power industry.

Status of Actions

NRC agreed with this recommendation, and as a result, began a number of major studies and initiatives. For example, the Agency created a separate branch to apply reliability and risk assessment techniques and insights to reactor regulation. Specific plants have been examined extensively through probabilistic risk assessment techniques, specific design studies, plant walkdowns, and analysis of operating experience. Major studies and programs are sponsored by the NRC to advance state-of-the-art techniques for assessment of accident initiators and multiple failures across plant systems. A comprehensive study was completed on system interaction events and numerous other studies have been completed on system and component reliabilities. These analyses led to hardware modifications, procedural improvements, and increased understanding of plant system interactions, dependencies and system/component reliability. These studies led to plant modifications and procedural improvements, and have been reflected in action requests in NRC Bulletins and Generic Letters, and incorporated in the Commission's severe accident program and the subsequent Individual Plant Examinations for all operating reactors.

Further, all licensees and applicants have conducted detailed control room design reviews to determine if their control rooms provide satisfactory information to allow operators to prevent or cope with accidents. As guidance for the effort, NRC published "Guidelines for Control Room Design Reviews" (NUREG-0700) in 1981. This document delineated basic human factors analysis techniques and accepted human factors design principles and criteria. In addition, Chapter 18, "Human Factors Engineering," of "The Standard Review Plan" (NUREG-0800), was published to provide licensees and applicants with the criteria by which the staff would review their designs for the main control room and control centers outside the main control room.

Part of this effort by each licensee and applicant included a function and task analysis to determine what tasks the operators were expected to perform and what information and control capability was needed to perform them. These information and control requirements were then compared to the controls and displays in the control room to determine the availability and acceptability of the instrumentation. In addition, each control room was surveyed to identify deviations from accepted human factors principles for control room layout, the usefulness of audible and visual alarm systems, its information recording and recall capability, and the control room environment. Each licensee and applicant then submitted a summary report outlining proposed changes and schedules for their implementation. The report also provided justification for those safety-significant human engineering deficiencies that were to be left uncorrected or partially corrected.

Implementation of control room improvements, including some significant design changes, is well under way. The NRC has identified no serious significant design flaws that have not been corrected.

With regard to the coordination of research on public health issues, NRC is an active participant on the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC). The CIRRPC has supported, coordinated, and reviewed efforts in the health effects area, including radio-epidemiological, radiobiological, and dosimetry studies. CIRRPC issued "The Federal Ionizing Radiation Research Agenda Related to Low Level Biological Effects: FY 1985," which delineates and compares federally supported research efforts in 1981 and 1985. Also, CIRRPC directly supports an update of the 1980 comprehensive report by the National Academy of Sciences (NAS) on the effects of low-level radiation. This update is being prepared by the NAS Committee on the Biological Effects of Ionizing Radiation (BEIR). Known as the BEIR V report, it is expected to be available in the spring of 1989.

NRC's budget for studies on the biological effects of ionizing radiation represents about 3 percent of all Federal expenditures in this area. NRC support is limited to projects of direct applicability to the Agency's responsibilities that are not sponsored by other agencies. Examples of NRC's projects include experimental development of models for early mortality and morbidity due to the accidental inhalation of radionuclides, development of models for assessing the health consequences of reactor accidents, and a feasibility study to better characterize the risks of low-level radiation through studies on the radiation effects at the molecular and cellular levels.

The development of a data base to support epidemiological research on the health effects of ionizing radiation will result from requirements included in a proposed revision of Agency regulations (10 CFR Part 20) now before the Commission. The proposed requirements were developed as a result of a request by the National Cancer Institute (NCI) and followed meetings with NCI staff, industry groups, labor unions, and others. The data base is to include nuclear power workers as well as other personnel in the nuclear industry.

A.5 Enforce Higher Standards for Licensee Responsibilities and Accountability for Safety

Presidential Commission Recommendation

Responsibility and accountability for safe power plant operations, including the management of a plant during an accident, should be placed on the licensee in all circumstances. It is therefore necessary to assure that licensees are competent to discharge this responsibility. To assure this competency, and in light of our findings regarding Metropolitan Edison, we recommend that the Agency establish and enforce higher organizational and management standards for licensees. Particular attention should be given to such matters as the following: integration of decisionmaking in any organization licensed to construct or operate a plant; kinds of expertise that must be within the organization; financial capability; quality assurance programs; operator and supervisor practices and their periodic reevaluation; plant surveillance and maintenance practices; and requirements for the analysis and reporting of unusual events.

Status of Actions

NRC fully agreed with this recommendation and shortly after the accident acted to upgrade organizational, management, and technical capabilities, such as emergency operating procedures, in order to minimize the potential for future serious accidents. Further, increased attention has been placed on the operating plants and the capabilities of licensee management through increased Commission and staff visits and meetings, including meetings with licensee Boards of Directors when warranted.

As discussed in a number of responses, the nuclear industry has made considerable progress since the accident at Three Mile Island. There is a heightened sense of responsibility and accountability for safe plant operations. Industry organizations, such as the Institute of Nuclear Power Operations, have actively encouraged higher organizational and management standards. Additionally, NRC has established a number of initiatives and elevated the standard of acceptability for licensees. The result has been increased awareness on the part of both industry and NRC of the importance of safe plant operations and the evolution of a much lower threshold of sensitivity to what constitutes safe operation.

The heightened awareness by industry of the importance of safe plant operations and the constant vigilance by NRC have resulted in substantial improvements in the integration of decisionmaking; in the acquisition of additional staff expertise for plant operations; in the implementation of more aggressive and comprehensive quality assurance programs; and in operator and supervisor practices. A strong emphasis has been placed on improving maintenance practices and upgrading requirements for the reporting of abnormal plant operations by the licensee.

In 1980, the Systematic Assessment of Licensee Performance (SALP) program was established. The NRC inspection program was also expanded and made more aggressive. The resident inspector program, for example, was established shortly after the TMI-2 accident and resident inspectors are now located at all reactor sites. A Diagnostic Evaluation Program was established in 1987 for NRC to conduct in-depth probes of management capabilities and plant performance at selected plants. A performance indicator program has been instituted as an additional tool to assess the performance of each plant. Finally, to integrate the results of the many assessment programs, senior NRC managers began holding semi-annual meetings in 1986 to analyze plant performance and to identify those plants needing additional regulatory attention. All of these efforts have contributed to a significant strengthening of the management and staff and to a high degree of safety awareness at every nuclear plant.

A.6 Locate New Power Plants in Remote Areas

Presidential Commission Recommendation

In order to provide an added contribution to safety, the Agency should be required, to the maximum extent feasible, to locate new power plants in areas remote from concentrations of population. Siting determinations should be based on technical assessments of various classes of accidents that can take place, including those involving releases of low doses of radiation. (See recommendation F.2.)

Status of Actions

Since the TMI-2 accident, NRC has reviewed its siting policy with a view towards the siting of advanced-design reactors. Although the basic regulations concerning site location of a nuclear plant (10 CFR Part 100) have not been modified since the issuance of the Presidential Commission's recommendation, NRC's policy remains that nuclear power plants should be located at a reasonable distance from densely populated areas. Technical analysis for a new siting rule was performed in the early 1980's and showed that NRC's current regulations and guidance (Regulatory Guide 4.8) result in the selection of suitably remote reactor sites. Work on the new siting rule was suspended pending availability of the results of the Severe Accident Research Program.

The Commission is presently completing a regulation (10 CFR Part 52) to provide for, among other things, the issuance of early site permits. This regulation will establish the procedures and procedural requirements that would apply to applications for nuclear power plant sites on which nuclear power plants of certified standardized design could be located. The intent of the regulation is to provide for an early resolution of environmental and safety licensing issues associated with nuclear power plant siting before construction begins.

The regulation will require that applicants consider a number of factors affecting acceptability of the site location that have been included in former siting reviews, including parameters for the site, the facility, the environment, the locale, and the population. An environmental report will be required that addresses the environmental effects of the construction and operation of a nuclear power plant (or plants) that have characteristics that fall within the postulated site and reactor parameters.

In addition, an applicant for an early site permit would be required to demonstrate that the area surrounding the site is amenable to emergency planning. This requirement would provide reasonable assurance that adequate protective measures could be taken in the event of a radiological emergency at the site, and that these measures employ well-established accident analysis techniques, including consideration of the potential effects of severe and design-basis accidents upon the surrounding populace and environment.

A.7 Plan for Post-Accident Cleanup and Recovery

Presidential Commission Recommendation

The Agency should be directed to include, as part of its licensing requirements, plans for the mitigation of the consequences of accidents, including the cleanup and recovery of the contaminated plant. The Agency should be directed to review existing licenses and to set deadlines for accomplishing any necessary modifications. (See recommendations D.2 and D.4.)

Status of Actions

NRC agreed with the general thrust of this recommendation, and in March 1980 required all reactor plant licensees to modify licensed operator training programs to include instructions on the use of installed plant systems to control or mitigate an accident in which the core is severely damaged. Such plant systems included additional plant shielding to protect safety equipment and allow access to vital areas, post-accident sampling capability, and reactor coolant system vents. Further, extensive work has been conducted to better understand, cope with, and minimize the probability of severe accidents. Action in this regard continues today and includes training programs, specific plant examinations, research in core-melt accident progression and mitigation, and the use of probabilistic risk analysis (PRA) techniques to identify and eliminate design weaknesses.

NRC is conducting major research studies on severe accident phenomena and uncertainties. These studies include (1) the behavior of severely damaged fuel, including the generation of oxygen and hydrogen, (2) the behavior of the core melt in its interaction with water, concrete, and core-retention materials, and (3) the effect of potential hydrogen burning and/or explosions on containment structure integrity. Work on the hydrogen control aspect of this program resulted in a Hydrogen Control Rule that was approved by the Commission and published in the Federal Register (FR) on January 25, 1985.

Severe accidents were addressed in April 1983 by a Policy Statement that set forth the Commission's intentions for rulemaking and other regulatory actions for resolving safety issues related to reactor accidents more severe than design-basis accidents (48 FR 16014). Certain severe accident technical issues will be dealt with for future and existing plants through procedures and ongoing severe accident programs identified in the Policy Statement and described more fully in NUREG-1070.

Further, in an August 1985 policy statement on severe accidents in nuclear power plants (50 FR 32138), the Commission proposed to require that each licensee perform a systematic examination of its plants to identify any plant-specific vulnerabilities to severe accidents. This plant-specific

examination, referred to as the Individual Plant Examination Program (IPE), was requested in Generic Letter 88-20, dated November 23, 1988. It entails an assessment of all operating plants to identify risks or severe accident vulnerabilities, and is being undertaken to assess severe accident risk at operating plants. These studies will be quite comprehensive, focusing on those areas which have previously been identified as significant to risk. This assessment will utilize PRA (or PRA based) techniques and include both fluid/electrical systems and containment performance and capabilities. Vulnerabilities identified by each utility will be reported to the staff, along with any planned improvements. The staff met with representatives of all operating plants in February 1989 to review the IPE program methods and reporting requirements. Final technical guidance for conducting the program will be transmitted to the industry by mid-1989. Completion of IPE studies for internal events for all operating plants is expected within three years of that date.

As a result of findings from a recent NRC draft study on reactor risk (NUREG-1150) which indicated large uncertainties in the ability of some light water reactor (LWR) containment buildings to successfully survive certain severe accident challenges, NRC undertook a new review of reactor containment building capabilities. This review, called the Containment Performance Improvement (CPI) program, was initiated in 1987 with a generic review of boiling water reactor (BWR) Mark I containments. The objective of this review is to determine containment building performance in accidents beyond the Design Basis by evaluating sequences that lead to core melt, reactor vessel failure, and challenges to containment structures, such as the potential for molten core-melt material to attack the dry well liner. The staff presented its recommendation on Mark I containment buildings to the NRC Commission in January 1989. The thrust of these recommendations is that Mark I containment buildings are adequately safe, but that cost-effective safety enhancements have been identified that would improve safety. The Commission has these staff recommendations under consideration. The staff will report its findings of reviews on other containment types to the NRC Commission over the next year.

Among the difficulties in timely cleanup and decontamination after the TMI accident was the uncertainty of adequate funding for such a large undertaking. The licensee had only $300 million in property insurance proceeds available for accident cleanup. Therefore, the NRC promulgated an interim regulation in 1982 which required each reactor licensee to obtain the maximum amount of property insurance then available (subject to exemptions for small reactors). A final property insurance rule was promulgated in 1987 requiring licensees to obtain $1.06 billion in property insurance at each site and requiring that a priority on decontamination funding be established, subject to review and approval of the Director, Office of Nuclear Reactor Regulation.

Petitions have been received from licensees and the insurance industry to clarify and perhaps change the nature of the decontamination provision. Therefore a followup rulemaking dealing with these petitions has been implemented. The NRC would not expect to weaken the public protection now available with the existing rule.

Finally, the post-accident examination and recovery program at TMI-2 has provided valuable lessons in the cleanup and disposal of highly contaminated waste. For example, experience with the development and use of robots at TMI-2

has lead to effective techniques for decontamination and inspection while minimizing the radiation exposure of personnel. The TMI-2 recovery program has been systematically developed and well documented, and thus serves to identify the issues and possible approaches to accident recovery. (See also Section D.6 of this report.)

A.8 and A.8.a Assess the Need for Safety Improvements and Evaluate New Criteria for Safety Standards

Presidential Commission Recommendation

Because safety measures to afford better protection for the affected population can be drawn from the high standards for plant safety recommended in this report, the NRC or its successor should, on a case-by-case basis, before issuing a new construction permit or operating license:

Assess the need to introduce new safety improvements recommended in this report, and in NRC and industry studies.

Status of Actions

NRC agreed with this recommendation. Soon after the accident at Three Mile Island (TMI) Unit 2, the Commission imposed a moratorium on licensing until new criteria for safety improvements could be developed. The new licensing criteria resulted from the "Lessons Learned" studies of the TMI accident. These studies resulted in the development of the TMI Action Plan, NUREG-0660, which provided a comprehensive and integrated plan to improve the safety of nuclear power plants. Specific items from NUREG-0660 were approved by the Commission in NUREG-0737 for implementation on operating reactors and on operating reactor license applications. The Commission later established the additional acceptance criteria for pending construction permit applications in a rule, 10 CFR 50.34(f).

The Commission also studied the lessons of previous experience with plant construction (NUREG-1055). As a result, additional emphasis is being placed on inspection of design activities and on the adequacy of control measures for the design process.

In August 1985, the Commission published its Severe Accident Policy Statement, which established the criteria needed for all future applications for construction permits (CP). That policy stated that a new design for a nuclear power plant can be shown acceptable for severe accident concerns if it meets the following criteria and procedural requirements:

> Demonstration of compliance with the procedural requirements and criteria of the current Commission regulations, including the Three Mile Island requirements for new plants as reflected in the Construction Permit Rule (10 CFR 50.34(f));
>
> Demonstration of technical resolution of all applicable Unresolved Safety Issues and the medium- and high-priority Generic Safety Issues, including a special focus on assuring the reliability of decay heat removal systems and the reliability of both ac and dc electrical supply systems;

Completion of a probabilistic risk assessment (PRA) study and consideration of severe accident vulnerabilities that the PRA exposes, along with the insights it may add to assurance of no undue risk to public health and safety; and

Completion of the staff review of the design with a conclusion of safety acceptability using an approach that stresses deterministic engineering analysis and judgement complemented by PRA.

A.8.b Review Licensee and Operator Qualifications

Presidential Commission Recommendation

Review, considering the recommendations set forth in this report, the competency of the prospective operating licensee to manage the plant and the adequacy of its training program for operating personnel.

Status of Actions

NRC agreed with the intent of this recommendation. Requirements for assuring the competency of a prospective operating licensee to manage the plant and the adequacy of its training program for operating personnel have been developed for new operating plants and for the licensing of future advanced plants.

Several Agency documents have been written and a number of initiatives have been developed to address the issue. For example, the inspection program now involves evaluations of licensee readiness to operate a plant for both a new licensee and for a licensee starting up a plant after a prolonged shutdown. These inspection requirements are normally satisfied by different team inspections, including the construction appraisal for new plants and operational readiness review team inspections. These inspections closely scrutinize the quality of construction, management capability, and the turnover process from construction management to operations management. The readiness of the new management to safely operate the plant is comprehensively assessed and includes detailed requirements for startup observations to gain a sense of operational competence.

The industry has also become increasingly sensitive to the need for increased competence at the start of new plant testing and operations and has embarked on an extensive startup lessons-learned information exchange program. This effort was accomplished, in part, by industry support groups, such as the Institute of Nuclear Power Operations and the Nuclear Utility Management and Resources Council, individual utility initiatives, and nuclear steam supply vendors. (See also Sections B.3.b and c of this report.)

Both the industry and NRC have initiated programs to assess the adequacy of a licensee's training program for operating personnel. A major role in assuring operator readiness to operate a new plant is filled by plant-specific simulators that have been built or ordered for most of the plants in the country. Further, utilities have established an extensive training program in many different areas and, upon review and demonstration of acceptability, receive accreditation of their program. The operator training and NRC examination process have also been upgraded. (See also Sections C.1, C.2, and C.3 of this report.)

A.8.c Establish Emergency Planning Prerequisites for New Licenses

Presidential Commission Recommendation

Condition licensing upon review and approval of the state and local emergency plans.

Status of Actions

NRC agreed with this recommendation. For all plants licensed to operate since the effective date of the revised emergency planning requirements (November 3, 1980), NRC has requested and received from the Federal Emergency Management Agency (FEMA) either formal approval or interim findings that State and local offsite plans and preparedness are adequate and capable of implementation, prior to full-power operation. For plants licensed before this date, the same FEMA findings were based primarily on observations made during field exercises and on the existence of upgraded plans.

In those situations where State and local governments have refused to cooperate in the planning effort, utilities may develop and submit offsite emergency response plans to NRC. These plans substitute utility resources for those of the State and local governments. In its evaluation of those utility offsite emergency response plans, NRC will assume that State and local governments will, in an actual event, use their best efforts to protect the public health and safety in responding to the emergency and will generally follow the utility's plan. If the utility offsite plan and the assumption of "realism" are not adequate to meet all the emergency planning requirements, FEMA has developed regulations, as directed by Executive Order, to provide Federal support and assistance in order to assure that utility plans are adequate to meet NRC licensing requirements.

To further assure that State and local governments receive adequate support in responding to a severe radiological accident, a comprehensive Federal Radiological Emergency Response Plan (FRERP) has been developed. This plan, published in final form in 1985, provides the means for organizing Federal resources in a coordinated manner to support State and local authorities.

A.9 and A.9.a Improve Rulemaking and Generic Safety Issues

Presidential Commission Recommendation

The agency's authorization to make general rules affecting safety should require the development of a public agenda according to which rules will be formulated.

Status of Actions

The NRC agreed with this recommendation and, as required by Executive Order 12044, established a semiannual agenda for significant rulemaking actions. Starting in October 1981, this regulatory agenda has been published as NUREG-0936 and is routinely noticed in the Federal Register. This agenda describes the need and legal basis for each regulation and indicates the status of each regulation on the agenda (or previous editions of the agenda) until the issuance of final rules.

A.9.b Set Deadlines for Safety Issue Resolution

Presidential Commission Recommendation

The Agency's authorization to make general rules affecting safety should require the agency to set deadlines for resolving generic safety issues.

Status of Actions

Soon after the TMI-2 accident, NRC established deadlines for resolution of the Unresolved Safety Issues that existed at that time and for their implementation on a plant-by-plant basis. NRC agreed that setting such deadlines was essential to assuring the staff and industry commitment to these important tasks. Unresolved Safety Issues are by definition the most significant sub-category of generic licensing issues. Each generic licensing issue has been ranked according to its assessed safety significance, and generic correspondence has been issued to licensees for those issues that have been resolved.

The early identification, assessment, and resolution of safety issues continue to be high priority activities within NRC. As these issues are resolved and as plants are modified, new issues continue to be identified through the assessment of domestic and foreign operating experience, design and safety analysis reviews, and research programs. In order to assure that new generic issues are properly characterized as to their safety importance, and that high priority issues are resolved through timely plant modifications, in April 1987 NRC consolidated all work on generic issues in the Office of Nuclear Regulatory Research under a Deputy Director for Generic Issue Resolution. A strong incentive for this reorganization was to assure that generic issues receive dedicated attention by an NRC senior manager, and that the path to resolution of each issue was carefully formulated and available for Commission review. In this regard, periodic Commission meetings are held to discuss the status and the timetable for resolution of priority issues.

A.9.c Conduct Periodic and Systematic Reevaluations of Existing Rules

Presidential Commission Recommendation

The Agency's authorization to make general rules affecting safety should require a periodic and systematic reevaluation of the agency's existing rules.

Status of Actions

NRC agreed with this recommendation and initiated action to assure that its regulations were reviewed for context and structure. Subsequently, Executive Order 12044 was issued requiring a periodic and systematic reevaluation of existing rules and that regulations be written in plain English. NRC initiated a review of its rules for content, quality, and clarity and placed initial priority on areas where rules may be affected by the accident at Three Mile Island.

The NRC rules most directly associated with TMI accident issues include operator training, emergency planning, environmental monitoring, radiation protection, hydrogen control, and consistent treatment of fission product

releases from failures of fuel cladding. The rules in these areas have been reviewed and actions taken as needed. Systematic reviews of other regulations also have been carried out or are under way for several programs throughout the Agency.

Additionally, in 1984 the NRC Office of Nuclear Regulatory Research (RES) initiated a program to review selected existing regulatory requirements in terms of risk effectiveness. The results of the review were issued in a two-volume report (NUREG/CR-4330, Volumes 1 and 2) was published in 1986. Volume 1 summarized the results of a survey to identify regulatory requirements that may have marginal importance to safety, and Volume 2 provided the results of a detailed evaluation in terms of risk, dose, and cost for assumed changes in requirements for three regulatory areas. Rule changes are being initiated as appropriate.

Another program was initiated in 1984 by the NRC Executive Director for Operations (EDO) to identify inconsistencies among safeguards (security) regulations, Regulatory Guides, inspection procedures, licensing criteria, and other Agency guidance. This effort was conducted by a Safeguards Interoffice Review Group that issued a series of reports documenting follow-up staff actions for the minor inconsistencies identified.

A program initiated in 1985 to systematically review and modify plant-specific Technical Specifications identified ways to improve their efficiency and effectiveness. These approaches are being implemented by the Technical Specifications Coordination Branch, Division of Human Factors Technology, Office of Nuclear Reactor Regulation.

Thus, a number of ongoing NRC programs have been established to systematically evaluate existing rules and to take appropriate action to eliminate or revise rules found to be overlapping, inconsistent, or unnecessary.

A.9.d Improve Rulemaking Procedures

Presidential Commission Recommendation

The Agency's authorization to make general rules affecting safety should define rulemaking procedures designed to create a process that provides a meaningful opportunity for participation by interested persons, that ensures careful consideration and explanation of rules adopted by the agency, and that includes appropriate provision for the application of new rules to existing plants. In particular, the agency should: accompany newly proposed rules with an analysis of the issues they raise and provide an indication of the technical materials that are relevant; provide a sufficient opportunity for interested persons to evaluate and rebut materials relied on by the agency or submitted by others; explain its final rules fully, including responses to principal comments by the public, the ACRS, and other agencies on proposed rules; impose when necessary special interim safeguards for operating plants affected by generic safety rulemaking; and conduct systematic reviews of operating plants to assess the need for retroactive application of new safety requirements.

Status of Actions

NRC has implemented a number of procedures to provide meaningful participation in its rulemaking activities by interested persons. NRC publishes an agenda of rulemakings under development and issues advance notices of proposed rulemaking and proposed rules for comment. Analyses of comments on proposed rules and discussion of their resolution are made public. Public hearings or meetings are held on rulemaking actions of particular interest and importance and important rulemaking actions are discussed in open NRC meetings. The Agency also permits the public to petition NRC to issue, revise, or withdraw a rule.

Careful consideration and explanation of rules adopted by NRC are assured by providing that proposed and final rules sent to the NRC Commissioners for consideration are accompanied by a staff paper that identifies the concerns, presents alternatives to the proposed action, discusses the value and impact of each alternative, and summarizes comments received and their resolution (final rules).

The rulemaking process was also reviewed to ensure that it is properly focused on resolving important safety issues and that the procedures are clear, understandable, efficient, and well documented. Several means to enhance the Commission's rulemaking efforts were addressed in NUREG-0499, including Supplement 1, and through delegation of some rulemaking authority to the Executive Director for Operations. In addition, the Office of Nuclear Regulatory Research has been assigned the responsibility of investigating and evaluating possible changes to the process as an ongoing activity.

In order to assure that new requirements are applied to operating plants in a systematic manner, NRC has modified its regulation on backfit (10 CFR 50.109), established a program to give direction and guidance on the application of plant-specific backfits (NRC Manual Chapter 0520), and established the Committee to Review Generic Requirements in 1981 to assure a thorough review of industry-wide requirements before their issuance.

A.10 Revise Licensing Procedures to Foster Early and Effective Resolution of Safety Issues

Presidential Commission Recommendation

Licensing procedures should foster early and meaningful resolution of safety issues before major financial commitments in construction can occur. In order to ensure that safety receives primary emphasis in licensing, and to eliminate repetitive consideration of some issues in that process, the Commission recommends the following [actions.] (See following Sections A.10.a through A.10.f.)

Status of Actions

Even before these recommendations were made by the Presidential Commission, NRC had in place a large body of regulations that gave applicants for construction permits and operating licenses opportunities to seek early resolution of both site issues (Subpart F of 10 CFR Part 2 and Appendix Q to 10 CFR Part 50) and design issues (Appendices M, N, and O to 10 CFR Part 50).

In response to this recommendation, NRC revised its "immediate effectiveness" procedures (10 CFR 2.764) so that no operating license would become effective until the NRC Commissioners had an opportunity to ensure that significant and relevant TMI-related issues were resolved before operation. In addition, it was originally assumed that legislation was needed to give the Agency clear authority to carry early resolution of issues further, including the authority to issue licenses combining a construction permit and an operating license. The NRC has since concluded that it already has sufficient authority to issue such licenses, and the Commissioners have before them now a draft final rule that provides for site permits issued apart from construction permits, certifications of standard designs, and combined construction permits and operating licenses, all aimed toward very early and meaningful resolution of safety issues before major financial commitments are made.

A.10.a Eliminate Duplicative Consideration of Issues During Plant Licensing

Presidential Commission Recommendation

Duplicative consideration of issues in several stages of one plant's licensing should, wherever possible, be reduced by allocating particular issues (such as the need for power) to a single stage of the proceedings.

Status of Actions

Since this recommendation was provided by the Presidential Commission, NRC has promulgated a number of rules designed to impose reasonable limits on duplicative consideration of issues. For instance, 10 CFR 51.106 bars consideration of the need for power or alternative sites in operating license hearings; 10 CFR 2.734 codifies and refines the NRC case law on the reopening of hearings; the Agency's "backfit rule," 10 CFR 50.109, assures that licensing action will proceed even though backfits not required for adequate protection of the public health and safety are under consideration.

Finally, the draft final rule on standardization and combined licenses (10 CFR Part 52) gives significant finality to the issue resolutions embodied in site permits and design certifications. In general, those issues will not be reconsidered during the term of the permit or certification unless adequate protection requires some change to the terms of the permit or certification. Thus, except in rare instances, applicants for construction permits or operating licenses that reference a site permit or design certification will not face duplicative consideration of issues resolved in the permit or certification.

A.10.b Resolve Recurrent Licensing Issues by Rulemaking

Presidential Commission Recommendation

Issues that recur in many licensings should be resolved by rulemaking.

Status of Actions

NRC agreed with this recommendation and in fact noted that this procedure was current practice in 1979 and remains so today. A large portion of the Agency's efforts are devoted to developing generic resolutions for safety issues.

Noteworthy examples of generic resolutions promulgated since the Presidential Commission's recommendation are the NRC rules on fire protection, environmental qualification of electrical equipment, reduction of risk from anticipated transients without scram, and reduction of risk from loss of offsite power. The final rule on standardization and combined licenses, if adopted by the Commission, should help further the process of generic resolution. One impediment to generic resolution has been the enormous variety of designs among U.S. power reactors. Widespread use of standardized designs should reduce this impediment.

A.10.c Combine Construction Permit and Operating License Hearings When Possible

Presidential Commission Recommendation

The agency should be authorized to conduct a combined construction permit and operating license hearing whenever plans can be made sufficiently complete at the construction permit stage.

Status of Actions

The NRC agreed with this recommendation. However, the Agency had initial doubts about both the NRC's legal authority to issue such a license and the technical feasibility of completing the design before construction.

Today, however, the Agency is confident both of its own authority and the designers' abilities to complete the detailed design before construction. The draft final rule (10 CFR Part 52) now before the Commission provides for single licenses that combine construction permits and licenses to operate. The preamble to the draft rule notes that Section 161h of the Atomic Energy Act gives the Agency the authority to issue such combined licenses, and that no other section of the Act denies it. The draft rule requires applicants for a combined license to bring forward complete design information. The combined license would incorporate the tests and inspections that would show that the plant had been built in conformance with the license. Also resolved before construction would be emergency planning issues. Under the draft rule, there would be no hearing between construction and operation unless an affected member of the public made a prima facie showing that the construction did not conform to the license, and that the issue was not exempt from adjudication under the provision in the Administrative Procedures Act which exempts from adjudication decisions that rest on clear-cut tests and inspections.

It is believed that the Commission's proposed 10 CFR Part 52 will foster early and meaningful resolution of safety and environmental issues; provide primary emphasis on the safety of nuclear plant designs; and eliminate repetitive consideration of issues through its provisions for early siting, for design certification rulemaking for standard designs, and for the issuance of combined licenses.

A.10.d Eliminate Further Appeal of Appeal Board Decisions

Presidential Commission Recommendation

There should be provision for the initial adjudication of license applications and for appeal to a board whose decisions would not be subject to further

appeal to the administrator. Both initial adjudicators and appeal boards should have a clear mandate to pursue any safety issue, whether or not it is raised by a party.

Status of Actions

Even before these recommendations were made by the Presidential Commission, the NRC had promulgated a rule, 10 CFR 2.786(b)(4), that greatly limited the grounds on which parties could seek further Agency review of an Appeal Board decision. However, in responding to these recommendations in 1979, NRC expressed significant doubts about closing off all further Agency review. The Agency believed then, and still believes, that if this recommendation were followed it would remove the NRC Commissioners from an important dimension of nuclear regulation.

Also, the NRC was reluctant in 1979, and still is, to give Agency adjudicators a "clear mandate to pursue any safety issue." This recommendation, although it may seem consistent with Recommendation A.10's emphasis on safety, is contrary to the same recommendation's emphasis on elimination of repetitive consideration of issues in licensing proceedings. In 1979, the Agency expressed its desire to continue to constrain adjudicators from pursuit of any uncontested issue that wasn't a "serious matter," but the Agency did say that it had decided to eliminate language in the regulations that said that this sua sponte authority should be exercised "sparingly" and only in "extraordinary circumstances." This language was removed in late 1979 (see, for example, 10 CFR 2.760a). On June 30, 1981 the Commission issued a memorandum to its Licensing and Appeal Panels relating to the raising of issues sua sponte in Agency adjudicatory proceedings. The Commission stated that if a Licensing or Appeal Board raises an issue sua sponte in an operating license proceeding, it shall issue a separate order making the requisite findings and briefly state its reasons for raising the issue. A copy of any such order is to be provided to NRC's Office of the General Counsel who advises the Commission on adjudicatory matters. If the Commission determines that the issue raised can best be resolved outside of the adjudicatory process, it will issue an order providing an alternative means for addressing the issue.

A.10.e Establish an Office of Hearing Counsel

Presidential Commission Recommendation

An Office of Hearing Counsel should be established in the agency. This office would not engage in the informal negotiations between other staff and applicants that typically precede formal hearings on construction permits. Instead, it would participate in the formal hearings as an objective party, seeking to assure that vital safety issues are addressed and resolved. The office should report directly to the administrator and should be empowered to appeal any adverse licensing board determination to the appeal board.

Status of Actions

NRC studied the need for a separate office that could be viewed as an additional representative of the public interest in nuclear safety. In addition, the Agency committed to consider a pilot program for intervenor funding.

Subsequently, NRC established a limited program of intervenor funding that consisted of providing intervenors to NRC proceedings with copies of hearing transcripts. Congress responded by including in our appropriations legislation every year, beginning in 1981, a provision that bars the Agency from paying the expenses of, or otherwise compensating, intervenors in Agency proceedings. Because of NRC's open regulatory process and the opportunities for public involvement, an Office of Hearing Council was judged not to be needed.

A.10.f Resolve Open Licensing Issues by a Given Deadline

Presidential Commission Recommendation

Any specific safety issue left open in licensing proceedings should be resolved by a deadline.

Status of Actions

In 1979, NRC agreed that plant-specific safety issues left open at the time of licensing had to be resolved by deadlines incorporated as conditions in each license. This practice continues.

NRC also agreed to consider whether each operating license should be conditioned with deadlines for resolution and implementation of the Unresolved Safety Issues (USI) applicable to each plant design. Although such license conditions were not subsequently put in force, the Agency took a number of steps to assure that plants licensed pending resolution of USIs and other generic issues provide adequate protection to public health and safety. Even before the report of the Presidential Commission, Congress required that NRC submit a plan, including timetables, for the resolution of USIs (PL 95-209, Sec. 210, December 13, 1977). As USIs are resolved, deadlines for plant-specific implementation of the resolutions are established (for example, the new "station blackout" rule, 10 CFR 50.63). Pending resolution of these issues, NRC has carefully evaluated whether current regulations provide adequate protection in the light of these issues (see NUREG-0649), and the NRC staff's Safety Evaluation Report for each plant under construction carefully considers the impact on that plant of each USI.

As to future plants, it is NRC policy, as expressed in its Policy Statement on Severe Reactor Accidents (50 Federal Register 32138, August 8, 1985), that any new design must incorporate design-specific resolutions of all the technically applicable USIs and medium- and high-priority generic issues. The draft final rule on standardization and one-step licensing incorporates this policy as a requirement for all applicants for design certification and combined licenses.

A.11 and A.11.a Increase Emphasis on Systematic Evaluation of Operating Plants and on Inspection and Enforcement

Presidential Commission Recommendation

The Agency's inspection and enforcement functions must receive increased emphasis and improved management, including the following elements:

There should be an improved program for the systematic safety evaluation of currently operating plants in order to assess compliance with current

requirements, to assess the need to make new requirements retroactive to other plants, and to identify new safety issues.

Status of Actions

At the time of the accident at TMI-2, NRC had in place the Systematic Evaluation Program (SEP). The SEP was initiated by NRC in 1977 to review the designs of older operating nuclear power plants to reconfirm and document their safety. The review provided (1) an assessment of the significance of differences between current technical positions on safety issues and those that existed when a particular plant was licensed, (2) a basis for deciding how those differences should be resolved in an integrated plant review, and (3) a documented evaluation of plant safety.

The review of each plant by the SEP compared the as-built design with current review criteria in 137 separate technical areas. These criteria were defined in Appendix A of NUREG-0820. The review revealed that certain aspects of plant design differed from current criteria. These discrepancies were considered in the integrated assessment of the plant, which consisted of evaluating the safety significance and other factors of the differences identified from current design criteria to arrive at decisions on whether backfitting was necessary for plant safety. To arrive at these decisions, engineering judgment and a limited probabilistic risk assessment study were used.

From 1982 through 1984, NRC issued reports NUREG-0820 through NUREG-0828 to document the SEP review and recommendations for 9 of the 10 subject plants. (NUREG-0829 for the last SEP plant was issued in 1986 after a lengthy plant shutdown.) NRC distilled the experience gained from the SEP and concluded that there were 27 technical areas where most of the plants reviewed deviated in some manner from current acceptance criteria. The final SEP phase was to evaluate all plants against these 27 technical areas.

In 1980, Congress enacted Public Law 96-295 (the NRC Authorization Bill for Fiscal Year 1980). Section 110 of that law required that NRC develop a program for the systematic safety evaluation of operating reactors. The program proposal would have extended the SEP to require licensees to compare their plant design to the acceptance criteria in NRC's "Standard Review Plan" (NUREG-0800). That program was not implemented for operating reactors. Instead, the Commission determined, and the Congress agreed, that the scope of the program was too broad to evaluate the safety of operating reactors efficiently. Congress later specified in subsequent authorization bills that funds should not be spent to implement that program. However, those activities were useful in that they focused attention on the needs and difficulties associated with the systematic safety evaluation of operating reactors as they relate to a constantly changing technology and the increasing scope of regulatory requirements.

Following the accident at TMI-2, NRC developed the TMI Action Plan (NUREG-0660) from the safety lessons learned. The TMI Action Plan identified a large number of corrective actions to be implemented by operating plants. In 1981, NRC senior management officials became concerned that the many new TMI-related requirements that had been identified were being implemented in a fashion that could adversely affect safety at the operating plants. They concluded that an improved process was needed for ranking and imposing new requirements. The

Commission addressed this concern by creating in October 1981 the Committee to Review Generic Requirements (CRGR). The CRGR imposed a disciplined review of all new generic requirements. This new process provided for a more orderly and thorough assessment of the relative safety significance and/or cost benefit of new generic requirements identified (1) to assure the expeditious implementation of improvements needed for safety, and (2) to more effectively apply the limited resources of both operating plant licensees and NRC in implementing improvements not required for adequate safety but which significantly reduce risk in operating plants. Analogous procedures for plant-specific actions were also developed and implemented by issuance of NRC Manual Chapter 0514. In 1985, the Commission approved a new rule for control of backfitting, 10 CFR 50.109, to codify the improved backfit control process which by that time had proven effective in practice.

The TMI Action Plan also initiated the Interim Reliability Evaluation Program (IREP) in which plant-specific probabilistic risk assessment (PRA) studies were to be performed to supplement the experience in NRC's "Reactor Safety Study" (WASH-1400).

One of the most significant conclusions drawn from SEP and IREP is that issues related to the safety of nuclear power plants can be implemented more effectively and efficiently in an integrated, plant-specific review. In addition, the experience learned from SEP served to focus on the set of current licensing criteria which should be evaluated for operating plants. Experience from IREP has defined the methodology used to conduct a plant-specific PRA so that consistent, comparable results can be obtained to enhance an integrated plant safety assessment.

Historically, licensing issues have been evaluated generically and guidelines for any necessary corrective actions have been applied uniformly to all plants. Although this approach has provided an effective means to ensure resolution of these issues, the generic implementation has not given sufficient attention to plant-specific characteristics that have a direct bearing on the appropriateness of the corrective action and the relative importance of the issue in relation to an overall plan for any necessary plant improvements. In some cases, focusing on plant-specific characteristics identified alternative corrective actions to provide an equivalent or greater measure of safety, often at less cost to a licensee.

Consequently, NRC initiated a pilot program in 1985 to conduct integrated assessments of two operating reactors using the combined experience of SEP and IREP. Called the Integrated Safety Assessment Program (ISAP), it was intended to be comprehensive in that it consisted of deterministic, probabilistic, and operating experience evaluations of operating nuclear power plants. The issues raised during the evaluation were integrated with all pending licensing actions, unresolved generic issues, and licensee-initiated plant improvements. The final outcome of ISAP was an integrated implementation schedule for these issues, which would be updated periodically using the ISAP methodology documented in the licensee's operating license.

In 1987 and 1988, NRC reviewed the ISAP pilot program experience in order to develop a comparable program for all operating power reactors. The benefits of the ISAP pilot program included: (1) finding common elements in separate review

areas and proposing a single integrated resolution; (2) addressing pending requirements on a plant-specific basis; (3) dropping issues from further consideration because of low safety significance; and (4) implementing plant modifications having high safety significance on an expedited schedule.

Integrated Safety Assessment, the follow-on to ISAP, was incorporated as an option for licensees into NRC's Severe Accident Program Individual Plant Examination (IPE, Generic Letter 88-20).

A.11.b Establish a Program for the Systematic Assessment of Experience in Operating Reactors

Presidential Commission Recommendation

There should be a program for the systematic assessment of experience in operating reactors, with special emphasis on discovering patterns in abnormal occurrences. An overall quality assurance measurement and reporting system based on this systematic assessment shall be developed to provide: (1) a measure of the overall improvement or decline in safety, and (2) a base for specific programs aimed at curing deficiencies and improving safety. Licensees must receive clear instructions on reporting requirements and clear communications summarizing the lessons of experience at other reactors.

Status of Actions

NRC agreed strongly with this recommendation. As a result, a number of significant organizational and program requirements were modified to establish a systematic and comprehensive process to collect, assess, and disseminate operational experience.

In mid-1979, NRC established the Office for Analysis and Evaluation of Operational Data (AEOD) to initiate a broad, coordinated program within major NRC program offices to assess operating experience. This was one of the Commission's earliest major steps toward improving the use of licensee operating experience to identify and resolve problems with potential safety-related implications. AEOD's focus and role are to provide a strong capability for the analysis of operating experience, independent of the routine regulatory activities associated with licensing, inspection and enforcement, and to disseminate the lessons learned to NRC, the nuclear industry (domestic and international), and the public. AEOD serves as a focal point for interaction with outside and foreign organizations performing similar work.

By 1989, AEOD had grown to encompass additional responsibilities for the incident response, investigation, and diagnostic evaluation programs, plus the agency's Technical Training Center. These areas all relate to assessing operating experience and applying the lessons learned.

Some of the major accomplishments of AEOD since 1979 include:

1. Feedback of lessons learned from operating experience through the issuance of 35 case studies, 180 engineering evaluations, 24 special studies, and 117 technical reviews. Case studies such as those on motor-operated valve problems, air system problems, and loss of the decay heat removal function resulted in considerable activity by NRC and licensees to assure the

safety of operations. These documents are widely disseminated to NRC offices, industry, and to the public.

2. Codification of the reporting requirements for events that expanded the scope and content of reporting for safety-related events, while eliminating the reporting of events of lesser importance, to better focus regulatory actions. These revised requirements (10 CFR 50.73) were clearly communicated to licensees in a series of documents (NUREG-1022 and Supplements 1 and 2) and discussed in a number of workshops.

3. Assessment of trends and patterns of operational experiences, such as rapid plant shutdowns, engineered safety system actuations, technical specification violations, and safety system failures. Focus is routinely placed on data from individual plants, from the industry as a whole, and from specific vendors. Abnormal plant occurrences are reported quarterly to Congress. In addition, special focus is devoted to trends from new plants (that is, those with less than 24 months of operational experience), with the feedback of lessons learned provided to subsequent new plants and plants resuming operations after extended outages.

4. Use of a new technique for storing and retrieving the information reported in Licensee Event Reports (that is, the coding of the sequences of occurrences that constitute an event), as well as development of specialized data bases for trends and patterns and performance indicators. These actions improve the Commission's ability to identify areas warranting regulatory attention and also provide a measure of the industry's overall improvement or decline.

5. Increased assessment of foreign operating experience and initiation of actions to enhance or assure the safety of operations for U.S. reactors. Also, active participation in the creation and implementation of international incident reporting systems, including major contributions from U.S. experience to the world wide base of information.

6. Investigation of events at operating plants that are most significant to safety using a team evaluation approach, including complete reports of findings on incidents and their root causes. Three such team investigations have been conducted to date.

7. Diagnostic evaluations of licensee performance in a safety-related framework to identify the root causes of performance adversely affecting plant safety. Four such evaluations have been conducted to date, with the lessons learned being made available to others and corrective actions implemented as appropriate by the various parties involved (for example, the licensee, the NRC regional office, or the program office).

In addition to AEOD activities, significant attention and resources were directed by other NRC offices, notably the Office of Nuclear Reactor Regulation and the Regions, on the review and assessment of operating events. The immediate notification reports (10 CFR 50.72) are carefully reviewed daily and weekly to identify potential generic concerns and significant plant-specific items requiring additional regulatory attention and followup. This effort is coordinated within the Agency and its results are incorporated into the longer-range studies conducted by AEOD. Additionally, the overall performance trends and adequacy of event followup and problem resolution are evaluated as

part of the Systematic Assessment of Licensee Performance (SALP) process. These periodic SALP reports provide an overall perspective and rating of operating plants in seven functional areas approximately every 15 months.

Industry has also initiated responsive actions. A Nuclear Safety Analysis Center has been established to conduct systematic reviews of available plant event reports and data; to identify possible precursor events, trends, and problem areas; to perform failure analyses; and follow up with utilities on identified problem areas. The electric utility industry has established an Institute of Nuclear Power Operations, whose charter includes review of nuclear power operating experiences for analysis and feedback to utilities; incorporation of lessons learned from such reviews into training programs; and coordination of reporting and analysis with other organizations. Each reactor manufacturer also improved its programs for review and feedback of operating experience to enhance operational safety and plant availability and to integrate their programs with those of other organizations.

The Commission's increased attention to the systematic assessment and feedback of lessons learned from operating experience, plus increased emphasis on implementing actions to lessen the recurrence of such events, has undoubtedly contributed to recent trends indicating industry-wide improvements. The trends show decreases in the frequency of rapid reactor shutdowns and some other reportable occurrences and marked improvements in on-line performance.

A.11.c Assess Substantial Penalties for Licensee Failures to Report Safety Information

Presidential Commission Recommendation

The agency should be authorized and directed to assess substantial penalties for licensee failure to report new "safety-related" information or for violations of rules defining practices or conditions already known to be unsafe.

Status of Actions

NRC agreed with this recommendation. At the time of the Three Mile Island accident, NRC's authority to impose civil penalties was limited by the Atomic Energy Act to $5,000 per-violation-per-day, with a maximum penalty of $25,000 for all violations within a 30-day period. The Atomic Energy Act of 1954 was subsequently amended at NRC's request to provide civil penalties of up to $100,000 per-violation-per-day without any maximum cap.

In addition to increasing the statutory amount of a civil penalty, the Commission has adopted an enforcement policy. At the time of the accident, the staff had developed enforcement guidance, but the Commission had not expressly approved the guidance. In 1980 the Commission promulgated "Policy and Procedure for Enforcement Action," which has since been periodically updated to reflect experience in applying the policy, and is codified at 10 CFR Part 2, Appendix C, of the Commission's regulations. The policy provides guidance on characterizing the severity of a range of violations by providing examples in eight subject areas, including plant operations, transportation, health physics, safeguards, and emergency planning. The policy also provides guidance on when to issue a citation, a civil penalty, or an order, and on important factors to include in

assessing a penalty, including who identified the violation, the extensiveness of corrective actions, any relevant prior performance, prior notice of the potential for a violation, number of examples involved, and duration of the violations. Applying these factors results in higher civil penalties for poor performance and, conversely, reduces penalties for licensees who promptly identify and correct violations. The failure of licensees to report violations and not respond to potential safety conditions may result in civil penalties.

Civil penalties have increased since the TMI-2 accident both in the number of actions and in the amounts of penalties. For example, NRC issued four penalties totaling $58,000 for reactors in 1977, while issuing 52 penalties totaling $3,585,500 in 1987.

A.11.d Improve Auditing and Conduct Unannounced Inspections of Licensees

Presidential Commission Recommendation

The Agency should be directed to require its enforcement personnel to perform improved inspection and auditing of licensee compliance with regulations and to conduct major and unannounced onsite inspections of particular plants.

Status of Actions

NRC inspection and enforcement activities have been significantly expanded, strengthened, and made more aggressive since the TMI-2 accident. Over the past decade, Resident Inspectors (RIs) have been located at all reactor sites. In fact, most sites have more than one RI. The RIs are the eyes and ears of the Agency, alerting NRC and plant personnel to possible emerging safety problems, in addition to providing assurance that NRC regulations are being strictly observed. Further, the inspection and auditing of licensing activities have been greatly expanded by the use of team inspections. Finally, NRC has shifted its enforcement function into a separate Office of Enforcement.

The use of inspection teams made up of members from various disciplines have strengthened onsite plant inspections to evaluate the effectiveness of licensee programs and systems. NRC has instituted a variety of team inspections at nuclear power plants, including:

1. Safety System Functional Inspection (SSFI) - An in-depth engineering review of the design configuration, maintenance, testing, and operation of reactor systems, their components, and their supporting systems. The inspection is performed by making a "vertical slice" review of a particular safety system and following the potential generic significance of the findings to other plant systems.

2. Safety Systems Outage Modifications Inspection (SSOMI) - An in-depth engineering examination of system functionality, oriented toward the safety impact of modifications that are made to safety systems during a particular plant outage. This inspection focuses on how the modifications have altered the original design considerations and safety margins, on observations of the quality of the installation work on the modified systems, and on the adequacy of full functional testing of the modified systems.

3. Operational Safety Team Inspection (OSTI) - An in-depth review of plant operational programs, including maintenance, operations, surveillance testing, corrective actions, management oversight, and safety review. The inspection typically includes about 72 hours of round-the-clock in-plant coverage, with emphasis on observation of control room operations and surveillance activities. If appropriate, some aspects of the SSFI inspection may be added to the scope of this inspection.

4. Operational Readiness Assessment (ORA) - A formal assessment of the licensee's readiness to operate a nuclear power plant. It is a comprehensive evaluation of the licensee's program for design, construction, and pre-operational activities, so that issues and problems are identified in a timely manner.

5. Emergency Operating Procedures (EOP) Team Inspection - An integrated regional and Office of Nuclear Reactor Regulation team inspection of a licensee's EOPs to determine if they are technically correct and can be performed in the plant by the staff. EOP team inspections have been completed for 26 plants. The results are being reviewed to determine the extent to which additional inspection resources should be expended on this effort and to determine the need for updating EOP guidance to the licensees.

6. Regulatory Effectiveness Review (RER) - A program conducted by the staff with the assistance of U. S. Army Special Forces personnel to evaluate the practical effectiveness of physical security measures at operating reactors. The program includes challenges to the licensee's physical security system.

7. Augmented Inspection Team (AIT) - A systematic and thorough inspection of a significant operational event. The purpose of an AIT is to diagnose a specific event to determine the cause(s), conditions, and circumstances relevant to that event and to communicate findings, safety concerns, and recommendations to NRC management.

8. Incident Investigation Team (IIT) - A team composed of technical experts who have not had previous significant involvement with licensing and inspection activities at the specific plant investigated. The team is led by a senior NRC manager and performs detailed investigations of significant operational events. The team reports directly to NRC's Executive Director for Operations (EDO) and is independent of regional and headquarters' office management.

9. Diagnostic Evaluation Team (DET) - The Diagnostic Evaluation Program described in NRC Manual Chapter 0520 is used as directed by the EDO in implementing a diagnostic evaluation of a few selected licensed reactor facilities each year. When used, the Diagnostic Evaluation Team effort is incorporated into the regional office's site-specific inspection plan and serves to complement the overall reactor inspection program. The DET provides for an independent, multi-discipline followup evaluation of NRC management-identified issues at licensed reactor facilities. It consists of an in-depth technical and management review associated with identified or perceived areas of concern, with emphasis placed on root cause determinations for identified weaknesses or problem areas. The overall goal of a DET is to improve licensee performance and public health and safety.

10. Maintenance Team Inspection (MTI) - This inspection is part of the Mandatory Team Inspection program within the Fundamental Inspection Program in which a specific subject area is selected as the focus for team inspection. The program is currently being performed once at each site. The Maintenance Team Inspections focus on all elements of the licensee's organization involved in supporting or conducting plant maintenance. It is intended to assess overall corporate management practices and their effectiveness in ensuring safe nuclear operations.

As a general policy, NRC continues to conduct unannounced inspections by region-based and onsite Resident Inspectors. Inspection Manual Chapter (IMC) 0300, "Unannounced Inspections," was issued on January 1, 1983, to describe the NRC policy concerning unannounced inspections. In this regard, NRC has recently modified its regulations (10 CFR 50.70) to strengthen its ability to conduct effective unannounced inspections. However, with the advent of performance-based specialized and mandatory team inspections, the licensee is usually made aware of team inspections in advance of the actual inspection, so that licensee personnel will be available to respond to team members for their specific areas of interest. Performance-based team inspections go into a greater level of detail and involve more inspection personnel than either resident or regional routine inspections. Therefore, it is more efficient, from a time and cost perspective, to ensure the availability of licensee information and personnel by notifying the licensee in advance of the actual team inspection. IMC 0300 is currently being revised to reflect this change in inspection policy.

A.11.e Conduct Intensive Reviews of Licensee Performance

Presidential Commission Recommendation

Each operating licensee should be subject periodically to intensive and open review of its performance according to the requirements of its license and applicable regulations.

Status of Actions

Following the TMI accident, NRC focused attention on the importance of sound corporate and plant management. Subsequently, the Agency undertook a more aggressive approach to evaluating licensee performance. In 1980, NRC initiated its program of Systematic Assessment of Licensee Performance (SALP). SALP is an integrated Agency effort to collect and analyze available Agency insights, data, and other information about a plant in a structured manner in order to assess and better understand the reasons for a licensee's performance. The SALP program is a mechanism to assess the quality of licensee activities and the degree to which a licensee is committed to superior performance.

Under this program, each operating nuclear power plant is assessed approximately every 15 months in seven specific functional areas:

- Plant operations
- Radiological controls
- Maintenance and surveillance
- Emergency preparedness
- Physical security

- Engineering and technical support
- Safety assessment and quality verification

For example, the engineering and technical support organizations are carefully assessed to assure that their activities are involved with the operations staff, and that coordination and resources are adequate to identify and resolve problems affecting plant operations.

Following issuance of NRC's SALP assessment, a meeting is held with the licensee's management to discuss it. These meetings are open to State and local government officials and members of the public.

Additionally, NRC established a Diagnostic Evaluation Program to conduct in-depth probes of performance at selected plants. Greatly expanded team inspections have analyzed such areas as engineering, system functional capability, emergency operating procedures, and plant maintenance. The NRC inspection program is now performance-oriented as well as safety-oriented, and diagnoses how well licensees are operating their nuclear plants.

In order to provide a more objective measure of licensee performance, NRC instituted a Performance Indicator Program in 1986 as another tool for assessing the performance of each operating reactor. These indicators supplement information about licensee performance from other sources. Taken together, they help NRC assess the direction and level of effectiveness of its regulatory programs.

To integrate the results of these assessment programs, senior NRC managers began holding semiannual meetings in 1986 to analyze those plants identified as, or perceived to be, poor performers. As a result of these meetings, plants are singled out for additional regulatory attention. Their top managers are then informed of this significant level of NRC concern. This process and resulting licensee action have produced positive results in plant performance.

A.11.f Adopt Criteria for Revocation of Licenses, Sanctions, and Immediate Plant Shutdowns

Presidential Commission Recommendation

The agency should be directed to adopt criteria for revocation of licenses, sanctions short of revocation such as probationary status, and kinds of safety violations requiring immediate plant shutdown or other operational safeguards.

Status of Actions

The Commission has approved a specific enforcement policy that includes guidance on when to issue a citation, a civil penalty, or an order. An order, for example, would normally be the mechanism to effect an immediate plant shutdown because of operational safety concerns. (See also Section A.11.c.)

Through experience, NRC has found that additional criteria beyond those contained in the enforcement policy and associated procedures are not needed. Enforcement actions involving the entire range of sanctions are routinely taken on the basis of specific plant conditions and situations. Additionally, enforcement actions, along with Systematic Assessment of Licensee Performance

(SALP) findings, performance indicators, and results of inspections are considered at semiannual meetings of senior NRC managers to identify poor performance and to determine which plants should have increased inspection and regulatory resources. In between these meetings, orders and Confirmatory Action Letters are issued when necessary to assure that only plants that provide reasonable assurance of safe operations continue to operate.

Further, a separate Office of Enforcement has been established to manage the NRC enforcement program. The staffing associated with enforcement has substantially increased since the TMI-2 accident. Senior regional and Office of Nuclear Reactor Regulation management personnel are regularly involved in enforcement actions to assure consistent Agency-wide decisions. Enforcement is an essential regulatory tool that is routinely used to improve compliance with safety requirements.

B. RECOMMENDATIONS FOR THE UTILITY AND ITS SUPPLIERS

B.1 and B.1.a Change Safety Attitudes and Establish Specific Safety Standards

Presidential Commission Recommendations

To the extent that the industrial institutions we have examined are representative of the nuclear industry, the nuclear industry must dramatically change its attitudes toward safety and regulations. The Commission has recommended that the new regulatory Agency prescribe strict standards. At the same time, the Commission recognizes that merely meeting the requirements of a government regulation does not guarantee safety. Therefore, the industry must also set and police its own standards of excellence to ensure the effective management and safe operation of nuclear power plants.

The industry should establish a program that specifies appropriate safety standards including those for management, quality assurance, and operating procedures and practices, and that conducts independent evaluations. The recently created Institute of Nuclear Power Operations, or some similar organization, may be an appropriate vehicle for establishing and implementing this program.

Status of Actions

In the years since the Presidential Commission, the industry has taken steps to upgrade its programs that specify appropriate safety standards for management, quality assurance, operations, and independent evaluations. The industry's Institute of Nuclear Power Operations (INPO), whose charter includes review of nuclear power operating experiences for analysis and feedback to utilities, incorporation of lessons learned from those reviews into training programs, and coordination of reporting and analysis with other organizations, has been especially active in the areas of operations, maintenance, and training. The industry also has established a Nuclear Safety Analysis Center to systematically review plant event reports and data, identify precursor events, perform failure analyses, and follow up with utilities on identified problem areas. A statement of understanding between INPO and NRC was signed, and both organizations are working independently with the common objective of improving nuclear plant safety.

NRC has upgraded its requirements for licensee technical and management support capabilities; operator qualification and training; licensed operators on shift; and for use of the quality assurance function. NRC certainly agrees that there is a continuing need for a high degree of safety awareness within NRC and at every nuclear power plant to assure that the public will be protected. Nuclear power demands diligence and vigilance, a high degree of discipline, and a professional and systematic approach. Although there have been noteworthy improvements in the operating record of the industry, vigilance and attention to safety must continue.

B.1.b Review Operating Experience

Presidential Commission Recommendation

There must be a systematic gathering, review, and analysis of operating experience at all nuclear power plants coupled with an industry-wide international communications network to facilitate the speedy flow of this information to affected parties. If such experiences indicate the need for modifications in design or operation, such changes should be implemented according to realistic deadlines.

Status of Actions

Both NRC and the industry strongly agreed with this recommendation. As a result, extensive efforts have been made to systematically collect and assess feedback and to act on the lessons of experience.

One of the earliest actions taken by the Commission in response to the TMI accident was the establishment of the Office for Analysis and Evaluation of Operational Data (AEOD) within NRC. AEOD reviews and evaluates operating experience to identify (1) significant events and their associated safety concerns and root causes, (2) trends and patterns revealed by these significant events, (3) the adequacy of corrective actions taken to address safety concerns, and (4) the generic applicability of these events and concerns to other nuclear power plants.

AEOD, other NRC offices, and the industry have continued to place a high priority on ensuring that operational events are thoroughly understood -- particularly with regard to root causes -- and communicating the lessons of these events to all users of nuclear power, both foreign and domestic, who may experience similar conditions. Weaknesses in design, fabrication, and construction continue to be identified through the study of operating experience. These findings, coupled with the results from probabilistic risk assessment (PRA) and other analytical safety analyses, have led to major improvements in reliability and overall plant safety.

Systematic programs to review operating experience have also been established by industry organizations, including the Institute of Nuclear Power Operations, the reactor vendors, the Electric Power Research Institute, and owners' groups. These efforts, together with NRC's programs, constitute a comprehensive industry-wide system for the dissemination of operating experience. Moreover, cooperative international activities continue to provide enhanced knowledge of safety concerns identified from operating experience. The International Atomic Energy Agency and the Nuclear Energy Agency have expanded programs in the generic analysis of operating experience. NRC is an active participant in these cooperative international efforts.

In addition, NRC has required each licensee to establish an engineering staff capability to assess and report pertinent operating experience. It is NRC's intent that its assessment programs, and those of industry groups, and vendors will be complemented by and integrated with each licensee's program to assure that operating experience is available, analyzed, documented, and understood by the reactor operators and plant technical support staff.

B.2 Conduct Independent Reviews of Plant Operational Activities

Presidential Commission Recommendation

Although the Commission considers the responsibility for safety to be with the total organization of the plant, we recommend that each nuclear power plant company have a separate safety group that reports to high-level management. Its assignment would be to evaluate regularly procedures and general plant operations from a safety perspective; to assess quality assurance programs; and to develop continuing safety programs.

Status of Actions

NRC agreed that there was a need for an independent safety review group that would assess plant operational activities to assure that they are conducted in accordance with requirements for safety.

As a result, for operating licenses issued after the TMI-2 accident, NRC required an onsite independent safety engineering group (ISEG) be established to perform independent reviews of plant operations. Their principal function is to examine plant operating characteristics, NRC issuances, licensing information service advisories, and other appropriate sources of plant design and operating experience information that may indicate areas for improving plant safety. The ISEG performs independent reviews and audits of plant activities, including maintenance, modifications, operational problems, and operational analysis, to aid the establishment of programmatic requirements for plant activities. The ISEG develops and presents detailed recommendations to corporate management for such things as revised procedures and equipment modifications. It also maintains surveillance of plant operations and maintenance activities to provide independent verification that these activities are performed correctly and that human errors are reduced as far as practicable.

B.3 and B.3.a Upgrade Management and Technical Qualifications for Design, Construction, Operation, and Emergency Response Capabilities

Presidential Commission Recommendation

Integration of management responsibility at all levels must be achieved consistently throughout this industry. Although there may not be a single optimal management structure for nuclear power plant operation, there must be a single accountable organization with the requisite expertise to take responsibility for the integrated management of the design, construction, operation, and emergency response functions, and the organizational entities that carry them out. Without such demonstrated competence, a power plant operating company should not qualify to receive an operating license.

These goals may be obtained at the design stage by (1) contracting for a "turn-key" plant in which the vendor or architect-engineer contracts to supply a fully operational plant and supervises all planning, construction, and modification; or (2) assembling expertise capable of integrating the design process. In either case, it is critical that the knowledge and expertise gained during design and construction of the plant be effectively transferred to those responsible for operating the plant.

Status of Actions

There was strong agreement with the major point of this recommendation. NRC believes that the utility-licensee, as the single accountable organization, must have the requisite expertise to take responsibility for the integrated management of the design, construction, operation, and emergency response functions.

Under new criteria, NRC reviews the corporate-level management and technical organizations of each utility and its major contractors, including the nuclear steam supply system vendor and architect/engineer for each plant. The technical resources available to support the nuclear power plant design, construction, testing, and operation are also assessed. The utility's emergency planning and response capability are evaluated for conformance to NRC regulations.

The objective is to assure that the corporate management is involved with, informed about, and dedicated to the safe design, construction, testing, and operation of the nuclear plant and that sufficient technical resources have been, are, and will be provided to meet the objectives.

Because there have been no recent commitments to new nuclear plant construction, utilities have not had the opportunity to contract for a "turn-key" plant, or to assemble expertise capable of integrating the design process. However, there are advanced, standardized light-water reactor designs in progress that are being reviewed by NRC. The utilities, in cooperation with the Electric Power Research Institute, are preparing a list of design requirements for future standard nuclear power plant designs.

B.3.b and c Establish Clearly Defined Roles and Responsibilities for Both Operating Procedures and Emergency Procedures

Presidential Commission Recommendation

Clearly defined roles and responsibilities for operating procedures and practices must be established to ensure accountability and smooth communication.

Since, under our recommendations, accountability for operations during an emergency would rest on the licensee, the licensee must prepare clear procedures defining management roles and responsibilities in the event of a crisis.

Status of Actions

NRC agreed strongly with the Presidential Commission recommendation concerning the need for clearly defined roles and responsibilities. With respect to operating plants, licensees were required by January 1, 1980, to review and revise their practices to provide for definitive and clearly articulated operations command responsibilities and improved administrative procedures and controls (to support the command function) for both normal and emergency conditions.

Specifically, the licensee's safety analysis report (SAR) is to describe the operating procedures that will be used by the operating organization (plant

staff) to assure that routine operating, off-normal, and emergency activities are conducted in a safe manner. The SAR also is to include the structure, functions, responsibilities, and authorities of the onsite organization established to operate and maintain the plant.

Applicants and licensees are also required to provide specific information in their SARs in the form of an organization chart that shows the title of each position, the minimum number of persons assigned to certain positions, the number of operating shift crews, and the positions for which Reactor Operator and Senior Reactor Operator licenses are required. A description of the functions, responsibilities, and authorities of important plant positions is required. The applicant/licensee is required to describe positions that require interactions with offsite personnel or positions that are identified in the SAR. These descriptions must include defined lines of reporting responsibilities as well as functional or communication channels, the line of succession of authority and responsibility for station operations in the event of unexpected contingencies, and the delegation of authority that may be granted to operators and shift supervisors. (Emergency operating procedures are discussed in Sections B.5.a, b, and c of this report. Emergency exercises are discussed in Sections E and F.)

To further reduce the risk associated with severe accidents, NRC is developing an Accident Management Program aimed at promoting the most effective use of existing equipment and resources to prevent and mitigate severe accidents. The program is expected to provide a framework for evaluating information developed through conduct of the Individual Plant Examinations, for preparing and implementing severe accident operating procedures, and for training operators and managers in these procedures. Also, a reassessment of roles and responsibilities for decisionmaking during emergencies will provide added assurance that lines of authority and communications, responsibilities for key decisions, and authority and criteria for procedural overrides and equipment modifications during an emergency are clear and well established.

B.4 Increase Operator Qualifications

Presidential Commission Recommendation

It is important to attract highly qualified candidates for the positions of senior operator and operator supervisor. Pay scales should be high enough to attract such candidates.

Status of Actions

NRC agreed that it is important to attract highly qualified candidates for the positions of senior operator and operator supervisor and that pay scales should be high enough to attract such candidates.

As an initial action, NRC imposed more stringent training requirements for an NRC senior operator's license. At the same time, the Agency increased the scope and passing criteria for the NRC licensing examination. Utilities were thus required to recruit more highly qualified applicants in order for these

applicants to be successful in obtaining an NRC senior operator's license. NRC has also encouraged utilities to recruit and license degreed engineers by allowing utilities to combine the position of Shift Technical Advisor (STA) with that of a shift Senior Reactor Operator (SRO), if the SRO possesses an appropriate degree.

B.5 and B.5.a, b and c Emphasize the Review and Evaluation of Plant Procedures and Improve Operating and Emergency Procedures

Presidential Commission Recommendation

Substantially more attention and care must be devoted to the writing, reviewing, and monitoring of plant procedures.

The wording of procedures must be clear and concise.

The content of procedures must reflect both engineering thinking and operating practicalities.

The format of procedures, particularly those that deal with abnormal conditions and emergencies, must be especially clear, including clear diagnostic instructions for identifying the particular abnormal conditions confronting the operators.

Status of Actions

NRC agreed with these recommendations. Following the TMI accident, NRC established requirements for licensees to upgrade the adequacy of plant procedures, focusing first on emergency operating procedures (EOP). These requirements, specified in Generic Letter 82-33, "Supplement 1 to NUREG-0737 - Requirements for Emergency Response Capability," were issued in December 1982. Since then, the industry and NRC have improved nuclear power plant procedures, especially emergency procedures.

In the early 1980's, the four nuclear steam supply system vendors and their respective owners' groups, applicants and licensees, reanalyzed plant transients and accidents and developed technical or engineering bases for plants to prepare upgraded procedures. The upgraded, or symptom-based, procedures differed from those used during TMI, which relied on the operator first diagnosing an event and then selecting the correct procedure to use. Symptom-based procedures focus the operator's attention instead first on maintaining the plant in a stable and safe condition, and then on diagnosing the specific event or failure.

While industry was revising the technical basis for emergency operating procedures, NRC was developing its long-term plan for upgrading all plant procedures. In response to the need for devoting attention to the human factors component in nuclear power plant operations, in August 1982 NRC issued NUREG-0899, "Guidelines for the Preparation of Emergency Operating Procedures," the initial product of its long-term human factors plan for upgrading plant procedures. This document provided the industry with human factors guidelines for preparing, revising, and maintaining procedures and for training operators in their use.

To further upgrade procedural formats, NRC recently issued a report to the industry that provides techniques for preparing EOPs in a flowchart format, a presentation style demonstrated to have several advantages over the more traditional text format. The Institute of Nuclear Power Plant Operations (INPO) also produced several guidance documents on procedure preparation.

The staff's approach to resolving technical concerns regarding the adequacy of EOPs has been to conduct an onsite inspection involving reviews of the simulator and procedures and a walkdown inspection of the plant.

Since the initial implementation of this upgrading process, all plants, except Browns Ferry, Units 1, 2, and 3, and Fort St. Vrain, have submitted procedure-upgrade plans to the NRC. (Browns Ferry Units 1, 2, and 3 are in long-term shutdown and the Fort St. Vrain licensee has notified NRC that it plans to permanently shut down Fort St. Vrain in 1990.)

As a follow-up to its long-term program for upgrading plant procedures, NRC began inspecting emergency operating procedures at all operating plants in 1986. The focus of these inspections is to verify their technical correctness, the ability of operators to implement them, and the adequacy of the technical and format guidance for their preparation to ensure that licensees are developing and implementing EOPs of suitable quality.

In addition to its efforts to upgrade EOPs, the staff has examined problems associated with other procedures, such as those for normal and abnormal operations and maintenance. As a result of these studies, the staff has issued reports such as "Development, Use and Control of Maintenance Procedures in Nuclear Power Plants: Problems and Recommendations" (NUREG/CR-3817) and "Study of Operating Procedures in Nuclear Power Plants: Practices and Problems" (NUREG/CR-3968) that provide guidance for improving other plant procedures.

Through the combined efforts of NRC, the Advisory Committee on Reactor Safeguards Subcommittee on Human Factors, and various industry groups, such as INPO and the owners' groups, licensees have received extensive guidance on the preparation of effective procedures. As a result, power plant procedures continue to be significantly upgraded.

B.5.d Diagnose and Resolve Plant Safety Questions Early

Presidential Commission Recommendation

Management of both utilities and suppliers must insist on the early diagnosis and resolution of safety questions that arise in plant operations. They must also establish deadlines, impose sanctions for the failure to observe such deadlines, and make certain that the results of the diagnoses and any proposed procedural changes based on them are disseminated to those who need to know them.

Status of Actions

NRC agreed with the need for utilities to give priority attention to safety questions that arise from plant operations and to the proper dissemination and resolution of such concerns.

Accordingly, licensees were required to prepare procedures to assure that operating information pertinent to plant safety originating both within and outside the utility organization is continually supplied to operators and other personnel and is incorporated into training and retraining programs. The licensees were required to:

1. Provide means to assure that affected personnel become aware of and understand information of sufficient importance that should not wait before being introduced through routine training and retraining programs;

2. Assure that plant personnel not routinely receive extraneous and unimportant information on operating experience in such volume that it would obscure priority information or otherwise detract from overall job performance and proficiency;

3. Provide suitable checks to assure that conflicting or contradictory information is not conveyed to operators and other personnel until resolution is reached; and

4. Provide periodic internal audits to assure that the feedback program functions effectively at all levels.

NRC conducted post-implementation reviews for all plants operating at the time of the TMI-2 accident. Additionally, reviews were conducted as a part of the licensing process for those plants that received an operating license subsequent to the TMI-2 accident.

B.6 Consider the Safety Implications of Rate-Making

Presidential Commission Recommendation

Utility rate-making agencies should recognize that implementation of new safety measures can be inhibited by delay or failure to include the costs of such measures in the utility rate base. The Commission, therefore, recommends that state rate-making agencies give explicit attention to the safety implications of rate-making when they consider costs based on "safety-related" changes.

Status of Actions

NRC agreed with this recommendation and committed to consider further the potential adverse impact that utility rate-making agencies may have on the implementation of new safety measures. This adverse impact may result from the failure of State agencies to include the costs of such measures in the utility rate base.

In 1984 NRC conducted a comprehensive study of utility and public utility commission (PUC) rate-making practices to determine how these might affect nuclear safety concerns. The study included discussions with PUCs and nuclear utilities and a national survey of rate-making practices. The study formed the basis for promulgation by NRC of a new financial qualifications rule affecting its applicants and licensees (49 Federal Register 35747; September 12, 1984). NRC determined in this rulemaking that, other than in exceptional cases, the rate-making process provides adequate funds to utilities for the safe operation of nuclear power plants.

Economic pressure continues on many reactors, primarily as a result of high construction costs and from PUC concerns about the impact of these costs on ratepayers. In many instances, PUCs have disallowed certain construction costs. However, NRC is not aware of any case where there was a shortage of funds to assure safe operation of the facility.

Since 1983 NRC has been studying the possible safety effects of PUC-established economic performance incentives. Such economic performance incentives vary widely from State to State, but typically they provide monetary rewards and penalties for performance above or below established levels. A common measure of performance is capacity factor. If a utility may be inclined to "push" a nuclear unit to a higher capacity factor threshold in order to earn a reward, there could possibly be an effect on plant safety. NRC's response to such possible safety effects has been to express its concerns to the nuclear utility industry and to the PUCs. In the past, NRC has assisted PUCs to assess whether newly formulated performance incentives could have negative safety effects. NRC has published the results of its latest nationwide survey of economic performance incentives in "Incentive Regulation of Nuclear Power Plants by State Public Utility Commissions" (NUREG-1256).

C. RECOMMENDATIONS FOR THE TRAINING OF OPERATING PERSONNEL

C.1 and C.1.a and b Establish Agency-Accredited Training Institutions

Presidential Commission Recommendation

The Commission recommends the establishment of agency-accredited training institutions for operators and immediate supervisors of operators. These institutions should have highly qualified instructors, who will maintain high standards, stress understanding of the fundamentals of nuclear power plants and the possible health effects of nuclear power, and who will train operators to respond to emergencies. (See recommendation A.4.a.)

These institutions could be national, regional, or specific to individual nuclear steam systems.

Reactor operators should be required to graduate from an accredited training institution. Exemption should be made only in cases where there is clear, documentary evidence that the candidate already has the equivalent training.

Status of Actions

Consistent with the Presidential Commission recommendation, a system for national accreditation of all facility licensee training programs for licensed and non-licensed operators was instituted by the Institute of Nuclear Power Operations (INPO). Additionally, the training programs for maintenance technicians (instrumentation and control, mechanical, electrical, chemistry and radiation protection) and technical staff managers are subject to the same accreditation scrutiny. The accreditation process is administered by INPO and monitored by NRC. Further, the NRC staff evaluates, on a sample basis, whether reactor operator candidates have successfully completed the prescribed training program, and assesses the adequacy of the training program through an examination of each candidate.

All licensee operator training programs are accredited. A second round of the accreditation is in progress for all licensee programs to ensure their currency and that they have implemented improvements. The currency and competence of the instructors are a part of the accreditation process. For a facility to receive accreditation it must have implemented what is referred to as performance-based training or the Systems Approach to Training (SAT). The NRC position on performance-based training considers the following five elements essential to these training programs:

1. Systematic analysis of the jobs to be performed,

2. Learning objectives that are derived from the analysis and that describe the performance desired after training,

3. Training design and implementation that are based on the learning objectives,

4. Evaluation of trainee mastery of the objectives during training, and

5. Evaluation and revision of the training based on the performance of trained personnel in the job setting.

Finally, all licensees are members of the National Academy for Nuclear Training, which is responsible for maintaining the high standards associated with the accreditation process.

C.1.c and d Reaccredit Training Institutes Periodically and Require Candidates to Meet Entrance Requirements

Presidential Commission Recommendation

The training institutions should be subject to periodic review and reaccreditation by the restructured NRC.

Candidates for the training institute must meet entrance requirements geared to the curriculum.

Status of Actions

As noted in other responses, NRC has reviewed the accreditation process and continues to monitor the adequacy and completeness of the training provided through examinations administered to reactor operators. Criteria for operator candidates are included in NRC requirements and are part of the accreditation process.

The Institute of Nuclear Power Operations (INPO) continues to conduct performance-oriented evaluations of training and qualification programs and reviews and reaccredits each facility's training program every 4 years.

C.2 Upgrade Training and Examining of Licensed Personnel

Presidential Commission Recommendation

Individual utilities should be responsible for training operators who are graduates of accredited institutions in the specifics of operating a particular plant. These operators should be examined and licensed by the restructured NRC, both at their initial licensing and at the relicensing stage. In order to be licensed, operators must pass every portion of the examination. Supervisors of operators, at a minimum, should have the same training as operators.

Status of Actions

NRC agreed with this recommendation and, as a result, improvements in training and operator examinations have been implemented through a revised regulation (10 CFR Part 55) effective in May 1987. All licensees are responsible for administering a comprehensive Systems-Approach-to-Training (SAT)-based training program. All applicants for NRC operator licenses must pass all sections of the NRC comprehensive written examination and operating test pursuant to 10 CFR Part 55. Examinations focus on knowledge and abilities in safety-related areas identified through job and task analyses. The passing grade for the written

examination was increased to 80 percent overall and 70 percent for each examination section. Passing grades are based on satisfactory performance in selected operator competencies. Senior Reactor Operators, who are responsible for the supervision of Reactor Operators, receive the reactor operator training plus additional training needed to perform the tasks associated with their increased safety responsibilities.

NRC administers all initial licensing examinations and requires all applicants for license renewal to pass an NRC-administered requalification examination.

C.3 and C.3.a and b Initiate Operator Retraining Programs and Provide Ongoing, Integrated Training

Presidential Commission Recommendation

Training should not end when operators are given their licenses.

Comprehensive ongoing training must be given on a regular basis to maintain operators' level of knowledge.

Such training must be continuously integrated with operating experience.

Status of Actions

NRC agreed with these recommendations and revised training program requirements to place more emphasis on developing and maintaining a high degree of knowledge concerning plant operations and performance, and on relating operator knowledge and skill to operational events at the plant or to events that occurred at similar plants.

Licensees are required by NRC regulations to provide comprehensive training to licensed operators that includes a written examination and an annual operating test to ensure operator currency and competency for the facility for which they hold an NRC license. Requalification programs are a component of the training required for licensing and are based on a Systems Approach to Training (SAT). Requalification programs must not exceed 24 consecutive months and must be followed immediately by another requalification program. These training programs have been substantially revised and upgraded as a part of the SAT process.

Subsequent to the TMI-2 accident, NRC regulations (10 CFR Part 55) were revised to require that all facility licensees have a simulation facility approved for use by NRC or a plant-reference simulator that has been certified to the NRC by the facility licensee. All facilities must be in compliance with this rule by March 1991. Industry is in the process of complying with this rule.

An integral aspect of the simulator training is the reflection of operational events and possible plant conditions in a realistic setting in order to assure that the training is oriented toward operations and provides comprehensive training in the diagnosis of and recovery from possible plant transients.

C.3.c and d Emphasize Diagnosis and Control of Complex Transients and Require Utility Access to a Control Room Simulator

Presidential Commission Recommendation

Emphasis must be placed on diagnosing and controlling complex transients and on the fundamental understanding of reactor safety.

Each utility should have ready access to a control room simulator. Operators and supervisors should be required to train regularly on the simulator. The holding of operator licenses should be contingent on performance on the simulator.

Status of Actions

NRC agreed with this recommendation. In order to assure that a substantial emphasis was placed on diagnosing and controlling complex transients, and to assure realism in operator training programs, simulator training has become an essential and vital component of all reactor operator training programs.

NRC developed a requirement for nuclear power plants licensed by NRC to have a simulation facility appropriate to conduct operator licensing tests. This requirement is included in the revised regulation (10 CFR Part 55) that became effective in May 1987. NRC also developed Regulatory Guide 1.149 which describes an acceptable method of complying with those portions of the regulations regarding certification of a simulation facility, and the applicable requirements set forth in ANSI/ANS Standard 3.5-1985, "American National Standard for Nuclear Power Plant Simulators for Use in Operator Training." This standard identifies functional requirements for control room simulators used for operator training, and specifies the type of operations and malfunctions that the simulator needs to be able to reproduce.

The need to review simulation facilities against the above requirements resulted in the development of NUREG-1258, "Evaluation Procedure for Simulation Facilities Certified Under 10 CFR Part 55." An inspection procedure is also under development to provide further guidance to the NRC staff for implementing the simulation facility evaluation program.

Nearly all facility licensees have now committed to certifying a plant-referenced simulator that demonstrates anticipated plant responses to normal, transient, and accident conditions.

C.4 Improve Simulator Research and Development

Presidential Commission Recommendation

Research and development should be carried out on improving simulation and simulation systems: (a) to establish and sustain a higher level of realism in the training of operators, including dealing with transients; and (b) to improve the diagnostics and general knowledge of nuclear power plant systems.

Status of Actions

NRC agreed with this recommendation and instituted a number of actions to improve simulators and their diagnostic capabilities.

Considerable research and development to improve simulators has occurred over the past decade. Following the TMI accident, initiatives were undertaken to encourage the installation of site-specific simulators at each nuclear plant. This generation of simulators was slightly modified to allow increased flexibility in the training for and display of certain event scenarios.

Industry initiatives to upgrade simulator performance call for utility simulators to be certified to an industry standard by March 1991. The certification criteria are specified in ANSI/ANS-3.5-1985, "Nuclear Power Plant Simulators for Use in Operator Training"; and Regulatory Guide 1.149, "Nuclear Power Plant Simulation Facilities for Use in Operator License Examinations." Related review criteria are contained in NUREG-1258, "Evaluation Procedure for Simulation Facilities Certified under 10 CFR Part 55." These industry initiatives led simulator vendors and other parties to develop computer code enhancements for existing simulators and for those yet to be delivered.

Simulator certification requires a substantial amount of simulator upgrading in most cases, since each simulator must be able to replicate events that have happened at that facility. Thus, more sophisticated simulator modelling has been developed than existed on first-generation simulators. For example, simulator research has resulted in improvements in such areas as engineering computer codes, best-estimate transient analyses, and operator-perceivable changes in simulated parameters. These improvements are expected to be incorporated into future revisions of the ANSI/ANS-3.5 standard.

NRC has acquired through lease-purchase agreements three full-scope reactor simulators which are located at its Technical Training Center (TTC) for training the NRC staff. These simulators are considered typical of first- or second-generation simulators, as contrasted with the third-generation simulators being delivered at this time. NRC has initiated an upgrade of its simulators so that they can be used effectively for advanced training and diagnostic purposes. Additionally, simulator time and the operational expertise of the TTC staff has been made available for simulator research projects associated with simulator evaluation tests, team skills and behavior evaluation, and value-impact assessment of potential upgrades to control room annunciators.

D. RECOMMENDATIONS FOR TECHNICAL ASSESSMENT

D.1 Improve Control Room Design

Presidential Commission Recommendation

Equipment should be reviewed from the point of view of providing information to operators to help them prevent accidents and to cope with accidents when they occur. Included might be instruments that can provide proper warning and diagnostic information; for example, the measurement of the full range of temperatures within the reactor vessel under normal and abnormal conditions, and indication of the actual position of valves. Computer technology should be used for the clear display for operators and shift supervisors of key measurements relevant to accident conditions, together with diagnostic warnings of conditions.

In the interim, consideration should be given to requiring, at TMI and similar plants, the grouping of these key measurements, including distinct warning signals on a single panel available to a specified operator and the providing of a duplicate panel of these key measurements and warnings in the shift supervisor's office.

Status of Actions

NRC strongly agreed with the recommendations on the need for improved control rooms and instrumentation. Consequently, all licensees were required to conduct detailed control room design reviews to determine if their control room provides satisfactory information to the operators to prevent or cope with accidents. As guidance for this review, NRC published "Guidelines for Control Room Design Reviews" (NUREG-0700) in 1981. This document provided basic human factors analysis techniques and accepted human factors design principles and criteria. In addition, NUREG-0800, "Standard Review Plan," Chapter 18, "Human Factors Engineering," provides licensees and applicants with the criteria by which the staff reviews the design of the main control room and control centers outside the main control room.

Part of the effort by each licensee and applicant included a function and task analysis to determine the tasks operators were expected to perform and the information and control capability needed to perform the tasks. These information and control requirements were then compared to the controls and displays in the control room to determine availability and acceptability of the instrumentation. In addition, each control room was surveyed to identify deviations from accepted human factors principles for control room layout, usefulness of audible and visual alarm systems, information recording and recall capability, and the control room environment. Each licensee and applicant then submitted a summary report to NRC outlining proposed changes and schedules for their implementation. The report also provided justification for safety-significant human engineering deficiencies to be left uncorrected or partially corrected.

Instrumentation to aid operators following an accident has been strengthened significantly since the TMI-2 accident. Based on guidance in Regulatory Guide 1.97, the reliability and capability of the instrumentation has been improved at all nuclear power plants. The most important safety parameter instruments are now located on a single panel and are required to survive the harsh

environment that could be generated by a range of postulated accidents. This post-accident monitoring instrumentation will provide operators with the information necessary to ensure that all safety systems have operated properly and to take the action necessary to respond to equipment malfunctions.

Implementation of control room improvements, including some significant design changes, is well under way. The staff has identified no serious safety-significant design flaws that have not subsequently been corrected.

D.2 Correct Design and Maintenance Inadequacies

Presidential Commission Recommendation

Equipment design and maintenance inadequacies noted at TMI should be reviewed from the point of view of mitigating the consequences of accidents. Inadequacies noted in the following should be corrected: iodine filters, the hydrogen recombiner, the vent gas system, containment isolation, reading of water levels in the containment isolation [sic], reading of water levels in the containment area, radiation monitoring in the containment building, and the capability to take and quickly analyze samples of containment atmosphere and water in various places. (See recommendation A.7.)

Status of Actions

NRC agreed that these inadequacies would be corrected. Six of the seven items were addressed by TMI Action Plan Requirements (NUREG-0737). However, several of these requirements proved so difficult to implement that deadlines had to be extended beyond January 1, 1981. The requirements have now been implemented. Therefore, all operating nuclear power plants (except for Browns Ferry, now in extended shutdown, which will complete these actions before the restart of each unit) now have, for example, safety-grade, high-range radiation monitors inside the containment building; enhanced provisions for containment building isolation; and the capability to use a hydrogen recombiner if needed.

The recommendation for the capability to quickly analyze containment building atmosphere and reactor coolant samples was implemented by the requirement for a post-accident sampling system (PASS). Although the PASS requirements proved formidable, every licensee now has the capability to take and analyze samples of reactor coolant and containment building atmosphere. These samples provide information about (a) the extent of core damage; (b) the radioactivity released to the water and to the atmosphere; and (c) the concentration of combustible gases in the containment building atmosphere.

Progress has been less rapid in correcting inadequacies in iodine filtration systems because of the complexity of the issue and because other issues were deemed to have greater safety significance. The necessary research has been conducted and an appropriate protocol for testing the filtration medium (nuclear-grade charcoal) has been developed (EGG-CS-7131). NRC guidance in this area (Regulatory Guide 1.52) is being revised on the basis of reported deficiencies in operating systems.

D.3 Record Critical Plant Parameters

Presidential Commission Recommendation

Monitoring instruments and recording equipment should be provided to record continuously all critical plant measurements and conditions.

Status of Actions

NRC was in complete accord with this recommendation for monitoring and recording initial plant parameters. Accordingly, licensees were required to install a Safety Parameter Display System (SPDS) in all nuclear plant control rooms. The objective of the SPDS is to provide a concise display of critical plant variables to control room operators to aid them in rapidly and reliably determining the safety status of the plant. Seven basic requirements for the SPDS were specified as follows:

- Display critical plant variables concisely
- Be located convenient to control room operators
- Continuously display plant safety status
- Possess a high degree of reliability
- Be isolated from safety systems
- Incorporate accepted human factors principles
- Provide minimum information sufficient to determine plant safety with respect to the following functions:
  - Reactivity control
  - Reactor core cooling and heat removal
  - Reactor coolant system integrity
  - Containment conditions
  - Procedures and training for actions with and without SPDS

In 1981 the staff published "Functional Criteria for Emergency Response Facilities" (NUREG-0696), which included a chapter on the SPDS. In addition, "Standard Review Plan" (NUREG-0800), Chapter 18.2, "Safety Parameter Display System," was published to provide guidance on the criteria by which the staff would review the SPDS. An SPDS has been installed in all nuclear power plant control rooms, except for three systems scheduled for installation and one licensee granted an authorized exemption.

D.4. and D.4.a, b, c and d Conduct Accident Studies

Presidential Commission Recommendation

The Commission recommends that continuing in depth studies should be initiated on the probabilities and consequences (onsite and offsite) of nuclear power plant accidents, including the consequences of meltdown.

These studies should include a variety of small-break loss-of-coolant accidents and multiple-failure accidents, with particular attention to human failures.

Results of these studies should be used to help plan for recovery and cleanup following a major accident.

From these studies may emerge desirable modifications in the design of plants that will help prevent accidents and mitigate their consequences. For example:

(i) Consideration should be given to equipment that would facilitate the controlled safe venting of hydrogen gas from the reactor cooling system.

(ii) Consideration should be given to overall gas-tight enclosure of the let-down/make-up system with the option of returning gases to the containment building.

Such studies should be conducted by the industry and other qualified organizations and may be sponsored by the restructured NRC and other Federal agencies.

Status of Actions

As a result of the TMI-2 accident and to be responsive to these recommendations, NRC increased and redirected its research program. The program has been revised to focus on: more probable transients caused by multiple failures; on experiments and analyses for small-break loss-of-coolant accidents (SBLOCA); on severe accidents and core-melt phenomena; on probabilistic risk assessment techniques, including those for specific systems, such as auxiliary feedwater systems, as well as complete plant designs; on hydrogen generation and its consequences; on system interaction studies; on component reliability studies and determination of principal failure causes; on emergency core cooling system performance and design-basis reliability; and on shutdown heat removal requirements.

In addition, a high level of priority was placed on research involving human performance. Activities in this area included research to (1) complete analysis of field-collected data for human reliability in maintenance and calibration activities at operating nuclear power plants; (2) review abnormal occurrence reports, Licensee Event Reports, and compliance reports to identify areas in which human performance reliability is low; (3) develop probability models to predict error rates for multiple human errors; and (4) identify patterns and basic associative factors for human-error rates associated with test, maintenance, and operator actions.

The primary goal of the small-break and transient research is to improve operator performance during off-normal events. The research on developing and assessing analytical methods is directed toward improving current computer codes, developing and applying advanced computer codes for SBLOCA and other accident analysis, and developing a fast, easy-to-use, engineering analyzer capability to provide accurate and sufficient information to operating personnel. Advanced control room and diagnostic instrumentation was used in the Loss of Fluid Test as part of the augmented operator capabilities program to assess operator needs to mitigate the consequences of loss of coolant accidents and transient sequences.

NRC is also participating in a joint program with the Department of Energy, the Electric Power Research Institute, and General Public Utilities to acquire, record, and study data from TMI-2 that relates to core-melt accident phenomena. The results will be used to help plan for recovery and cleanup in the highly unlikely event of a major accident.

The revised research program includes extensive hydrogen studies to increase understanding of the formation of hydrogen in a reactor from metal-water reactions, radiolytic decomposition of coolant, and corrosion of metals, and to determine its consequences in terms of pressure-time histories and hydrogen detonation. This work also includes: (1) the preparation of a compendium of information related to hydrogen as it affects reactor safety; (2) analysis of radiolysis under accident conditions; (3) a review of hydrogen sampling and analysis methods; (4) a study of the effects of hydrogen embrittlement of reactor vessel materials; and (5) a review of the means of handling accident-generated hydrogen, with recommendations on improving current methods. The results of these studies were in support of Unresolved Safety Issue (USI) A-48, "Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment." Additional research on hydrogen effects has been conducted as part of the analyses in "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants" (NUREG-1150).

In order to update risk assessment provided in NRC's 1975 "Reactor Safety Study" (WASH 1400), identify plant-specific vulnerabilities, and provide a current risk perspective on plant designs and severe accident phenomena, NRC undertook a major assessment of five different plant designs using probabilistic risk assessment (PRA) methodology. Known as NUREG-1150, this assessment provides perspectives on:

- issues significant to the frequency, consequences, and risks of severe accidents;
- risk uncertainties significant enough to merit further research; and
- the potential benefits of a severe accident management program for reducing risk.

The draft NUREG-1150 provides a set of PRA models and results that support ranking potential safety issues and related research. Although not an estimate of risks at all U.S. nuclear power plants, NUREG-1150 is an important NRC staff resource document. It provides quantitative and qualitative PRA information on key severe accident sequences, a means for investigating where safety improvements might best be pursued, the cost-effectiveness of possible plant modifications, the importance of generic safety issues, and the sensitivity of risks to issues that arise for the five plants studied. The staff is in the process of resolving comments received on the draft NUREG-1150 and expects to issue the final report in 1989.

D.5 Research the Chemical Behavior of Radioactive Iodine in Water

Presidential Commission Recommendation

A study should be made of the chemical behavior and the extensive retention of radioactive iodine in water, which resulted in the very low release of radioiodine to the atmosphere in the TMI-2 accident. This information should be taken into account in the studies of the consequences of other small-break accidents.

Status of Actions

NRC agreed that additional information was needed on the realistic behavior of iodine, other radioisotopes, and chemicals in the primary systems of severely damaged reactors. Accordingly, shortly after the TMI accident, NRC initiated a severe accident research program with a strong emphasis on fission product (so-called "source terms") transport and retention within plant systems.

Special attention was given to the behavior of radioactive iodine and its ability to be retained on surfaces of the reactor coolant system and in water pools in the containment building. A group dedicated to this issue was formed in 1983 to pursue this study, and completed its work in 1986 with publication of "Reassessment of the Technical Bases for Estimating Source Terms" (NUREG-0956). This study was broadly reviewed by peers within the nuclear community, by an independent study group of the American Physical Society, and by the general public.

This research program produced a set of analytical tools called the Source Term Code Package, which has more recently been used in the NUREG-1150 studies. Results from this study and other aspects of the Severe Accident Research Program are providing the technical basis for efforts to reach closure on severe accident issues in accordance with NRC's Integration Plan for Closure of Severe Accident Issues documented in a report to the Commission (SECY-88-147).

Inadequacies in iodine filtration systems have not been fully resolved because of the complexity of the issue and because other issues have been deemed to have greater safety significance. An appropriate protocol for testing the filtration medium nuclear-grade charcoal has been developed (EGG-CS-7131), and guidance (Regulatory Guide 1.52) is being revised in response to deficiencies in operating systems that have been identified.

D.6 Monitor TMI-2 Recovery

Presidential Commission Recommendation

Since there are still health hazards associated with the cleanup and disposal process, which is being carried out for the first time in a commercial nuclear power plant, the Commission recommends close monitoring of the cleanup process at TMI and of the transportation and disposal of the large amount of radioactive material. As much data as possible should be preserved and recorded about the conditions within the containment building so that these may be used for future safety analyses.

Status of Actions

NRC agreed with this recommendation and since 1979 has taken a number of actions to ensure its full and proper implementation. The NRC staff at the site, which reached a peak of approximately 25 professionals, continues to monitor, audit, and review the licensee's cleanup and recovery activities. Today, two project engineers (one at the site), assisted by onsite Resident Inspectors and other NRC technical experts, are involved with the review and approval of TMI-2-related activities, including the disposal of wastes.

Over the past 10 years, much progress has been made in facility cleanup. Approximately 75 percent of the estimated 300,000 pounds of fuel and other

debris has been loaded into casks and shipped off site to Department of Energy (DOE) facilities in Idaho. By the end of 1990, the facility is expected to enter the post-defueling, monitored storage phase of the recovery plan. At that point, the reactor will have been defueled, the radioactive water will have been disposed of, and decontamination will have been essentially completed on the major reactor systems and principal buildings. Throughout this period, offsite radiation monitoring has been conducted by the Environmental Protection Agency, the State of Pennsylvania, NRC, and the licensee. Public involvement in all cleanup activities has been facilitated through widespread public meetings and by the establishment of a TMI-2 Advisory Panel made up of area citizens, public officials, and nuclear scientists.

Throughout the cleanup, transportation, and disposal of radioactive waste material, NRC has given close attention to assure that a deliberate and systematic approach to each step of the cleanup process has been taken. Priority attention has been paid to the protection of public health and safety, and to the documentation of the condition of the reactor and auxiliary systems. The as-found condition, the decontamination processes, and the supporting analyses have been documented in (1) a series of GEND reports (representing General Public Utilities, the Electric Power Research Institute, NRC, and DOE); (2) a number of NRC technical reports, including an extensive Environmental Impact Statement (NUREG-0683 and supplements); (3) numerous technical papers and speeches; and (4) comprehensive utility reports and documents, including extensive video tapes made of cleanup operations. In November 1988, the American Nuclear Society sponsored a special technical meeting on TMI-2, where over 100 papers were presented on the accident, accident scenerio, and recovery program. Thus, the technical data and lessons of experience from the TMI-2 accident have been well documented for use in ongoing safety analyses, accident modelling, and design studies for advanced reactors.

To ensure that the knowledge and lessons of experience from the TMI-2 accident are widely disseminated, the TMI-2 recovery program has also been the subject of wide international cooperation and interest. For example, in 1984 the utility entered into a cooperative arrangement with Japan involving financial contributions and the long-term assignment of Japanese technical personnel. Further, NRC has joined with 10 other countries in a comprehensive program to sample and characterize partially melted fuel samples from the lower portions of the TMI-2 reactor pressure vessel. This latter effort should help validate NRC's safety approach and improve the understanding of the current safety margins in U.S. reactors. Additionally, engineers have been assigned, for approximately 6-month periods, from a number of other countries, including Belgium, Italy, and Taiwan. Numerous foreign representatives have also visited the TMI-2 site and have been briefed on the recovery program.

D.7 Conduct Accident and Abnormal Event Reviews

Presidential Commission Recommendation

The Commission recommends that as a part of the formal safety assurance program, every accident or every new abnormal event be carefully screened, and where appropriate be rigorously investigated, to assess its implications for the existing system design, computer models of the system, equipment design and quality, operations, operator training, operator training simulators, plant procedures, safety systems, emergency measures, management, and regulatory requirements.

Status of Actions

Since the TMI-2 accident, NRC has established a comprehensive program for receiving, screening, analyzing, and thoroughly investigating operational events.

The first element of this program is the NRC Incident Response Plan, which includes the NRC Operations Center. The Operations Center receives reports of licensee events 24 hours a day, 365 days a year; responds to emergencies; and forwards information about potentially significant events to other NRC staff organizations for screening. The Commission's regulations, 10 CFR 50.72 and 50.73, were revised to require the reporting of the most significant events. These regulations require licensees to notify the Operations Center immediately over dedicated telephone lines and to submit detailed written Licensee Event Reports within 30 days following a reportable event. Since the program was established, the NRC Operations Center equipment, staffing, training, and procedures have all been enhanced. The staff routinely conducts exercises with licensees, NRC regional offices, and others to ensure its readiness.

The screening of events received by the Operations Center involves a combination of efforts. The initial screening is performed by the Headquarters' Operations Officer (HOO). The HOO is a degreed engineer with extensive training who ensures that events are as completely described as possible and that the appropriate notifications are made.

Subsequently, events received by the Operations Center are screened each workday morning in a conference call between two NRC program offices. During the call, assignments are made to determine which events are of plant-specific significance and which are of generic significance. NRC regional offices also review events soon after they are received by the Operations Center. Further, each week a conference call is held between the Office of Nuclear Reactor Regulation (NRR) and other NRC offices to review the significant events of the week. Followup action may be assigned as a result of this review.

Another element of the program, the analysis of events, also combines different efforts. Short-term analysis based on immediate notifications to the Operations Center is conducted by NRR at Headquarters and through onsite reviews by regional inspectors. Longer-term analysis, which is done by the Office for Analysis and Evaluation of Operational Data (AEOD), can take many forms: engineering case studies, trends and patterns analyses, performance indicator studies, and a variety of reports for the public, Congress, and technical specialists. Such analyses often result in the dissemination of important information to the staff, and to licensees in the form of information notices, bulletins, generic letters, and formal NRC technical reports.

The final element, an Incident Investigation Program (IIP), responds to especially significant events by activating specially trained investigation teams. The IIP was established in 1985 by the NRC to assure that investigations of significant events would be timely, thorough, well coordinated, and formally administered. NRC has developed and implemented detailed procedures for the program, selected the most qualified prospective team members from a variety of appropriate technical disciplines, and conducts special training sessions on a range of investigative techniques and procedures. The scope of the IIP includes the investigation of significant operational events involving

reactors and non-reactor activities licensed by NRC. The IIP's primary objective is to ensure that operational events are investigated in a systematic and technically sound manner, to gather all available information pertaining to the causes of the events -- including those involving NRC's activities -- and to provide appropriate feedback regarding the lessons of the events to the NRC, the industry, and the public.

E. RECOMMENDATIONS FOR WORKER AND PUBLIC HEALTH AND SAFETY

E.1 and E.1.a, b, c, d and e Expand and Better Coordinate Federal Radiation Effects Research

Presidential Commission Recommendation

The Commission recommends the establishment of expanded and better coordinated health-related radiation effects research. This research should include, but not be limited to:

biological effects of low levels of ionizing radiation;

acceptable levels of exposure to ionizing radiation for the general population and for workers;

development of methods of monitoring and surveillance, including epidemiologic surveillance to monitor and determine the consequences of exposure to radiation of various population groups, including workers;

development of approaches to mitigate adverse health effects of exposure to ionizing radiation; and

genetic or environmental factors that predispose individuals to increased susceptibility to adverse effects.

This effort should be coordinated under the National Institutes of Health -- with an interagency committee of relevant Federal agencies to establish the agenda for research efforts -- including the commitment of a portion of the research budget to meet the specific needs of the restructured NRC.

Status of Actions

NRC agreed with these recommendations. During 1978 and 1979, the NRC staff worked with and supported an interagency effort chaired by the Department of Health, Education and Welfare that arrived at the same conclusion as the Presidential Commission. As a result, an interagency committee on radiation research, chaired by the National Institutes of Health, was established in early 1979, on which NRC was represented.

The functions of the Interagency Radiation Research Committee subsequently were assumed by the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), established on April 9, 1984 under the Office of Science and Technology Policy and chartered under the Federal Coordinating Council for Science, Engineering and Technology. In addition to assuming the responsibilities of the former Interagency Radiation Research Committee, CIRRPC was also assigned the responsibilities of the former Radiation Policy Council and replaced the Committee on Interagency Radiation Policy. Its overall charge is to coordinate radiation matters among Federal agencies, evaluate radiation research, and provide advice on the formulation of radiation policy. At the present time, there are 18 CIRRPC member agencies, 14 of which have members on the CIRRPC Science Panel. Each of these agencies has significant research, operation, or policy functions in the area of radiation.

The CIRRPC has supported, coordinated, and reviewed efforts in radiation health effects, including radio-epidemiological, radio-biological, and dosimetry studies. A major effort resulted in a report on "The Federal Ionizing Radiation Research Agenda Related to Low Level Biological Effects: FY 1985." This report delineates and compares Federally supported research efforts in 1981 and 1985. Also, CIRRPC is directly supporting an update of the 1980 comprehensive report by the National Academy of Sciences (NAS) on the effects of low-level radiation. This update is being prepared by the NAS Committee on the Biological Effects of Ionizing Radiation (BEIR). Known as the BEIR V report, it is expected to be available in the spring of 1989.

NRC's budget for studies on the biological effects of ionizing radiation represents about 3 percent of all Federal expenditures in this area. NRC support is limited to projects of direct applicability to the agency's responsibilities that are not sponsored by other agencies. Examples of projects sponsored by NRC include experimental development of models for early mortality and morbidity caused by the accidental inhalation of radionuclides, development of computer code models for assessing the health consequences of reactor accidents, and a feasibility study on the reduction of uncertainties in low-level radiation risk through research on the effects of radiation at the molecular and cellular levels.

The development of a data base to support epidemiological research as an aid to understanding the health effects of ionizing radiation is expected to result from requirements included in a revision to 10 CFR Part 20 now before the Commission. These proposed requirements were developed as a result of a request by the National Cancer Institute (NCI) and followed meetings with NCI staff, industry groups, labor unions, and others. The data base is to include nuclear power workers as well as others.

E.2 Establish Department of Health and Human Services Oversight of NRC Activities

Presidential Commission Recommendation

To ensure the best available review of radiation-related health issues, including reactor siting issues, policy statements or regulations in that area of the restructured NRC should be subject to mandatory review and comment by the Secretary of the Department of Health and Human Services. A time limit for the review should be established to assure such review is performed in an expeditious manner.

Status of Actions

NRC agreed with the value of a Federal oversight of NRC activities that affect public health. NRC believed that the Federal Radiation Policy Council (FRPC), established by the President, would provide a more effective and balanced oversight. Subsequently, the function of the FRPC was transferred to the Environmental Protection Agency (EPA). In 1987, EPA published "Radiation Protection Guidance to Federal Agencies for Occupational Exposure," which was approved by the President. These recommendations were developed with EPA oversight by an interagency working group which included NRC representatives. It incorporates new concepts developed by the International Commission on Radiation Protection. NRC has incorporated the Presidential guidance into a

major revision of its regulations, 10 CFR Part 20, "Standards for Protection Against Radiation" now under consideration by the Commission.

Additional Federal oversight of NRC activities was provided by the Interagency Radiation Research Committee, established in early 1979 and chaired by a representative of the National Institutes of Health. The functions of this Committee were later transferred to the Committee on Interagency Radiation Research and Policy Coordination, established on April 9, 1984, under the Office of Science and Technology Policy and chartered under the Federal Coordinating Council for Science, Engineering and Technology. NRC participates as a member of this Committee.

E.3 Educate State and Local Health Professionals and Emergency Response Personnel

Presidential Commission Recommendation

The Commission recommends, as a state and local responsibility, an increased program for educating health professionals and emergency response personnel in the vicinity of nuclear power plants.

Status of Actions

NRC agreed with this recommendation and, although the Presidential Commission identified this as a State and local responsibility, NRC provides guidance and assistance in implementing this recommendation. In particular, NRC helps develop NRC-Environmental Protection Agency guidance already available to States on the preparation of emergency response plans and will provide more detailed guidance on the education and training necessary for personnel who respond to emergencies at nuclear power plants. In addition, NRC continues to offer technical assistance to the States in the preparation or upgrading of emergency response plans.

The Commission has aggressively pursued the upgrading of licensee, State, and local radiological emergency-response capabilities. This upgrading has been accomplished, in close coordination with the Federal Emergency Management Agency (FEMA), through rulemaking and guidance. Specifically, the regulations and guidance require that training be provided by the utility and the State and local governments to all personnel who are likely to respond to a radiological emergency. These individuals are identified in each organization's Radiological Emergency Response Plan. Training includes classroom work, on-the-job instruction, lectures, seminars, drills, and exercises. Biennially, each utility conducts an emergency preparedness exercise involving State and local personnel. These exercises are a primary training tool and serve as a "final exam" for all those involved in the response program. Following an exercise, each participating organization provides a critique of its own performance, which is followed by a critique by NRC and FEMA.

NRC has prepared and distributed to all licensees and States copies of the manuals used to train NRC personnel on responses to reactor accidents. These manuals discuss the source of the threat from reactors, the range of appropriate responses, and their bases. In addition, NRC has supported FEMA's training courses for State and local response personnel. This support has included developing training material and providing instructors for courses on

reactor systems, reactor accidents, and public protective actions. NRC developed material on reactor accidents for the FEMA home study course, "Radiological Emergency Management," which is available to the public and response personnel through FEMA. NRC has supported various ongoing efforts, such as Harvard University's "Planning for Nuclear Emergencies" course and FEMA-sponsored State workshops to assure that all response organizations have a basic understanding of severe reactor accidents and the appropriate responses to them. NRC also participates with FEMA on the Education and Training Subcommittee of the Federal Radiological Preparedness Coordinating Committee to develop and update training courses for State and local government responders. Further, NRC regional offices conduct workshops with State and local officials, licensees, and local Federal officials to discuss responses to severe accidents.

In addition to the training provided through regulatory requirements, NRC and FEMA also provide direct training to State and local personnel. NRC provides radiological health professionals a 5-week comprehensive course in basic radiological safety. FEMA provides a number of courses for radiological emergency responders in basic emergency response techniques in both classroom and in-the-field environments. In the past 10 years, NRC has trained approximately 400, and FEMA has trained approximately 3400, State and local personnel through these programs.

E.4 and E.4.a, b, c and d Prepare in Advance for Radiological Emergencies

Presidential Commission Recommendation

Utilities must make sufficient advance preparation for the mitigation of emergencies:

Radiation monitors should be available for monitoring of routine operations as well as accident levels.

The emergency control center for health-physics operations and the analytical laboratory to be used in emergencies should be located in a well-shielded area supplied with uncontaminated air.

There must be a sufficient health-related supply of instruments, respirators, and other necessary equipment for both routine and emergency conditions.

There should be an adequate maintenance program for all such health-related equipment.

Status of Actions

NRC agreed with this recommendation. To ensure that utilities have made adequate advance preparations for emergencies, NRC emergency preparedness regulations have been extensively revised since the TMI accident. Before an operating license can be issued, NRC requires that utilities develop and implement detailed onsite and offsite emergency plans and response facilities to provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

Licensees must develop emergency preparedness plans following the guidance and requirements for emergency preparedness programs provided in the regulations, NUREG-0696, NUREG-0396, and NUREG-0654/FEMA-REP-1, Revision 1 and Supplement 1. These plans must be approved by NRC. In addition to submitting these plans, licensees must provide the necessary facilities, equipment, personnel, and training to carry out their plans. Periodic emergency response drills and exercises are required, ranging in scope from specialized onsite drills to major graded exercises involving all Federal, local, and emergency response organizations.

Licensees are required to establish emergency action levels (EALs) for a specified variety of emergency conditions and to develop protective action recommendations based on the EALs and other factors.

The readiness and adequacy of each licensee's emergency preparedness program are assessed by NRC personnel during exercises of its plans and during routine inspections by NRC regional and headquarters' personnel. They are also assessed by participating personnel from other Federal and State agencies.

Each newly licensed facility has area and system radiation monitoring instrumentation in accordance with the guidance in NRC's Standard Review Plan (NUREG-0800). Each facility design and layout is reviewed by NRC staff for the location of these monitors relative to likely release points for radioactive liquids, gases, and particulates. These monitors perform routine functions and may perform accident mitigation functions, such as system shutdowns or alarms.

In addition, NRC has required that high-range radiation monitors be installed in reactor containment structures to monitor possible post-accident conditions at each power reactor facility. Their installation and maintenance are verified by routine NRC inspection. Other requirements for radiation monitoring capability have also been implemented in the industry and include a noble gas effluent radiological monitor and a capability to sample post-accident releases of iodines and particulates. NRC has inspected power reactor facilities for compliance with these requirements.

NRC has also required that areas vital to accident control and mitigation meet certain occupancy requirements that would allow the personnel in these areas to perform their functions within specified dose guidelines. The health physics control center, as part of the onsite technical support center, must meet these requirements, which include ventilation filtration and dose rate/airborne radioactivity monitoring, alarm, and shutdown functions. Other health physics control centers to which operations may be transferred as an accident progresses, such as the emergency operations facility, are required to monitor with appropriate alarm and shutdown functions the dose rate and the airborne activity during an emergency. Facility emergency preparedness plans are routinely inspected by NRC to verify that areas vital to accident control and mitigation meet NRC criteria.

Analytical laboratories at power reactor facilities that are used for post-accident analyses must meet shielding, occupancy, and sampling time limitations established in NUREG-0737. These laboratories require low background counting areas and the consideration of "as-low-as-reasonably-achievable" doses in the sampling and analysis processes. Adequate supplies of instruments,

respirators, and other equipment necessary for normal and emergency conditions are evaluated in the licensing process and verified in the inspection process.

Adequate maintenance of health-related equipment is required by the regulations (10 CFR 50.47 and 10 CFR Part 50, Appendix E) and is further discussed in NUREG-0696, NUREG-0396, and NUREG-0654. Maintenance programs are part of emergency response plan reviews by the regions and headquarters, and verified by routine inspections in radiation protection, emergency preparedness, instrumentation, and other areas.

E.5 Make Potassium Iodide Available

Presidential Commission Recommendation

An adequate supply of the radiation protective (thyroid blocking) agent, potassium iodide for human use, should be available regionally for distribution to the general population and workers affected by a radiological emergency.

Status of Actions

NRC agreed with this recommendation for workers and institutionalized persons. NRC and the Federal Emergency Management Agency have issued guidance to licensees of operating nuclear power plants and to State and local authorities (NUREG-0655/FEMA-REP-1) recommending the stockpiling and distribution of radioprotective drugs for emergency workers and institutionalized persons during emergencies. Emergency planning implementation inspections by NRC have confirmed that nuclear power plant licensees are maintaining supplies of potassium iodide (KI) for emergency workers remaining or arriving onsite during an emergency.

The Federal position with regard to the predistribution or stockpiling of KI for use by the general public is that it should not be required. While valid arguments may be made for the use of KI, the preponderance of information indicates that a nationwide requirement for the predistribution or stockpiling for use by the general public would not be worthwhile. This conclusion is based on plans for evacuation of the general population and the cost-effectiveness of a nationwide program which has been analyzed by NRC and by Department of Energy National Laboratories (NUREG/CR-1433). While the use of KI can clearly provide additional protection in certain circumstances, the assessment of the effectiveness of KI and other protective actions and their implementation problems indicate that the decision to use KI (and/or other protective actions) should be made by the States and, if appropriate, local authorities on a site-specific basis. This position was reflected in a policy statement published in the Federal Register on July 24, 1985 (50 FR 30258).

F. RECOMMENDATIONS FOR UPGRADING EMERGENCY PLANNING AND RESPONSE

F.1 and F.1.a, b, c, and d — Upgrade the Role of the Federal Emergency Management Agency and State and Local Governments

Presidential Commission Recommendation

Emergency plans must detail clearly and consistently the actions public officials and utilities should take in the event of offsite radiation doses resulting from release of radioactivity. Therefore, the Commission recommends that:

Before a utility is granted an operating license for a new nuclear power plant, the state within which that plant is to be sited must have an emergency response plan reviewed and approved by the Federal Emergency Management Agency (FEMA). The agency should assess the criteria and procedures now used for evaluating state and local government plans and for determining their ability to activate the plans. FEMA must assure adequate provision, where necessary, for multi-state planning.

The responsibility at the federal level for radiological emergency planning, including planning for coping with radiological releases, should rest with FEMA. In this process, FEMA should consult with other agencies, including the restructured NRC and the appropriate health and environmental agencies. (See recommendation A.4.)

The state must effectively coordinate its planning with the utility and with local officials in the area where the plant is to be located.

States with plants already operating must upgrade their plans to the requirements to be set by FEMA. Strict deadlines must be established to accomplish this goal.

Status of Actions

NRC agreed with this recommendation and has worked closely with FEMA to formally document agreements that (1) FEMA should have the lead role at the Federal level for emergency planning for coping with radiological releases and (2) both FEMA and NRC should concur in State emergency response plans before NRC issues an operating license.

In late 1979, the President directed that FEMA assume the lead responsibility in offsite emergency planning and response. The directive, however, did not deal explicitly with FEMA's role in the NRC licensing process. To assure the effective implementation of the President's directive, NRC and FEMA signed a Memorandum of Understanding (MOU) on January 14, 1980, describing each agency's responsibilities in improving emergency preparedness at nuclear plants. This MOU was revised and updated on November 1, 1980, and again on April 18, 1985.

FEMA's responsibilities in the MOU include making findings and determinations as to whether State and local emergency plans are adequate and capable of implementation. The procedures for requesting and reaching administrative approval of State and local plans by FEMA are set forth in the Code of Federal

Regulations (44 CFR Part 350), which was issued as a proposed rule for comment and interim use on June 24, 1982, and as a final rule on August 19, 1982. Recognizing that the formal approval process under 44 CFR Part 350 could be lengthy, and that it was a FEMA administrative procedure outside the NRC licensing process, NRC included provisions in the MOU for obtaining timely submittals of FEMA findings and determinations upon NRC request to support NRC licensing reviews. Findings and determinations provided under the 44 CFR Part 350 process are known as "formal" findings while those obtained as a result of an NRC request under the provisions of the MOU are known as "interim" findings.

For all plants licensed to operate since November 3, 1980, NRC has requested and received from FEMA either formal approval or interim findings that offsite preparedness plans are adequate and capable of implementation prior to full-power operation. For plants licensed before November 3, 1980, FEMA findings were based primarily on observations during field exercises and the existence of upgraded plans.

In those situations where State and local governments have refused to cooperate in the planning effort, utilities may develop and submit offsite emergency response plans to NRC. These plans substitute utility resources for those of the State and local governments. In its evaluation of those utility offsite emergency response plans, NRC will assume that State and local governments will, in an actual event, use their best efforts to protect the public health and safety in responding to the emergency and will generally follow the utility's plan. If the utility offsite plan and the assumption of "realism" are not adequate to meet all the emergency planning requirements, FEMA has developed regulations, as directed by Executive Order, to provide Federal support and assistance in order to assure that utility plans are adequate to meet NRC licensing requirements.

To further assure that State and local governments receive adequate support in responding to a severe radiological accident, a comprehensive Federal Radiological Emergency Plan has been developed. This plan, published in final form in 1985, provides the means for organizing Federal resources in a coordinated manner to support State and local authorities.

F.2 Base Emergency Response Plans on Potential Plant-Specific Classes of Accidents

Presidential Commission Recommendation

Plans for protecting the public in the event of offsite radiation releases should be based on technical assessment of various classes of accidents that can take place at a given plant.

Status of Actions

NRC agreed with this recommendation. Accordingly, in November 1980, after a formal consideration of the role of emergency planning in ensuring the protection of public health and safety around nuclear power plant facilities, NRC issued amended regulations on emergency planning (45 FR 55402). The final rule required that Emergency Planning Zones (EPZs) of about 10 miles in radius for plume exposure and about 50 miles in radius for ingestion exposure be established. The final rule also specified 16 emergency planning standards

that must be met by licensee onsite emergency plans and by State and local offsite plans. Guidance on developing emergency plans to meet the revised regulations is given in NUREG-0654/FEMA-REP-1, Revision 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," issued in November 1980.

The EPZs for nuclear power plants are defined as the areas for which planning is needed to assure that prompt and effective actions can be taken to protect the public in the event of an accident. The choice of the size of the emergency planning zones represents a judgment on the extent of detailed planning which must be performed to assure an adequate response. In a particular emergency, protective actions might well be restricted to a small part of the zones. On the other hand, the response measures established within the 10-mile and 50-mile EPZs can and will be expanded if the conditions of a particular accident so warrant.

The principal technical documents that describe the process of defining the size of the EPZs and the planning and protective measures to be taken within them are NUREG-0396/EPA 520/1-78-016, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light-Water Nuclear Power Plants," December 1978 and NUREG-0654/FEMA-REP-1.

F.2.a Tailor Response Plans According to a Variety of Scenarios

Presidential Commission Recommendation

No single plan based on a fixed set of distances and a fixed set of responses can be adequate. Planning should involve the identification of several different kinds of accidents with different possible radiation consequences. For each such scenario, there should be clearly identified criteria for the appropriate responses at various distances, including instructing individuals to stay indoors for a period of time, providing special medication, or ordering an evacuation.

Status of Actions

NRC agreed with this approach. An NRC-Environmental Protection Agency (EPA) Task Force concluded (in NUREG-0396) that the objective of emergency response plans is to provide dose savings for a spectrum of accidents that could produce offsite doses in excess of Protective Actions Guides (PAGs). No single specific accident sequence was isolated as the one for which to plan because each accident could have different consequences, both in nature and degree. Further, the range of options on which to base plans is very large, starting at a point where no planning is required because significant offsite radiological consequences are unlikely to occur, to planning for the worst possible accident, regardless of its extremely low likelihood.

The NRC/EPA Task Force did not attempt to define a single accident sequence or even a limited number of sequences. Rather, it identified the parameters for which planning is recommended, based upon knowledge of the potential consequences, timing, and release characteristics of a spectrum of accidents. Although the selected planning basis is independent of specific accident sequences, a number of accident descriptions were considered in the development of the guidance, including the core-melt accident release categories of the "Reactor Safety Study" (WASH-1400).

F.2.b and c Activate Plans According to the Potential Hazards Identified and Plan to Protect the Public from Radiation Levels Lower Than Used in NRC-Prescribed Plans

Presidential Commission Recommendation

Similarly, response plans should be keyed to various possible scenarios and activated when the nature and potential hazard of a given accident has been identified.

Plans should exist for protecting the public at radiation levels lower than those currently used in NRC-prescribed plans.

Status of Actions

The emergency planning regulations require licensees to have a standard emergency classification and action level system. A standardized scheme for classifying emergencies in an ascending order of seriousness has been established. The four classes of emergencies and the general meaning of each of these classifications is provided below:

UNUSUAL EVENT This emergency class provides early and prompt notification of minor events that could possibly lead to more serious conditions. It is expected that there would be no threat to the reactor fuel and there would be no radiological releases above technical specification limits.

ALERT Events classified at this level involve an actual or potential substantial degradation of the level of safety in the plant. Any radiological releases are expected to be limited to small fractions of the U.S. Environmental Protection Agency (EPA) Protective Action Guides.

SITE AREA EMERGENCY In this emergency classification, events would be in progress or have occurred that involve actual or likely major failures of plant functions needed for protection of the public. Releases are not expected to exceed EPA Protective Action Guide exposure levels, except possibly near the site boundary.

GENERAL EMERGENCY This classification indicates that events are in progress or have occurred that involve actual or imminent substantial core degradation or melting. Risks of exceeding Protective Action Guide exposure levels in more than the immediate area are considerably elevated. A general emergency indicates that plant conditions are substantially degraded and, as a result, protective actions are expected.

Each licensee is required to use this emergency classification system and to develop specific plant instrument readings, referred to as emergency action levels which if exceeded would initiate the appropriate emergency class. Emergency plans must include predetermined protective actions for severe core damage accidents, including those for evacuation and shelter in the plume exposure emergency planning zone. Protective actions are taken to minimize radiation doses to the public based on EPA's protective actions guidelines dose levels.

F.2.d Provide Local Communities with Funds and Technical Support to Prepare New Plans

Presidential Commission Recommendation

All local communities should have funds and technical support adequate for preparing the kinds of plans described above.

Status of Actions

Although NRC has no requirements for funding of State and local governments, the Agency recognizes that a utility may have an incentive, based on its own self interest, as well as on its responsibility to provide power, to assist in supporting offsite response organizations. Experience has shown that, in the great majority of cases, utilities and offsite organizations have developed cooperative arrangements for support, including the provision of manpower, equipment, training and other resources.

F.3 Expand Medical Research on Means of Protecting the Public from Radiation

Presidential Commission Recommendation

Research should be expanded on medical means of protecting the public against various levels and types of radiation. This research should include exploration of appropriate medications that can protect against or counteract radiation.

Status of Actions

Although this recommendation is beyond the purview of NRC, other agencies are actively supporting this type of research. For example, since the late 1940s, a large-scale research program on the use of chemical radioprotectors has been conducted jointly by the Armed Forces Radiobiology Research Institute and by the Walter Reed Army Medical Center.

In March 1987, these organizations sponsored a symposium on "Perspectives in Radioprotection." Papers were presented by 42 scientists, including those from universities and hospitals. Sessions focused on whether radioprotectors are feasible, what protection is needed at the molecular level, protection by sulfur compounds, use of immunotherapeutic agents, and enhancement of protection. In addition to research from animal studies, cancer patients are receiving radioprotectors to shield healthy tissue while they undergo radiotherapy. While a fully effective compound has not yet been developed, research continues in this vital area.

F.4 Better Inform the Public About Nuclear Power

Presidential Commission Recommendation

If emergency planning and response to a radiation-related emergency is to be effective, the public must be better informed about nuclear power. The Commission recommends a program to educate the public on how nuclear power

plants operate, on radiation and its health effects, and on protective actions against radiation. Those who would be affected by such emergency planning must have clear information on actions they would be required to take in an emergency.

Status of Actions

NRC continually emphasizes openness with the press and the public to assure that they have an opportunity to obtain information through inquiries, review of NRC documents, and attendance at meetings. Public document rooms are available near all nuclear plant sites and in Washington, D.C. Schedules of public meetings are published and available on call-in tape recordings. Public meetings are conducted across the country on major issues such as Safety Goals and Standards for Protection Against Radiation. Seminars are conducted in local areas for the news media on nuclear power and radiation, and more than 300 reporters and editors have attended these seminars. Further, NRC has initiated a program in which NRC representatives work with schools and describe NRC activities. The program also provides speakers to other organizations at their request.

Emergency response plans for both onsite and offsite activities require that utilities make available to the public on a periodic basis information on how the public will be notified in the event of an accident and what initial actions should be taken. NRC regulations explicitly require that licensees inform and educate the public: "Information is made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency (e.g., listening to a local broadcast station and remaining indoors), the principal points of contact with the news media for dissemination of information during an emergency (including the physical location or locations) are established in advance, and procedures for coordinated dissemination of information to the public are established" (Title 10 of the Code of Federal Regulations, 50.47(b)(7)).

Thus, licensees are required to disseminate (at least annually) information to the public regarding how the public will be notified and what actions they should take in an emergency. This notification generally takes the form of a public information brochure which is distributed to all the residents within the 10-mile emergency planning zone. Residents are also informed through such means as information in local telephone directories, periodic notices in utility bills, and posters in public areas. The transient population is informed through signs or other measures (e.g., decals or posted notices placed in hotels, motels, gasoline stations, and phone booths) with appropriate information that would be helpful if an emergency occurred. Such notices refer visitors to the telephone directory or other sources of local emergency information and inform them about radio and television stations that would carry relevant news. In addition, licensees conduct coordinated programs at least annually to acquaint news media with their emergency plans, to disseminate information concerning radiation, and to provide points of contact for sources of public information in an emergency.

F.5 Study the Costs of Radiation-Related Mass Evacuations

Presidential Commission Recommendation

Commission studies suggest that decision-makers may have over-estimated the human costs, in injury and loss of life, in many mass evacuation situations. The Commission recommends study into the human costs of radiation-related mass evacuation and the extent, if any, to which the risks in radiation-related evacuations differ from other types of evacuations. Such studies should take into account the effects of improving emergency planning, public awareness of such planning, and costs involved in mass evacuations.

Status of Actions

In response to this recommendation, NRC agreed that further studies should be made. Accordingly, additional studies of the potential human costs, in injury and loss of life, for mass evacuations have been completed. They are summarized in NUREG/CR-4726, "Evaluation of Protective Action Risks" (June 1987), and incorporate an Environmental Protection Agency study, "Evacuation Risks - An Evaluation." The study found that the key factors for a successful evacuation included an emergency plan, good communications and coordination, practice drills, and defined lines of authority. Few evacuations studied used an emergency broadcasting system or warning sirens to communicate the need to evacuate. Reports of panic and traffic jams during an evacuation were very few.

For accidents which result in relatively low projected dose levels, or under higher risk evacuation conditions (e.g., bad weather), protective actions other than evacuation, such as sheltering, may reduce the radiation risk to a point significantly lower than the evacuation risk. During accidents which result in higher projected doses, the protective action of evacuation would not subject a population to a larger risk than the radiation risk.

F.6 Delineate Responsibilities Among Support Organizations

Presidential Commission Recommendation

Plans for providing Federal technical support, such as radiological monitoring, should clearly specify the responsibilities of the various support agencies and the procedures by which those agencies provide assistance. Existing plans for the provision of Federal assistance, particularly the Interagency Radiological Assistance Plan and the various memoranda of understanding among the agencies, should be reexamined and revised by the appropriate Federal authorities in the light of the experience of the TMI accident, to provide for better coordination and more efficient Federal support capability.

Status of Actions

NRC agreed that improvements were needed in this area and initiated efforts to examine and revise the then-existing Federal interagency agreements on emergency assistance.

Since the TMI-2 accident, much has been accomplished in the area of Federal response coordination. Through the efforts of organizations such as the

Federal Radiological Preparedness Coordinating Committee, of which NRC is a member, coordination among members of the Federal community has improved. Consequently, there is an improved overall Federal response capability to events at NRC-licensed facilities. On November 8, 1985, the Federal Radiological Emergency Response Plan (FRERP) was published in the Federal Register. This document clearly defines the concept of a Cognizant Federal Agency (CFA) that has lead authority for responding to events at a facility over which it has jurisdiction. This document also defines the relationship of the other Federal organizations to the CFA in supporting the response effort.

In addition, Federal coordination has been responsible for the development of NUREG-0654/FEMA-REP-1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." This document provides Federal guidance for licensee response to events at licensed facilities. NRC and the Federal Emergency Management Agency have developed response cooperation procedures in NUREG-0981, "NRC/FEMA Operational Response Procedures for Response to a Commercial Nuclear Reactor Accident." In support of these procedures, NRC has conducted two Federal Field Exercises (FFEs). These exercises, involving the full Federal community, including NRC headquarters' and regional staffs, and State and local officials, have resulted in improvements of the response capability of the Federal government by encouraging communications on response issues between licensees, States, and the federal government. The first FFE took place in March 1984 at the St. Lucie facility in Florida. Another FFE was conducted at the Zion facility in Illinois in June 1987. Both exercises were successful in demonstrating that the FRERP is a functional concept that can be quickly implemented in support of licensee and State resources. In addition, reports on lessons learned have been written and tracked for both of the FFEs, assuring that problem areas identified through the exercises are corrected.

G. RECOMMENDATIONS FOR THE PUBLIC'S RIGHT TO INFORMATION

G.1 and G.1.a and b Prepare a Systematic Public Information Program

Presidential Commission Recommendations

Federal and state agencies, as well as the utility, should make adequate preparation for a systematic public information program so that in time of a radiation-related emergency, they can provide timely and accurate information to the news media and the public in a form that is understandable. There should be sufficient division of briefing responsibilities as well as availability of informed sources to reduce confused and inaccurate information. The Commission therefore recommends:

Since the utility must be responsible for the management of the accident, it should also be primarily responsible for providing information on the status of the plant to the news media and to the public; but the restructured NRC should also play a supporting role and be available to provide background information and technical briefings.

Since the state government is responsible for decisions concerning protective actions, including evacuations, a designated state agency should be charged with issuing all information on this subject. This agency is also charged with the development of and dissemination of accurate and timely information on offsite radiation doses resulting from releases of radioactivity. This information should be derived from appropriate sources. (See recommendation F.1.) This agency should also set up the machinery to keep local officials fully informed of developments and to coordinate briefings to discuss any federal involvement in evacuation matters.

Status of Actions

The procedure in effect prior to the TMI accident was that NRC public affairs staff members were sent to an accident site to support NRC personnel in dealing with the news media, but that the utility was in charge of information activities. During the accident, however, NRC took responsibility for public information, and it is realistic to expect that both the State and the public will look to the Federal regulator to talk authoritatively about any future emergency situation. In view of the differing responsibilities and points of perspective, NRC actions have focused on achieving a Joint Public Information Center (JPIC) where Federal, State, and utility officials operate so that, where the facts warrant, a coordinated view of the situation can be presented.

Towards this end, NRC and the Federal Emergency Management Agency (FEMA) have worked jointly to develop and exercise emergency plans and guidance for coordinating and disseminating public information. Workshops and exercises have been conducted to familiarize all participants with their own role as well as the roles of others. JPICs have been identified near reactor sites so that all parties with responsibilities for informing the public can work together to assure that prompt and accurate information is disseminated. Each party maintains its own independence and can speak separately should the situation warrant. Lead spokespersons having primary responsibility for speaking on a given topic are designated, and are recognized by all parties. For example, the utility and NRC are primarily responsible for information about onsite

status and conditions, while the State is responsible for information relating to the impact of the emergency on the health and safety of its citizens. Beyond the JPIC, information will be issued in such places as NRC headquarters, State capitals, and at Congressional hearings. A broader joint information system has been developed to coordinate these activities with the JPIC. These systems have been implemented and tested to the extent practical during the two Federal Field Exercises held at the St. Lucie and Zion operating reactors.

G.2 and G.2.a, b, and c Provide Timely and Accurate Information

Presidential Commission Recommendation

The provision of accurate and timely information places special responsibilities on the official sources of this information. The effort must meet the needs of the news media for information but without compromising the ability of operational personnel to manage the accident. The Commission therefore recommends that:

Those who brief the news media must have direct access to informed sources of information.

Technical liaison people should be designated to inform the briefers and to serve as a resource for the news media.

The primary official news sources should have plans for the prompt establishment of press centers reasonably close to the site. These must be properly equipped, have appropriate visual aids and reference materials, and be staffed with individuals who are knowledgeable in dealing with the news media. These press centers must be operational promptly upon the declaration of a general emergency or its equivalent.

Status of Actions

The TMI-2 experience made clear the need to implement this recommendation. As a result, pre-designated Joint Public Information Centers (JPIC) have been identified near reactor sites that will be operational during a major accident, i.e., a general emergency situation. These JPICs have appropriate visual aids, reference materials, and communication and reproduction facilities readily available to meet the needs of the media. Emergency public information plans for NRC, other Federal agencies, the utility, and the State call for each party responsible for disseminating information to have a spokesperson at the JPIC with the appropriate expertise and authority to speak publicly for his or her organization.

In addition, communication and information approval links between the reactor site, the JPIC, and various control and support facilities have been established to ensure, to the extent practical, timely, consistent, and accurate information. These communication links permit the rapid flow of validated information to the principal spokesperson of each organization. Further, NRC, as well as other organizations, have designated selected technical experts to serve as advisors and briefers at the JPIC.

The JPIC and its support functions has proven effective in a number of major exercises. The exercises demonstrated that the anticipated needs of the media

have been accommodated without an undue impact on or interference with accident management and protective action assessment activities being implemented in other locations.

G.3 and G.3.a, b, and c Provide News Media Personnel a Greater Understanding of Nuclear Power

Presidential Commission Recommendation

The coverage of nuclear emergencies places special responsibilities on the news media to provide accurate and timely information. The Commission therefore recommends that:

All major media outlets (wire services, broadcast networks, news magazines, and metropolitan daily newspapers) hire and train specialists who have more than a passing familiarity with reactors and the language of radiation. All other news media, regardless of their size, located near nuclear power plants should attempt to acquire similar knowledge or make plans to secure it during an emergency.

Reporters discipline themselves to place complex information in a context that is understandable to the public and that allows members of the public to make decisions regarding their health and safety.

Reporters educate themselves to understand the pitfalls in interpreting answers to "what if" questions. Those covering an accident should have the ability to understand uncertainties expressed by sources of information and probabilities assigned to various possible dangers.

Status of Actions

Although NRC is unable to implement these recommendations, it has supported the objective by providing training opportunities for members of the media. This training covers how nuclear power plants operate, the effects of radiation, and the principles of reactor safety. For example, NRC has periodically conducted all-day seminars for news media "Nuclear Power and Radiation." Such seminars have been conducted in major cities throughout the country, including at the Technical Training Center in Chattanooga, Tennessee. The seminars provide background information and terminology useful in covering nuclear power plants or other stories involving radioactive materials. Several utilities have conducted seminars for the news media in their areas, and NRC has encouraged professional societies to do the same. On the basis of comments from participants in these seminars, they have been helpful in providing accurate information about the design and operation of commercial reactors and associated safety perspectives.

NRC and the utilities have also invited the news media, and in some cases college journalism classes, to participate in emergency exercises. Such participation provides more realism for the exercise, and offers reporters and students an opportunity to learn about nuclear plants and radiation.

G.4 Create Emergency Broadcast Networks

Presidential Commission Recommendation

State emergency plans should include provision for creation of local broadcast media networks for emergencies that will supply timely and accurate information. Arrangements should be made to make available knowledgeable briefers to go on the air to clear up rumors and explain conditions at the plant. Communications between state officials, the utility, and the network should be prearranged to handle the possibility of an evacuation announcement.

Status of Actions

NRC agreed that this recommendation had merit and revised its regulations to assure its implementation. As a result, NRC regulations (10 CFR 50.47(b)(5)) now state that "procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and followup messages to organizations and the public has been established; and means to provide early notification and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone have been established."

To implement this requirement, licensees have arranged with State and local government organizations for announcements to be made over the Emergency Broadcast System by designated local radio stations in order to disseminate appropriate information to the public. Information to clear up rumors and to explain current plant conditions will also be provided during scheduled briefings of the news media at a Joint Public Information Center (JPIC) established near the plant site following a serious emergency. State and local officials will also be present at the JPIC to disseminate information in their area of responsibility.

G.5 Routinely Inform the Public of Abnormal Radiation Measurements

Presidential Commission Recommendation

The Commission recommends that the public in the vicinity of a nuclear power plant be routinely informed of local radiation measurements that depart appreciably from normal background radiation, whether from normal or abnormal operation of the nuclear power plant, from a radioactivity cleanup operation such as that at TMI-2, or from other sources.

Status of Actions

NRC agreed with this recommendation. It is NRC's practice to ensure that a public announcement is issued on any release of radioactivity to the environment from a licensed facility if NRC radiation limits are exceeded. In this regard, NRC radiation limits are a small additional increment above normal background radiation levels to assure a low threshold for reporting and assessment purposes.

In addition, NRC encourages licensees to publicly announce any releases of radiation beyond the site boundary and releases within the site boundary that are significant in terms of exposure or potential exposure of employees. Most

utilities make it a practice to issue such announcements. Further, licensees are required to notify responsible State and local governmental agencies promptly after declaring an emergency. Such emergencies range from unusual events, in which usually no radioactivity is released but the potential for a degradation in safety exists, through levels of emergency classifications that could or do involve radiation releases. NRC also encourages licensees to publicly announce the declaration of such emergency classifications, even when radiation is not released, and most licensees do.