NUREG-0698
Rev. 1

50 pgs.

NRC Plan for Cleanup Operations at Three Mile Island Unit 2

Manuscript Completed: February 1982
Date Published: February 1982

TMI Program Office

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

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

March 16, 1982

ERRATA SHEET

for

NUREG-0698, Rev. 1

NRC PLAN FOR CLEANUP OPERATIONS
AT THREE MILE ISLAND UNIT 2

U.S. Nuclear Regulatory Commission

Please make the following corrections, as indicated, to report pages 1-1, 2-3, 4-6, and 6-1, and replace pages A-2 and A-3 with the attached revised pages.

Page 1-1	Correct footnote reference number appearing in last line of Section 1.1. Change "(NUREG-0689).[1]" to (NUREG-0699).[2]
Page 2-3	Correct last paragraph, first sentence, by deleting "The licensee...established" and starting with "A TMI-2 technical assistance and advisory group (TAAG) was recently established for the purpose of..."
	Correct last paragraph, last sentence, by adding after DOE--", through DOE's prime contractor at TMI-2, EG&G Idaho, Inc.
Page 4-6	Correct Section 4.21, subsection (4), by deleting last word of paragraph. Change "(ALARA) levels." to (ALARA).
Page 6-1	Correct reference number (4), line 1. Change EPICOR-I to EPICOR-II.
Pages A-2 and A-3	Replace with revised attached pages.

DIVISION OF TECHNICAL INFORMATION
AND
DOCUMENT CONTROL

The DOE will provide technical support to the licensee and the NRC as deemed appropriate.

DOE will work closely with the NRC and keep NRC informed of DOE's activities.

IV. Currently Identified TMI-2 Accident Generated Solid Radioactive Wastes

The following lists those TMI-2 accident generated solid radioactive wastes which currently exist or are planned to be generated. This listing may be modified in the future as the cleanup progresses.

1. EPICOR-II System Wastes

Forty-nine ion exchange resin liners with loadings up to 1500 curies/liner are in temporary storage at the TMI-2 site. DOE plans to develop a prototype high integrity container (HIC), production units of which, if utilized by the licensee, may allow these liners to be acceptable for licensed disposal in commercial land burial facilities some 1-2 years from now. DOE is also performing characterization experiments on one of these liners and may find it desirable to extend its R&D program to other liners. Should a more expeditious handling of these wastes be required due to the potential for a limited release to the storage environment (which could cause public concern), a contingency plan will be implemented wherein DOE would at its discretion take receipt of these EPICOR liners on a reimbursable basis from the licensee for storage or disposal. Future EPICOR II liners are anticipated to be loaded to allow commercial shallow land disposal offsite by the licensee

2. Submerged Demineralizer System Wastes

It is anticipated that the dispersed radioactivity in accident generated water will be deposited on zeolites in submerged demineralizer system (SDS) liners. Due to the unique character and nature of these wastes, DOE will take possession of and retain these liners to conduct a waste immobilization research and development and testing program.

3. Reactor Fuel

The present plan for the damaged core is to remove the fuel, provide appropriate fuel assemblies and samples to DOE for analysis characterization and archiving, place the balance in fuel storage containers, and store the fuel in the TMI Unit 2 spent fuel storage pool. As is the case with other nuclear power plant spent fuel, disposition of the balance of the TMI-2 fuel will await resolution of the spent fuel storage issue.

4. Transuranic Contaminated Waste Materials

As the cleanup progresses, some waste materials (e.g., sludges) may be found to be contaminated with transuranics at levels above which commercial low level burial facilities are authorized to accept. Alternatives for such material will be considered on a case-by-case basis and could include archiving, R&D evaluation or temporary storage onsite, or at a DOE facility awaiting further processing and/or disposal in a permanent repository offsite. Depending on the nature of

...se materials, DOE's activities could either take the form of an R&D program of generic value, or would be subject to reimbursement by the licensee.

5. Makeup and Purification System Resins and Filters

During the TMI-2 accident, the makeup and purification system demineralizer vessels and filters were highly contaminated by letdown of reactor coolant through the system. These resins and filters have not been characterized, however, based on radiation measurements, the resins and filters are believed to have specific activities well in excess of the loadings on the high specific activity EPICOR-II prefilters and are considered unsuitable for commerical land disposal. Due to the generic value of the information to be obtained and the very high specific activities of the filters, DOE will take possession and retain these filters for research and development activities. DOE's activities regarding the purification system resins will either take the form of an R&D program of generic value, or DOE will take possession of these resins for storage or disposal on a reimbursable basis.

6. Other Solid Radioactive Wastes

The low-level wastes associated with decontamination (e.g., some ion exchange media, booties, gloves, trash) will be disposed of by the licensee in licensed commercial low level burial facilities.

V. This Memorandum of Understanding will take effect when it has been signed by the authorized representative indicated below for each agency. DOE and NRC shall each have the right with the consent of the other party to modify this agreement.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Bernard J. Snyder, Program Director
TMI Program Office
Office of Nuclear Reactor Regulations

Date: 7/15/81

FOR THE U.S. DEPARTMENT OF ENERGY

Franklin E. Coffman
Acting Director
Office of Coordination and
Special Projects
Office of Nuclear Energy

Date: 7/15/81

TABLE OF CONTENTS

PREFACE

This plan defines NRC's role in cleanup operations at Three Mile Island Unit 2 (TMI-2) and outlines NRC's regulatory responsibilities in fulfilling this role. These responsibilities include reviewing and approving GPU Nuclear's (the licensee's) proposals for cleanup actions, overseeing the licensee's implementation of approved activities, coordinating with other Federal and state governmental agencies on their activities in the cleanup, and informing local officials and the public about the status of the cleanup operation.

Since the initial issuance of this NRC Plan in July 1980, the Final NRC Programmatic Environmental Impact Statement has been issued and a number of policy developments have occurred which will have an impact on the course of cleanup operations. This revision reflects these developments in the area of NRC's review and approval process with regard to cleanup operations and the NRC's interface with the Department of Energy's involvement in data acquisition and research and development activities. Another purpose of this revision is to update the cleanup schedule by presenting the cleanup progress that has taken place and the NRC's role in ongoing and future cleanup activities. However, because major uncertainties in the condition of the reactor plant still exist, portions of this plan are subject to further changes as cleanup work and related investigations continue. The estimated schedule as revised in this plan is likely to require further changes as availability of funding and other factors affect the pace of cleanup.

Dr. Bernard J. Snyder, Director
Three Mile Island Program Office
U.S. NRC

INTRODUCTION

Limited progress has been made on the cleanup of Three Mile Island Unit 2 (TMI-2) since the "NRC Plan for Cleanup Operations at TMI-2" (NUREG-0698) was initially issued in July 1980. The purpose of this revision to the NRC Plan is to reflect this progress by updating the status and schedule of cleanup activities. This revision also reflects policy developments in the area of NRC's review and approval process with regard to cleanup proposals and the NRC's Memorandum of Understanding reached with the Department of Energy (DOE) on disposal of radioactive waste from the TMI site. In addition, DOE has implemented a data collection and a research and development program for the acquisition and dissemination of generically valuable information on the accident and cleanup. Some of the major cleanup-related activities completed thus far include the following:

- On March 9, 1981, the Nuclear Regulatory Commission (NRC) issued a Final Programmatic Environmental Impact Statement (PEIS)[1] (NUREG-0683) related to the decontamination and disposal of radioactive wastes resulting from the accident. In that statement, a wide range of alternatives for decontaminating the TMI-2 facility, defueling the reactor and disposing of the radioactive wastes were considered and their potential impacts on the environment, members of the public and plant workers were indicated. In conjunction with the issuance of the PEIS, the Commission also issued a Policy Statement in April 1981 which stated that the cleanup should be expedited, consistent with maintaining public health and safety. In the Policy Statement, the Commission also outlined the NRC's policy in the review and approval of subsequent cleanup operations.

- The decontamination of 750,000 gallons of accident-generated water in the auxiliary and fuel handling building has been completed using the EPICOR-II System. Subsequently, in March 1981, NRC approved the shipment and disposal of commercial low-level waste consisting of 22 EPICOR-II resin liners used in processing this water. By July 1, 1981, all of these resin liners had been shipped to the commercial waste disposal site at Hanford, Washington, for final burial. Processed water is being stored onsite and at the same time being used for other cleanup activities.

- Following NRC approval, the reactor building's atmosphere was purged of krypton via a controlled purging method in June-July, 1980. Since that time, numerous entries into the reactor building have been made by the licensee for purposes of data gathering and maintenance work in support of decontamination efforts. Very small releases of krypton have been made (on the order of 10 curies or less) prior to each entry.

- In September 1981, decontamination of the balance of accident water located in the reactor building sump and reactor coolant system was initiated using the Submerged Demineralizer System (SDS), an underwater ion-exchange system. It is estimated that this initial treatment process will take a total of about 9 months to complete. Subsequent reprocessing with the SDS may be needed as the cleanup progresses.

1 OBJECTIVES

1.1 The NRC Objectives in TMI-2 Cleanup Operations

The expeditious cleanup and decontamination of Three Mile Island Unit 2 (TMI-2), including removal of the fuel from the accident-damaged reactor, are necessary for the long-term protection of public health and safety as well as to ensure the TMI site does not become a long-term or permanent waste repository. The NRC is responsible for the regulation of TMI-2 cleanup operations to assure the protection of the health and safety of the public and the environment. For all post-accident operations at TMI-2, NRC has maintained the following regulatory objectives:

(a) Maintain reactor safety and reactor building integrity,

(b) Assure that environmental impacts are minimized, and that radiation exposures to workers, to the public, and to the environment are within regulatory limits and are as low as reasonably achievable (ALARA), and

(c) Assure the safe storage and/or disposal of radioactive wastes from cleanup operations.

Implementation of cleanup activities is the responsibility of GPU Nuclear (the licensee). However, should the licensee and its parent company go bankrupt or otherwise default on its obligation to decontaminate the TMI-2 facility, NRC's role in decontamination operations may change. Nevertheless, NRC objectives in TMI-2 cleanup operations will remain the same because of its mandate to protect public health, safety, and the environment. To plan for such an eventuality, the NRC staff has prepared a contingency study of NRC actions required should the licensee be unable to finance the TMI-2 cleanup, entitled "Potential Impact of Licensee Default on Cleanup of TMI-2" (NUREG-0689).[1]

1.2 The Purpose and Scope of This Plan

The purpose of this NRC plan is to define the functional role of the NRC in cleanup operations at Three Mile Island Unit 2 to assure that agency regulatory responsibilities and objectives will be fulfilled. The plan outlines NRC functions in the following areas: (1) the relationship of NRC to other government agencies, the public, and the licensee for the coordination of activities, (2) the NRC review and decisionmaking procedure for the licensee's proposed cleanup activities and investigations, and (3) NRC's role in overseeing implementation of approved licensee activities. This plan also outlines a general schedule of major cleanup actions and the NRC's role in meeting these milestones.

Inspection functions at the site are carried out by Office of Inspection and Enforcement personnel under the direction of the onsite TMI Program Office (TMIPO) and are not described in detail in this plan.

2 NRC FUNCTIONS

The TMI Program Office (TMIPO) was established within the NRC Office of Nuclear Reactor Regulation (NRR) to provide overall direction of TMI-2 cleanup operations. The TMIPO has the following regulatory responsibilities:

(1) Planning and managing all NRC involvement in TMI-2 cleanup activities,

(2) Obtaining information and evaluating current facility status,

(3) Analyzing and reviewing the licensee's proposed action and procedures,

(4) Preparing technical review documents on the safety and environmental impacts of proposed licensee cleanup actions,

(5) Approving or disapproving the licensee's proposed actions and procedures,

(6) Advising the Commission on major cleanup actions,

(7) Coordinating NRC's TMI-2 cleanup activities with other governmental agencies as necessary,

(8) Informing State and local governments and the public on the status and plans for cleanup activities,

(9) Overseeing day-to-day licensee activities to ensure that operations are implemented in accordance with the facility's operating license and relevant orders and plans. Ensuring activities are carried out in compliance with approved NRC limits and procedures, and

(10) Coordinating with the NRC Office of Inspection and Enforcement on its TMI-2 inspection activities.

To perform these functions, the TMIPO has established a staff possessing management and technical expertise in key areas of the TMI-2 cleanup activities, e.g., radiation protection, radiological assessment, radwaste treatment, nuclear safety. Support by experts in other areas (e.g., meteorology, hydrology) is available from other NRC staff and, under arrangement with DOE and the National Laboratories. Contractors and consultants provide technical assistance when determined by the TMIPO to be necessary. The TMIPO also coordinates its activities with the licensee, other Federal agencies, State and local government officials, and the public. Figure 2.1 depicts the major TMI functional roles of these organizations and provides an overview of their functional relationship.

2.1 Support Functions

The NRC staff offices may be requested by TMIPO to provide specialized technical support in a number of areas. These may include the following: The Office of Nuclear Reactor Regulation (NRR) for hydrology, meteorology, geology,

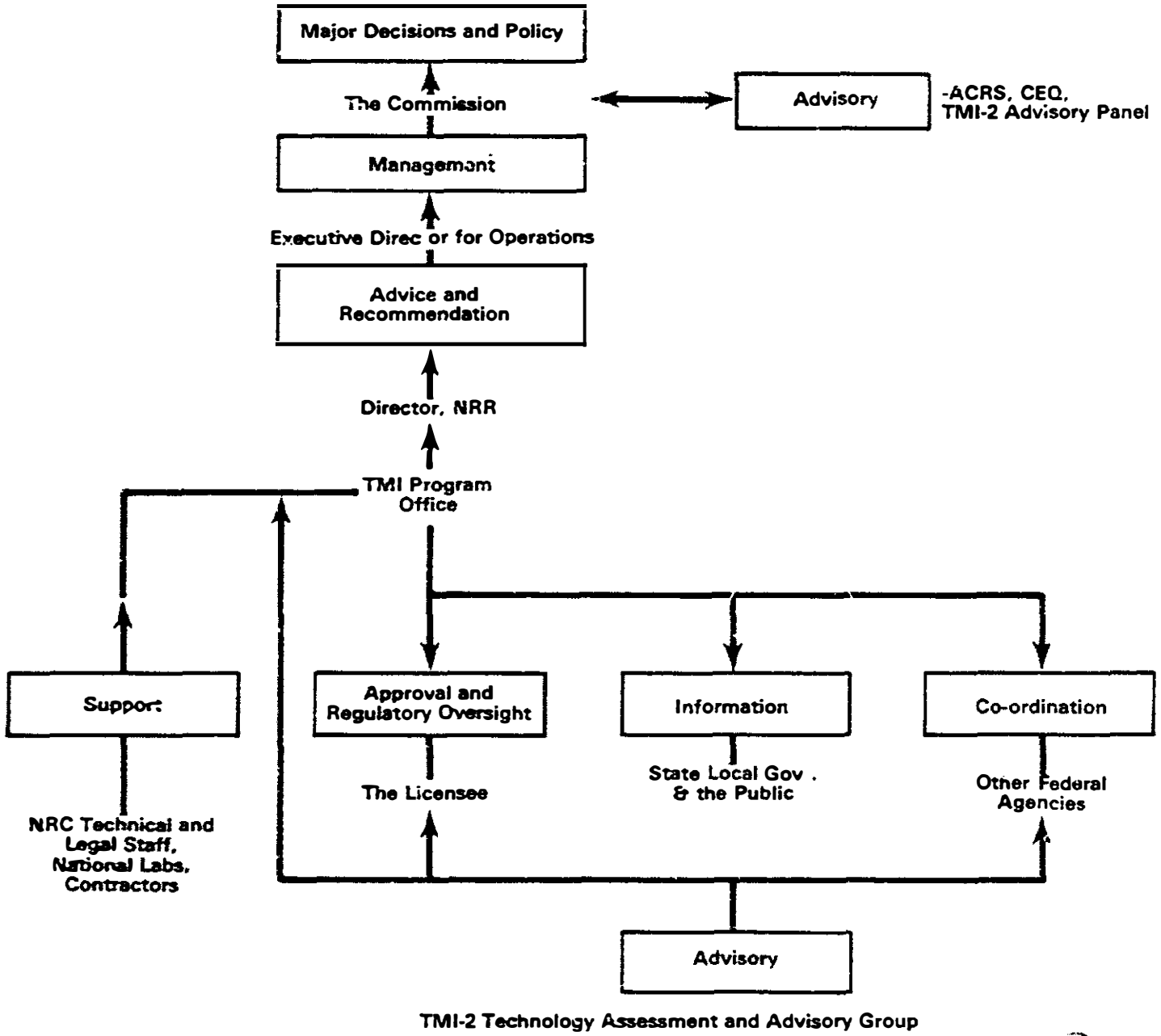


Figure 2.1 Major NRC Functional Roles in TMI-2 Cleanup Operations

reactor core analysis, and instrumentation and control systems; the Office of Nuclear Material Safety and Safeguards (NMSS) in processing, transportation, disposal and/or storage of radioactive waste; the Office of the Executive Legal Director (OELD) for legal advice; and Research (RES) in support for any needed research programs.

The TMIPO also obtains technical support from organizations such as National Laboratories and other contractors or consultants. These support tasks are managed by the TMIPO.

2.2 Coordination Functions

The TMIPO coordinates NRC functions with several other Federal agencies that are participating in cleanup operations. On July 15, 1981, a Memorandum of Understanding (MOU) was signed by the NRC and the Department of Energy which formalized the working relationship between the two agencies with respect to the removal and disposition of radioactive wastes generated during the cleanup of TMI-2 (Appendix 1). The memorandum addresses the following three basic categories of TMI-2 wastes:

(1) Wastes determined by DOE to be of generic value in terms of beneficial information to be obtained from further R&D activities (the MOU calls for DOE to perform such R&D activities at appropriate DOE facilities).

(2) Wastes determined to be unsuitable for commercial land disposal due to high levels of contamination, but which DOE may assume responsibility for their removal, storage and disposal on a reimbursable basis from the licensee, and

(3) Low-level wastes which are to be disposed of by the licensee in licensed, commercial low-level burial facilities.

The MOU specifically highlights currently identified TMI-2 wastes, e.g., EPICOR-II system wastes, Submerged Demineralizer System wastes, and reactor fuel wastes. The MOU also covers wastes which may be generated as the cleanup progresses.

The Environmental Protection Agency (EPA) is participating as the lead agency for offsite environmental monitoring programs, and the President's Council on Environmental Quality (CEQ) has been advising the Commission on its National Environmental Policy Act (NEPA) responsibilities. The TMIPO also coordinates with the Commonwealth of Pennsylvania, the State of Maryland, and local government officials on TMI-2 cleanup activities.

The licensee, with the cooperation of the Department of Energy and NRC staff, has recently established a TMI-2 Technical Assessment and Advisory Group (TAAG) for the purpose of providing independent technical assessment and advice on the decontamination and defueling of TMI-2. The objective is to assure that approaches to the various cleanup and defueling operations are technically adequate and that consideration has been given to maintaining radiation exposures as low as reasonably achievable (ALARA). The TAAG consists of between 6 to 10 permanent members and additional ad hoc members where special expertise is needed. The group will respond to specific requests from any of the three parties: the licensee, the NRC-TMIPO, or DOE.

A TMI Information and Examination Program has been established to acquire data which could significantly improve current understanding of nuclear plant accident environments and the phenomena which contribute to those environments. General Public Utilities, Electric Power Research Institute, NRC, and DOE jointly sponsor and participate in this program. In addition to the participation of NRC in the technical working group for this program, the NRC reviews the data acquisition tasks of the program to ensure that these tasks are implemented in coordination with ongoing cleanup activities, and to the maximum possible extent, utilizes these tasks and the data acquired for the benefit of the cleanup.

2.3 Information Functions

The TMIPO has the responsibility of keeping State and local government officials and the public informed on a continuing basis of the progress and the status of cleanup operations, as well as of future plans. This function is performed both by the TMIPO headquarters and onsite staff and by the TMIPO Field Office personnel in Middletown, PA. These offices disseminate information (for example, the weekly plant status report on the cleanup) routinely to local officials and the public. Additionally, meetings are conducted to keep the public and officials informed of the status and specific aspects of the cleanup effort.

2.4 Advice and Recommendation Functions

Licensee proposed cleanup operations may require the approval of the Commission if the estimated environmental impacts exceed those given in the PEIS. Towards this end, the TMIPO keeps the Commission informed as to the current status of cleanup operations and planning. To facilitate Commission decisionmaking for those proposals which require Commission approval, the TMIPO will develop recommendations based on its review and evaluation of the licensee's proposed cleanup plans. The TMIPO will also inform the Commission when staff actions are taken on significant cleanup activities which the staff is authorized to approve.

In 1980, the NRC established a 12-member TMI-2 Advisory Panel to consult with and provide advice to the Commission on major activities related to the decontamination and cleanup of TMI-2. The panel consists of members from the Commonwealth of Pennsylvania, local government, the scientific community as well as the public in the vicinity of TMI. The TMIPO provides liaison between the Commission and the TMI-2 Advisory Panel and also provides information to the panel on the status of the cleanup.

2.5 Regulatory Oversight Functions

NRC maintains regulatory oversight of the licensee's cleanup activities. In general, this function is accomplished in three phases: (1) long-term planning, (2) review and approval of proposed cleanup activities prior to their implementation, and (3) oversight of day-to-day operations. The NRC maintains cognizance of the licensee's long-term planning to assure that the licensee's cleanup objectives are consistent with those of the NRC in maintaining the health and safety of the public and workers, and minimizing environmental impacts. Day-to-day oversight by the TMIPO onsite staff provides assurance that activities are implemented according to approved plans and assures

compliance with existing NRC regulations, the facility's operating license and technical specification requirements, and approved procedures.

For certain activities, written procedures proposed by the licensee will require TMIPO review and approval. As part of the TMI-2 License, Section 6.8 of the Technical Specifications details the type of activities and requirements on written procedures. Technical Specification 6.8.1 is reproduced in Appendix 2.

3 NRC REVIEW AND DECISIONMAKING PROCEDURE

NRC review and approval are required prior to the implementation of cleanup operations by the licensee. Each cleanup activity proposed by the licensee will be reviewed by the TMIPO to assure that all applicable NRC requirements are met to protect the public's health and safety and minimize worker exposure. To the extent applicable, such review will draw upon the evaluation of the cleanup alternatives discussed in the PEIS and will focus on the safety and environmental impacts of the proposed activity.

In its Policy Statement[3] accompanying the PEIS, the Commission directed the staff to determine whether specific licensee cleanup proposals and the associated potential impacts fall within the scope of those already assessed in the PEIS. If the proposed actions are within the PEIS scope, the Director, TMIPO, has been delegated the approval authority, while keeping the Commission informed of the staff's actions on each major proposal. In addition, if a specific proposal requires an amendment to the facility operating license, public notice will be provided in accordance with Commission regulations. If the licensee's proposal is not within the PEIS scope, additional reviews by the TMIPO staff will be undertaken in accordance with NEPA and subsequent recommendations submitted to the Commission. The Commission has also reserved to itself any NRC action on licensee proposals with regard to the disposition of processed accident water.

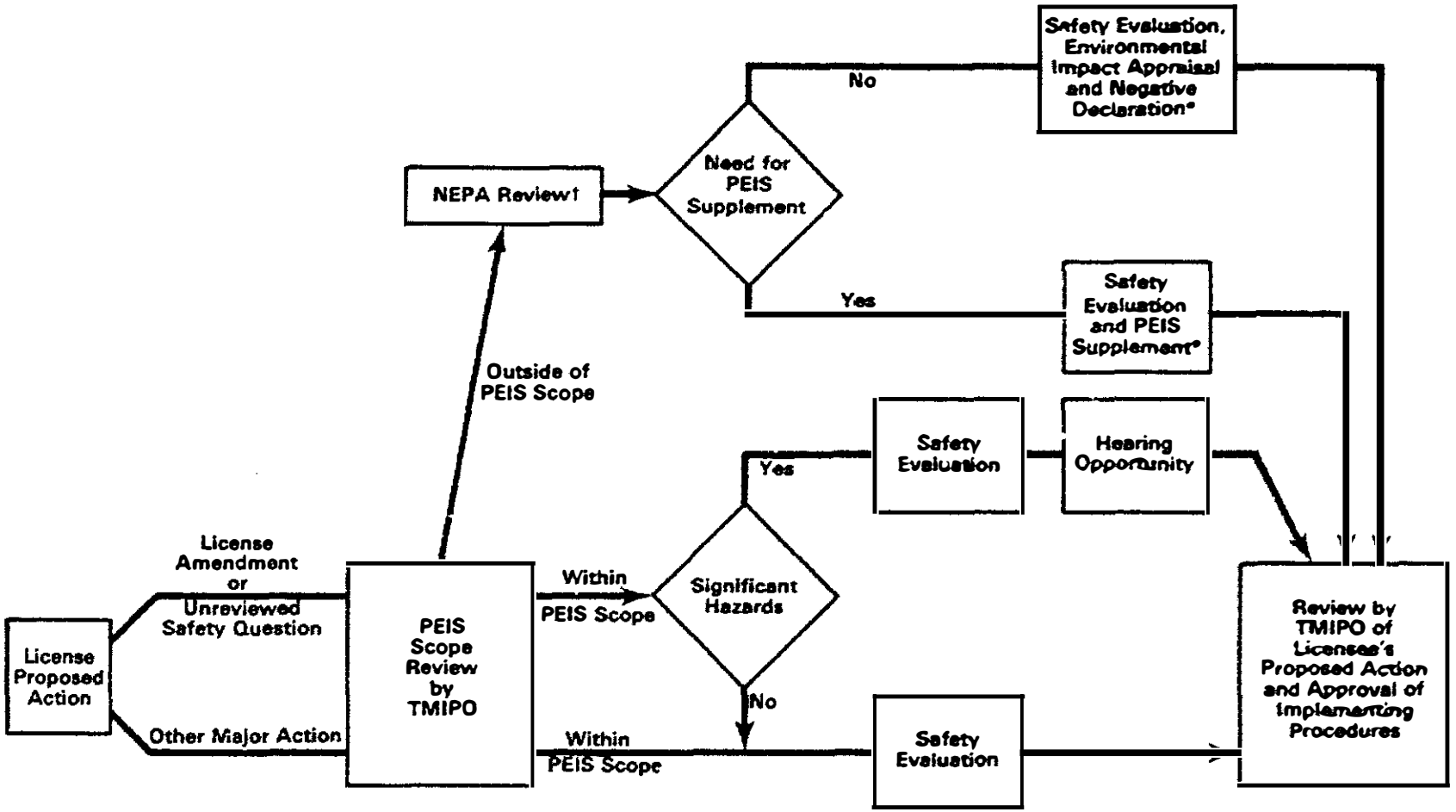
3.1 Proposals From the Licensee

NRC will independently review the licensee's proposed actions and, consistent with NRC's responsibilities, ensure that public health and safety and the environment will be adequately protected. In order to expedite the implementation of the licensee's activities, it is imperative that the licensee provide timely information on proposed actions to enable the TMIPO Staff to conduct safety and environmental reviews.

3.2 The NRC Review Process

The TMIPO has access to sufficient technical expertise to review, evaluate, and determine the adequacy of TMI-2 cleanup actions proposed by the licensee. All actions proposed by the licensee will be reviewed by TMIPO to determine whether the action can be undertaken with reasonable assurance that it will not endanger the health and safety of the public and is environmentally acceptable. Cleanup actions proposed by the licensee and the appropriate level of TMIPO review of these actions fall into two categories as shown in Figure 3.1:

(1) If the proposed action involves a request for a license amendment or an unreviewed safety question, the TMIPO staff will first determine if it is within the scope of the PEIS. A proposed cleanup activity would be considered to be within the scope of those already addressed in the PEIS if the following conditions are satisfied:



*Commission Approval Required

†Also Significant Hazards Determination if Involves License Amendment or Unreviewed Safety Question

Figure 3.1 NRC Review of License Proposed Activities

a. The proposed method is similar to the general type of activities discussed in the PEIS for the cleanup and/or disposal of radioactive wastes from the TMI facility.

b. Its potential environmental impacts are not significantly different (qualitatively and quantitatively) from those environmental impacts asssociated with this type of activity as assessed in the PEIS.

In addition to the PEIS scope of review, a significant hazards determination will be performed by the TMIPO staff and a safety evaluation will be prepared. If significant hazards are found to exist, an opportunity will be given for a public hearing prior to approval of the proposed action. In accordance with NRC Regulations, if no significant hazard exists, a notice for an opportunity of a hearing prior to approval and implementation of the proposed action, will not be given. For either case, TMIPO review of the proposal would be accompanied by its review and approval of the procedures to implement the proposed activity.

If it is determined that any major activity or predicted environmental impacts fall outside the scope of those already assessed in the PEIS, the TMIPO staff will complete necessary reviews in accordance with the National Environmental Policy Act (NEPA) and NRC requirements. If it is determined that a supplement to the PEIS is appropriate, the supplemental environmental statement will be prepared under the direction of the TMIPO. In the event a proposed activity falls outside of the scope of the PEIS, but does not require the preparation of a supplemental environmental impact statement, the TMIPO staff will publish a negative declaration to that effect and provide an Environmental Impact Appraisal in support of the negative declaration. Action on proposals which are outside the scope of the PEIS will be taken by the Commission itself.

Figure 3.2 illustrates the NRC review process for the supplement to the PEIS. Opportunity for the review of a draft supplement to the PEIS is afforded the public during a defined comment period. Other government agencies having an interest in the review, monitoring, and in some cases, participation in some phases of the proposed cleanup operation will be involved in the review of the supplement to the PEIS. Government agencies likely to have such potential interests and their involvement in the review process are indicated in Figure 3.2.

(2) If the action, although major, does not involve the need for a license amendment and the action does not involve an unreviewed safety question as described in 10 CFR Part 50.59, the TMIPO performs a safety review of the licensee's proposal and approves detailed implementation procedures prior to implementation. In this case, the TMIPO review must also determine the proposed action and its potential environmental consequences are within the scope of that discussed in the PEIS. If they are outside of the scope of activities evaluated in the PEIS, the TMIPO will proceed with the review in accordance with NEPA and NRC requirements as outlined in Paragraph 3.2(1) above.

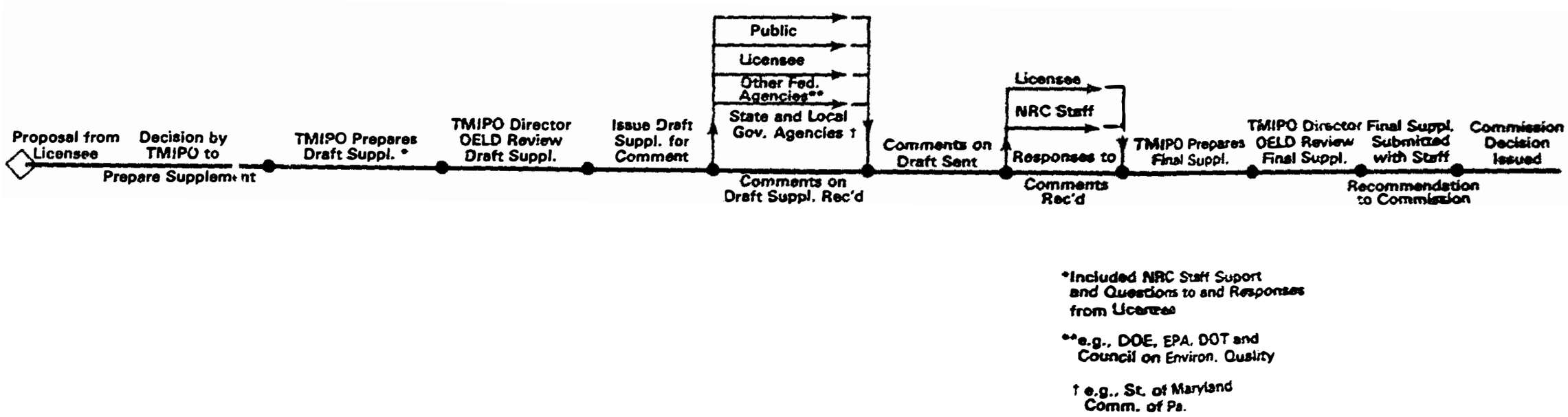


Figure 3.2 NRC Review for TMI-2 Operation Requiring a Supplement to the PEIS

4 THE MASTER SCHEDULE OF MAJOR CLEANUP ACTIONS

Each cleanup operation could he accomplished by a number of alternative methods. A review of generalized alternatives has been presented in the PEIS. The alternative chosen for a specific operation will depend, to a large degree, on the specific condition of the facility, the anticipated environmental impact as well as available financial resources. Specific information about these conditions will become available only as the cleanup progresses. Depending on the alternatives selected, the type and extent of preparation and support facilities required will vary. For this reason, the anticipated schedule of cleanup actions will only designate the type of operation and support activities and not the methods to be used.

Although there are overlapping cleanup efforts (e.g., the processing of contaminated water would be an on-going task), operations, in general, are expected to proceed sequentially according to the milestones shown in Figure 4.1. Also scheduled are a number of major support activities and facilities that are planned to be in place for each milestone prior to those cleanup operations.

An outline of the master schedule of anticipated actions is presented in Figure 4.2. The time lines in Figure 4.2 are based on the licensee projections as of October 1981 and are subject to modification depending on the pace of the cleanup which will be determined, in large part, by available funding and the condition in the reactor. The sequencing of cleanup activities is anticipated to generally remain the same. Not included in Figure 4.2 is the schedule for disposition of processed water. This schedule is dependent on possible reuse of processed water for decontamination activities, specific proposals by the licensee and the Commission's approval of an alternative for the disposition of processed water. The removal of radwaste from the TMI site is an ongoing activity. With the MOU between DOE and NRC, it is expected that DOE will be able to take those radwastes needed for generic research and development and those unacceptable for commercial disposal sites. Thus, onsite storage of radwastes for significant duration should not be necessary, assuming adequate funding for DOE's research and development efforts and the availability of sites for waste which are suitable for disposal in commercial burial facilities.

4.1 Current Status and Cleanup Accomplishments

TMI-2 cleanup activities began soon after the accident on March 28, 1979. To date, a number of milestones have been reached in the cleanup effort. In this regard, the following tasks and associated NRC actions have been or are currently being completed.

Auxiliary and Fuel Handling Building (AFHB) Cleanup

Cleanup of contaminated surfaces and equipment in the AFHB is about 80% complete, with the exception of a number of isolated cubicles. It should be noted, however, that near-term access to these cubicles is not considered vital to

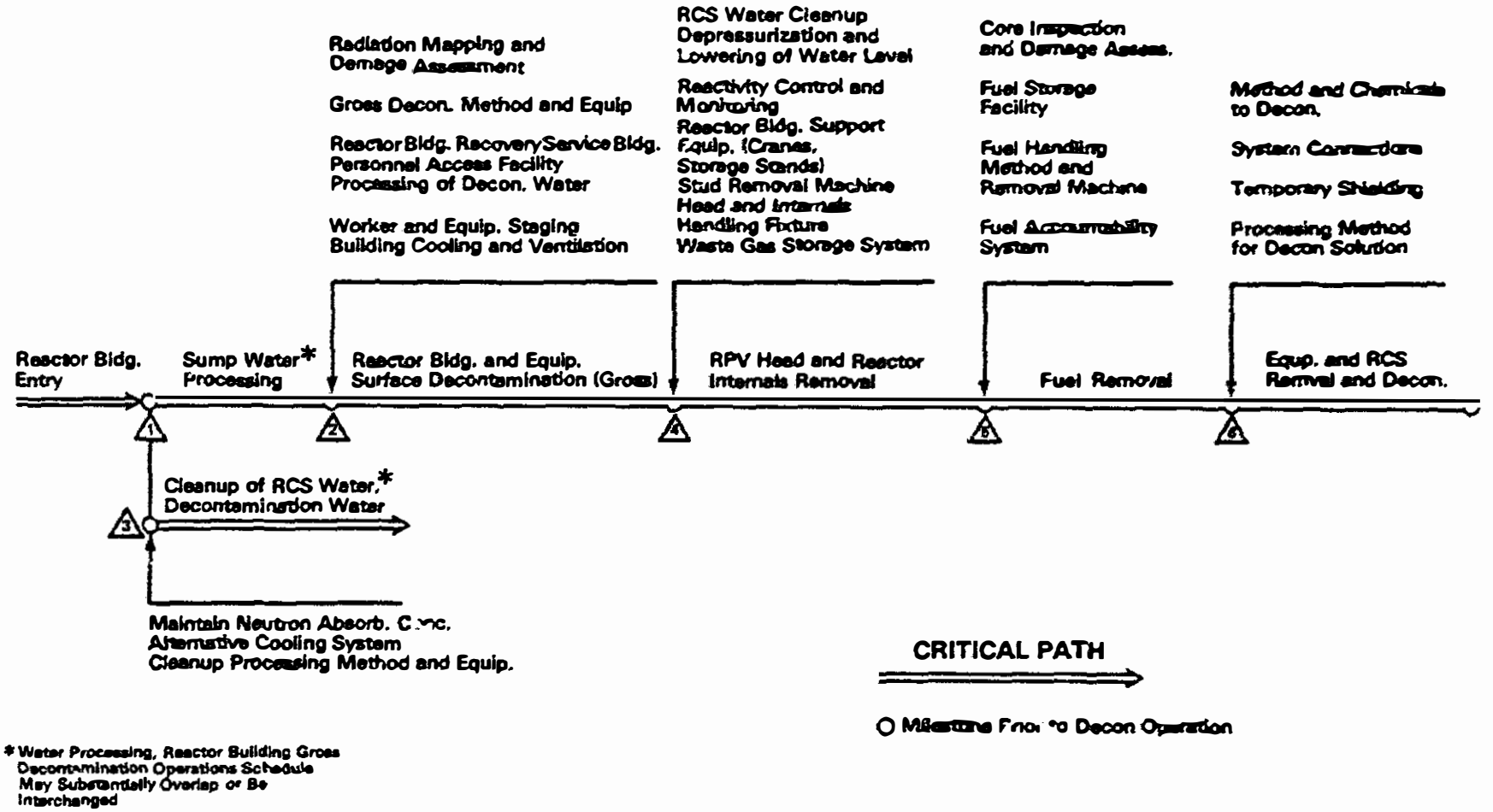


Figure 4.1

Critical Path and Key Preparations for Cleanup Operations

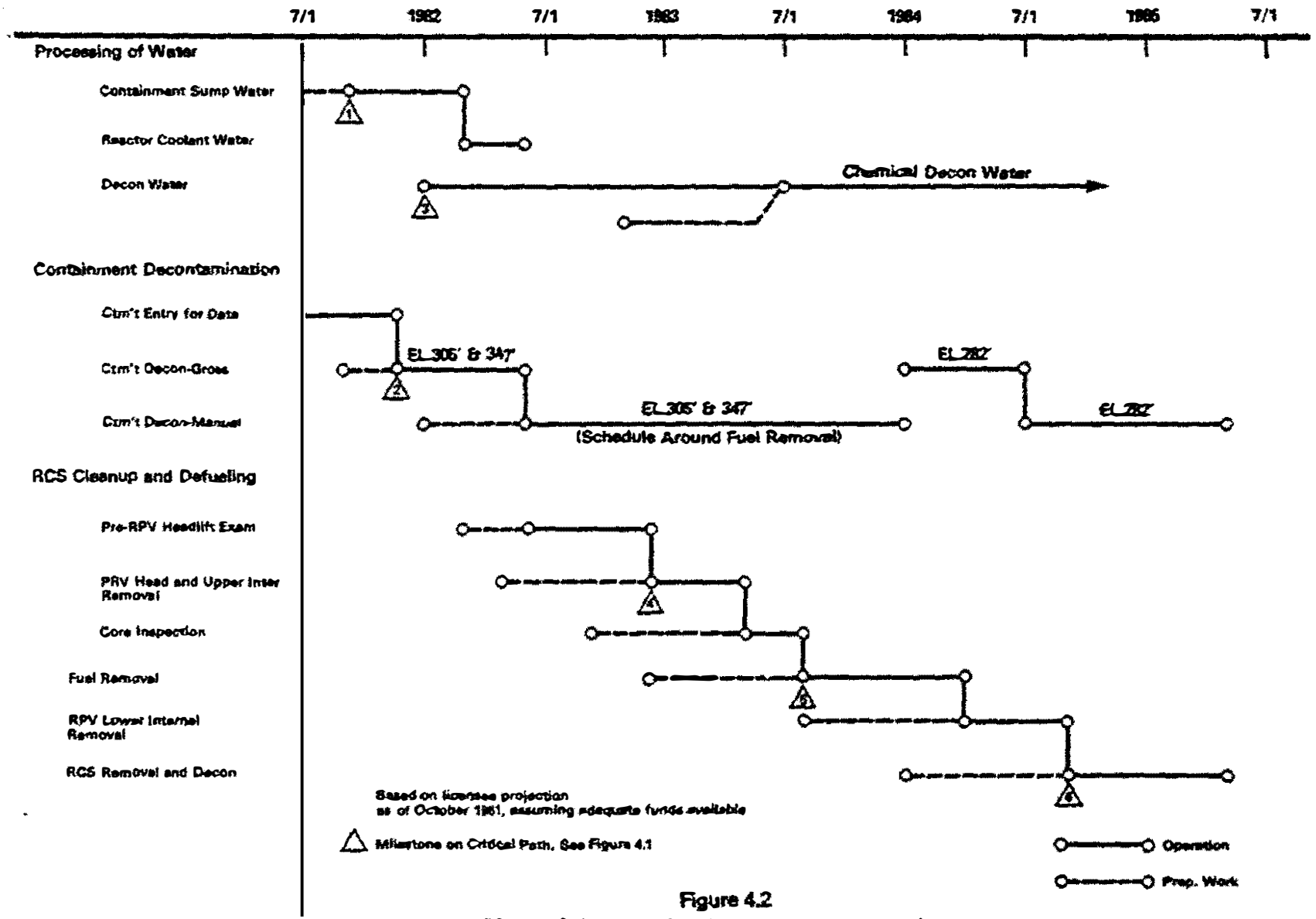


Figure 4.2
Master Schedule of Major NRC/Licensee Actions

reactor safety maintenance or other on-going cleanup efforts in the reactor building.

Following the accident, about 450,000 gallons of water contaminated with intermediate levels of radioactivity (i.e., between 1 and 100 uCi/mL) were held in various tanks and sumps in the AFHB. To decontaminate this water, the licensee proposed using a three stage demineralization system--the EPICOR-II System. The NRC staff reviewed the proposal and performed an environmental assessment of the use of the EPICOR-II System and provided the Commission with its recommendations (NUREG-0591).[4] After considering the staff's recommendation, the Commission issued a Memorandum and Order on October 16, 1979, directing the licensee to use the EPICOR-II System for cleanup of the water in the AFHB. Subsequently, appropriate detailed operating procedures were reviewed and approved by the NRC staff. Processing of this water has been completed.

Reactor Building Atmosphere Cleanup

In order to facilitate safe access to the reactor building, gaseous radioactive materials in the reactor building atmosphere had to be removed. In March 1980, the NRC staff issued a draft environmental assessment of a number of alternatives for the decontamination of the reactor building atmosphere. Comments from the public and government agencies were received and ultimately incorporated in a final environmental assessment (NUREG-0662).[5] One month later, the Commission issued a Memorandum and Order authorizing the licensee to decontaminate the reactor building's atmosphere of krypton gas via controlled purging. The NRC decision to permit krypton purging was reached on the basis that it would pose negligible physical public health risks and be the quickest and simplest method, thereby reducing the time local residents would be under potential psychological stress. Purging operations began on June 28, in accordance with detailed procedures approved by the TMIPO staff, and were completed by July 11, 1980. Approximately 43,000 curies of krypton-85 were purged during this period. Small quantities (order of 100 curies) remain in the reactor building and a few curies are vented prior to each manned entry into the reactor building.

Reactor Building Entries

Entries into the reactor building for purposes of damage assessment, data collection and equipment maintenance began on July 23, 1980, after the reactor building atmosphere cleanup had been accomplished. By January 1982, 31 entries had been made by the licensee and its contractors. Prior to each entry, the NRC TMIPO onsite staff reviewed the planned tasks and radiation protection precautions and closely monitored the activities of each entry. Occupational doses incurred during these reactor building entries continue to be monitored by the TMIPO staff to ensure that radiation doses are kept as low as reasonably achievable (ALARA).

Plant Effluents and Waste Disposal

Following the issuance of the PEIS, the technical specifications of TMI-2 governing the limits for radioactive material in effluents were amended to incorporate those proposed in Appendix R of the PEIS. In general, these technical specifications now limit the radioactive material releases in gaseous

and liquid effluents to those stated as design objectives for operating reactors in Appendix I of 10 CFR Part 50.

Low-level solid wastes (e.g., compacted trash, dewatered resins with radioactivity less than 1 μCi/mL) have been shipped to commercial disposal sites for burial. EPICOR-II prefilter resin wastes are currently stored onsite, awaiting subsequent shipment to DOE facilities for research and development purposes. On July 15, 1981, NRC and DOE entered into a Memorandum of Understanding whereby DOE agreed to accept certain TMI wastes for purposes of research and development at appropriate DOE facilities. In addition, DOE may also assume responsibility for removal, storage and disposal (on a reimbursable basis from the licensee) of wastes determined to be unsuitable for commercial land disposal due to high levels of contamination.

SDS/EPICOR-II System Operations

The licensee proposed to decontaminate accident water in the reactor building sump and the reactor coolant system via a Submerged Demineralization System (SDS). Effluents from the SDS would then be polished with the EPICOR-II System.

The TMIPO staff reviewed this proposal and determined the potential environmental impacts from the proposed operation of the SDS to be within the scope of the PEIS. Subsequently, in June 1981, the staff issued a Safety Evaluation Report (NUREG-0796)[6] which authorized the licensee to proceed with the processing of water by the SDS/EPICOR-II System. Processing of the reactor building sump water, in accordance with detailed procedures reviewed and approved by the TMIPO staff, began on September 16, 1981 and is expected to continue for about 9 months. System operation and quality of the processed water is being monitored by the TMIPO staff. The processed water will be reused and/or stored onsite in two 500,000-gallon tanks until a disposal proposal is submitted by the licensee, review and recommendations are made by the TMIPO, and a decision on the proposal is made by the Commission.

4.2 Future Major Cleanup Activities

The following is a discussion of anticipated major cleanup activities and relevant NRC staff involvement.

4.2.1 Reactor Building and Equipment Surface Decontamination

The purpose of this cleanup activity is twofold. First, by means of a gross decontamination, it should be possible to decrease the radiation exposure and contamination levels in the reactor building to acceptable occupational exposure levels so that worker occupancy-intensive activities such as hands-on decontamination work related to fuel removal can be carried out. Subsequent to the gross decontamination, manual decontamination efforts will be employed to cleanup the facilities such that fuel removal and, subsequently, decommissioning or refurbishment operations can be initiated.

The staff's review of the proposal to implement this operation would, in part, be based on the following information:

(1) radiation levels and damage assessment gathered when the reactor building is entered and surveyed,

(2) the proposal for gross and (subsequent) manual decontamination methods that specifies equipment and detergents or other chemicals needed for cleanup operations,

(3) the proposal for processing the resulting decontamination liquids (water and detergents, if any),

(4) an analysis of the safety and environmental consequences of the proposed action, including estimates of occupational exposures and radiation protection measures necessary to maintain these doses as low as reasonably achievable (ALARA) levels.

In the PEIS, decontamination of the reactor building was determined to be the cleanup activity which could result in the highest occupational dose (although health effects would not be significant). Consequently, the NRC staff will closely monitor this decontamination operation and track occupational exposures incurred to ensure adherence to the ALARA principle.

4.2.2 Reactor Pressure Vessel (RPV) Head and Reactor Upper Internals Removal

The licensee's proposal for this activity should be based on prelift examination data and should contain information on methods of RPV head and reactor upper plenum assembly removal. Special consideration should be given to damage from the accident that would possibly hinder removing the RPV head (e.g., distortion, warping, and/or physical dislocation), criticality control, core cooling, reactor coolant cleanup, RCS depressurization and lowering of reactor coolant level. The following concerns will also be reviewed by the staff regarding the proposed activity:

(1) the radiation levels expected in the worker occupancy areas,

(2) total occupational exposure and radiation-protection features,

(3) safety concerns of handling to prevent heavy loads to strike the core after RPV head removal, and

(4) airborne radioactivity control and environmental consequences

The reactor building polar crane, or its replacement, must be operational for this activity. In addition, other support systems, facilities, and equipment requiring NRC reviews include systems to monitor and control the reactivity of core debris, a system for the processing and storage of waste gases from the primary cooling system, facilities for the staging and storage of the RPV head and internals, an RPV head and internals handling fixture, and stud-removal equipment.

4.2.3 Fuel Removal

The licensee's proposal should contain information on the status of the reactor following the RCS water cleanup and RPV head and reactor upper plenum removal operations, with special attention given to those factors that would affect core examination (e.g., reactor water purity, fuel assembly debris, and radiation levels at the top of the RPV). The staff review would also include the following concerns with regard to proposed fuel removal activity:

(1) the proposed core examination objectives and methods;

(2) condition of the core and methods to prevent recriticality during defueling operations;

(3) fuel removal methods (including the anticipated damaged condition of the reactor core and proposed procedures to remove the fuel under those conditions);

(4) methods to retrieve and clean materials that may become detached (e.g., fuel pellets, cladding fragments) during the proposed fuel removal;

(5) methods of fuel transfer, canning, and storage;

(6) fission-product monitoring and consequences of releases;

(7) the safety and environmental consequences of the proposed action, including estimates of occupational exposures and radiation-protection measures required to maintain these doses as low as reasonably achievable (ALARA);

(8) an accident analysis of the potential consequences of a dropped fuel assembly and/or an accident caused by equipment dropped onto the reactor core;

(9) the design criteria and technical information about the equipment proposed for the core examination and fuel removal operations, and

(10) detailed procedures for each phase of the defueling operation.

A number of support systems and special equipment for the proposed actions will require NRC review. These items include equipment for core examination; fuel containers and a storage facility; underwater cutting and grappling equipment; fuel handling and lifting apparatus; a fission-product gas monitoring and processing system; detached material collection and cleanup systems and a water cleanup system. In addition, during this phase of the cleanup operation, the NRC staff will be in close coordination with DOE which is expected to participate in the defueling operation.

4.2.4 Reactor Coolant System Decontamination

The licensee's proposal for this operation should contain information on the levels of contamination of, and damage to, the reactor system components that require decontamination or removal. For each of these major components, cleanup methods should be proposed (e.g., drain/flush and chemical decontamination and/or removal). The staff review on the proposal will also include consideration of the following topics:

(1) the amounts, activity levels, and chemical properties of liquid radwastes to be generated from the proposed action,

(2) the methods of detecting fuel and fission products,

(3) the method for processing the liquid radwaste and the expected results,

(4) radiation protection features and estimates of occupational exposures,

(5) criteria and information for RCS decontamination, and

(6) procedures proposed for the operation.

Depending on the condition of the facility and on the proposed method of cleanup, supporting systems for this operation may include the use of the reactor coolant pumps, special equipment for high-pressure flushing of coolant lines, systems to prepare and introduce chemical decontamination solutions, solid radwaste processing systems, and processed decontamination water and solid radwaste storage or staging facilities.

5 LICENSEE IMPLEMENTATION OF ACTIONS

The licensee is responsible for maintaining reactor safety and for implementing NRC-approved actions throughout the TMI-2 cleanup operation. NRC's responsibility is to ensure that the licensee's actions meet NRC cleanup objectives and that they are implemented according to existing regulations, TMI-2 Operating License and Technical Specifications, and approved procedures. The NRC is also responsible during the implementation of cleanup actions for coordination with other agencies involved in the cleanup.

NRC Actions

The NRC, mainly through the onsite TMIPO, will maintain cognizance of the current status of on-going cleanup operations to ensure that they are proceeding according to NRC orders, the facility operating license and Technical Specifications, and approved procedures.* The licensee's monitoring data and effluent releases reports will be reviewed. Independent monitoring of licensee results will be performed. This information and the progress of cleanup operations will be routinely communicated to government officials and the public, for example, through the issuance of weekly plant status reports.

Other-Agency Actions

Other agencies will participate in cleanup operations. For example, the EPA has the responsibility to monitor the area around Three Mile Island. DOE has proposed a major research and development and data acquisition program in connection with the cleanup to ensure that useful generic information is obtained and disseminated. Pursuant to the July 15, 1981 Memorandum of Understanding with NRC, DOE has, as part of its program, agreed to accept radioactive wastes needed for research and development purposes. Also, the TMIPO will continue to be in contact with the Pennsylvania Department of Environmental Resources and the Maryland Department of Natural Resources. These and any other activities that may be needed from Federal, State, or local government agencies will be coordinated by the TMIPO.

*See Section 2.5 for procedures requiring approval.

6 REFERENCES

(1) NUREG-0683, "Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting From March 28, 1979, Accident Three Mile Island Nuclear Station, Unit 2," March 9, 1981.

(2) NUREG-0689, "Potential Impact of Licensee Default on Cleanup of TMI-2," November 1980.

(3) NRC Policy Statement on Cleanup of Three Mile Island Plant, April 28, 1981.

(4) NUREG-0591, "Environmental Assessment for Use of EPICOR-I at Three Mile Island; Unit-2," October 3, 1979.

(5) NUREG-0662, "Final Environmental Assessment for Decontamination of the Three Mile Island Unit 2 Reactor Building Atmosphere, Final NRC Staff Report," May 1980.

(6) NUREG-0796, "Safety Evaluation Report Related to the Operation of the Submerged Demineralizer System at Three Mile Island Nuclear Station, Unit No. 2," June 1981.

APPENDIX A

Memorandum of Understanding
Between the
U. S. Nuclear Regulatory Commission
and the
U. S. Department of Energy
Concerning the Removal and Disposition of
Solid Nuclear Wastes from Cleanup of the
Three Mile Island Unit 2 Nuclear Plant

I. Objective

This memorandum of understanding specifies interagency procedures for the removal and disposition of nuclear wastes resulting from cleanup of the Three Mile Island Unit 2 plant.

II. NRC Roles and Responsibilities

The NRC has the responsibility under the Atomic Energy of 1954 as amended (42 U.S.C. 2011 et seq.), to regulate all licensee activities at the TMI-2 site, including waste management, and ensure these activities are carried out in accordance with the requirements of applicable rules and regulations and the requirements of Facility Operating License Number DPR-73, as modified by amendments or orders issued by the NRC. NRC will carry out its responsibilities by onsite observation of licensee activities. As required, policy, and technical support will be provided to the NRC TMI Site Office by NRC Headquarters and Regional Offices(s).

NRC will work cooperatively and closely with the DOE, and will keep DOE fully and currently informed of NRC's activities.

NRC will continue to keep public, state and local officials informed of NRC's activities. When appropriate, NRC will involve DOE in these information exchanges with the public, state and local officials.

III. DOE Role and Responsibilities

Where DOE determines that generically beneficial research, development and testing of the TMI-2 accident generated solid wastes can be carried out, DOE will perform such activities at appropriate DOE facilities. For those other wastes that cannot be disposed of in commercial low level waste facilities, DOE may also assume responsibility for removal, storage, and disposal to the extent that the licensee provides reimbursement to the DOE. These activities will be undertaken to the extent consistent with apropriate statutory authority. NRC licensing of DOE facilities that are utilized for storage, processing or disposal of TMI-2 accident generated wastes will not be required since these facilities have primary uses other than for receipt and storage of wastes resulting from licensed activities.

The DOE will provide technical support to the licensee and the NRC as deemed appropriate.

DOE will work closely with the NRC and keep NRC informed of DOE's activities.

IV. Currently Identified TMI-2 Accident Generated Solid Radioactive Wastes

The following lists those TMI-2 accident generated solid radioactive wastes which currently exist or are planned to be generated. This listing may be modified in the future as the cleanup progresses.

1. EPICOR-II System Wastes

Forty-nine ion exchange resin liners with loadings up to 1500 curies/liner are in temporary storage at the TMI-2 site. DOE plans to develop a prototype high integrity container (HIC), production units of which, if utilized by the licensee, may allow these liners to be acceptable for licensed disposal in commercial land burial facilities some 1-2 years from now. DOE is also performing characterization experiments on one of these liners and may find it desirable to extend its R&D program to other liners. Should a more expeditious handling of these wastes be required due to the potential for a limited release to the storage environment (which could cause public concern), a contingency plan will be implemented wherein DOE would at its discretion take receipt of these EPICOR liners on a reimbursable basis from the licensee for storage or disposal. Future EPICOR II liners are anticipated to be loaded to allow commerical shallow land disposal offsite by the licensee.

2 Submerged Demineralizer System Wastes

It is anticipated that the dispersed radioactivity in accident generated water will be deposited on zeolites in submerged demineralizer system (SDS) liners. Due to the unique character and nature of these wastes, DOE will take possession of and retain these liners to conduct a waste immobilization reseach and development and testing program.

3. Reactor Fuel

The present plan for the damaged core is to remove the fuel, provide appropriate fuel assemblies and samples to DOE for analysis characterization and archiving, place the balance in fuel storage containers, and store the fuel in the TMI Unit 2 spent fuel storage issue.

4. Transuranic Contaminated Waste Materials

As the cleanup progresses, some waste materials (e.g., sludges) may be found to be contaminated with transuranics at levels above which commercial low level burial facilities are authorized to accept. Alternatives for such material will be considered on a case-by-case basis and could include archiving, R&D evaluation or temporary storage onsite, or at a DOE facility awaiting further processign and/or disposal in a permanent repository offsite. Depending on the nature of these materials, DOE's activities could either take the form of an R&D program of generic value, or would be subject to reimbursement by the licensee.

information to be obtained and the very high specific activities of the filters, DOE will take possession and retain these filters for research and development activities. DOE's activities regarding the purification system resins will either take the form of an R&D program of generic value, or DOE will take possession of these resins for storage or disposal on a reimbursable basis.

6. Other Solid Radioactive Wastes

The low-level wastes associated with decontamination (e.g., some ion exchange media, booties, gloves, trash) will be disposed of by the licensee in licensed commercial low level burial facilities.

V. This Memorandum of Understanding will take effect when it has been signed by the authorized representative indicated below for each agency. DOE and NRC shall each have the right with the consent of the other party to modify this agreement.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Bernard J. Snyder, Program Director
TMI Program Office
Office of Nuclear Reactor Regulations

Date: 7/15/81

FOR THE U.S. DEPARTMENT OF ENERGY

Franklin E. Coffman
Acting Director
Office of Coordination and
Special Projects
Office of Nuclear Energy

Date: 7/15/81

Appendix B

TMI-2 Technical Specification on Written Procedures

6.8 Procedures

6.8.1 Written procedures shall be established, implemented and maintained covering the activities referenced below:

a. The applicable procedures recommended in Appendix "A" of Regulatory Guide 1.33, Revision 2, February 1978.

b. Recovery Operations Plan implementation.

c. Surveillance and test activities of safety-related equipment and radioactive waste management equipment.

d. Security Plan implementation.

e. Emergency Plan implementation.

f. Radiation Protection Plan implementation.

g. RECOVERY MODE implementation. (Specifically RECOVERY MODE procedures which involve a reduction in the margin of safety, including those which:)

   1. Directly relate to core cooling.

   2. Could cause the magnitude of radiological releases to exceed limits established by the NRC.

   3. Could increase the likelihood of failures in systems important to nuclear safety and radioactive waste processing or storage.

   4. Alter the distribution or processing of significant quantities of stored radioactivity or radioactivity being released through known flow paths.

Pending approval by the NRC of written procedures required by 6.8.1a. through g. above, the licensee shall follow the previously approved procedures.

NRC FORM 335 (7-77) U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER (Assigned by DDC)
NUREG-0698 Revision 1

4. TITLE AND SUBTITLE (Add Volume No., if appropriate)
Plan for Cleanup Operations at Three Mile Island Unit 2: Revision 1

2. (Leave blank)

3. RECIPIENT'S ACCESSION NO.

7. AUTHOR(S)
Ronnie Lo and Bernard Snyder

5. DATE REPORT COMPLETED
MONTH February YEAR 1982

9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Three Mile Island Program Office
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, D.C. 20555

DATE REPORT ISSUED
MONTH February YEAR 1982

6. (Leave blank)

8. (Leave blank)

12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)
Three Mile Island Program Office
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, D.C. 20555

10. PROJECT/TASK/WORK UNIT NO.

11. CONTRACT NO.

13. TYPE OF REPORT

PERIOD COVERED (Inclusive dates)

15. SUPPLEMENTARY NOTES

14. (Leave blank)

16. ABSTRACT (200 words or less)

This NRC Plan, which defines NRC's functional role in cleanup operations at Three Mile Island Unit 2 and outlines NRC's regulatory responsibilities in fulfilling this role, is the first revision to the initial plan issued in July 1980 (NUREG-0698).

Since 1980, a number of policy developments have occurred which will have an impact on the course of cleanup operations. This revision reflects these developments in the area of NRC's review and approval process with regard to cleanup operations as well as NRC's interface with the Department of Energy's involvement in the cleanup and waste disposal. This revision is also intended to update the cleanup schedule by presenting the cleanup progress that has taken place and NRC's role in ongoing and future cleanup activities.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

18. AVAILABILITY STATEMENT
Unlimited

19. SECURITY CLASS (This report)
Unclassified

21. NO. OF PAGES

20. SECURITY CLASS (This page)
Unclassified

22. PRICE
$