EVALUATION OF THE CLEANUP ACTIVITIES AT THREE MILE ISLAND

Report of a special task force formed by
NRC's Acting Executive Director for Operations

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I. INTRODUCTION

A. Background

The accident at the Three Mile Island, Unit 2, nuclear reactor occurred on March 28, 1979. Since that time the reactor and its damaged nuclear fuel have been maintained in a stable condition -- currently the primary system is at about 280 psi pressure and about 150°F average temperature. (See Appendix 1)

Manned entry into the highly radioactive containment building housing the reactor has not occurred since the accident. The building contains roughly 500,000 curies of activity in approximately 600,000 gallons of water more than 7 feet deep on the floor. How much more radioactive material may be clinging to the walls or equipment or submerged under water inside the building will be uncertain until personnel can enter and make measurements. A relatively small amount of the total activity within the containment is in Krypton 85 gas (44,000 curies) which is dispersed throughout about 2 million cubic feet of atmosphere in the building. (See Appendix 2)

On November 21, 1979, the Nuclear Regulatory Commission published a statement of policy and notice of intent to prepare a Programmatic Environmental Impact Statement (PEIS) on the decontamination and disposal of radioactive wastes resulting from the accident. This statement established the overall policy framework within which cleanup operations are to be planned.

Current objectives of the cleanup process at the reactor are to ensure the reactor is maintained in a safe state, to decontaminate the plant and dispose of the radioactive waste, and to achieve safe removal and disposal of the damaged fuel. However, at the current pace it is unlikely that (a) any significant decontamination within the containment will occur by the second anniversary of the accident, and (b) the damaged fuel will be removed before the mid-1980s.

The containment building and surrounding structures have been successful since the accident in preventing significant releases of radioactivity. Estimates are that about 65-80 curies of radioative gas escape into the environment each month due to maintaining the reactor in its current cooling mode and due to sampling -- less than 10% of the normal radioactive gas releases from a similar operating nuclear unit.

As long as the damaged fuel can continue to be immersed in water and kept subcritical, and as long as the containment building does not leak significantly, public health and safety can be maintained. However, the longer the damaged fuel and radioactive waste remain in the present state, greater is the possibility that some unplanned event could trigger a release that would increase risk to workers, complicate the cleanup process, and be of concern to the public. Also, worker risk in the contaminated environment stays higher than normal until the radioactive waste is cleaned up.

Following two small and unplanned releases from the reactor during the week of February 11, Victor Stello, Director of NRC's Office of Inspection and Enforcement, was sent to the site by Acting Chairman Gilinsky. Mr. Stello was to evaluate not only the releases but also the progress of cleanup. Upon Mr. Stello's return, he told the Commission it would be desirable to assign a team to assess quickly the pace of the cleanup operation, particularly institutional delays that may be causing cleanup to proceed more slowly than it should. Mr. Stello was also concerned about the envelope of release criteria under which this particular reactor was being forced to operate -- an envelope that is perhaps more restrictive than normally operating plants.

At about the same time Mr. Stello reported to the Commission, Mayor Reid of Middletown, a state legislator, and an anti-nuclear group sent President Carter a telegram asking that the Health, Education and Welfare Department monitor radiation at Three Mile Island. Mayor Reid was quoted as saying "We want someone in there to tell us the truth ... someone we can put faith in."

On February 26, 1980, Lt. Governor Scranton of Pennsylvania published the report of a special Commission to Governor Thornburgh on Three Mile Island. Among other things, the Lt. Governor urged that cleanup proceed as expeditiously as possible, within careful safety guidelines, to avoid the significant public health risk that further deterioration inside the facility could cause.

B. Purpose

On February 19, Mr. Dircks, NRC's Acting Executive Director for Operations, met with a specially appointed task force he had chartered "to evaluate the cleanup operation at Three Mile Island, how they are being accomplished, and the rate at which they are being accomplished to insure that the public health and safety is being protected."

The task force also was to assess plans for future activities, critically examine potential problems which could adversely impact public health and safety and make recommendations for avoiding or minimizing such problems, and identify legal requirements and appropriate actions to respond to them. Both licensee and NRC activities were to be covered.

The complete scope of the review is enclosed (Enclosure 1).

C. Approach

The task force approached its job through meetings with key licensee and NRC personnel directly associated with the cleanup. To the extent time permitted, special technical analyses were also conducted. Members of the task force also met with officials of the Pennsylvania State government and the CEQ staff, and the task force chairman met briefly with the Mayor of Middletown.

A list of key meetings is in Appendix 5. Other separate follow-up conversations by individual members of subgroups of the task force also took place with knowledgeable persons. Reference documents used by the task force are listed in Appendix 6.

II. SUMMARY OF FINDINGS

A. The maintenance of TMI-2 in a stable condition cannot be accomplished with zero radiation releases. At present, between 65 and 80 curies -- primarily Krypton 85 -- per month are being released in maintaining and confirming stability of the plant. (See Sections IV-C and J)

B. The November 21, 1979 Policy Statement of the Commission is being interpreted by the NRC staff as a "zero release" requirement insofar as it affects cleanup. Since cleanup cannot be done with zero releases, there is a trend toward sending all proposals for cleanup-related releases of radioactive materials, however trivial, forward for prior approval by the Commissioners. (See Sections IV-C and F)

C. Both NRC and the licensee have allowed what was once a relatively high priority on developing and implementing TMI-2 cleanup plans to erode. (See Section IV-G)

D. The full extent of approval authority of the NRC TMI Support Staff is unclear. (See Section IV-C)

E. The staff's interpretation of current Commission prohibitions hampers the licensee's ability to obtain timely information and data to plan for later cleanup steps and handle unforeseen contingencies. (See Sections IV-C, I, J, K and M)

F. The Commission's Policy Statement provides sufficient flexibility so that prompt actions which are shown to be in the best interest of the public health and safety may be undertaken by the Commission prior to completion of the PEIS. There is a need for prompt actions that are not specifically mentioned in the Policy Statement (e.g. opening the airlock door or entry into containment). If such prompt actions become numerous and must go to the Commission for approval, delays will be introduced. (See Sections IV-A, B, and E)

G. Neither the NRC staff nor the licensee has proposed a set of criteria that would provide an interim envelope for the conduct of day-to-day activities (e.g. maintenance and data gathering) pending completion of the PEIS. (See Sections IV-C, G and H)

H. A preliminary assessment made for the task force by NRC's Probabilistic Analysis Staff has not identified any substantial threat to health and safety of the offsite public. However, the recriticality aspects of this assessment need to be confirmed. The major problems associated with the plant in its present state are (a) the possibilities of equipment failure or human error leading to increased difficulty in the cleanup, exposures, and some offsite releases, and (b) the concern which such occurrences would evoke in members of the public. (See Sections IV-J and K)

I. Occupational exposure is a significant concern. Existing high levels of radioactivity have hampered and continue to hamper maintenance of systems and locating and repairing leakage paths. Delays in cleaning up TMI-2 will increase occupational exposures. Delays also increase the probability of non-radiological hazards to workers (e.g. due to having to work with awkward protective clothing). (See Sections IV-J and K)

J. The licensee has correctly identified the major steps that will have to be completed during the cleanup. Planning for these steps is based on current perceptions of release levels that will eventually be allowed for each step. (See Section IV-B)

K. Neither the precise decontamination sequence nor the precise radiological impact of the individual steps of the TMI-2 cleanup process can be predicted with certainty at this time. (See Section IV-B)

L. The completion of the PEIS has become an important mi' tone in the cleanup of TMI-2. However, the Commission's intended e of the PEIS after completion is not clear to the NRC staff. There would be benefit in defining more clearly the document's end use now because such definition could influence the content of the PEIS. (See Section IV-N)

M. Insufficient resources have been allocated to assure the completion of the draft PEIS and final PEIS on or before the scheduled dates and with high quality. (See Sections IV-I and N)

N. Neither NRC nor the licensee has given sufficient consideration to concerns related to the waste form for ultimate disposal of TMI-2 waste off site. (See Sections IV-D and O)

O. There exist strong feelings of fear and anxiety among citizens about the activities at TMI-2. Many local citizens and officials do not have confidence in what they are told either by the licensee or NRC. Except for a few organized citizen groups and some local officials, citizens near the plant have little knowledge about the need to clean up TMI-2, the nature of the cleanup operations, and the impact these operations will have on their health and safety. (See Sections IV-J and L)

P. Local and state officials are not satisfied with the effectiveness or accuracy of the channels by which they are informed of planned and unusual events at TMI-2. (See Section IV-P)

Q. Insufficient permanent qualified staff exists at the Middletown NRC office and on site to perform adequately present TMI-2 duties. (See Sections IV-G and I)

R. The current NRC decision-making process hampers effective use of the limited financial resources of the licensee. (See Sections IV-I and M)

S. There is some risk that the licensee may go bankrupt and may not be able to complete the cleanup. There are no known plans to cover this contingency. Delays contribute to this possibility. (See Sections IV-G and M)

T. The report of the Governor's Commission on Three Mile Island (Pennsylvania) has called for expeditious cleanup of TMI-2 and for a prompt NRC decision on controlled venting of the containment building. (See Section IV-P)

U. The CEQ staff believes that interim actions for data gathering and equipment maintenance prior to completion of the PEIS are consistent with the Commission's responsibilities under NEPA. However, controlled venting of the containment building prior to completion of the PEIS would probably be viewed by CEQ as undesirable segmentation of the total cleanup process. (See Section IV-O)

III. RECOMMENDATIONS

A. Commission announce a commitment to proceed with the cleanup of TMI-2 in as expeditious a manner as possible. Schedules for staff and licensee actions should be established and closely monitored by EDO. (Based on Findings C and T)

B. Staff immediately propose for Commission approval rational, conservative interim criteria to permit releases associated with plant maintenance and data-gathering for future cleanup requirements while awaiting completion of PEIS. An environmental assessment would be prepared for establishment of these criteria, and CEQ would be consulted. The need to provide opportunity for public comment should be considered. (Based on Findings, A, B, E, F, G, K, R and U)

C. Staff require licensee to submit promptly revised plans and schedules reflecting interim criteria plus current status. The revisions should focus on actions needed prior to estimated completion of the PEIS (i.e. for maintenance or data-gathering). (Based on Findings J and K)

D. Commission decide that, pending completion of PEIS, environmental assessments need only be prepared for proposed cleanup operations that fall outside interim criteria. EDO establish schedules for completing assessments and reaching decisions. (Based on Findings F and G)

E. Staff promptly complete the environmental assessment of the licensee's November 13, 1979 proposal to vent the TMI-2 containment. Upon completion of the assessment, the Commission make a prompt decision on this matter. (Based on Findings C and T)

F. Commission establish and EDO enforce priority system that places cleanup and PEIS preparation higher than issuing new operating licenses. (Based on Finding C)

G. EDO require that (a) NRC Onsite Support Staff be permanent (i.e. assignments of 1-2 years); (b) a full-time spokesman be selected and assigned to the site staff to communicate with the public; (c) environmental assessment preparations be accomplished in Headquarters; and (d) the onsite staff be increased as required (estimated 5 to 7 additional positions) to handle their assigned responsibilities. (Based on Finding Q)

H. Commission provide sufficient funding and management attention to ensure timely completion of the draft and final PEIS. In addition, EDO should reexamine current schedules for the PEIS to determine if completion can be accelerated. (Based on Finding M)

I. EDO ensure cleanup has adequate review for long-term waste impact by having full staff coordination on all waste disposal actions. (Based on Finding N)

J. Commission, in conjunction with other government agencies, prepare contingency plan for cleanup in case of financial failure of licensee. (Based on Finding S)

K. Staff take positive actions to ensure local citizens are (a) informed of the need for timely cleanup of TMI and the steps to be taken to clean up the plant, including evaluation of alternatives; (b) alerted when particular planned releases are to be made, with advice on precautions the public should take, if any; and (c) provided data promptly about radiation levels in their communities during the course of any release. (Based on Finding O)

L. Staff ensure effective channels are established for accurately notifying local and state officials about both planned and unusual events during the cleanup process. (Based on Finding P)

M. Staff provide an on-going avenue for public input in development of the PEIS. Consider formation of citizen's advisory committee. (Based on Finding O)

N. Staff recommend soon for Commission approval how and by whom major cleanup decisions will be made after PEIS is complete, and the expected role of the PEIS in making these decisions. EDO ensure PEIS fulfills intended purpose. (Based on Finding L)

O. Staff continue to assess the risks to the public and to workers from TMI-2 which might arise from causes such as deterioration of equipment or human error during the future course of cleanup operations. In addition, Staff reevaluate the potential for recriticality and ensure that adequate procedures and equipment are available to prevent its occurrence. (Based on Findings H and I)

IV. KEY QUESTIONS & ANSWERS

A. What is the overall policy framework for cleanup, and how are broad decisions to be made within that framework?

The NRC Commissioners have set the policy framework for cleanup of TMI-2 in a series of policy statements and orders published in the Federal Register and in letters to Congress.

On November 21, 1979, the Commission issued a "Statement of Policy and Notice of Intent to Prepare a Programmatic Environmental Impact Statement (PEIS)" on the decontamination and disposal of radioactive waste resulting from the TMI-2 accident. The Commission expressed the judgment that this overall process would assist the Commission in carrying out its regulatory responsibilities under the Atomic Energy Act and further was consistent with the purposes of the National Environmental Policy Act (NEPA). The PEIS will provide the basic planning tool for analyzing environmental issues and alternatives before making commitments to specific actions for the decontamination and disposal of radioactive wastes. This PEIS will serve as a planning tool by providing an overall description of the planned activities and a schedule for their completion, a discussion of the alternatives considered and the rationale for the choices made. However, because current information related to cleanup is incomplete, the PEIS can be expected to have gaps which will be filled by supplemental analyses as more information becomes available.

The scope of the PEIS is being determined with the benefit of public scoping meetings which have already been held at Harrisburg, Middletown, and Baltimore. Public meetings will be held to solicit comments on the appropriateness of applying effluent limits established for normal operations to TMI clean-up activities.

Under the terms of the November 21, 1979 policy statement, the Commission stated that development of the programmatic statement would not preclude prompt Commission action when needed. If the need to take such prompt action arises, the Commission stated that it would consider the advice of the Council on Environmental Quality (CEQ) as to the Commission's NEPA responsibilities and, moreover, as stated in its May 25, 1979 statement, will not take such action until the activity has undergone an environmental review with opportunity for public comment. The Commission further recognized that there may be emergency situations, not now foreseen, which could require rapid action. In these situations, the Commission indicated its intention to consult with CEQ to the extent practicable.

Another key ingredient of NRC policy is the NRC Order to Met. Ed., dated February 11, 1980. This order imposes several requirements upon the Licensee, effective immediately and set forth in a set of proposed technical specifications attached thereto, which reflect the actual post-accident condition of the facility. The Order explicitly prohibits venting or purging or other treatment of the reactor building atmosphere, the discharge of water decontaminated by the Epicor-II system, and the treatment and disposal of high-level radioactively contaminated water in the reactor building, until each of these activities has been approved by the NRC, consistent with the Commission's November 21, 1979 policy statement. It is explained in the combined Safety Evaluation and Environmental Assessment attached to the February 11 Order that these activities could have been allowed under the same effluent limitations as would apply in the case of a normally operating facility had the Commission not determined the public interest warranted prohibiting these undertakings pending completion of an environmental review. The order provides that the existing Appendix B Technical Specifications, imposed for the protection of the environment, including the established limitations on effluent releases and discharges contained therein, are unchanged and would remain in effect except as provided in the Order.

As a related matter, in a letter dated February 4, 1980 to Senator Hart from Chairman Ahearne, the Commission stated that the regulatory criteria and guidelines to be used for the recovery program at TMI-2 are those embodied in existing Commission regulations. He also indicated that the Commission had expressed an intent to solicit public comment, within the context of the draft programmatic statement, on whether these limits, which were developed for effluents resulting from normal operations, are appropriate for the TMI-2 cleanup activities in light of the differences in the volume and duration of the release of such effluents. Moreover, in a December 31, 1979 letter from Chairman Ahearne to Congressman Ertel, the Commission decided that concerned citizens should be given the opportunity to present their views orally at a public meeting prior to any approval of proposals to dispose of radioactive gases in the TMI-2 containment.

Commission approval is presently required for most, if not all, stages of the cleanup operation. Such approvals are required in advance of licensee actions to treat the containment building atmosphere, discharge of water decontaminated by the EPICOR-II system, and treatment of radioactive water in the containment building under the terms of the Commission's May 25, 1979 Policy Statement. In addition, solidification of EPICOR-II system resins is required before off-site shipment, under the Commission's October 16, 1979 Memorandum and Order regarding EPICOR-II operation.

B. What is the overall plan for clean-up and how are the sequential steps determined?

The licensee's plan for decontamination and defueling at TMI-2 is contained in a report by Metropolitan Edison Company dated December 12, 1979, entitled "Summary Technical Plan for TMI-2 Decontamination and Defueling." Although the NRC Staff has not reviewed the various decontamination processes in detail, nor has the PEIS been completed, it is the general view of the TMI Support Staff and the technical members of the Task Force that Met Ed has correctly identified the major steps that will need to be completed. These major steps are listed below.

- Decontamination of Auxiliary and Fuel Handling Buildings. This activity includes removal of the approximately 400,000 gallons of contaminated water, decontamination of the interior building surfaces, the exterior surfaces of equipment installed in the building, and the interior of ventilation and piping systems installed in the building. (Already substantially completed.)

- Decontamination of Containment. This activity includes removing the radioactive gaseous atmosphere (primarily Kr 85) from the containment building, removal of the approximately 600,000 gallons of contaminated water in the containment building sump, and decontamination of the interior building surfaces and exterior surfaces of equipment.

- Reactor Examination and Defueling. This activity includes inspection of the reactor core and upper internals prior to reactor pressure vessel head removal, removal of the reactor pressure vessel head and upper internals, and removal and encapsulation of the fuel.

- Decontamination of the Reactor Coolant System. This activity involves removal of radioactivity deposited on the primary system internal surfaces.

- Radioactive Waste Processing. This activity involves the EPICOR-II system for decontamination of the approximately 400,000 gallons of liquid in the Auxiliary and Fuel Handling Buildings (currently in progress), a Submerged Demineralized System for decontamination of the approximately 600,000 gallons of liquid in the containment building sump and the approximately 90,000 gallons of liquid in the reactor coolant system, and an Evaporator/Solidification System for decontamination of as yet unknown amount of liquids that will be used during the overall decontamination process.

- Solid Radioactive Waste Management. This activity involves the accumulation, processing, and packaging of the solid radioactive waste in preparation to transportation off site.

The Met Ed objectives of the process are to:

- Maintain the reactor in a safe state.
- Decontaminate the plant.
- Process and immobilize dispersed fission products.
- Remove and dispose of the reactor core.

This represents a logical sequence for accomplishing the major essential steps of the decontamination process and follows the generally acceptable process of first cleaning areas of lesser contamination and working toward cleaning areas of higher and higher contamination. The sequence also results in first immobilizing contamination that could inadvertently be released.

It is important to recognize that neither the precise decontamination sequence nor the precise radiological impact of any of the individual steps of the process can be predicted with certainty at this time. Generally, each major step of the decontamination process will require the previous step to be completed before specific detailed plans for the next step can be made. This is because each major decontamination operation requires data that usually cannot be obtained until the previous steps of the process are essentially completed and personnel access is possible. For instance, the specific decontamination process for cleaning the interior surfaces of the primary system cannot be established until samples of these surfaces are available for analysis and development of the optimum process. This will require completion of all previous steps in the clean-up process.

C. <u>What are the current criteria for conducting cleanup activities?</u>

The current criteria are contained in the Commission's Order of February 11, 1980. This Order establishes new Technical Specifications governing operation of the facility in what is called a "Recovery Mode." The specifications for release of radioactive material from the site and for occupational exposures are consistent with (and no more stringent than) existing Commission regulations, guidelines and criteria applicable to a normal operating facility. However, the Order "prohibits venting or purging or other treatment of the reactor building atmosphere, the discharge of water decontaminated by the EPICOR-II system, and the treatment and disposal of high-level radioactively contaminated water in the reactor building, until each of these activities has been approved by the NRC." These prohibitions effectively preclude the planned release of any radioactive liquid or gaseous material from TMI-2 without prior Commission approval. Low-level solid waste (rags, clothing, etc.) generated during cleanup operations in the auxiliary building are permitted to be transported off site.

Notwithstanding the February 11, 1980 Order, there continues to be a lack of well-defined criteria to govern the day-to-day activities that involve handling, and planned or unplanned releases, of the materials covered by the prohibitions. Such criteria, which could be based on existing Technical Specification limits with an upper bound on allowable total quantities to be released, are essential to the continued conduct of the cleanup operation. The task force found no evidence that the Staff or the licensee was preparing such interim criteria for Commission consideration. Without them, the cleanup operation is being unnecessarily prolonged, and minor unplanned releases that would be inconsequential in a normal operating plant are elevated to an unwarranted significance. An example of the former is the perceived need to obtain Commission approval to open the outer personnel air lock door which would release about 0.05 curies of Krypton-85 (see Appendix 4). An example of the latter is the occurrence on February 11 in which the incidental off-gassing of about 0.3 curies of Krypton-85 from some leaked primary system water caused considerable public concern. To put these releases in perspective, TMI-2 has been releasing between 65 and 80 curies of Kr-85 per month in recent months; a normal operating facility of this type may release over a thousand curies of radioactive gasses per month. In 1978, TMI-1 released an average of 1300 curies of radioactive gasses per month.

D. Do these criteria differ from criteria for operating nuclear plants, and if so, how?

The technical criteria, in terms of allowable concentrations of radioactive material discharges, are the same as for operating nuclear plants. However, the prohibitions mentioned above are much more restrictive than for operating facilities. There is no established envelope within which the licensee, the on-site NRC staff, or the Headquarters NRC staff can operate for day-to-day activities. Approval authorities are not specified. Most actions are handled on an ad hoc basis. When in doubt, the inclination is to refer decisions to higher levels, even to the Commission.

For the longer term, the criteria that will govern the ultimate disposal of the radioactive materials generated by the accident are not yet developed and may well be different than what has been previous operating practice. The licensee does not know if the eventual criteria for liquid and gaseous releases are going to be the same as, or more restrictive than, existing regulatory criteria for normal plants. In addition, there is uncertainty as to the criteria for and destination of ultimate disposal of solid wastes.

The solid wastes resulting from TMI-2 cleanup operations must eventually be shipped from TMI-2 as the TMI site would not meet the site criteria for permanent disposal of radioactive waste. The assumption behind the licensee's current planning is that all such solid wastes, except for the reactor core, could be disposed of by shipment to an existing commercial shallow land burial site for low level radioactive waste. To date, the solid wastes have been shipped to the commercial low level burial site located at Hanford, Washington. However, the continued availability of the Hanford site to low level radioactive wastes from outside the State of Washington is tenuous.

Furthermore, the characteristics of the solid wastes resulting from subsequent cleanup operations may dictate disposal as high level waste. For example, the waste resulting from cleanup of the contaminated water in the containment building, using the submerged demineralizer system planned by the licensee, will produce waste with higher specific activity than previously disposed of as low level waste and higher than wastes presently identified as high level waste. The method of processing these wastes must not preclude the option of providing the waste to the Department of Energy for subsequent processing and disposal as high level waste.

Such concerns regarding ultimate form of the solid waste will be addressed in the PEIS but must also be communicated to Met-Ed in their ongoing planning effort to ensure their planning does not preclude options necessary to permit ultimate disposal of the solid waste. As Met-Ed continues the planning for operations which will result in solid wastes close cooperation and coordination must be maintained between NRC personnel who are responsible for waste processing operations on site and NRC personnel who are responsible for waste disposal.

E. <u>To what extent do the criteria differ because of (a) technical considerations, and (b) legal and policy considerations?</u>

(a) <u>Technical considerations</u> - The TMI-2 accident has created a decontamination effort of unprecedented proportion. Because of this, the cleanup operation must be carefully planned and closely monitored. Accordingly, it is appropriate that the "criteria" include detailed NRC review and approval of all significant operations to a far greater extent than normally conducted for operating reactors. In terms of radiological health and safety, there is no known technical reason for the release criteria to be more restrictive than has been acceptable at normal operating facilities. However, because of the unique characteristics of the cleanup operation that were not considered and evaluated in the safety review of the plant, there is a need to determine what is "as low as reasonably achievable" with respect to offsite releases and occupational exposures. The PEIS should provide the basis for making that determination.

(b) <u>Legal and policy considerations</u> - There are no readily identifiable legal requirements of the Atomic Energy Act of 1954, as amended, that would require that different criteria be applied to the cleanup of TMI-2 than are applied to operating plants. In keeping with the purposes of the National Environmental Policy Act, the Commission has decided to prepare a PEIS on the decontamination and disposal of TMI-2 radioactive wastes. It has also decided essentially that any Commission decisions to authorize specific cleanup actions -- other than emergencies -- prior to completion of the PEIS will be preceded by an environmental review and opportunity for public comment.

The existing policy framework governing consideration of the clean-up process is described in Part IV.A of this report. The Commission's intention to reconsider the applicability of existing effluent criteria to the cleanup operation apparently derives from the unique post-accident situation.

F. <u>What is the process for deciding whether an individual cleanup operation can proceed?</u>

Once Met-Ed has decided that an individual operation should proceed, the written procedure covering that operation is provided to the NRC site office for review and approval. No operation can proceed without the NRC site office approval of the procedure. The on-site NRC personnel are kept informed of Met-Ed's thinking and progress leading up to the submittal for approval. If the NRC site personnel have a problem with the procedure, this is communicated to Met-Ed and changes are negotiated. If approval of the procedure is considered within the authority of the NRC site office, approval is granted when the procedure is acceptable. In the early stages of recovery from the accident the NRC site office understood that procedures which met existing regulations for environmental releases for operating plants could be approved locally. However, in view of the Commission decision process which has evolved to date, as summarized in Section IV.A, the NRC site office now considers that they do not have authority to approve procedures which would involve the potential for environmental releases.

A chronology is given in Appendix 4 detailing the licensee's development of a proposal to enter the airlock and NRC's actions to review this proposal. This chronology clearly shows current pitfalls in reaching prompt decisions.

G. <u>What is the relative priority of cleanup for NRC and the licensee?</u>

The actions of the NRC and licensee shortly after the March 28 accident had high priority in each organization (e.g., design and installation of the EPICOR II system). However, this initial high priority has eroded as time elapsed.

The licensee's senior vice president, Mr. Robert Arnold, stated to this task force that, due to financial difficulties, cleanup of TMI-2 is fourth priority. GPU has placed ahead of TMI-2 cleanup in their list of priorities: maintenance of a safe condition at TMI-2; preparations for restart of TMI-1; and refueling and restart of the Oyster Creek plant. Mr. Arnold further stated that if the priority of TMI-2 cleanup were raised above that of TMI-1 and Oyster Creek refueling and restart, an accelerated TMI-2 cleanup schedule could be pursued. He pointed out that GPU/Met. Ed are concerned about the Pennsylvania Public Utility Commission's actions on proposed rate increases. Mr. Arnold expressed concern that unfavorable action by the PUC will further exacerbate Met.Ed's financial position, causing further delays in TMI-2 cleanup.

It is the Task Force's opinion that NRC has also placed a low priority on TMI-2 cleanup, relative to review of operating plants, developing and implementing the TMI Action Plan, and taking action on near-term operating licenses. A very limited staff has been assigned to the TMI Support Group both at Headquarters and on site. Temporary assignments of staff continue to be made to the on-site group which has a permanent core group of only 3 to 4 professionals. Although the Commission itself has not specifically placed a lower priority on reaching decisions for TMI-2 cleanup activities, the Commission's lack of ensuring that definitive cleanup criteria are established and the need for Commission approval of all activities which could provide releases has led to the staff's perception that the Commission considers this to be a low priority activity.

H. What has been the pace of cleanup to date, and how much of the licensee's plan has been accomplished?

The Met-Ed Summary Technical Plan for TMI-2 Decontamination and Defueling dated December 12, 1979, identifies a total time span for decontamination and defueling of approximately 2 to 2-1/2 years from working entry to containment. The NRC site staff consider this time span will be on the order of 5 or more years. To date, the pace for those operations actually underway (i.e., cleanup of the auxiliary building and processing of the contaminated water from the auxiliary building through EPICOR-II) has been determined by availability of equipment and personnel. Operation of EPICOR-II has resulted in processing 100,000 gallons of the 400,000 gallons of contaminated water in the auxiliary building. Met-Ed's schedule for remaining work indicates completion of this effort by September 1980. Decontamination of the auxiliary building is substantially complete and is scheduled for final completion by the end of 1980. The pace of these efforts to date would tend to reinforce the site staff estimate. There is a consensus among the licensee, the NRC site and State representatives that the pace of subsequent operations will be further reduced due to the decision-making processes for subsequent operations.

The licensee has not yet submitted a plan for solidification of the resins resulting from EPICOR-II operation. The pace of this effort does not seem consistent with the Commission's Memorandum and Order dated October 16, 1979 directing the licensee to expeditiously construct a facility for solidification of these resins.

I. What factors have influenced the pace and how have the licensee, NRC and others affected the effort?

The principal concern is whether the schedule of the clean-up effort has been adversely influenced by the variety of resource, policy, legal, and technical factors associated with, and influencing the clean-up schedule, and whether these factors adversely affect the public health and safety. Such factors include:

- Law suits by the Susquehanna Valley Alliance and the City of Lancaster, et.al., regarding disposal of waste water.
- The NRC staff interpretation of the Commission policy statement to prepare a Programmatic Environmental Impact Statement (PEIS).
- The size and authority of NRC TMI-Support Staff on site.
- The strength and resolve of Met Ed to deal with the outstanding technical issues.
- The February 11, 1980 Order revising TMI-2 Technical Specifications.
- The lack of specific performance and release criteria for the decontamination activity.
- The public, local official, state, and press interest and the need to accommodate the interests of these groups.

It is the opinion of the Task Force that through late 1979, given the uncertainties associated with the first few months after the accident, the pace of the clean-up activities was as rapid as reasonably can be expected. The principal constraints have been the lack of sufficient professional staff, both Med Ed and NRC, to prepare all needed actions, studies, and reports in a timely manner, concurrent with a continual need to attend meetings and briefings and to be physically available on site as needed.

It is the Task Force opinion, however, that these constraints placed on the TMI Support Staff and Met Ed have now begun to create delays. Actions such as the perceived need to obtain Commission permission to vent 0.05 curies of Kr 85 in the containment building air lock is both time consuming on the part of the TMI Support Staff and improvident in view of the normal releases of 65-80 curies of Kr 85 per month and in view of the insignificant health and safety impact to the public. (A detailed chronology on development and NRC action on the air lock entry proposal is given in Appendix 4.) The Task Force believes that freedom from this type of constraint is vital if the decontamination program is to move on at a responsible pace. Thus, setting of specific criteria, below which releases would be allowed without prior Commission approval, is essential.

The Commission decision to prepare a PEIS, and the schedule that this effort is on, may result in some delay in decisions that affect the eventual clean-up of the facility. The item that is on the critical path at this time is obtaining the licensee's proposal, Commission staff approval, and proceeding with procurement and installation of the clean-up system for the containment sump water and the primary system water, the Submerged Demineralizer System (SDS). The current schedule calls for this equipment to be operational by the end of 1980 although Met Ed has yet to provide the safety analysis of operation of this equipment for staff review. Thus the entire activity, at this time, associated with the SDS is being done by Met Ed at its own risk with only approval of the individual component design criteria by the NRC staff. System performance criteria have not yet been submitted for NRC approval. Nevertheless, the schedule roughly dovetails with that of the PEIS which would be the precursor of this and all subsequent clean-up activities.

The current schedule of preparing a PEIS by the end of 1980 and use of the findings of this document as a basis for approval of future clean-up activities will allow the clean-up to proceed on a schedule roughly commensurate with the technical evaluation, procurement, installation of necessary equipment, and the interests of public health and safety as long as the licensee made correct assumptions in the design of needed equipment. On the other hand, the lack of definitive release criteria hampers the planning and engineering activities, and the need to obtain specific Commission approval for activities that have insignificant impacts has resulted in a dilution of personnel resources. Specifying acceptable release criteria that must be observed prior to completion of the PEIS would be a significant step forward in improving the quality of the overall decontamination process.

Additionally, it would seem prudent to place a greater sense of urgency on the completion of the PEIS, since it can directly influence ultimate cleanup schedules. Even though some design, procurement, and fabrication is going on in parallell with the PEIS development, the findings of the PEIS may dictate a different design requirement than is presently being pursued.

J. What have been the problems associated with cleanup operations to date, and what has been done to solve these problems?

To date, the problems can be classified into four major categories. These are:

1. Health and Safety
2. Public perception of health and safety
3. Decisional process
4. Technical issues

Health and safety problems can be subdivided into off-site (public) and on site (occupational). Under the present conditions, and for the forseeable future, the judgment of those who have evaluated potential population doses have concluded that the cleanup operations have posed no real physical threat to the health and safety of the public. While there were substantial risks at the time of the accident, they have decreased with time as the radioactive materials have decayed, reducing both the potential for additional core damage and the inventory of radioactive materials which could be released. Presently, these risks appear to be very low even in the event further degradation should lead to loss of coolant in the core.

Occupational exposures have been a significant concern, and continue to hamper maintenance of systems and the location and repair of leakage paths in those areas that contain high levels of radioactivity.

The current prohibition against the discharge to the environment of any wastes associated with the Unit 2 cleanup introduces additional effort to the cleanup process.

The public concerns for health and safety appear to stem from a lack of public confidence in either the licensee or NRC, coupled with a conviction on the part of a substantial fraction of the population that releases of any quantity are dangerous and/or that the magnitude of releases is consistently understated. These concerns have led to a high degree of stress for a segment of the population, which needs to be alleviated.

The decisional process is beginning to affect the cleanup activities, largely as a result of the interpretation of the Commission's November 21, 1979 Statement of Policy. This statement is being interpreted to require a prohibition of any releases to the environment of "accident generated radioactivity" without prior NRC approval and consultation with CEQ. While such a decision is unquestionably a conservative one, it makes planning for cleanup very difficult, since it is not at all clear what the ultimate criteria for release will be. Some releases are inevitable. Without clear criteria, the design and procedure preparation for cleanup is speculative at best. The current best estimate for completion of the PEIS is December 1980 (a draft by June 1980), thus progress toward cleanup will remain very slow unless some interim criteria are established prior to that time or at least until there is definition of discharge limits for radioactive materials.

The technical issues really cannot be separated from the decisional process. It appears that the licensee has been constrained by not being able to use the same release criteria as operating units, or at least to have articulated for him the limits that will be used. Since the design of equipment is to a large degree dependent upon the criteria selected, planning is limited. Something of a "Catch 22" exists in at least two areas. The first is the absence of criteria to use for design of equipment. The second involves the inability to develop a comprehensive cleanup plan until some preliminary investigations of the actual conditions inside containment are completed.

Additionally, it should be noted that deterioration of equipment will continue under existing conditions. While the time-to-failure of equipment cannot be known with certainty, the concern for failure is real. For example, the containment coolers must operate to maintain a negative containment pressure. These units have already operated well beyond their design specification without maintenance. Since they are now inaccessible, normal maintenance cannot be performed. Their failure will eventually lead to a positive containment pressure, and an increased rate of release of the gases in containment. There are hundreds of feet of piping now under water, which are directly connected to the primary system. The uncontrolled chemistry of the water increases the potential for failure of these pipes. Only one channel of nuclear instrumentation remains operable, and nearly all of the flow and pressure instrumentation has failed, although much of the temperature measuring instrumentation remains operable. With these conditions existing, it seems prudent that cleanup proceed as expeditiously as possible.

To solve these problems, efforts have been made to limit releases and to inform the public of those releases that have been made. These efforts have obviously not been completely successful, since public concern remains high, and apparently unintended releases still occur. The decisional process has remained as stated in the policy statement, with no visible effect being made to alter that process. The lack of final criteria for disposal makes resolution of design and planning difficult to achieve.

K. <u>What are the more severe problems that could occur during future cleanup activities?</u>

The more severe problems that could occur during future cleanup activites include difficulties in maintaining a subcritical configuration for the core; maintenance of proper core cooling; and controlling the containment integrity.

There is great uncertainty about the geometry of the damaged core and the location of the control rod material in it. It is believed that some of the control rod material melted during the accident and may now be drained out of the core. The licensee is relying on boron in solution in the reactor coolant to maintain the subcriticality of the core. It is not likely that the boron concentration will vary enough that criticality could occur. But it is prudent to monitor the boron concentration closely and be prepared to add boron if needed. Only one nuclear instrument channel is presently operating. If this instrument fails there will be no direct measurement to provide assurance that the reactor core is not going critical again. In order to replace any of the damaged nuclear instruments the licensee needs relatively free access to the upper operating deck areas in the reactor building.

Maintenance of core cooling is important as well. At the present time, the core is being cooled by natural circulation flow through the damaged core and the steam generator where subatmospheric steaming is still taking place. The reactor decay heat is now less than 200 Kw thermal. Even without flow through the core it appears that with water in the system enough heat could be transferred by conduction and local convection in the reactor vessel out to the structure of the vessel itself and the reactor building atmosphere to keep the core in an acceptably cool condition.

There is a question, however, of maintaining the water around the core. At the present time, there are literally hundreds of feet of tubing, piping, and other instrument lines, most of which cannot be isolated, that are connected directly to the reactor coolant system and submerged under the water in the bottom of the reactor building. The water level in the reactor building is at an elevation just above 290 feet MSL which means that the water in the bottom of the reactor building has already submerged the bottom end of the steam generators as well as the cold leg piping. The bottom of the reactor pressure vessel is still about 3 feet above water. The water in the bottom of the building is contaminated with chloride and other impurities. Even though this water is not extremely corrosive, and the reactor coolant system is at relatively low temperature and pressure, there is always the possibility of degradation, cracking, and leaking. The licensee would be forced to provide makeup flow adding further to the inventory of water in the reactor building. Unless one was willing to continue adding water to the building, there would be a need to establish a recirculation flow through the auxiliary building. This would circulate the highly radioactive water out through the auxiliary building, greatly increasing local dose rates in the auxiliary building.

The licensee will soon be able to operate a low flow decay heat removal system. This system, which is attached to the normal decay removal system, will provide very low circulating flow from the reactor coolant system and back to it, to remove the small amount of decay heat remaining in the core. The system will require, just as the normal decay heat removal system does, that the containment sump drain valves (DHV1 and DHV171) be opened in order to open the system to the reactor coolant system. These valves are located in the reactor building with their electric motor operators about 1 foot above the water level. Further addition of water in the reactor building would probably render them inoperable. The licensee has not opened these valves against that contingency because if they do they would open a path for the highly radioactive reactor coolant to the auxiliary building. This would somewhat increase the already high levels there and would further complicate the work that still goes on in the auxiliary building. The licensee is using electrical resistance measurement or "meggering" weekly to check on the operability of these valves. The present intent is to open these valves if they are further threatened by submergence.

The reactor containment building atmosphere has been held at a pressure somewhat below atmospheric for essentially all the time since the high pressures experienced during the accident itself. The pressure is controlled by reactor building fan coolers which are located inside the reactor building. These fan coolers have been operating continuously for almost a year since the accident. They are not rated for such long service unattended. Soon they should be thoroughly inspected, lubricated, and checked; if not, there is a danger that they will begin to fail from lack of preventive maintenance.

Access to these coolers requires access to the reactor building itself for a reasonable period of time. If the coolers fail, there will be an increase of the reactor building pressure. This in turn would result in increasing the leakage rate of Krypton 85 gas from the reactor building to the atmosphere. The leakage of the Krypton 85 gas in this unintended way would be less desirable than deliberate venting through the stack, but would in itself cause no great risk to offsite personnel. In addition, without the atmospheric control of the fan coolers the interior temperatures during the summer could be quite high. Sustained decontamination efforts then would require repair of the reactor building coolers before any substantial activity could be carried forward.

Another problem associated with maintaining containment integrity is found at the sump leading out into the auxiliary building. The reactor building has about 600,000 gallons of radioactive water in it and this water is connected to the auxiliary building through large suction lines drawing from the reactor building sump and leading out to the reactor building spray pumps and the decay heat removal pumps in the auxiliary building. Those pumps are located in the lowest levels of the auxiliary building for purposes of drawing the most reliable suction under accident conditions. As a result the large volume of radioactive water in the reactor building is standing above that location and provides pressure on those valves and pipes inside the auxiliary building which are connected to the sump. One of the large valves in these lines is opened on every shift to provide a direct pressure measurement to determine the level of water in the reactor building. The licensee is planning to replace this system with a manometer which would not require the frequent cycling of this valve. The difficulty with cycling this valve is that a failure of it in the shut position might frustrate use of the line for withdrawal of the water at a later time; and its failure in the open position would leave this pressure of reactor building water continually on other valves downstream, possibly leading to increased leakage and increased dose rates in the auxiliary building.

As long as the 600,000 gallons of radioactive water lie in the bottom of the reactor building there is a substantial risk of spills, leaks and radiation exposures in the auxiliary building. The Submerged Demineralizer System (SDS) is intended to treat this water. Delays in the development and use of the SDS will prolong the exposure to the risks associated with this water. The licensee told us that the SDS might be ready for use later this year with the appropriate NRC approvals.

Examination of the problems which can be encountered in the cleanup indicates that it would be prudent to expedite access to the containment and removal and treatment of the radioactive water from its lower level. Urgency or priority should be based on the likelihood of presenting unnecessary and undesirable complications in the cleanup. As described in Appendix 3, there appears to be no substantial risk to the offsite public which would justify urgency.

Additionally, other problems could arise. Of significance among these are the concerns for various kinds of accidents that can occur to workers encumbered with extra layers of clothing, breathing apparatus, and hostile environments. Until the Krypton is removed from the containment building and the orygen content of the air increased to normal levels, workers entering containment must wear clothing which is relatively impervious to gas, and use self-contained breathing equipment. Even after removal of Krypton, self-contained breathing equipment will likely be required, but with normal oxygen levels the risk of asphixiation or fainting would be greatly reduced. Less cumbersome clothing will also be permitted once the Krypton is removed, resulting in less potential for falls or other industrial accidents. (See also Appendix 2)

L. What has been public perception of the cleanup activities, and how can confidence in licensee and NRC actions be improved?

Public opinion is an intangible concept to a great degree. Accordingly, public perception and degree of public confidence in the Licensee and NRC in the cleanup effort is difficult to gauge since there is no monolithic "public."

The level of public awareness of the recovery process and degree of confidence therein is dependent on a myriad of factors, including philosophical persuasion, proximity to the site, education, and so on. Some or all of the task force were able to meet with Licensee, NRC technical support staff, and State and local officials. Others were provided the opportunity (independent of this task force) to observe several public scoping meetings occasioned by the preparation of the programmatic environmental impact statement. An unmistakable impression emerges from this that there is an appreciable level of anxiety over the condition of the plant and its plans for recovery and a mistrust of the Licensee as well as the NRC in that connection.

The on-site NRC support staff feel that there had been considerable improvement in the public's confidence in the licensee during the past 10 months, but that this confidence was severely eroded by the events that took place at TMI-2 and were so widely publicized during the week of February 11, 1980. The Mayor of Middletown expressed a similar view.

Four important points regarding public confidence were identified during this investigation and the public scoping meetings held to date:

1. Many local citizens have a deep-seated fear of radiation at any level.

2. With regard to planned releases of radioactivity from TMI-2, the general public does not have a clear perception of the need for timely (and in some cases any) cleanup of TMI-2, the steps involved, and the extent of risks they face.

3. With regard to unplanned events, local officials point out that they are frustrated in their efforts to help their communities unless they are promptly and accurately apprised of the situation so that they can respond to citizens' inquiries.

4. Local citizens have such a low level of confidence in what they are told about releases of radioactive material by the licensee and NRC that they would like to have a local source of data about radiation levels in their communities during the course of either planned or unplanned releases.

It is clear from these points that a more concerted effort is needed to cope with public fears and lack of confidence. This effort should include the following:

1. Inform the local citizenry about the need to clean up TMI-2 in a timely and safe manner.

2. Provide knowledge about the steps to be taken for cleanup including evaluation of the alternatives considered.

3. Alert citizens when particular planned releases are to be made with advice on precautions the public should take, if any.

4. Provide instrumentation in the hands of trained local individuals to furnish data about radiation levels in nearby communities during the course of any releases.

5. Establish formal means to obtain input from the public on the overall cleanup plan and the individual steps to be taken before they are made final and are implemented. This could take the form of a citizens' advisory group to contribute to development of the programmatic statement as has been recommended at several scoping meetings.

6. Establish an effective process of communication between the licensee, NRC, and local and state officials to advise them accurately about events at the plant that might have an impact on the public.

7. Provide the local NRC office with a full-time public affairs spokesman who is knowledgeable about TMI-2 to help with the informational process.

It must be recognized that without local public understanding and acceptance of the cleanup operation at TMI-2, an orderly and expeditious cleanup will be difficult, if not impossible, to accomplish. Public fears and stress can be expected to persist until the plant is cleaned up.

Perhaps the best prospect for restoring public confidence in the cleanup process is for the principals--the Licensee, NRC, State and local officials and civic groups--to recognize their integral roles in the recovery process and the protection of the public health and safety. These roles should be performed in a cooperative and responsible manner which will lead to sound, reasoned decision-making, with a minimum of discord. Salient facts regarding the process must be candidly presented to the public enabling them to appreciate the relative risks presented at each stage of the process and the overriding need to accomplish the cleanup safely and diligently. Hopefully, this will permit the cleanup of TMI-2 to be carried out with a maximum of public safety and a minimum of public doubt.

M. <u>How does the pace of cleanup or the sequencing of cleanup activities relate to these problems?</u>

The pace at which cleanup is accomplished will have an impact on a number of aspects of TMI-2. These aspects include:

1. Ability to maintain the plant in a stable condition to avoid a major accident that could lead to unsafe off-site releases of radioactive material. This ability depends on a very limited number of instruments (e.g., only one neutron detector is now available) and items of equipment, some of which are not accessible for maintenance or repair; their continued integrity over long periods of time under existing conditions is questionable.

2. Ability to avoid small unplanned releases of radioactive material as a result of minor equipment failures and routine operations needed to keep the plant stable.

3. Continued radiation exposure to workers in the plant.

4. Complication of eventual cleanup as in-plant equipment deteriorates.

5. Prolonged public stress.

6. Ineffective use of limited financial resources of the licensee and the possibility that the licensee could go bankrupt and not be able to complete the cleanup, an eventuality for which no contingency plans have been identified.

With regard to sequencing of cleanup steps, in addition to the foregoing items, special provisions must be made to allow the licensee to obtain timely information about the status of the plant (such as the extent and nature of contamination in the reactor containment) so that detailed procedures and equipment can be developed for later steps in the cleanup process. This is especially important because a number of the cleanup operations involve application and evaluation of procedures and techniques not previously used in this type of undertaking.

To permit maintenance of a reasonably well-paced cleanup plan and to permit the obtaining of data for detailed planning of and designing of equipment for later cleanup steps, some interim reasonable allowance for controlled but safe radiation releases must be established prior to completion of the PEIS, since just about every step involves some modest releases. The NRC staff should be given the authority to approve procedures and backup analyses that will stay within these limits. Once an Environmental Assessment is prepared for these interim criteria, additional assessments need be prepared only for cleanup steps outside these criteria.

N. Are pace of and resources for the PEIS satisfactory, and is its end use well defined?

The completion of the PEIS is an important milestone in the cleanup of TMI-2. The PEIS needs to be completed as a high quality, comprehensive statement as close as possible or prior to the scheduled dates for the following three reasons:

1. There must be expeditious cleanup of TMI-2 within procedures that assure no undue risk to the health and safety of the public. In the plant's present state, the contamination in the auxiliary building, the reactor containment building, and the primary system impose a continuing potential risk to the health and safety of the public via uncontrolled leakage path that can develop as a result of equipment deterioration and failure. Any such releases, even if of no health significance, alarm and distress the local public.

2. Delays in cleanup will result in increased radiation doses to the TMI-2 work force who must continue to attend to and monitor the plant. Furthermore, the deterioration of equipment will lead to higher doses to workers both during cleanup and during efforts to cope with the consequences of interim failures.

3. The cleanup of TMI-2 cannot be accomplished with zero radiation releases. Just maintaining the plant in a stable condition and taking samples to confirm this stability bring about releases of 65 to 80 curies per month.

During our discussions, individuals working on the PEIS indicated that there could be significant slippage in the June 1980 completion date for a draft PEIS and the December 1980 date for completion of the final PEIS. Funding for Argonne National Laboratory (ANL) runs out this April. The Task Force found no current basis that assures additional funding to carry on this work. We believe that, for the reasons given above, it is important for the PEIS to be completed by or before the prescribed dates and that sufficient manpower and resources must be provided to do so.

While the PEIS is being prepared, attention should be given to how the PEIS will be used in the decision-making process. The Commission's November 21, 1979 Policy Statement indicates the PEIS will be useful as a planning tool. However, the steps that the Commission plans to take upon completion of the PEIS are not now clear, especially as they relate to the allowable radiation release limits to be used for cleanup of TMI-2. It would appear essential for the Commission to use the PEIS, among other things, to reconfirm the Appendix I (10 CFR 50) release limits or to establish other appropriate limits.

O. <u>What are CEQ's current views on the NRC's NEPA responsibilities for cleanup actions?</u>

The Task Force met with members of the CEQ staff to obtain its views on the Commission's responsibilities under NEPA. CEQ staff views NRC's approval of total cleanup operations at TMI as a major federal action which legally obligates the Commission to prepare an Environmental Impact Statement. By total operations, CEQ staff means actions extending from the reactor cleanup through to ultimate disposal of the wastes resulting from that cleanup. [1/] Until that Statement is prepared, CEQ staff believes that NRC approval of certain actions, such as purging the radioactive gas from the containment, would be a segmentation of the entire clean-up program in a manner inconsistent with NEPA. However, CEQ staff recognizes that NEPA permits the NRC to approve certain actions which could result in limited radioactive effluents prior to completion of the Programmatic Statement. These actions include steps to obtain more information and data relevant to further clean-up activities, and actions necessary to maintain TMI in a safe and stable condition. Maintenance to ensure continued operation of the fan coolers inside the containment was specifically referred to as an example of permitted interim maintenance operations.

1/ The task force was informed that, under current plans, the PEIS would cover delivery of the waste to a waste disposal site, but would not address the environmental impact of disposal of the waste at that site.

P. What are current State and Local government views?

The Commonwealth of Pennsylvania has, from the first day of the TMI-2 accident, maintained an intense interest and involvement in matters affecting the well being of its citizens as a result of the accident. On May 14, 1979 Governor Thornburgh of Pennsylvania established a special commission under the chairmanship of Lt. Governor Scranton to study and evaluate the consequences of the accident. The results of that commission's work were released on February 26, 1980 in a report entitled, "Report of the Governor's Commission on Three Mile Island." It contains a number of recommendations and findings aimed at protecting public health and safety in the wake of the TMI-2 accident.

One of the recommendations submitted to Governor Thornburgh is that Unit 2 be promptly decontaminated, under proper safety controls, in order to avoid possibly serious and uncontrolled releases of radiation. The Lt. Governor stated that Commission members felt that a failure to address the difficult and sensitive decisions regarding cleanup would only serve to perpetuate TMI's present status as an unintended nuclear waste dump, posing seriously potential dangers for the citizens.

Lt. Governor Scranton also said that the Governor's Commission would not oppose an NRC decision to begin controlled venting of radioactive gases into the atmosphere under strict safety guidelines. Such gradual venting should however be accompanied by strict public notification procedures, concurrence by state officials with venting plans, independent state monitoring and careful attention to weather conditions. However, Mayor Reid of Middletown, Pa., a member of the Governor's Commission, voiced displeasure with venting, urging instead that NRC and the licensee should seek another solution to this problem.

In a meeting with Mr. Haller, Mayor Reid indicated that "credibility" was his major concern. He was concerned because the original information he said he received from the licensee about the February 11 release from the plant was later contradicted by press notices. Thus the Mayor was in the uncomfortable position of providing conflicting information to citizens who called him for information. This affected his own credibility. The Mayor did say that notification of the February 13 release was satisfactory. His overall view was that the licensee must notify the public promptly and correctly about what is going on in order that credibility be restored and maintained.

APPENDIX 1

Current Plant Situation

1. Most of the equipment and surfaces in the Auxiliary Building have been decontaminated.

2. About 100,000 gallons of the 400,000 gallons of water from the Auxiliary Building has been processed by the EPICOR II clean-up system. The processed water is being stored on-site.

3. The used resins from the EPICOR II clean up system demineralizer are being stored on site.

4. The Reactor Building, which currently contains about 44,000 curies of gaseous radioactivity (primarily Kr-85) has not been entered since the accident. The building pressure is being maintained at slightly less than atmospheric pressure by the internal fan coolers.

5. The Reactor Building sump contains approximately 600,000 gallons of water in a 7½ foot deep pool at the bottom of the building. This is within one foot of the motor operator of one of two valves that isolate the sump. The current leak rate of water from the reactor coolant system to the containment building is estimated at 0.1 to 0.2 gallon/minute (corresponding to about 1" rise in the water level per month).

6. The reactor and primary system is in a natural circulation mode using core decay heat (currently estimated to be 200 KW). The coolant is pulsing at a period of 10 to 18 hours due to loss of natural circulation driving force. Pressure is being maintained at 280 psig by the Standby Pressure Control System. The average temperature of the primary system is 154°F. The highest in-core thermocouple reads 195°F. A single neutron monitoring channel is operable.

7. Met Ed has spent approximately $100,000,000 on the decontamination and maintenance of TMI-2 since March 28, 1979. There currently are about 1000 people on site associated with TMI-2.

8. TMI-2 is releasing gaseous activity (primarily Kr-85) at a rate of 65-80 curies/month from a variety of sources.

9. The exposure experienced by the Met Ed and contractor employees has been about 40 person-rem per month at Unit 2.

APPENDIX 2

OFF-SITE DOSES FROM KR-85

	Individual Doses at Site Boundary		Population Dose
	Skin	Whole Body	(50-mi. radius, 2.2 million people)
1. With controlled purging as proposed by Met-Ed (2 months)	0.005 R	0.0001 R	0.75 person-rem
2. With uncontrolled release - over 2-hour period, worst meteorology	0.019 R	0.0002 R	20 person-rem
3. Natural Background - over 2-month period as in Item 1 above	--	--	~ 46,000 person-rem
- over 2-hour period as in Item 2 above	--	--	~ 64 person-rem

PERSONNEL ENTRY INTO CONTAINMENT

The number of planned entries is unknown at present. Each 1/2-hour entry is estimated to result in a dose of 0.3-0.5 R if the Krypton has not been purged. If the Krypton is purged, the comparable dose is 0.2-0.4 R. Therefore, failing to purge the Krypton would add to each individual a dose of about 0.1 R for each 1/2-hour entry.

Each entry is assumed to involve two people. Therefore, about 0.2 person-rem is attributable to Krypton for each entry if the Krypton has not been purged. Four such entries would, therefore, incur about the same person-rem dose from the Krypton as would be received by the population if the Krypton were purged from containment (estimated to be 0.75 person-rem).

With the added protective equipment needed when working in a Kr^{85} atmosphere, worker risks are increased because of the increased chance of stumbling or falling and because of the loss of efficiency in performing necessary chores, thereby increasing stay-times (estimated to be a factor of two greater than if the Kr^{85} were purged). Marginal levels of oxygen in the building atmosphere may also be hazardous for breathing.

TMI - 2

RADIOACTIVITY SOURCES

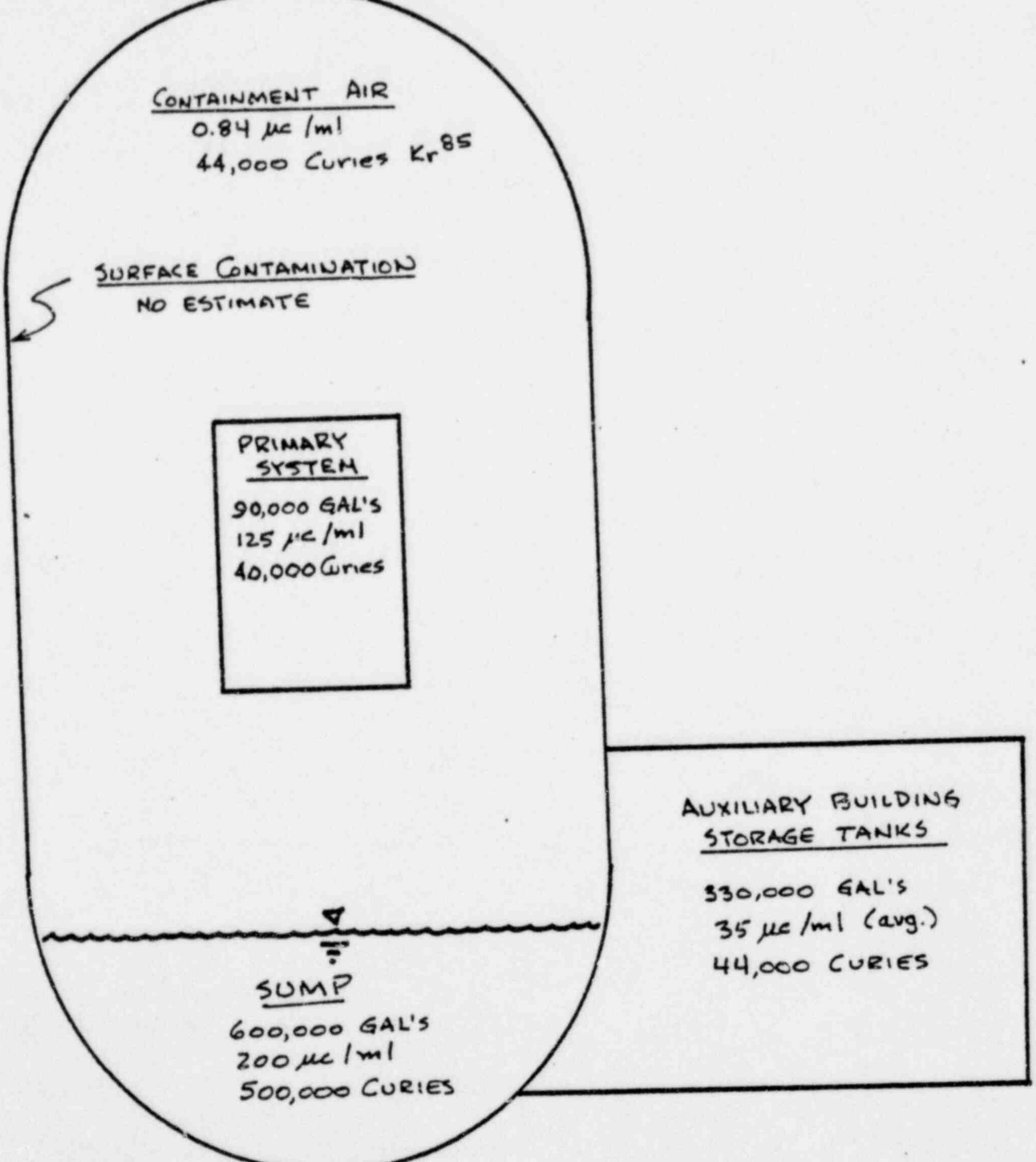

FIGURE 1

TMI-2

DOSE RATES INSIDE CONTAINMENT

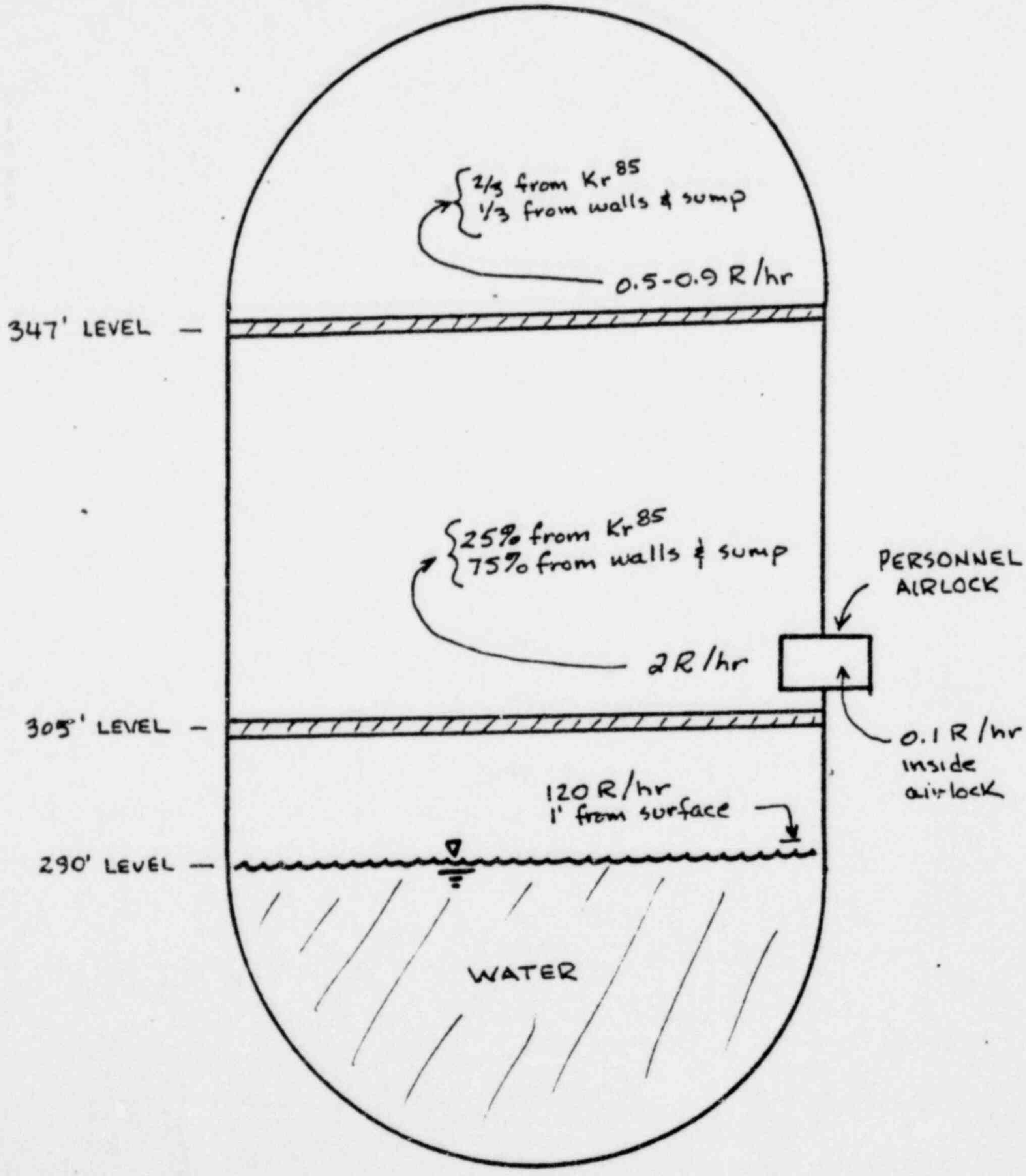

FIGURE 2

APPENDIX 3

The Urgency of Cleanup

This Appendix was prepared on short notice at the request of the task force by staff members in NRC's Probabilistic Analysis Group in order to provide illustrative bounding calculations. As such, this Appendix should only be considered to represent a rough approximation of possible offsite consequences for various hypothetical scenarios involving the damaged reactor at Three Mile Island.

The analyses presented in the Appendix were performed by R. Blond, M. Taylor, J. Murphy and M. Cunningham, of NRC along with R. Denning and P. Cybulskis of Battelle-Columbus. They have not been subjected to independent review.

The Probabilistic Analysis Branch evaluated the plant in its present state for ways in which it might fail and what the results of such failure would be. In addition, calculations were obtained of the possible consequences of some specific accident scenarios of a conservative bounding nature in order to define an upper limit to offsite consequences. This analysis is discussed in the following sections in the categories:

- Loss of Core Cooling or Coolant
- Loss of Containment
- Loss of Criticality Control

There follows a description of the accident cases analyzed and a summary of the conclusions which can be drawn.

Loss of Core Cooling or Coolant

As shown in Figure 3-1, the reactor building is isolated with about 600,000 gallons of water in the lowest part of the building. One can see from the general arrangement in the figure that this water level is sufficient to cover a great deal of equipment in the building with water. The items thus flooded include:

- the reactor building sump pumps
- portions of the steam generator lower heads
- portions of the reactor coolant system cold legs
- the Reactor Coolant Drain System
- lines leading from the bottom of the reactor vessel which contain in-core flux monitor and thermocouple leads.
- portions of the Decay Heat Removal System

- portions of the primary plant instrumentation.

Thus, there are hundreds of feet of piping, most of it small diameter and unisolable, attached to the reactor coolant system, which are exposed to this contaminated water. This water is not highly corrosive to the piping but the piping is in an uncontrolled exposure situation that may accelerate the processes that could lead to leakage. To deal with this uncertainty the system was analyzed for response to small break loss-of-coolant sequences for a 1/2-inch diameter and a 2-inch diameter. The results of that analysis are contained in the description of Case 3 described at the end of this appendix. As described in Cases 2, 3 and 4 there, we varied the principal assumptions of these accident calculations to allow degradation to core melt. (Case 1 deals only with the release of Krypton now held in the containment.) Even with the containment open the offsite consequences are low. The principal reason for this is that the more volatile and dangerous radionuclides have relatively short half-lives and have decayed significantly since the accident last year.

Loss of Containment

The containment free volume is about 2 million cubic feet. In addition to the contaminated water there, the air space contains about 44,000 curies of Kr-85 gas. At the present time the containment air pressure is being held below outside pressure by operating the reactor building air coolers which are located on an upper deck of the reactor building. Consequently, the pressure difference prevents leakage of Kr-85 from the containment. Some of the gas is apparently leaking from of the plant through the steam system. A strong vacuum is being maintained in the steam system to enable the reactor decay heat to generate steam at low temperature. It appears that Kr-85 from the reactor building atmosphere is being drawn through the packing of miscellaneous steam valves in containment by that vacuum and is being released to the atmosphere through the plant air ejectors. The rate of release is not large. If the packing on one of these valves were to fail, the rate of Kr-85 loss could increase substantially over what it is now. If that happened the leak could be stopped by isolating the steam generator. Suspension of steaming would not pose a serious problem because two backup cooling methods are available, the backup water cooling system through Steam Generator B and a low flow decay heat removal system which is presently being tested.

If the reactor building fan coolers were to fail, there would no longer be an installed cooling system to maintain containment pressure lower than the ambient pressure. If the reactor building pressure goes above atmospheric, leakage of Kr-85 to the atmosphere will ensue. The failure of a large opening in the containment could lead to an even greater release. An independent analysis of such an accidental Kr-85 release using the CRAC modeling developed for the Reactor Safety Study was performed. The result of that analysis, Case 1, is displayed in a succeeding section together with the core melt accident cases previously described. The risk of Kr-85 release is shown there to be very low.

The loss of the reactor building coolers might pose a problem more serious than Kr-85 release if they fail. Without those coolers in operation the temperature in the reactor building would increase, making it difficult for work in the containment. Such a situation would require the use of some auxiliary cooling system or the repair and restoration of the existing containment cooling system. Either of these alternatives would certainly entail additional occupational radiation exposure. The failure of the coolers is considered likely. There are five of these coolers, operating on two separate power supplies. They were qualified for several hours operation in the accident environment. However, the coolers require periodic maintenance and have received none for almost one year of continuous operation. Prudence dictates inspection and maintenance as soon as possible.

Perhaps the greatest risk of loss of containment is a confined leak of the reactor building water to the lower parts of the Auxiliary Building. Figure 3-2 shows an elevation of the Auxiliary Building with the water level in the reactor building. Note that the water in the reactor building stands almost 30 feet above the Decay Heat Removal pumps (2) and the Reactor Building Spray pumps (2) which are not shown but are at the same elevation. These four pumps will be important later when the reactor building is to be drained. The reactor building sump pumps are already failed. The four pumps just described are the only installed pumps for drawing out or recirculating water from the reactor building sump. With a thirty-foot head of water on these pumps and lines there is a continuing risk of leakage that could bring high activity water down into the spaces where the pumps are located. The increased dose rate could limit access severely or the water could flood the pump compartments. Either misfortune could greatly complicate the final cleanup operations. The risk of leakage into the Decay Heat Pump area is increased every shift when the decay heat removal suction valve (DHV-6) is opened in one of these large lines in order to measure reactor building water level using a sensitive pressure gauge at a pipe connection in the Auxiliary Building. The licensee told us that they are preparing another way to measure the water level in order to avoid opening this valve again and again.

Loss of Criticality Control

Reactor shutdown is now maintained with about 3850 ppm boron in the reactor coolant. During the accident the core was severely damaged and some analysts have estimated that some of the control rods have melted away from the fuel so that the dissolved boron may be the only means to maintain subcriticality. Therefore it is prudent to maintain this high boron concentration and to use nuclear instruments to monitor core reactivity to be sure of shutdown.

With respect to recriticality concerns, it is difficult to arrive at precise quantitative values of the likelihood of a recriticality accident at TMI-2 because of our imprecise information on the status of the core. However, qualitative considerations, presented below, clearly indicate that a recriticality accident is highly unlikely and, even if it were to occur, the consequence would be bounded by TMI-2, Case 3 presented on Fig. 3-3.

The core is presently shut down, as it has been since March 28, 1979. The reactor coolant system is borated to a concentration of 3850 ppm and is slightly basic (pH = 7.8). The core is severely damaged and it is quite possible that portions of several control and safety rods may have melted. Any control material which may have melted probably has not left the core region, however, but has redistributed in the fashion of resolidified candle wax drippings. The best estimate of the keff of the core in its present condition of which we are aware was prepared for the President's Commission on the Accident at Three Mile Island and is discussed in the Technical Staff Analysis Report on Alternative Event Sequences where a keff of 0.862 was estimated, given a boron concentration of 3180 ppm. Because the current boron concentration is significantly higher, the present keff should be much lower than 0.86.

We have briefly considered the possibility that an impulse or vibration could lead to dislodging a control rod or redistributing the debris bed. The core is presently shut down by greater than 14 percent Wk/k. The total rod worth is less than 3 percent. Clearly, even if all rods were lost, the core would remain subcritical.

Similarly, while rearrangement of the debris bed by starting a RCS pump or due to external forces could cause a local increase in core reactivity, we do not believe that any geometrical arrangement of the TMI-2 core can achieve criticality with 3850 ppm boron in the moderator.

The only method we can identify which could lead to recriticality of the core is boron dilution. However, the timing of such an accident is very long and it should be detected.

The normal RCS makeup capability has been disabled due to a leak in an instrument line fitting. Makeup is presently added using a supplementary system with the rate of makeup equal to the RCS leakage rate which averages about 0.2 gpm and has varied as high as 0.4 gpm. The effect of makeup flow rate on the time required to dilute to a critical solution was estimated for a range of possible critical boron conditions from 1500-2800 ppm. 1500 ppm approximates the critical boron condition in a clean cold undamaged core and is probably a lower bound. Use of the President's Commission analysis and pre-accident boron worths leads to an estimate of 2150 ppm. 2800 ppm was arbitrarily chosen as an upper bound. Results are presented in Fig. 3-4.

Clearly it would require several weeks of continuous boron dilution at the present makeup rate to reach criticality. Since the boron concentration is checked weekly, a monotonic decrease over this time period should be readily observed even if the last operable BF_3 is lost. This analysis is based on subjective judgments on the status of the core and boron worth. It should not be regarded as being definitive but does present an order of magnitude estimate of the timing involved, i.e., detection time is of the order of a month or more, rather than a week or less. Thus, ample time is available for detection and the accident is considered highly unlikely.

Because the time could be short if a large makeup flow were required, we recommend frequent checks to verify the makeup systems are lined up to deliver borated water (once per shift) and, if possible, more frequent determinations of RCS boron content, particularly if the nuclear instrumentation is lost.

The consequences of a recriticality accident have not been directly estimated. Dilution is a slow process and the reactivity addition rate is small (10-7, 10-8 Wk/k/sec). To bound the releases that might occur if a recriticality were to lead to melting, a release similar to sequences TKQ in WASH-1400 can be considered. This is equivalent to TMI-2, Case 3, on Fig. 3-3.

We were told that only one nuclear instrument is still functioning on the reactor. Replacement or repair of the nuclear instruments which have failed requires access to the reactor head area, around elevation 327 feet. We speculate that the repair or replacement of one of these instruments would take at least several hours labor, a difficult task with the present radiation levels in the building which limit access to perhaps 30 minutes per person. Although it is not likely that boron precipitation or stratification would lead to recriticality, it is especially desirable to have at least one functioning nuclear instrument to monitor the shutdown condition.

The assessment dealing with inadvertent criticality for the TMI Unit 2 core is imprecise and incomplete. It represents the best information available on short notice. In view of the limited nuclear instrumentation remaining, it would probably be prudent to request a more thorough evaluation of both the probability of criticality and the likely consequences of such an occurrence.

Accident Cases Analyzed

As part of this analysis a number of specific accident cases were analyzed using models and techniques developed in the Reactor Safety Study.

The results of these analyses are presented in Figure 3-3 and compared with with some of the major core melt accident sequences analyzed in the Reactor Safety Study. The results are shown as the conditional probability per year of a person a given distance from the reactor site suffering a latent cancer fatality due to the accident. By conditional probability we mean that the probability of the accident occurring is not included. For this comparison the accident is assumed to happen. Figure 3-3 also shows the probability of individual fatality from a number of common causes for comparison. It must be emphasized that the statistics for these common causes are much better known than those on which the reactor accident analyses are based. Therefore, there is much less certainty in the prediction of the reactor accident risks. The statistical uncertainty in the predictions of nuclear accident risks as shown in Figure 3-3 is believed to be no more than a factor of 100.

The following specific cases used the assumptions of the WASH-1400 study, appropriately adjusted to account for the conditions which prevail at TMI Unit 2. No protective action is assumed to occur except for Cases 2 and 3a where containment sprays are assumed to operate. Modeling of the events studied also followed the models developed for WASH-1400 or modifed versions thereof.

Case 1

Case 1 approximates the accidental release of the noble gases (i.e., ~ 44,000 Ci of Kr-85) presently residing inside of the TMI-2 containment. A fairly rapid release of the noble gases was assumed to cover possible scenarios involving the accidental loss of isolation and purging of the containment. This case predicts a tenfold greater impact than the controlled discharge of containment atmosphere -- at times of favorable atmospheric dilution -- which has been proposed as part of the cleanup operations (e.g., to minimize adverse occupational exposures on eventual entry to containment). Figure 3-3 herein shows that if an accidental discharge of all the Kr-85 inside of containment were to be assumed the individual risk of latent cancer fatality from such an event would be on the order of 10^{-10}/year for any reasonable off-site distances.

Case 2

This case involves an assumed meltdown of the current TMI-2 core inside an essentially intact containment. The current fission product inventories at TMI-2 were considered by using established computer techniques (CRAC) to estimate off-site consequences. The containment itself was assumed to be leaking during the meltdown processes at about 1 volume percent per day. Actually driving forces for such high leakage should be quite small for the TMI-2 core at its current level of decay heat.

In certain respects, this scenario parallels those included under Release Category #7 of the Reactor Safety Study; the main differences being that;

(1) the TMI-2 core would not be expected to penetrate the containment base mat, thus loss of containment integrity due to the melt processes would not occur.

(2) The fractional releases of halogens and noble gases (e.g., I, Xe) would be negligibly small due to long decay times now existing.

(3) The reduced decay heat level coupled with water levels at the bottom of the reactor vessel make it questionable whether or not the reactor vessel would be breached by a molten core (although the Case #2 analysis assumes a breach to occur).

(4) Should the reactor vessel be breached, the presence of considerable water in the containment should result in retaining a significant amount of particulate material that was assumed to become airborne for this Case #2 analysis. This latter conservative treatment is

not likely to have important overall impact on the consequence predictions inasmuch as the containment heat removal and spray systems are assumed operable (and used) in Case #2. However if the water levels below the core succeeded in retaining particulates that could become airborne after the molten core breached the reactor vessel, the effect of such a conservative treatment would be larger as in Case #3. This subsequent case assumes a meltdown without the presence of containment sprays and heat removal and it also assumes the existence of a rather large pathway for leakage from containment (> 4" dia. opening).

Case #2 is intended to estimate public risk from a core melt at TMI-2 should it occur. It is intended to cover all foreseeable scenarios whereby makeup coolant to the core is lost and not recovered.

The results of Case #2 indicate that the individual risk of experiencing a latent cancer fatality would be on the order of 10^{-9}/year for any reasonable distance beyond TMI-2 site.

Cases #3 and 3a

Cases #3 and #3a are intended to cover loss-of-coolant accidents leading to core meltdown in the presence of an unisolated containment (e.g. > 4" dia. pathway of leakage). Case #3 essentially bounds all foreseeable scenarios where (1) no core cooling makeup exists (2) no containment heat removal or sprays exist and (3) containment is accidently unisolated.

Case #3a is similar to Case 3 except that the effect of operating the containment sprays was considered to observe what effects such an action would have in mitigating the release magnitudes. (In general it was found that the spray operation would have a benefit of about factor of 2 in reducing the individual risk.)

In exploring the LOCA scenarios with no makeup it was decided to use core-meltdown modeling developed under NRC/RES sponsorship. This code[1] was run for several small LOCA scenarios assuming ~ 1/2" and 2" diameter piping failures. To bound the Reactor Coolant System draining rates and the timing of core melt in these cases, it was assumed that the failures were located in the bottom of the reactor vessel. In the case of the ~ 1/2" diameter LOCA, the computer run was terminated at ~ 100 hours (calculated) after the LOCA because of the inordinate computer running time. At this point the primary system was still ~ 60% full of water. A drain rate of about 40 lbs./minute was associated with the 1/2 inch diameter LOCA and it was estimated that roughly another 100 hours would be required before the top of the core became uncovered. By a rough estimate, nearly another one hundred hours would be needed to reach significant melting of the core.

[1] MARCH Computer Code - Battelle Columbus.

In the case of the 2" diameter LOCA the computer run was continued until significant (~ 20%) core melting was predicted (then the run was terminated for economic reasons). Results for this assumed 2" diameter LOCA are summarized below.

- Assumed Initial Conditions

  Vessel pressure = 200 psia
  Primary temperature = 160 F
  Secondary temperature = 120 F
  Shutdown time = 300 day
  Primary water inventory ≃ 685,700 lb
  90 percent cladding oxidation in top 4 ft of core
  No coolant makeup provided.

- Principal Results (2" break located in Bottom head)

Time, hr	Peak Core Temperature, F	Clad Reacted	Comments*
18.7	220	0.30	Start core uncovery
22.2	348	0.30	
33.8	950	0.30	
62.4	2392	0.31	
82.2	4130	0.33	Start core melt
119.8	4130	0.36	20% core melted

*(Containment conditions were relatively constant at containment pressure ~ 1.2 psig, sump temperature ~ 120F.)

If one assumes that the above LOCA scenarios were to occur the individual risk of latent cancer fatality due to Cases #3 and #3a is estimated (through CRAC modeling) to be $\frac{1}{1,000,000}$ to $\frac{1}{100,000}$ for any reasonably close distance to the plant (< 5 miles). Obviously, the probability of experiencing these rather severe scenarios is not unity; it is probably less than 10^{-2}.

Case #4

Case #4 was performed for the purpose of illustrating an upper bounding case for which no credible mechanisms exist. In this case it was assumed that the TMI-2 core was located in the island field outside of its present resting place within the reactor vessel and containment. The core was then assumed to have no heat removal mechanisms (e.g., air cooling). Under these conditions the core would reach melting in about 4 days. The core was assumed to continue to melt and release meltdown fractions[1] of the radioactivity that is currently residing in the core. Unlike those retention or deposition mechanisms that

[1] See Appendix VII to WASH-1400 (Reactor Safety Study)

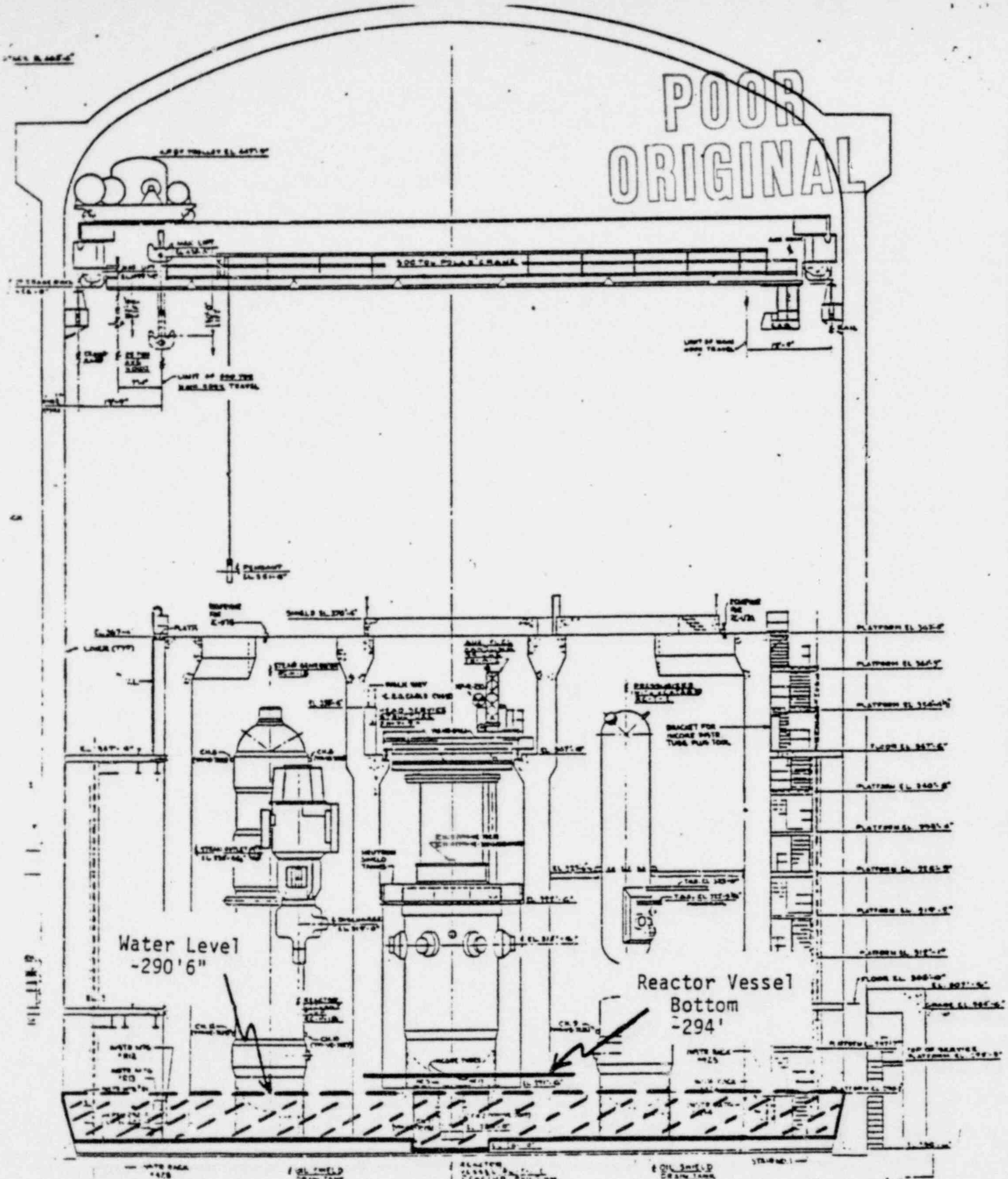

Figure 3-1 Reactor Building Elevation

would exist if the core melted within the reactor vessel and containment, <u>none</u> were assumed to exist to reduce the Case #4 releases. With the assumption that the Case #4 scenario occurred and the further assumption that no mitigating actions were taken in the number of days involved, it is estimated the chance of an individual experiencing a latent cancer fatality within 5 miles distance off the island would be $\frac{1}{100,000}$ to $\frac{1}{10,000}$.

It must be emphasized that there is no credible way in which the scenario described by Case 4 could occur. It is used here only to provide an essentially unassailable upper bounding case for core melt for comparison to more realistic possibilities.

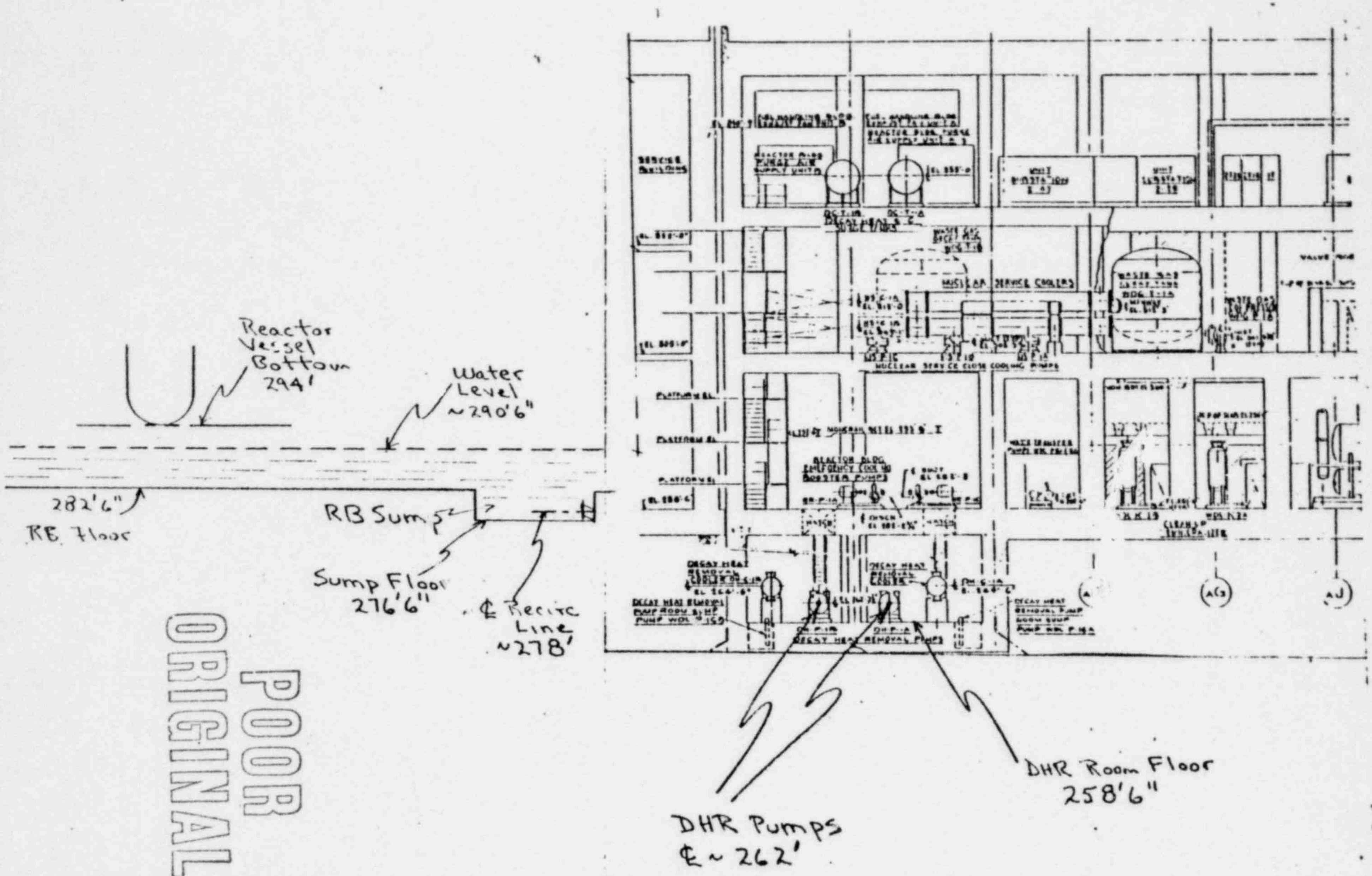

Figure 3-2 Auxiliary Building and Reactor Building Water Level

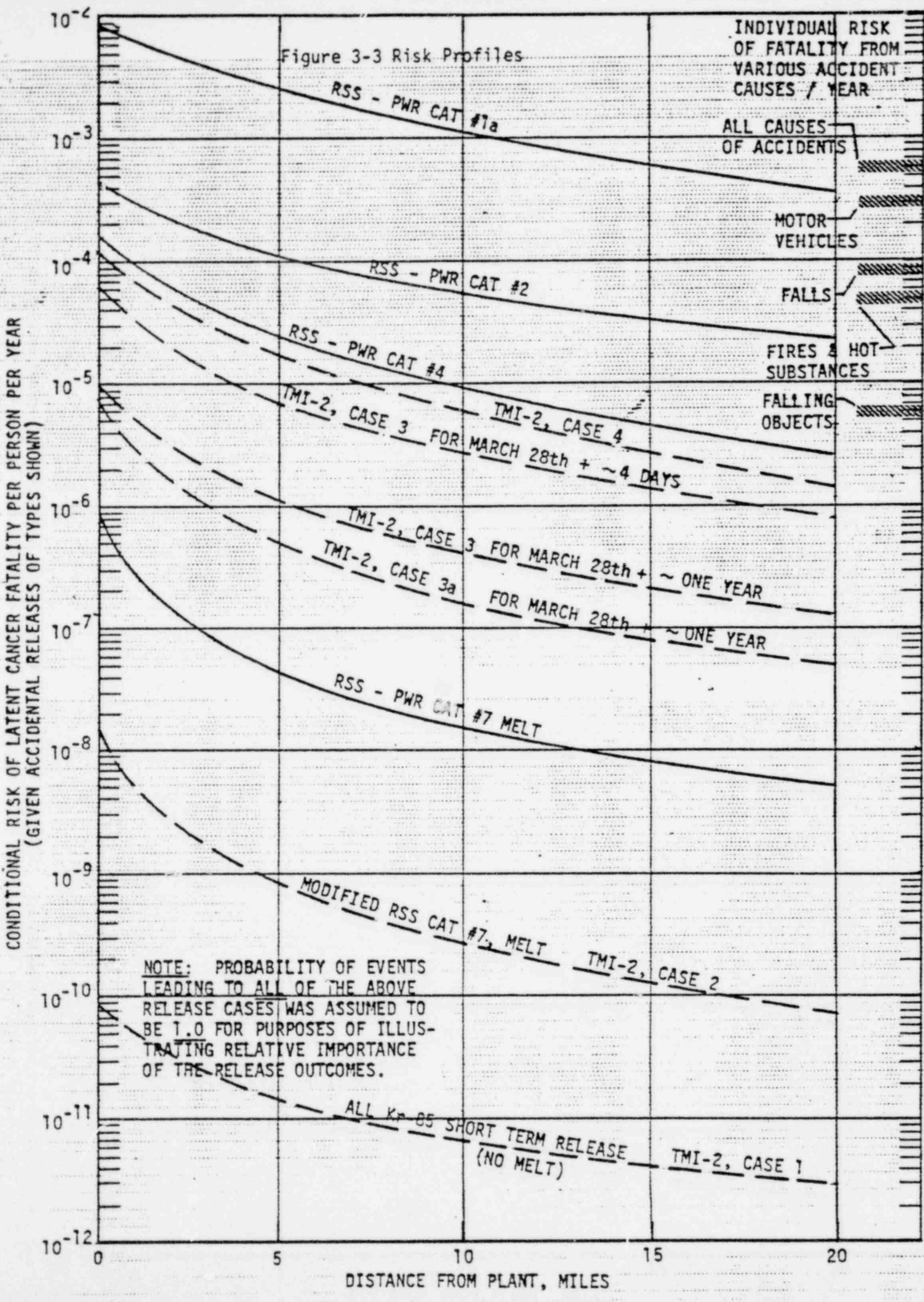

Figure 3-3 Risk Profiles
INDIVIDUAL RISK OF FATALITY FROM VARIOUS ACCIDENT CAUSES / YEAR
ALL CAUSES OF ACCIDENTS
MOTOR VEHICLES
FALLS
FIRES & HOT SUBSTANCES
FALLING OBJECTS
RSS - PWR CAT #1a
RSS - PWR CAT #2
RSS - PWR CAT #4
TMI-2, CASE 4
TMI-2, CASE 3 FOR MARCH 28th + ~4 DAYS
TMI-2, CASE 3 FOR MARCH 28th + ~ ONE YEAR
TMI-2, CASE 3a FOR MARCH 28th + ~ ONE YEAR
RSS - PWR CAT #7 MELT
MODIFIED RSS CAT #7, MELT TMI-2, CASE 2
NOTE: PROBABILITY OF EVENTS LEADING TO ALL OF THE ABOVE RELEASE CASES WAS ASSUMED TO BE 1.0 FOR PURPOSES OF ILLUSTRATING RELATIVE IMPORTANCE OF THE RELEASE OUTCOMES.
ALL Kr-85 SHORT TERM RELEASE (NO MELT) TMI-2, CASE 1
CONDITIONAL RISK OF LATENT CANCER FATALITY PER PERSON PER YEAR (GIVEN ACCIDENTAL RELEASES OF TYPES SHOWN)
DISTANCE FROM PLANT, MILES
0
5
10
15
20
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}

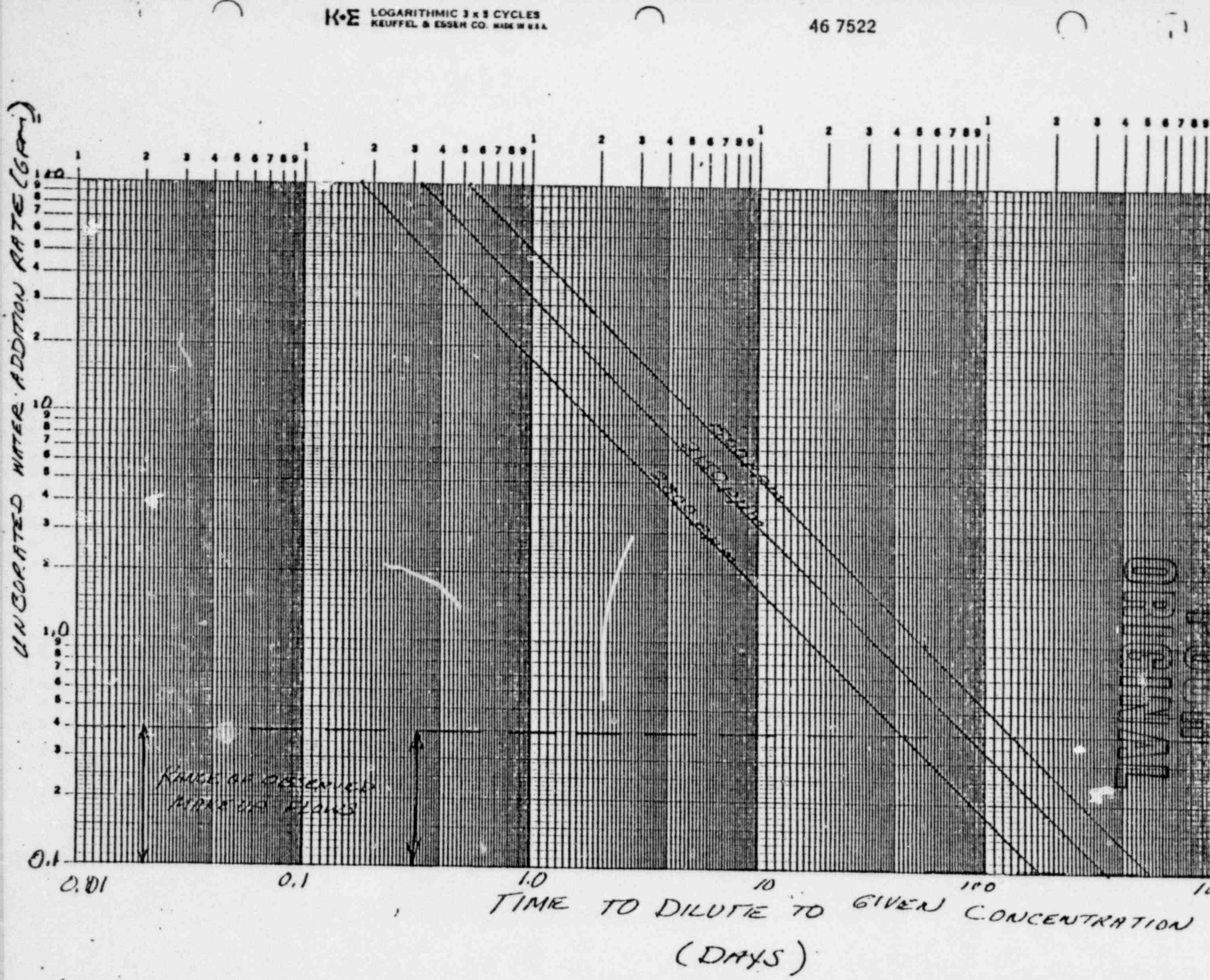
K•E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 7522
UNBORATED WATER ADDITION RATE (GPM)
10
1.0
0.1
RANGE OF OBSERVED MAKE UP FLOWS
0.01
0.1
1.0
10
100
1000
TIME TO DILUTE TO GIVEN CONCENTRATION
(DAYS)

FIGURE 3-4

APPENDIX 4

Chronology of Decision to Approve Airlock Entry

The following chronology traces the sequence which was followed in attempting to reach a decision for approval of the licensee's proposal to make initial manned entry into the containment building airlock. Most of the following information was provided by the NRC TMI support office at the site. Two points should be noted from this chronology:

- NRC has not yet acted on a recommendation to enter the airlock although it was presented for approval by the licensee on December 10, 1979.
- Until late on January 31, 1979 (the day entry was planned) the NRC TMI On-Site Support Staff was unaware that approval of this proposal would be required by off-site management.

July 1979	The licensee presented an overall TMI-2 reactor containment building entrance program with a tentative schedule to their management and to the NRC on-site staff. During this presentation they expressed a need for obtaining air samples and dose maps from reactor building personnel airlock No. 2 and then entry to airlock No. 2 prior to actual containment building entrance.
September 9, 1979	The licensee initiated preparing required procedure for passage to and from barrel of personnel airlock No. 2.
October 11, 1979	The licensee submitted this procedure to their Radiological Operations Review Committee (RORC) for review and appraisal.
October 18, 1979	The procedure was disapproved with comments by RORC.
October 30, 1979	The licensee resubmitted revised procedure to RORC incorporating comments by RORC.
December 4, 1979	Revised procedure was approved by RORC.
December 10, 1979	The NRC on-site staff received the procedure for our review and approval.
December 11, 1979	The NRC on-site staff reviewed and approved the procedure.
December 19, 1979	The Licensee stated in reactor building entry program meeting that the procedure has been approved by the NRC and they expect entry into the airlock No. 2 on January 28, 1980. The NRC on-site staff was in the meeting.

January 31, 1980 (0730 hours)	The licensee stated in daily meeting (plan of day meeting) that they will make entry to airlock No. 2 on this day. The NRC on-site staff was in this meeting.
January 31, 1980 (1720)	The NRC notified the licensee to cancel the implementation of procedure to enter airlock No. 2. This procedure would have resulted in the release of approximately .047 Ci of Kr-85 in 870 cubic feet of airlock No. 2 atmosphere.
February 13, 1980	On-Site TMI Support Staff drafted a Commission paper to obtain approval for release of Kr-85 gas in reactor building personnel airlock at TMI-2.
February 20, 1980	Staff paper (SECY-80-105) submitted for Commission approval. Office of the Secretary requested Commission action by c.o.b. February 29.

APPENDIX 5

List of Key Meetings

February 19	W. Dircks	Acting Executive Director for Operations, NRC	Reviewed charter of task group
	V. Stello	Director, Office of Inspection and Enforcement, NRC	Summarized results of his trip to TMI-2 to review the two releases of Krypton-85 which occurred week of February 11, 1980.
February 20	R. Vollmer	Director, TMI Site Support, NRC	Provided overview of TMI-2 cleanup effort
	H. Feinroth	Chief of Reactor Evaluation Branch, Nuclear Power Development Division, Office of Nuclear Energy Programs, DOE	Reviewed the DOE's interest and involvement in the TMI-2 cleanup.
	W. H. Regan, Jr.	Acting Assistant Director, Environmental Projects, Div. of Site Safety & Env. Anal., NRC	Reviewed the effort to prepare PEIS for the TMI-2 cleanup
	Paul H. Leech	Senior Environmental Project Manager, NRC	
February 21	John Collins	Deputy Director, TMI Site Support, NRC	Described site operations and role of the site NRC personnel.
	R. F. Wilson G. Hovey J. Thorpe	Director, TMI-2 Prospective Director, TMI-2 Director, Environment, Health and Safety, Met-Ed/GPU	Described TMI-2 cleanup effort and Met-Ed/GPU perspective of problem areas.
February 22	Joyce Freeman Don Lowry	Office of Lt. Governor	Provided review of conclusions
	T. Gerusky	Dept. of Environmental Resources, Commonwealth of Pennsylvania	reached by the Governor's TMI Commission regarding cleanup of TMI-2.

APPENDIX 5

List of Key Meetings (continued)

February 22	R. Arnold	Sr. Vice President, Metropolitan Edison	Provided overview of TMI-2 cleanup operations and Met-Ed concerns
	Robert Reid	Mayor of Middletown, PA	Discussed subject of credibility
February 25	G. Brubaker J. Shea J. MacKenzie	Council on Environmental Quality Staff	CEQ's staff position on TMI-2 cleanup

APPENDIX 6

Reference Documents for the TMI-2 Special Task Force

1. Memo from W. Dircks to E. Helminski, dated February 15, 1980, regarding establishment of a Special Task Force to assess TMI cleanup with attached memorandum from W. Dircks to Task Force Members.

2. Press Release of February 19, 1980 announcing establishment of Special Task Force to study cleanup operations at TMI.

3. TMI-2 Order dated February 11, 1980 imposing requirements of proposed tech specs attached thereto with accompanying safety evaluation and environmental assessment and negative declaration.

4. NRC Statement of Policy and Notice of Intent to Prepare a Programmatic Environmental Impact Statement published in the Federal Register on November 27, 1979 (44 F.R. 67738).

5. Press announcement telegrammed to President Carter from Pennsylvania State Legislator, Mayor, and anti-nuclear group (undated).

6. Letter from G. W. Cunningham, DOE, to W. Dircks, NRC, dated February 5, 1980, regarding DOE-EPRI cooperative program regarding evaluation of TMI-2 lessons.

7. Preliminary notification of event or unusual occurrence (PNO-TMI-80-03) dated February 11, 1980, regarding primary water leak at TMI-2.

8. NRC press release dated February 13, 1980, regarding release of some radioactive gas at TMI-2.

9. Bechtel Power Corporation Report entitled "Three Mile Island - Unit 2 Planning Study for Containment Entry and Decontamination" dated July 2, 1979.

10. Letter from R. L. Rider, Bechtel, to R. W. Heward, GPU, dated July 13, 1979 and accompanying Preliminary Assessment of Potential Cost and Schedule for the Recommission of the Three Mile Island Unit 2 Containment Building and Systems.

11. Letter from R. C. Arnold, Met-Ed, to R. Vollmer, NRC, dated November 13, 1979, and accompanying document entitled "Three Mile Island Unit 2, Reactor Building Purge Program, Safety Analysis and Environmental Report" (GQL-1416), dated November 12, 1979.

12. Summary of Technical Plan for TMI-2 Decontamination and Defueling, Met-Ed, dated December 12, 1979.

13. Letter from J. T. Collins, NRC, to R. C. Arnold, Met-Ed, dated December 18, 1979, transmitting list of questions on Met-Ed "Reactor Building Purge Program" report.

14. Letter from R. H. Vollmer, NRC, to R. C. Arnold, Met-Ed, dated December 18, 1979, regarding reactor containment building atmosphere cleanup and withholding approval of request to purge the TMI-2 reactor building.

15. Letter from R. F. Wilson, Met-Ed, to J. T. Collins, NRC, dated January 4, 1980, enclosing responses to question raised in Collins' letter of December 18, 1979.

16. TMI-2 Memorandum and Order, dated October 16, 1979, authorizing operation of EPICOR-II and accompanying environmental assessment (NUREG-0591) prepared by NRR, dated August 14, 1979.

17. NRC Statement, dated May 25, 1979, directing preparation of environmental assessment regarding proposals to decontaminate and dispose of radioactively contaminated waste water from TMI-2.

18. Discussion of public comments and staff recommendation on use of Epicor-II at TMI, prepared by NRR, dated October 4, 1979.

19. Letter from Chairman Ahearne to U. S. Senator Hart, dated January 22, 1980, in response to November 15, 1979 letter raising questions on TMI-2.

20. Letter from H. Denton, NRC, to Congressman Ertel, dated August 9, 1979.

21. Letter from L. V. Gossick, NRC, to Congressman Ertel, dated November 2, 1979.

22. Letter from Commissioner Kennedy to Senator Hart, dated October [illegible], 1979.

23. Letter from Chairman Ahearne to Senator Hart, dated Feburary 4, 1980, regarding TMI-2 decontamination program.

24. Letters from L. V. Gossick, NRC, to Senators Hart and Simpson, dated January 2, 1980.

25. Recommendation from H. Denton to NRC Commissioners regarding release of Krypton gas in reactor building personnel airlock at TMI-2, dated February 20, 1980.

26. Internal NRC Memorandum from R. Vollmer to S. Eilpern, dated January 3, 1980, regarding proposed draft settlement on City of Lancaster, et al. v. NRC.

27. Internal DOE Memorandum from W. Bicksby to H. Feinroth, dated February 8, 1980, attaching EPA Report entitled "Long-term Environmental Radiation Surveillance Plan for Three Mile Island," dated September 27, 1979.

28. NRC Staff document entitled, "TMI-2, February 11, 1980 Event Radiological Chronology."

29. Transcript of NRC Commission Meeting regarding status of TMI-2 Minor Radiological Release, dated February 15, 1980.

30. Internal NRC Memorandum from V. Stello to E. Case, dated February 20, 1980, regarding inquiries at TMI-2.

31. Tentative outline for TMI-2 Programmatic Environmental Impact Statement, dated January 10, 1980.

32. Memorandum from Chairman Ahearne to the Commissioners, dated January 15, 1980, regarding TMI-2 decontamination program plan.

33. Memorandum from R. Kennedy to Chairman Ahearne, dated January 18, 1980, re TMI-2 Decontamination Plan.

34. Letter from Chairman Ahearne to Congressman Ertel, dated December 31, 1979, responding to attached incoming letter of October 4, 1979.

35. NRC press release announcing NRC staff issuance of environmental assessment of decontaminating Three Mile Island waste water, dated August 14, 1979.

36. Memorandum from B. J. Snyder, NRC, to the Commissioners, dated October 9, 1979, regarding operation of Epicor-II system at TMI-2.

37. NRC news release, dated February 13, 1980, announcing staff placement of new conditions on Three Mile Island Unit 2.

38. Memorandum from E. J. Hanrahan to NRC Commissioners, dated February 5, 1980, enclosing report of B. J. Snyder covering two public meetings attended in Harrisburg, Pennsylvania, on January 29, 1980.

39. Three Mile Island Unit 2 Radiation Protection Program report of the Special [NRR] Panel (NUREG-0640), dated December 1979.

40. Letter from Senator Hart to Commissioner Hendrie, dated November 20, 1979, regarding November 9, 1979 hearing before U. S. Senate Committee on Environmental and Public Works.

41. Letter from G. Speth, CEQ, to then Chairman Hendrie, dated October 10, 1979.

42. Letter from J. Hendrie to G. Speth, dated October 15, 1979.

43. Letter from G. Speth to J. Hendrie, dated October 16, 1979.

44. Settlement agreement in City of Lancaster, et al. v. NRC, U.S. District Court for the District of Columbia, Civil Action No. 79-1368

45. Proposed stipulation and order of dismissal with prejudice in Civil Action No. 79-1368.

46. Report of the Governor's Commission on Three Mile Island, William W. Scranton, III, Lt. Governor, Chairman, dated February 26, 1980.

47. Internal memorandum from V. Stello to E. Case, dated February 20, 1980, regarding inquiries at TMI-2 initiation of evaluation.

48. TMI-2 Reactor Building Entry Program, Attachments, dated February 20, 1980.

49. Press release announcing release of Pennsylvania Governor's Commission on Three Mile Island Report, dated February 26, 1980.

50. Letter from Mayor Reid of Middletown, PA, to Lt. Governor Scranton, dated February 22, 1980.

51. Letter from G. A. Kudner, Met Ed, to staff, dated February 19, 1980, regarding emergency plan Memorandum #1.

52. Letter from M. A. Parsont, NRC to Dr. E. Stonehill, NIH, February 21, 1980, enclosing TMI Dose Summaries.