
Three Mile Island, Unit 2, Radiation Protection Program

Report of the Special Panel

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W. R. Casey, Brookhaven National Lab.

Office of
Nuclear Reactor Regulation

U.S. Nuclear Regulatory
Commission



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



The Report of the Special Panel

on

Three Mile Island Unit 2 Radiation Protection Program

Abstract

A special panel was appointed by the Director of Nuclear Reactor Regulation, NRC, to review the radiation protection program at Three Mile Island Unit 2.

The Panel confirmed several management and technical deficiencies in the program. Recent major GPU/Met Ed commitments and actions demonstrated a major change in management attitude.

The Panel concluded that exposures to personnel can be maintained to as low as is reasonably achievable while limited preparatory recovery work continues and when further needed improvements are implemented as needed, the radiation safety program will be able to support major recovery activities.



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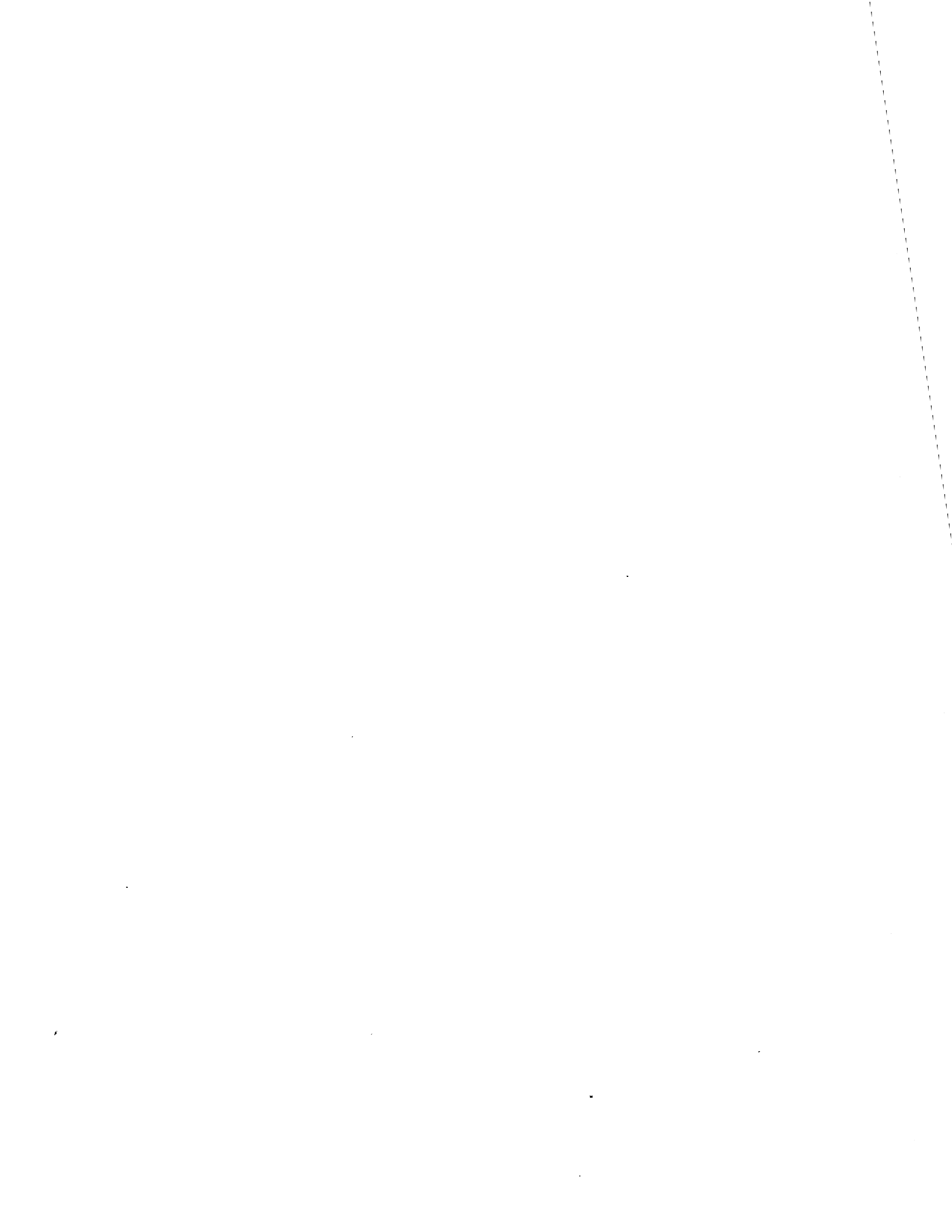
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Executive Summary

of the

Special Panel

on

Three Mile Island Unit 2 Radiation Protection Program

There have been well deserved criticisms of the Radiation Safety Program supporting the recovery of Unit 2 at Three Mile Island. However, major GPU/Met Ed commitments and actions have recently demonstrated a major change in management attitude. Although the Panel concluded that exposures to employees can be maintained as low as reasonably achievable while the initial preparations for recovery continue, further improvements in the radiation safety program will be able to support the major recovery effort.

The progress of GPU/Met Ed in expanding and developing its radiation safety program must be consistent with the time schedule planned for major recovery activities.

Acknowledgements

The Panel wishes to acknowledge Robert Casey's effort as Rapporteur in generating the initial draft of the minutes and the report in an exceptionally short time frame and to members of the secretarial staff at Brookhaven National Laboratory, Carol Ogeka and Jodi Earle for assisting in this effort.

The Panel also appreciates John Collins' TMI Operations Support Team for their hospitality and the staff at the NCRP Headquarters for the warm hospitality they showed Ms. Morrison. We would also like to particularly thank Louisa Morrison for her efforts in preparing the final version of the report and for coordinating arrangements for various meetings of the Panel.

The Report of the Special Panel

on

Three Mile Island Unit 2 Radiation Protection Program

I. Introduction

Following the accident at Unit 2 of the Three Mile Island (TMI) Nuclear Generating Station, extraordinary radiation safety problems were faced by the General Public Utilities/Metropolitan Edison (GPU/Met Ed). Both the technical and management requirements in these first few weeks were substantial, and certainly unparalleled in the history of the U.S. Nuclear Power Program. The problems were associated with emergency activities necessary to assure that the reactor was placed in a safe shutdown condition. In the first few weeks after the accident, many entries into high radiation areas, frequently involving high level concentrations of airborne radioactivity were made to mitigate airborne releases and to provide storage for high level radioactive liquids. Additionally, many personnel were hired to meet increased needs, imposing unusual demands related to coordination and integration of these people into the radiation safety program.

The Nuclear Regulatory Commission (NRC) had become increasingly concerned during the months following the accident concerning the ability of GPU/Met Ed to adequately manage the program for worker radiation safety during the recovery of Unit 2. There was evidence of a lack of total management commitment conveyed throughout the workforce that radiation protection needed to be an integral part of the recovery effort. Unplanned exposures above the NRC guidelines reinforced this concern. At meetings on July 13 and 18, 1979, senior NRC officials formally identified to GPU/Met Ed senior management a number of significant problems in the radiation safety program. As a result of these meetings, the NRC received commitments from GPU/Met Ed to upgrade its radiation safety program according to a specified schedule.

By mid-September, GPU/Met Ed had been unable to meet these commitments. The continuing uncertainty of the adequacy of the radiation safety program at TMI prompted concern by others, including members of the Congress of the United States, officials of the Commonwealth of Pennsylvania, and the NRC Commissioners.

On Wednesday, September 26, 1979, Harold R. Denton, Director of the Office of Nuclear Reactor Regulation (NRR), NRC, created a special panel to provide an independent review of the radiation protection program at TMI. The Panel was charged with evaluating the capability of the existing and planned radiation safety program to maintain radiation exposure to personnel as low as is reasonably achievable during the decontamination and recovery of Unit 2.

To meet the schedule requested by Mr. Denton, the Panel concentrated its efforts on the most pressing problem, program management. The Panel realized that GPU/Met Ed had many technical problems which needed to be solved prior to recovery activities. However, because of time constraints only a limited evaluation of some technical problems is included in this report.

II. Chronology of the Activities of the Panel

The activities of the Panel are briefly highlighted in this section. A more detailed accounting is provided in the official minutes (See Appendix A).

| | |
|-------------------------|---|
| September 26 - 28, 1979 | Formation of the Panel by Mr. Denton |
| October 9 | Initial meeting and briefing at NRC Headquarters, Bethesda, Maryland |
| October 10 | Visit of the Panel to the TMI Nuclear Generating Station, Middletown, Pennsylvania and tour of the site. |
| October 11 | Analysis of data and preparation of action plan, including schedule of interviews for October 22, 1979. Visit to certain health physics facilities. |
| October 19 | Scheduled interviews postponed to November 5, 1979 |
| November 5 | Panel convenes for meetings with GPU/Met Ed management at which time a major reorganization and management commitment is revealed. In subsequent executive session, the Panel revised its action plan to accommodate these changes. |
| November 6 - 7 | Panel meets with selected GPU/Met Ed contractor personnel. |
| November 8 | Panel consolidates meeting notes and reviews sources of information. Panel formulates preliminary conclusions. |
| November 12 - 16 | Draft minutes and report prepared and circulated to Panel members. |
| November 26 | Meeting with the newly appointed manager of new GPU/Met Ed TMI-2 Radiation Control Department. |
| November 26 - 30 | Panel convenes in NRC Headquarters, Bethesda, to prepare report for submission to Mr. Denton. |

III. Conclusions of the Panel

On the basis of information derived from the tours, interviews, written source material, and its subsequent deliberations, the Panel has concluded the following:

Conclusion A

The present radiation safety program has substantial deficiencies and requires significant corrective action to support major recovery activities.

Basis

- 1) The Nuclear Regulatory Commission staff under the Directors of TMI Operations and Region I had identified a number of management and technical deficiencies in the radiation safety program through management meetings, inspection reports, technical evaluations and informal interactions with GPU/Met Ed management and technical staff.
- 2) Mr. Robert C. Arnold, Senior Vice-President, GPU/Met Ed stated to the Panel that despite all the comments and recommendations that GPU/Met Ed has received from various sources, including its own contractors and consultants, the utility had been unable to establish an effective radiation safety program. He attributed these problems to: i) an inability to find a strong management person to head the radiation safety group despite several personnel changes and extensive recruiting, and ii) an attitude that radiation safety was not a line (operational) responsibility, but rather that of a staff radiation safety group.
- 3) The Panel's interviews with station personnel at all levels revealed a consistent feeling that safety was not respected. They felt themselves to be "second class" members of the GPU/Met Ed team, although this attitude was not intended by management. It appeared to the Panel that this problem resulted from pressures and basic attitudes of all levels of management as well as a lack of ability of the radiation safety staff to inspire confidence and respect.
- 4) The GPU/Met Ed radiation safety program was observed to lack organization and direction. The several GPU/Met Ed and contractor program elements appeared independent and fragmented, lacking overall coordination and control. The need for a confident, respected, and supported (by top management) manager of the radiation safety program was evident. Also, technicians and their foremen were required to make decisions in situations dominated by operational pressures without the security of a technically strong organization and procedurally sound program.
- 5) The Panel offers the following as examples of specific management deficiencies:

(a) Management Commitment in Support of Radiation Safety Program

On the basis of interviews with GPU/Met Ed senior management and others in supervisory positions, the Panel confirmed that a serious morale and attitude problem existed in the radiation safety organization. Several

personnel, both in operations and radiation safety, characterized personnel in the organization as being treated as "second class" citizens. As an example, first line radiation safety foremen were not convinced that they had the management support to stop operations in the interest of worker safety. *(Panel Comment: GPU/Met Ed management recognized this attitude problem and took action to correct it.)*

(b) Organizational Structure

The Panel observed a high degree of uncertainty regarding responsibilities, function, assignments, and lines of authority. For example, the Panel noted that the radiological engineering function lacked clear definition of its areas of responsibility. *(Panel Comment: GPU/Met Ed management has recognized this problem and is taking action to correct it. See Attachment C.)*

(c) Technical Depth of Radiation Safety Program

The Panel noted that professional input for the radiation safety program is lacking. For example, many of the decisions which should have professional review are being made by technicians. *(Panel Comment: GPU/Met Ed has recognized this problem and is taking action to correct it.)*

(d) Training

During the Panel's interviews, several deficiencies in the radiation safety training program were observed. For example, the Panel noted that the understanding of risk of low level radiation exposure by radiation safety and operations personnel was inadequate. In addition, specific training deficiencies were identified in: i) operation of radiation safety instrumentation by field personnel, ii) understanding of the radiological hazards associated with the recovery activities, iii) familiarization with plant systems, and iv) radiation and contamination control measures. *(Panel Comment: GPU/Met Ed has included in its reorganized Unit 2 radiation safety program, a training function which reports directly to the radiological controls manager. The Panel considers that the deficiencies in training can be corrected by this increased management attention and commitment during the period between now and commencement of recovery operations. GPU/Met Ed should use this period to prepare for handling large quantities of radioactive material by gaining experience with the handling of radioactive materials in the auxiliary/fuel handling buildings. This training is mandatory if an adequate cadre of personnel capable of performing major recovery work is to be available.)*

(e) Resolution of Audit Findings

The Panel noted that there were several deficiencies in the resolution of audit findings. It appeared to the Panel that management had not comprehended the importance of these findings. *(Panel Comment: The GPU/Met Ed management has recognized this problem and is taking action to correct it.)*

(f) Preparation and Implementation of Procedures

The NRC has determined that many Met Ed procedures are written in such a manner that strict compliance is not possible. Strict compliance with procedures is a key to a successful radiation safety program. *(Panel Comment: GPU/Met Ed management has stated that the procedures for Unit 2 are being revised and that verbatim compliance will be required.)*

6) The Panel offers the following as examples of specific technical deficiencies.

(a) External Personnel Dosimetry

The response of the TLD badge is known to be inadequate for the β radiations that are present in the mixture of radionuclides present in Unit 2. Non-penetrating doses can be underestimated, and penetrating dose can be overestimated using this badge.

Although plans have been made by GPU/Met Ed to improve the quality assurance of personnel dosimetry through inter-comparison with accepted programs, no such program exists at present.

The present system of radiation exposure management does not permit assessment of exposure by job or by group. Furthermore, the system does not permit the rapid updating of exposure totals in a timely fashion.

The investigation of unusual exposures is conducted by members of the dosimetry group. The Panel is concerned that there is not sufficient technical expertise within this group to permit a comprehensive evaluation. The initial failure of the dose assessment group to consider gonadal exposure and exposure to the lens of the eye in the radiation incident of August 28, 1979 is an example of this weakness. The long time period that has been spent reviewing the gonadal exposure question (as yet this issue is still unresolved) is another example. *(Panel Comment: GPU/Met Ed management has informed the Panel that evaluations are underway to correct the problems with the badge and the exposure management system.)*

(b) Internal Dosimetry

The Panel was informed of several examples of problems in determining internal dose. These problems include: i) overestimate of dose to the thyroid because of failure to consider the fractional transport, ii) assignment of iodine uptake based on peaks produced by cesium Compton scattered peaks, and iii) failure to interpret the effective half-life of iodine properly.

The GPU/Met Ed criteria for requiring ^{90}Sr bioassay is a ^{137}Cs uptake of 150 nCi as measured by whole body monitoring. However, to the dosimetry group's knowledge, no assessment has been made which demonstrates that this technique is adequate to assure that significant ^{90}Sr uptake will not go undetected.

(c) Instrument Program

The Panel is concerned that sufficient professional input into the instrument program is lacking. Selection of instruments, installation, calibration, and maintenance is performed by contractor technicians. *(Panel Comment: The Panel encourages the evaluation by the Radiological Engineering group of portable survey instruments which are needed for the major recovery activities. The Panel also believes that an auditing program needs to be established by GPU/Met Ed to assure that instruments are being properly calibrated and maintained.)*

(d) Radiation Control

The Panel notes that the radiation protection plan does not include adequate emphasis on reduction of personnel exposures to ALARA. Such emphasis should include goals and mechanisms for demonstrating progress.

Conclusion B

During the Panel's review, the management of GPU/Met Ed at TMI demonstrated a strong commitment to upgrade the radiation safety program to assure that radiation exposure to all employees will be as low as reasonably achievable.

Basis

1) The Panel participated in an all day discussion with Mr. Arnold and had the opportunity to inquire into his understanding of the radiation safety problems and their solutions. The Panel noted that Mr. Arnold understood the problems and had initiated positive solutions, including securing the services of a senior radiation safety consultant. He told the Panel of his intention to: i) reorganize the Unit 2 radiation safety program, ii) separate the Unit 1 and Unit 2 radiation safety program, iii) appoint a new manager, and iv) raise the reporting level of the manager in the recovery operations. On November 8, 1979, Mr. Arnold took these actions.

2) The Panel met with Murray Miles of Basic Energy Technology Associates, Inc. and a consultant to GPU/Met Ed, and discussed his evaluation of the situation. He asserted that GPU/Met Ed was indeed taking strong action in correcting their problem and described for the Panel the extensive program improvements.

3) Immediately prior to the visit of the Panel and continuing through the week, Mr. Arnold conducted a series of meetings with GPU/Met Ed employees in which he demanded that each individual accept his/her responsibility for safety. Every report, that the Panel heard of these meetings, confirmed that Mr. Arnold was firm, direct, and insistent that a change in attitude and performance was mandatory.

4) On November 1, 1979, Mr. Arnold wrote a memo (see Attachment B) to all personnel working at TMI requiring a more disciplined, professional approach to radiological work be implemented. This memo was viewed as further evidence of the management commitment to improve performance.

5) During the initial visit to TMI, the Panel noted poor housekeeping throughout the site, which was felt to be symptomatic of an undisciplined and/or unorganized management approach, and could be influencing the radiation safety program. On November 6, 1979, a site-wide cleanup was ordered by Mr. Arnold. All operational activities ceased and full time was devoted to the cleanup. The cleanup continued throughout the duration of the Panel's visit.

6) During the Panel's meeting with Richard W. Heward, Jr., the newly appointed manager of the Radiological Controls Department (see Attachment C), he presented an extensive list of important steps already taken to correct deficiencies in the radiation safety program. The Panel was impressed by the capability that Mr. Heward demonstrated during the visit and believes his appointment is a further strong indication of the GPU/Met Ed commitment to improve the radiation safety program.

Conclusion C

The radiation safety program is capable of supporting limited work activities with the continuation of existing management controls.

Basis

1) GPU/Met Ed has restricted access to very high level radiation fields in the auxiliary/fuel handling buildings. Management controls have been established which require approval of highest level GPU/Met Ed management prior to entry into these areas.

2) GPU/Met Ed has established the following limited recovery activities for the present and immediate future work in radiation areas:

(a) Decontamination of external surfaces of the Unit 2 fuel handling/auxiliary buildings, and the flushing and decontamination of systems containing high levels of radioactive liquid.

(b) Cleanup of contaminated water from the Unit 2 fuel handling/auxiliary buildings (Epicor II).

(c) Remote exploration of environmental conditions in the reactor building via collection of water, air, and surface contamination samples; monitoring of radiation fields, and visual observation by means of cameras, probes, and samples inserted through reactor containment penetrations.

(d) Removal of ^{85}Kr from the atmosphere of the reactor containment.

Each of these activities has and will continue to be controlled by the requirement that procedures be prepared for the execution of any work in these areas, and that GPU/Met Ed and NRC approve these procedures.

3) On the basis of its interviews, the Panel believes that sufficient management and technical expertise exists in the radiation safety program to provide adequate control of hazardous operations associated with the activities in 2) above. In addition, GPU/Met Ed has taken steps to strengthen this expertise by organizing the radiation safety program in a manner that will allow for satisfactory implementation of the various technical radiation safety disciplines.

Conclusion D

The upgrading of the radiation safety program for the major recovery activities is not complete. The Panel cannot judge the capability of this future program.

Basis

The long-term effectiveness of the many changes that are presently being made in the organization and staffing of the GPU/Met Ed program cannot be assessed at this time. Several months will be needed by the new manager of the Radiological Control Department to fill the existing vacancies and to establish an effective working relationship within the organization. The many technical and management weaknesses identified earlier will require more time to resolve. The level of hazard in terms of the number of people and the exposure potential will substantially increase once the major recovery activities begin. Such conditions will exist when work commences in very high radiation fields existing in the Unit 2 reactor building and certain areas in the auxiliary/fuel handling building.

IV. Recommendations

On the basis of its investigation, the Panel recommends:

- (1) GPU/MET ED BE PERMITTED TO CONTINUE LIMITED RADIOLOGICAL RECOVERY OPERATIONS, PROVIDING THAT THE RECENTLY ESTABLISHED ADMINISTRATIVE CONTROLS AND POSITIVE MANAGEMENT ATTITUDE TOWARD THE RADIATION SAFETY PROGRAM ARE MAINTAINED.
- (2) GPU/MET ED NOT PERFORM MAJOR RADIOLOGICAL RECOVERY EFFORTS UNTIL AN UPGRADED RADIATION SAFETY PROGRAM HAS BEEN IMPLEMENTED.
- (3) THE ADEQUACY OF THE UPGRADED PROGRAM BE INDEPENDENTLY ASSESSED PRIOR TO INITIATION OF MAJOR RECOVERY ACTIVITIES.
- (4) GPU/MET ED PROVIDE A MANAGEMENT PLAN AND FIRM SCHEDULE FOR, AS WELL AS DEMONSTRATE SUSTAINED PROGRESS TOWARDS, ITS INTENDED RESOLUTION OF EXISTING MANAGEMENT AND TECHNICAL DEFICIENCIES IN THE RADIATION SAFETY PROGRAM.

APPENDIX A

Minutes

of the

Special Panel on Three Mile Island Unit 2 Radiation Safety Program

Panel Membership

Charles B. Meinhold, Brookhaven National Laboratory (Chairperson)
Ronald L. Kathren, Battelle, Pacific Northwest Laboratories
Thomas D. Murphy, Nuclear Regulatory Commission
Donald R. Neely, Nuclear Regulatory Commission
Bryce L. Rich, Exxon Nuclear Idaho Company, Inc.
Gilbert F. Stone,* Tennessee Valley Authority
W. Robert Casey, Brookhaven National Laboratory (Rapporteur)

October 9, 1979 -- 9:00 a.m. -- Initial Meeting

The initial meeting of the Panel was held at the Nuclear Regulatory Commission (NRC) Headquarters with all members in attendance. The general background leading to the formation of the Panel and the Charter (Attachment A) were reviewed by Dr. William E. Kreger, Assistant Director for Site Analysis, Office of Nuclear Reactor Regulation, NRC and Richard H. Vollmer, Director of Three Mile Island Operations, Office of Nuclear Reactor Regulation, NRC. The basic mission of the Panel was described as an assessment of the radiation safety capabilities of General Public Utilities - Metropolitan Edison Company (GPU/Met Ed) with regard to the recovery of Three Mile Island Unit 2 (TMI-2). The Panel was instructed to limit its retrospective inquiries to those with direct bearing on the present and future radiation safety capability of GPU/Met Ed. In addition, the Panel was informed that Mr. Robert C. Arnold, Senior Vice-President, GPU/Met Ed, had requested that interviews be delayed until such time as he could brief the GPU/Met Ed staff on the activities of the Panel.

Following this initial review, the Panel received an in-depth briefing on the radiation safety program, conditions, and activities from its two NRC members (Murphy and Neely). The Panel then met in executive session and developed an informal plan of operation, including a site visit the following day and an in-depth interview program for the week of October 22, 1979. The Panel adjourned at 5:30 p.m. until 1:00 p.m. the following day at Harrisburg.

October 10, 1979 -- 1:00 p.m. -- TMI Site Visit

The Panel (Meinhold, Kathren, Murphy, Rich, Stone, Casey) toured the site paying particular attention to the Unit 2 fuel handling building, service building (including control room), the Epicor II building, and the Unit 1 auxiliary building. Mr. John White, Lead Radiation Specialist, TMI-2 Operations Support, NRC, escorted the Panel. During the tour, the Panel had the opportunity to observe operations and talk informally with contractor and utility technicians in Epicor II, in the fuel handling building, and in the Unit 1 auxiliary building. As had been requested by Mr. Arnold, no formal interviews were conducted

*Alternate for Ernest J. Belvin, originally appointed to Panel.

nor did the Panel initiate any technical discussions or lines of inquiry. The Panel was struck by and informally noted poor housekeeping practices throughout the TMI complex. Adjournment was at 7:40 p.m. until the following morning.

October 11, 1979 -- 7:00 a.m. -- Executive Session

The Panel (Meinhold, Kathren, Murphy, Neely, Rich, Casey) prepared an agenda of topics to be evaluated and a list of key individuals to be requested for interview. This information was submitted to Mr. John Collins, Deputy Director of TMI Operations, Office of Nuclear Reactor Regulation, NRC, for transmittal to GPU/Met Ed. The week of October 22nd was reaffirmed as the time for carrying out these activities. The meeting was temporarily adjourned at 8:45 a.m. to reconvene at 9:00 a.m. at the TMI Site.

October 11, 1979 -- 9:00 a.m. -- Additional Meeting

The Panel (Meinhold, Murphy, Neely, Rich, Casey) reconvened at 9:00 a.m. in the NRC offices at the TMI site. Additional documentation in the form of independent audits of the radiation safety program and other technical information was provided by NRC Region I, I&E team. In the afternoon several members of the Panel visited the instrument calibration facility, the respirator fitting and maintenance facility, and the personnel dosimetry facility.

November 5, 1979 -- 8:30 a.m. -- Executive Session

The Panel (Meinhold, Murphy, Neely, Rich, Stone, Casey) met* in an executive session to prepare for the meetings of the week. Mr. Collins sat briefly with the Panel and discussed events at TMI since the Panel's previous visit. Panel member Murphy discussed a meeting that he, Dr. Kreger, and Mr. Collins had with Robert Arnold at TMI on November 1st. At that meeting the timing of the Panel's review had been discussed again. Mr. Arnold believed that the review would be better done at a later date since GPU/Met Ed had conducted its own evaluation and was now in the process of extensive changes. No decision was made at that meeting, but panel member Murphy indicated that Mr. Arnold would probably wish to discuss this topic with the Panel. In preparation for the interview, the Panel reviewed the general approach to the meeting, the topics that should be covered and the type of questions that should be asked.

November 5, 1979 -- 10:30 a.m. -- Meeting with Robert Arnold, John Herbein and Murray Miles

The meeting with Robert Arnold, John Herbein, Vice President of Metropolitan Edison and Murray Miles of Basic Energy Technology, Inc., convened at 10:30 a.m. in the NRC offices on the TMI site. Chairperson Meinhold initiated the discussion with a review of the Charter of the Panel. He emphasized the two-fold mission of the Panel: (1) evaluate the present radiation safety program and determine if the current level of activity is being conducted in a safe manner

* Although originally scheduled for the week of October 22, 1979, the interviews were made the week of November 5, 1979 and November 26, 1979. The two-week delay was requested on October 19 by the utility, which was then in the process of developing and implementing major organizational changes to the radiation safety program assisted by outside consultants.

and (2) evaluate the planned radiation safety program for Unit 2 recovery and determine if that mission can be conducted in a safe manner. The Chairperson also stated that the evaluation of the program would include both management (organization, staffing, communications, and policy) and technical areas. Finally, he stated that the Panel intended to function in a positive manner and that the Panel was at Three Mile Island to judge the program against accepted industry standards and not to determine compliance with NRC regulations or requirements.

Mr. Arnold expressed concern about the timing of the Panel's review. As a result of the recent evaluation of the radiation protection program by its consultant, Mr. Miles, GPU/Met Ed was in the midst of making significant changes in both organization and staffing. He suggested that the Panel would be able to conduct a more effective review if it waited several months to start these talks. Mr. Arnold indicated that the changes would be completed and that an adequate radiation safety program would be functioning within this time period.

Chairperson Meinhold replied that the Panel was chartered by NRC and that it could not discharge its assigned responsibilities if the review was not conducted this week. However, he stated he would ask the Panel to reconsider the planned review following Mr. Arnold's discussion of his reorganization and improvements in the radiation safety program.

Mr. Arnold continued, reviewing the GPU/Met Ed perception of its radiation safety program prior to the accident of March 28, 1979. The company felt its radiation safety program was adequate and that while the majority of the negative comments resulting from NRC inspections were in the radiation safety area, these deficiencies were not indicative of fundamental problems in the program. This opinion had been confirmed with NRC in a meeting in February 1979. However, the Jersey Central Power and Light Company of GPU had received extremely critical comments from NRC on the radiation safety program at the Oyster Creek Nuclear Generating Station. In response to the NRC comments, GPU contracted with the NUS Corporation to perform an independent audit of the radiation safety program at Oyster Creek and to make recommendations for corrective action. Mr. Arnold indicated that the magnitude of the problem identified by NUS and the extent of the recommendations came as a surprise to GPU management. Therefore, Mr. Arnold recommended that Met Ed hire NUS to perform a similar audit at TMI even though this program was judged to be basically sound. This audit of TMI was performed by NUS in late February 1979, and considered by both NUS and GPU/Met Ed to be an overview, not an in-depth evaluation. However, the review identified a significant number of problem areas. As a result of these recommendations, Mr. Arnold, Mr. Herbein and Mr. Herman Dieckamp (President, GPU) had been considering potential actions. However, the accident on March 28, 1979 shifted attention from these problems and no further action was taken.

The radiation safety program in the first two weeks of the accident was entirely directed to the circumstances of the emergency. The emphasis was on off-site monitoring and to entries into the auxiliary building. Normal procedures were not being followed for these entries, but it was felt by GPU/Met Ed that adequate safety was being provided through administrative controls.

While the operations had become more routine within two weeks, capability and staff requirements needed were substantially greater than those of an operating reactor. GPU/Met Ed attempted to solve these problems by bringing in resources from such organizations as Westinghouse Electric Company, The Electric Boat Division of General Dynamics, Yankee Atomic Electric Company, Nuclear Support Services (NSS), and others.

Mr. Arnold indicated that GPU/Met Ed had recognized deficiencies in the previous program and the need to increase the technical capability. He cited the July 18th meeting with NRC as a point at which further emphasis on developing an improved program was stressed and recognized.

He acknowledged that to date GPU/Met Ed had been unable to establish a satisfactory radiation safety program. He identified the basic problem preventing such a program as being two fold: (1) an inability to find a strong management person to head the radiation safety group despite several personnel changes and extensive recruiting and (2) an attitude that safety was not an operational responsibility, but rather that of the radiation safety group. He indicated that strong steps were being taken at present to correct both of these problems.

Mr. Arnold also identified two other problems which were hindering the performance of the radiation safety group: (1) the many contract radiation safety technicians had not been effectively trained in Met Ed procedures and therefore had not been integrated into the program and (2) communications between shifts had not been effective. Actions were being taken to eliminate these problems.

There was also discussion of the GPU/Met Ed capability to handle the current activities in a safe manner. Mr. Arnold believed that the staff can handle the day-to-day activities without difficulty at the present time. He mentioned that an important meeting had been held with many supervisory personnel on Friday, November 2 and that he had specifically directed them to accept radiation safety as a part of their responsibility.

Following lunch, Mr. Arnold presented to the Panel a proposed reorganization and staffing plan. The principal features were as follows:

- (A) Unit 1 and Unit 2 activities and management will be completely separated. (Previously, certain activities in Unit 2 not associated with the recovery had been managed by J. Herbein. In the future, Unit 2 activities will be managed by Richard F. Wilson, Acting Director of Unit 2 recovery.)
- (B) The manager of the radiation safety group will report to the director of the Unit 2 recovery. (Previously, this manager reported lower in the organization chain.)
- (C) All station-wide activities, e.g., dosimetry, respiratory protection, will be administered by the Unit 2 radiation safety group and will supply support as needed to Unit 1.
- (D) The manager of the radiation safety program will be a technical person but will not necessarily possess health physics background. GPU/Met Ed is seeking an individual with 20 years experience and a good record in organizing, managing, and administering complex jobs.

This organization will probably be implemented by mid-November.

The discussion shifted to a review of the types of activities presently being conducted in Unit 2. Mr. Arnold identified these as follows:

- (A) Decontamination of fuel handling and auxiliary buildings -- the

decontamination is being managed by James Renshaw with technician support provided by Vikem, Incorporated and Chem-Nuclear Systems, Incorporated.

- (B) Decontamination of water from the auxiliary buildings with the Epicor II system -- 400,000 gallons of water have to be treated, 20,000 gallons have been decontaminated to this point.
- (C) Exploration of containment via collection of water and air samples and the insertion of a television camera and articulated arm. Mr. Arnold emphasized that no human entry would be made into containment until the atmosphere in containment had been purged. He did not expect human entry to be attempted for at least another four to six months.

A recurring topic of discussion throughout the afternoon was centered on management support for the radiation safety program, including the ability of upper management to evaluate the safety program performance.

Mr. Arnold stated there were many ways upper management was kept informed about safety problems. He identified these: (1) several people on the present staff who could bring unresolved problems to his attention, (2) the GPU corporate capability (one person) and (3) NRC inspections. Other sources of input to upper management were identified as special committees or consultants and through the internal audit groups in the GPU/Met Ed organization. Mr. Arnold mentioned that the audit function was being re-examined and that a strong, tough evaluator might be hired.

Mr. Arnold stressed that the management commitment to radiation safety was very strong. As a first step, he cited his recent meeting with first line supervisors and several meetings he plans with department heads and management personnel. His message at these meetings is that radiation safety has top priority. The Panel questioned him on this subject, particularly with regard to resolution of potential conflicts between maintaining schedules and safety. Mr. Arnold believed that his views were clear but suggested that we should discuss this point with Wilson and other operations supervisors.

The Panel discussed with him at length the potential weakness of a non-health physicist as head of the radiation safety group. This position was viewed by the Panel as a key to the success of the radiation safety program. Mr. Arnold re-emphasized that the fundamental problems had been attitude and management know-how. He was convinced that the solution was through better management. He believed the technical know-how did not have to reside in the manager, but he did acknowledge a need to increase the technical capability in the organization below the manager. He was committed to providing this increased capability.

The Panel stressed to Mr. Arnold the importance of strong, continuing management commitment to radiation safety. The success of the Naval Reactors radiation safety program was cited by the Chairperson as an example. The strong commitment to radiation safety by upper management is reflected at all levels and permits the use of technical managers with limited health physics background to implement various phases of the program. The Panel emphasized GPU/Met Ed would need to achieve a similar level of dedication if its program is to succeed.

The capability of the existing GPU/Met Ed program was discussed at length. The Panel expressed the view that the present program appeared to be technician oriented, with most of the professional health physics input coming from the NRC inspectors on site. Mr. Arnold challenged this opinion and stated that while he acknowledged the need for increased technical capability of the staff for the upcoming actions, he believed that the existing staff had sufficient expertise to handle the problems to this point. During the discussion, he stated that only four technical problems had occurred since the accident;

- a) lack of in-vivo counting capability initially following the accident,
- b) lack of control leading to over exposure during the emergency phase,
- c) lack of awareness of high airborne radioactivity in the auxiliary building during July,
- d) failure to recognize the contribution of beta radiation to the extremity and whole body doses during August.

He also mentioned the release of 4000 gallons of slightly contaminated water to the Susquehanna River, but did not believe this incident to be significant.

He stressed that in his opinion these problems were not caused by lack of technical capability, but rather by a lack of sensitivity or awareness created by the tremendous pressure of the post-accident activities coupled with the recognized organizational problems. He believed that these pressures and problems no longer exist and that the current activities were being conducted with satisfactory safety review and coverage. He again expressed concern that a report by the Panel at this time could damage the effectiveness of the impending reorganization and that he would prefer the Panel delay its actions until a later time.

November 5, 1979 -- 5:00 p.m. -- Executive Session

Following the discussion with Mr. Arnold, the Panel convened in executive session. While acknowledging that the reorganization and staffing changes created the burden of having to evaluate a proposed program in addition to the existing one, the Panel unanimously agreed that the review must continue without further delay. However, the Panel recognized the need for administrative confidentiality with regard to the impending reorganization.

As a result, the list of people to be interviewed was examined and revised. The Panel also felt that it should interview Mr. Miles immediately to discuss his findings and conclusions, since these were pertinent to both the Panel's review and the planned organization changes.

November 5, 1979 -- 6:00 p.m. -- Meeting with Murray Miles

The Panel reviewed with Mr. Miles the principal findings of his audit. Mr. Miles believed that major problems were attitude and management control. He stressed that previously there had been a lack of accountability and discipline in the organization. The radiation safety organization did not have sufficient prestige to be effective and was in fact treated as "second class" citizens. He also mentioned there was a serious morale problem.

Mr. Miles stated that GPU/Met Ed upper management had not recognized this problem earlier, despite the audit by NUS and the exchange of letters and meetings with NRC. He indicated that Mr. Arnold now recognized the problems and was strongly committed to upgrading the program for the projected four year recovery effort.

Mr. Miles asserted that the proposed organization would be effective and would be able to meet the requirements the recovery imposed. He noted that the new organization was not yet solidified and suggested the Panel use caution in its interviews so as not to breach confidence.

November 6, 1979 -- 8:00 a.m. -- Executive Meeting of the Panel

The Panel met in executive session the following morning to review the results and implications of the interviews of the previous day.

November 6, 1979 -- 9:00 a.m. -- Meeting with Paul Ruhter

Mr. Ruhter presented his perception of the radiation safety program at the present time and reviewed his role as lead technical staff in the proposed organization. Although he has been employed by GPU/Met Ed for only about two months he nonetheless has observed problems in the management, organization and technical areas, but was convinced that Messrs. Arnold and Wilson were now committed to improving the program. He indicated that a strong, tough manager for the radiation safety program was important and sorely needed.

Mr. Ruhter identified several other problem areas;

- a) measurement of beta radiation doses,
- b) determination of dose from internally deposited radionuclides,
- c) tabulation of radiation exposure on a day-to-day basis via inadequate computer programs,
- d) lack of definitive criteria which determine those jobs and operations requiring radiation safety review,
- e) contamination control using outdated portal monitors,
- f) lack of radiation safety review in items going to the Recovery Operations Review Committee (RORC) for approval,
- g) need for additional technical people, particularly in the ALARA-Radiological Engineering group,
- h) lack of proper evaluation by GPU/Met Ed of the technicians being supplied by NSS.

He also provided a listing of nine contractors providing service to the radiation protection group.

The Panel reviewed instrument calibration and maintenance with Mr. Ruhter, who stated that quality assurance was lacking but that he believed the program to be good. He also stated air monitoring had been a problem a few months back, but was now improving.

November 6, 1979 -- 11:00 a.m. -- Meeting with Dale Ferguson

Mr. Ferguson discussed his role as the technical manager for the 117 member radiation safety support staff provided by NSS. The technician ranks are made up of senior and junior technicians, supervised by 17-21 foremen. All senior technicians meet the qualifications of ANSI N18.1 and all technicians are trained by NSS before being sent out on a job. The ratio of senior to junior technicians is 1:2 - 1:3 in the working groups.

Mr. Ferguson identified several problem areas;

- a) level of on-site training for new employees,
- b) radiation safety personnel have been treated as "second class" citizens on the site,
- c) automatic counting systems for wipes are needed,
- d) detection capability for beta radiation fields,
- e) increased management support,
- f) coordination and planning between the operations groups and radiation safety.

Mr. Ferguson stated that his role was to supervise the radiation safety technicians and not to define the program. He said the present program had problems and was not confident that all areas were properly covered. He specifically pointed out that radiation exposures to his technicians were limited by applying the administrative limits of GPU/Met Ed.

November 6, 1979 -- 1:00 p.m. -- Meeting with James Thiesing

Mr. Thiesing of Bechtel Power Corporation is project manager for the group doing the engineering and construction for the recovery activities. This group presently has ten people on site supported by 40 in the Bechtel home office. Staffing will eventually expand to 15 on site and 55 in the home office.

Mr. Thiesing discussed the scope of their present activities which include cleanup studies of the auxiliary building and reactor building. They have been designing new structures which will be required to support the recovery operations and making ALARA assessments of the proposed activities. Six to eight Bechtel health physicists are involved in these activities.

Mr. Thiesing stressed that Bechtel is involved in planning, design, and construction, but that actual operations including radiation safety will be provided by GPU/Met Ed. He anticipates internal radiation safety review by Bechtel of all design and proposed operations, with coordination with GPU/Met Ed. He indicated that to this point, there had been no GPU/Met Ed radiation safety reviews.

November 6, 1979 -- 2:30 p.m. -- Meeting with Richard Wilson

The Panel discussed at length with Mr. Wilson his role as director of the Unit 2 recovery operations and, in particular, his perception of the role of radiation safety in the recovery program. He noted that there had been radiation safety problems earlier which had been caused by poor coordination and management. In the months following the accident, most activities were reactive

to day-to-day events. He indicated that these problems would be corrected via the reorganization which he viewed as absolutely essential, and by the addition of increased technical capability. In his opinion, the present level of radiation safety was adequate for current work but improvement would be rapidly needed to provide proper coverage for the anticipated reentry decontamination, and recovery.

Mr. Wilson indicated that safety was a line responsibility with radiation safety serving in an advisory role. However, he stated that he would give and expect radiation safety to use shut-down authority if operations were being conducted unsafely. He emphasized that he saw no need for an adversary relationship between operations and radiation safety because he would insist that all activities be planned, organized, and scheduled to factor in safety.

Mr. Wilson stated that the primary requirement for the new head of radiation safety was strong management skills. Although he would prefer that the manager also have health physics background, he did not consider that essential. The Panel and Mr. Wilson vigorously discussed whether other than a professional health physicist could be sensitive, aware, and concerned for the real needs of the radiation safety group and adequately present radiation safety precepts to upper management. Mr. Wilson said that he believed it was possible, but that strong technical back-up would be required in the organization below the manager. He indicated that he had full support of Mr. Arnold to emphasize radiation safety and that GPU/Met Ed was determined to upgrade the program for the proposed four year effort.

November 6, 1979 -- 4:00 p.m. -- Meeting with Ralph Jacobs

The Panel (Meinhold, Murphy, Neely, Rich, Casey) reviewed with Mr. Jacobs his functions as leader of the Radiation Services Corporation instrumentation group, performing under contract to GPU/Met Ed. He and his staff of eight - ten technicians maintain and calibrate all portable radiation survey meters, air monitoring equipment, and counting equipment for both Units 1 and 2. They also prepare the procedures that are in use for all testing and calibration of instruments.

Mr. Jacobs works independently, but he does get some technical input from Messrs. Ferguson, Mulleavy, and Dubiel concerning instrument needs. He stated that he had received funding from GPU/Met Ed whenever he decided to purchase additional instruments.

Mr. Jacobs stated that GPU/Met Ed did not have any audit functions of the instrument calibration operation; however, his own company did.

Mr. Jacobs then discussed the portal monitors that were in use. He felt the units currently used had inadequate sensitivity, but that new units (utilizing liquid scintillation detectors) were better but highly complex and difficult to maintain. He also discussed the constant air monitors (CAMs) recently installed in the fuel handling/auxiliary buildings. His group calibrated air flows, determined efficiencies and set alarm points for these units. Because of problems with these units, a daily maintenance schedule had been established. Mr. Jacobs questioned whether the radiation safety technicians understood the purpose and function of the CAMs.

November 7, 1979 -- 9:00 a.m. -- Meeting with Ira Seybold

The Panel discussed with Mr. Seybold his activities as head of the dosimetry group. This group is responsible for the evaluation of both external and internal exposures. Mr. Seybold joined GPU/Met Ed in mid-summer 1979 and indicated that substantial progress had been made in some areas. For example, many administrative problems regarding badge issuance have been cleared up. Initially, record keeping was so poor that some badges had been turned in with no record of issuance. In other cases, badges had been recorded as assigned to different persons than those actually wearing them. He stated that these problems had been completely corrected.

Another problem that he is now working on involves the daily tabulation of personnel radiation exposures. At the present time, exposure records are not being updated daily, primarily because they are unable to collect all of the Radiation Work Permits (RWPs) on a daily basis. Mr. Seybold is bringing in a consultant to prepare and implement a computerized exposure control system incorporating update capabilities at each radiation control point. He believes this system to be quite important for control of higher exposure activities scheduled to begin next spring, and essential to have the system operational by mid-April 1980.

Presently, TLD badges are read out on-site except for extremity badges, which are being read off-site by Harshaw Chemical Company. Intercomparison of exposure results are performed with Harshaw on test badges irradiated on site. Mr. Seybold plans a more detailed intercomparison with Dr. Plato of the University of Michigan, and also plans spot checks on the Harshaw extremity dosimeter interpretations using Yankee Atomic Electric Company to prepare test badges.

He discussed a recent problem in which extremity badges were issued without TLD chips. Review of this incident indicated that an insufficiently trained person had been allowed to prepare the badges. He has taken steps to prevent the recurrence of this problem.

An unsolved problem that was discussed involved the assessment of penetrating radiation exposure. One of the TLD chips in the badge is shielded by $\sim 270 \text{ mg/cm}^2$. Because many beta particles are sufficiently energetic to penetrate to this depth, the true penetrating dose is being overestimated and the non-penetrating dose underestimated. Mr. Seybold reviewed procedures for assessing unusual exposures. Members of his group review the circumstances of the exposure utilizing data on dose rates provided by the radiation safety technicians. They interview the individuals involved in the exposure to determine relevant factors important to the assessment. Final approval of the assessment is subject to the review of Mr. Ruhter for Unit 2 exposures and Mr. Richard Dubiel for Unit 1 exposures.

The program for evaluation of internal dose was reviewed with Mr. Seybold. Currently two contractors perform in-vivo counting and three contractors perform bioassay of urine and feces.

The criteria for in-vivo counting are:

- a) facial contamination of 10,000 dpm or greater,
- b) work in a RWP area requiring respirators (monthly),
- c) work in areas where airborne radioactivity exceeds 5 maximum permissible concentrations (biweekly).

In addition any employee with an indicated body burden of ≥ 50 nCi of ^{137}Cs is restricted from further entry into RWP areas until the sources of his exposure has been determined and evaluated. A criterion of ≥ 150 nCi of ^{137}Cs determined by whole body counting has been established as an action level for a mandatory strontium bioassay. Mr. Seybold stated that this would assure that no significant depositions of Sr^{90} would go undetected, although no detailed evaluation had been performed. Also, a program to spike bioassay samples is being discussed with Yankee Atomic Electric Company. Professors Skrable and Chabot from the University of Lowell serve as consultants in internal dosimetry.

November 7, 1979 -- 10:15 a.m. -- Meeting with Peter Velez

The Panel reviewed with Mr. Velez the responsibilities of his newly created position of radiological control inspector. In this position, Mr. Velez is independent of the radiation safety group, reporting directly to Messrs. Herbein (Unit 1) or Wilson (Unit 2) and has immediate stop-work authority. Mr. Velez stated that he would be visiting all areas of Units 1 and 2 and spot-checking the adequacy of radiation safety procedures in effect for the tasks he was evaluating. If he observed discrepancies of a minor nature, these would be discussed with the individual and supervisor involved. If there were violations of a more serious nature, he would have the job stopped immediately until specific corrective action had been taken and approved by Messrs. Herbein or Wilson, as appropriate. Mr. Velez highlighted an instance in which he had stopped an ongoing operation and had recommended specific corrective actions.

The Panel questioned whether stop-work authority had existed earlier within the radiation safety group. Mr. Velez replied that it probably had, but the group foremen did not feel sufficiently supported to attempt to implement it. Mr. Velez said further that he had been discussing his new role with the radiation safety foremen, encouraging them to contact him if they had difficulty implementing radiation safety procedures.

November 7, 1979 -- 11:15 a.m. -- Meeting with Thomas Mulleavy

The Panel discussed with Mr. Mulleavy the present radiation safety training program for GPU/Met Ed and contractor employees. All employees who are to enter a radiation area are required to attend a four hour lecture covering basic health physics issues, e.g., dose limits, radiation signs, exposure control. Employees completing this lecture are permitted to enter radiation areas if escorted by individuals who have been qualified to work in RWP areas. A second course, eight hours in duration, includes the four hour basic course plus an additional four hours on topics such as contamination control, respirator usage, the contents of 10 CFR 19 and 20, and NRC Regulatory Guide 8.13. Individuals completing this course are required to pass a written test to be granted access to RWP controlled areas.

The training provided to NSS radiation safety technicians was also discussed. Each new technician is given a $2\frac{1}{2}$ day orientation, including the eight hour course mentioned above. GPU/Met Ed does not test or review qualifications of the NSS technicians, nor evaluate their performance on the job. A training program on GPU/Met Ed procedures and their modifications is now being provided to the NSS technicians. Records are maintained on this training program by Mulleavy. In response to specific queries from the Panel, Mr. Mulleavy replied

that the training programs did not include a discussion of the risks associated with exposure at low levels of radiation.

The adequacy of the overall radiation safety program was reviewed with Mr. Mulleavy. He indicated the program to be adequate, but needed improvements in facilities and control of the movement of radioactive materials and contamination. He also stressed the need for the radiation safety group to be more assertive, and noted that the new management attitude as expressed by Mr. Arnold would do much to strengthen the position of the radiation safety group.

November 7, 1979 -- 12:30 p.m. -- Meeting with James Renshaw

The Panel reviewed with Mr. Renshaw his functions as head of the group responsible for decontamination of the fuel handling/auxiliary building of Unit 2. Mr. Renshaw first reviewed the contamination status of the building prior to the start of decontamination and the progress up to the present. He displayed detailed charts and records documenting the progress of this effort.

Four people assist Mr. Renshaw in review and planning of the operation, with the assistance of Chem-Nuclear Systems. Supervision and actual performance of the decontamination efforts has been conducted by Vikem, supplemented by up to 50 GPU/Met Ed employees. Mr. Renshaw discussed the management of the Vikem contract, noting that he had developed a surveillance schedule for off-shift and weekends.

He reported that radiation safety input into decontamination planning and scheduling had been ineffective until he requested a radiation safety technician be assigned to him. He also now has a radiation control engineer from the ALARA-Radiological Engineering group assigned to support this effort and that input from these sources was timely and effective.

Mr. Renshaw commented that the training program for radiation workers may not be sufficient, citing specific problems involving inadequate use of contamination control procedures and noting there had been times when he had been forced to assign his staff to observe work in contamination areas to assure that contamination was not spread.

Finally, Mr. Renshaw reviewed the total radiation exposure accumulated to date in the decontamination efforts. The collective dose equivalent to date totals 59.4 man-rem and averages 234 mrem per individual. He estimates a total of 140 man-rem will be incurred before the decontamination of the fuel handling/auxiliary building is completed.

November 7, 1979 -- 1:15 p.m. -- Meeting with Will Zurliene

The Panel reviewed with Mr. Zurliene, an employee of the Electric Boat Division of General Dynamics, his activities and responsibilities since arriving at TMI. He is presently in charge of the ALARA-Radiological Engineering group in the radiation safety organization.

Mr. Zurliene mentioned that his group had participated in the review of the following:

- a) containment for penetrations through the reactor building walls,
- b) mini-decay heat removal system,
- c) sample sink tie-in,
- d) hot chemistry lab,
- e) submerged demineralizer system,
- f) resin liner transfer bell,
- g) Epicor II.

He stated that the above list was not complete, but indicative of the type of operation that his group has reviewed. There are no criteria defining projects which must be reviewed by the ALARA-Radiological Engineering group. Mr. Zurliene stated whenever he became aware of an operation or project which needed review, he would seek out the engineer in charge and ask for an ALARA review. He indicated that important items had been reviewed, particularly since the formation of the RORC. If items came to this committee without previous review by ALARA-Radiological Engineering, the chairman of the RORC would postpone further discussion pending review.

Mr. Zurliene mentioned two criteria which provide for review of day-to-day activities: 1) Maintenance requests requiring an RWP, and 2) work activity in beta radiation fields with dose rates exceeding 2 rad/hr.

The Panel reviewed with Mr. Zurliene his concepts of ALARA. He indicated that ALARA had to be a company effort, and that his group could not be the sole group concerned with ALARA. In a discussion of shielding criteria, he stated that he would specify sufficient shielding to reduce the dose rate to a designated level. For example, for Epicor II, design criteria called for 25 mrem/hr as maximum level from system piping. A similar level was also used for the design of transfer bell. Mr. Zurliene stated that he did not use cost-benefit analysis in designing his shields.

November 7, 1979 -- 3:00 p.m. -- Meeting with Beverly Good

The Panel reviewed with Ms. Good her responsibilities at TMI. She is presently coordinating and editing the radiation protection plan. Previously she had worked in both Units 1 and 2 as a foreman for the radiation safety technicians. Prior to the accident, she had worked in the Met Ed corporate office in Reading as part of the Radiation Safety and Environmental Engineering group. Ms. Good believed that this group had essentially been dissolved since the accident.

November 7, 1979 -- 3:30 p.m. -- Meeting with Sydney Porter

The Panel discussed with Mr. Porter, a principal of Porter-Gertz Consultants, his activities at TMI. His group, the TMI Effluent and Environmental Assessment Group, has a long-term contract with GPU/Met Ed to provide assistance in health physics, emergency planning, and environmental monitoring. Since the accident, a major mission of this group has been assessment of effluent releases from Unit 2. Mr. Porter established the collecting and counting procedures presently in use. His group also collects and evaluates environmental data and publishes a quarterly report.

Mr. Porter reviewed some of the particular problems that he has been involved with at TMI. He noted beta radiation dosimetry remains an unsolved problem, and that the present badge does not properly assess the non-penetrating and penetrating dose. Mr. Porter has been reviewing the dosimeter requirements with other outside experts and expects to have recommendations soon. He commented that substantial progress had been made towards solution of some of the beta radiation dosimetry problems. For example, experiments which had been performed in the annulus between the fuel handling/auxiliary and reactor buildings had provided important information on the beta energies. Secondly, the preparation of a beta radiation source from a primary coolant water sample had permitted more accurate calibration of dosimeters and instruments. The source output was measured by the National Bureau of Standards.

Mr. Porter stated that he had also been involved in dose assessments of unusual exposures. Presently he is assisting with evaluation of high beta radiation exposures received in August by several employees.

He reviewed the in-vivo dosimetry program being performed by Helgeson Nuclear Services and Radiation Management Corporation. He indicated the program was generally good at this time and noted the principal problem had been false positives caused by cesium back-scatter peaks in the iodine channels. Bioassay is being done for strontium off site, and the principal problem was the long time period required for completion of the analysis.

Mr. Porter mentioned that his participation in resolution of political and legal questions was time consuming and took him away from working on purely technical problems. He cited low level releases of radioactivity to the environment as indicative of this type of involvement.

November 7, 1979 -- 4:30 p.m. -- Meeting with George Kunder

The Panel reviewed with Mr. Kunder his responsibilities at TMI. He is superintendent for technical support for Unit 2, whose principal activity at present is the operation of Epicor II. He noted that the Epicor II system has been operating well, and that radioactivity concentrations in the processed water had been determined operationally as $<10^{-7}$ $\mu\text{Ci/cc}$ for both ^{137}Cs and gross beta activity. The State of Maryland had also analyzed samples and determined the concentrations to be $<10^{-9}$ $\mu\text{Ci/cc}$. Two prefilters in the system have been changed, with the more radioactive one having a "contact" radiation level of 400 R/hr and containing an estimated 900 Ci of radioactivity.

Mr. Kunder stated that there was a need for stronger commitment to radiation safety and for the improvement in the technical capability of the radiation safety staff. He also stated that he fully understood his line responsibility for safety, and was committed to operate safely, noting that Mr. Arnold's vigorous message that afternoon had strongly influenced him.

Mr. Kunder reviewed his actions in preparing for the start up of Epicor II and emphasized the preparations for radiation safety in both normal and emergency conditions. He was now seeking to improve his understanding of the sources of radiation exposure on a continuing basis and striving to maintain an effective contamination control program.

Mr. Kunder also serves as chairperson of the RORC. This group reviews new procedures or modifications to existing procedures and new operations to assure that radiation safety has been adequately considered.

A committee quorum consists of the chairperson, one member with qualifications of the radiation protection manager specified in NRC Regulatory Guide 1.8 and three members qualified to ANSI N18.1. According to Mr. Kunder, the present members of the RORC who meet Regulatory Guide 1.8 qualifications are Messrs. Mulleavy, Zurliene, Ferguson, and Penelton. Just prior to adjournment at 6:45 p.m., Mr. Miles briefly visited to inform the Panel that the reorganization had been completed, and offered his assistance in arranging further interviews should they be desired.

November 8, 1979 -- 8:00 a.m. -- Executive Session

Each member's notes were reviewed to assure that a complete and accurate set was available to the Rapporteur. A draft outline for the report and a chronology was prepared. The Panel then discussed at length the positions to be taken in the report on various aspects of the TMI-2 radiation safety program. The Panel asked members Murphy and Neely to tour Units 1 and 2 to observe first hand the effectiveness of cleanup efforts which had been mentioned by various interviewees. The Panel adjourned at approximately 11:00 a.m.

November 26, 1979 -- 8:30 a.m. -- Meeting with Richard Heward

The Panel met in Bethesda, Maryland with Richard Heward, the Manager of Radiological Controls for TMI-2. Mr. Heward first reviewed for the Panel his qualifications and briefly discussed the organization, bringing to the attention of the Panel the fact that he now reported directly to Mr. Arnold and was on the same reporting level as R. F. Wilson (see Attachment B).

He then reviewed the mission of his newly created position stating that the need for change in the approach to radiation safety has been clearly identified by Mr. Arnold through his letter of November 1 (Attachment C) and at subsequent meetings with supervisory personnel. Mr. Heward is to see that this change is successfully implemented. He indicated the fundamental problem is attitude.

Mr. Heward said members of the Radiological Controls Department had previously incorrectly believed that management was lacking. He is seeking to change that by giving members of his group the support and authority needed to carry out their assigned responsibility. In this context, he is preparing an organization and assignment of responsibilities document which will fully define the roles and assignments of each member of the group. He stressed that he is seeking to improve the morale of the group and that each is responsible and accountable for radiation safety. He also emphasized that the responsibility of the craftspeople and technicians to implement the radiation control procedures was being stressed by their own supervision.

The Panel (Meinhold, Kathren, Murphy, Neely, Rich, Casey) discussed the role and responsibility of the radiation control inspectors (Tuttle and Velez) with Mr. Heward, who stated that these inspectors evaluate the radiological control procedures in the daily operation. They also meet daily with Mr. Heward and review their findings with him. Mr. Heward stated that the inspectors were performing a valuable function and that he planned to rotate radiation safety technician

foremen through these positions periodically to gain the experience of performing in this role.

Mr. Heward reviewed the actions that he has taken since his appointment two weeks earlier. These include:

- (A) Acquisition of a new trailer for his group to provide additional space needed to carry out their functions.
- (B) The active seeking of personnel to fill the existing vacancies within the group. He is particularly looking for certified health physicists and/or master's level personnel with health physics background. If he cannot acquire personnel with these qualifications, he plans to use engineers and provide them with appropriate health physics training.
- (C) The addition of six people. These are: 1) James Renshaw who will be in charge of Radiological Field Operations, 2) Beverly Good who will work in the Radiological Engineering group, 3) a new foreman for the technician group, and 4) three engineers who have been assigned to the Radiological Engineering group.
- (D) The development of written criteria which define operations which must be reviewed by the Radiological Engineering group.
- (E) Change in procedures to assure that entries of personnel into controlled areas are made with TLD badges and dosimeters.
- (F) Issuance of criteria defining the role of the Radiological Engineering group in preparation for purging the containment building atmosphere.
- (G) Issuance of a draft Radiation Protection Plan.
- (H) Issuance of a weekly report of total radiation exposure.
- (I) A directive to Babcock and Wilcox to include measurement of alpha radioactivity in all future radiological analysis of the primary coolant water.
- (J) Preparation of objectives and goals for 1980.
- (K) Preparation of a summary for Mr. Arnold of the beta radiation dosimetry problem, including a listing of priorities and a schedule for further follow-up.
- (L) Issuance of a directive to all operating groups stating that no additional storage areas for radioactive materials will be established in the future without review and approval of the Radiological Control Department.

- (M) Requested Bechtel to submit plans of the support building for TMI-2 entry, presently under design.
- (N) Establishment of approval authority with NSS of the arrivals and departures of radiological control technicians. Additionally, GPU/Met Ed testing and qualifications requirements are being prepared for these technicians.

The Panel specifically asked about the problems of beta radiation dosimetry, and Mr. Heward replied that a TLD dosimeter study was in progress and a report was due December 7, 1979. Also due on the same date were reports of studies in progress on portable survey instrument evaluation and protective clothing as a means of reducing beta radiation dose.

The Panel discussed with Mr. Heward other areas of concern. He mentioned that he felt training programs in general needed improvement, noting that in particular, contamination control training of radiation control technicians and operators, and the general training of all workers on the biological effects of low level radiation needed improvement.

Mr. Heward plans to issue radiation control procedures specific to Unit 2 and to require verbatim compliance with them. He also indicated that he would seek NRC approval to allow him to make temporary changes in these procedures.

The computer program which handles radiation exposure information is another problem which Mr. Heward is having corrected. In particular, he wants the exposure information to include tabulation by both department and task.

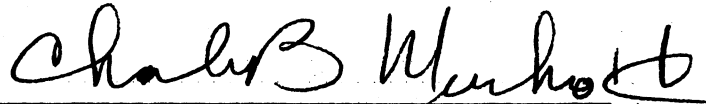
In summation, Mr. Heward believed that his principal technical problems at this point were: 1) dosimetry and dose assessment, and 2) radiation exposure control. The Panel discussed the implication of maintaining exposures ALARA with Mr. Heward. Among other points, he viewed ALARA as a continuing review of sources of radiation exposure and consideration of alternative methods or procedures which might reduce the exposure. He also emphasized the importance of considering potential exposures in advance.

Resolution of radiation safety deficiencies previously identified by NRC inspectors was discussed with Mr. Heward. He stated that Ms. Good has been assigned responsibility for reviewing and prioritizing the items so that corrective actions could be taken.

The final item of discussion focused on the Panel's concern that actions of the radiation control inspector could damage the position of the radiological control foremen. Mr. Heward understood these concerns and stated that GPU/Met Ed management had already taken actions to correct this problem.

The Panel adjourned to executive session at 11:45 a.m. to evaluate its findings and prepare the final report.

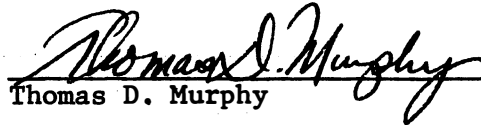
Minutes Approved by Panel Members:



Charles B. Meinhold, Chairman



Ronald L. Kathren




Thomas D. Murphy



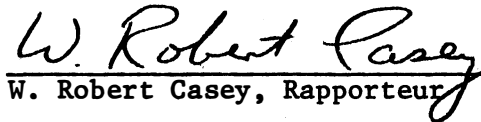
Donald R. Neely



Bryce L. Rich



Gilbert F. Stone



W. Robert Casey, Rapporteur

November 29, 1979

Attachment A

CHARTER FOR THE PANEL

The panel is hereby constituted with the following charter:

Objective: To review the radiation protection program of the Metropolitan Edison Company at the Three Mile Island Nuclear Station, as currently constituted and planned to support the decontamination and recovery of Unit 2. To determine whether the organization, management and planned program will be capable of supporting the recovery stages with exposures to plant workers and contractor personnel that will meet the requirements of the Commission's regulations and that will assure that occupational radiational exposures will be as low as is reasonably achievable.

Scope: The recovery operations at the TMI Nuclear Station will involve many activities and associated health physics problems that were not anticipated prior to the accident at TMI-2. Extensive decontamination of structures and systems and operations necessary to maintain the facility in a safe shutdown condition are accompanied by an unusual distribution of radioisotopes throughout the containment building, the fuel handling building and the auxiliary building. The particular spectrum of radionuclides encountered in these operations is unique to the occurrence at the station.

Deficiencies in the radiation protection program have previously been identified in the NUS Corporation study prior to the accident, in I&E inspections and their report of the accident, and in reports by the NRR TMI-2 Support Task Force. The Committee should become familiar with the plant programs, review appropriate reports and studies and should conduct meetings as necessary with the licensee, the NRC, and others as necessary in order to carry out its objective of reporting to the Director, NRR, on both the current capability and competence of the Met Ed program and on recommendations for actions that may be needed in order that operations can be accomplished within NRC requirements.

The Committee should function so as to make its final report to the Director, NRR, no later than December 7, 1979.

Panel Membership

Charles B. Meinhold, Chairman
Bryce Rich, Exxon Nuclear Idaho
Ernest Belvin, TVA
Ronald Kathren, PNL
Thomas D. Murphy, NRC
Donald Neely, NRC
Robert Casey, BNL (Rapporteur)

File HP

METROPOLITAN EDISON COMPANY

Subsidiary of General Public Utilities Corporation

Subject TMI Unit 2 Radiological Controls

Location TMI/Trailer 201


To All TMI Department Heads
and Contractors

Date November 8, 1979

Effective November 12, 1979 the Radiological Controls Department for Unit 2 will be organized as shown on the attached chart. R. W. Heward, Jr. is appointed Manager of Radiological Controls, reporting to R. F. Wilson, Director of TMI-2 Recovery. Although a part of the recovery organization, Mr. Heward will have direct access to me.

Dave Fick is assigned to Mr. Howard full time to assist in staffing and personnel matters.

As you are all aware, radiological controls for the TMI-2 recovery is a major concern which requires maximum diligence from all employees and contractors to achieve compliance with proper radiation protection procedures and ensure personnel exposures are as low as possible.



R. C. Arnold
Senior Vice President

RCA:ves
attachment

- cc: J. T. Collins - NRC
- H. M. Dieckamp
- J. G. Herbein
- R. F. Wilson

TMI-2 RECOVERY
DIRECTOR

R. F. Wilson

MANAGER OF
RADIOLOGICAL
CONTROLS

R. W. Heward, Jr. *

ADMIN. STAFF - BUDGET, COORDINATION & PLANNING

RADIOLOGICAL
FIELD OPERATIONS

J.A. Renshaw
DEPUTY
R.C. Ferguson

Foremen
Radiological Techs

RADIOLOGICAL
TRAINING

R.W. Heward, Jr.
DEPUTY
T.A. Mulleavy

RADIOLOGICAL
ENGINEERING

P.E. Ruhter
DEPUTY
To Be Assigned

A.L.A.R.A.
W.G. Zurliene
Emerg. Planning
Data Eval. &
Assessment

DOSIMETRY

I. Seybold
DEPUTY
To Be Assigned

RADIOLOGICAL
SERVICES

R.W. Heward, Jr.
DEPUTY
To Be Assigned

Instrument Calib.
& Repair
Respirators
Radiological Lab
Claims
Bioassay
Medical

METROPOLITAN EDISON COMPANY

Subsidiary of General Public Utilities Corporation

Subject TMI Generation Group Organization

Location TMI/Trailer 201

To TMI Generation Group
TMI Contractors

Date November 16, 1979

By memorandum of July 30, 1979, Mr. H. M. Dieckamp announced the integration of personnel in the Generation Divisions of Met-Ed and GPUSC to form the TMI Generation Group. The Group's organization was described in general terms and the Directors of the Group have issued a number of memoranda since then to further explain the structure of the various segments of the TMI Generation Group. As we have gained experience with the initial functioning of the Group, within the framework established by these actions, we have realized that some further adjustments are needed. This process has been aided by an extensive review of the Group's functions, responsibilities, interface requirements, and problems as perceived by the managers in the Group, undertaken by Mr. F. Glickman and by a review of the Radiological Controls Program conducted by Mr. M. E. Miles of Basic Energy Technology Associates. We also believe these changes address problems identified by various investigations conducted since the accident.

The attached organization charts provide definition of the realignment of responsibilities within the staffs for TMI Units 1 and 2 of the TMI Generation Group. The major changes are:

1. The line management responsibilities for TMI Units 1 and 2 are completely separated.
2. TMI Unit-2 Radiological Controls Department will report directly to the head of the TMI Generation Group.
3. Each TMI unit is, to the maximum extent feasible, to have direct control of the resources necessary for effective and safe conduct of plant activities. Organizational structures for each unit reflect this policy and implementation of this policy is the reason for no longer having a site-wide maintenance component to the organization.
4. Mr. R. F. Wilson will devote his full efforts to the direction and management of the TMI Unit-2 activities.

(continued)

INTER-OFFICE MEMORANDUM

Subject: TMI\Generation Group Organization

November 16, 1979

While we expect the effort by Mr. Glickman may lead to definition of staffing requirements for fulfilling additional functions by the TMI Generation Group, we do not expect any further fundamental changes in the operational and technical responsibilities, functions and interfaces within the Group. I appreciate very much the constructive and supportive attitude taken by everyone during this very difficult period. We are confident that these changes will facilitate projecting the spirit of professionalism we all desire and will improve the effectiveness of the efforts of all of us.



R. C. Arnold
Senior Vice President

RCA:ves
attachs.

cc: System Officers
GPUSC Division Heads

~~J. T. Collins - NRC~~

TMI GENERATION GROUP

R. C. ARNOLD

- Sr. v.p. Met-Ed
v.p. CPUSC

| | |
|------------------------|--|
| _____ J.G. Herbein | v.p. Met-Ed director TMI Unit-1 Attachment 2 |
| _____ R.F. Wilson | director (acting) TMI-2 Attachment 3 |
| _____ R.W. Howard, Jr. | manager - TMI Unit-2 Radiological Controls |
| _____ R.C. Arnold | director, (acting) Technical Functions |
| _____ J.R. Thorpe | director, Environment, Health and Safety |
| _____ R.L. Long | director, Reliability Engineering |
| _____ J.G. Hover | manager - Management Services |

TMI UNIT 1

J.G. HERBEIN
V.P.

Unit 1 Recovery
R.L. WILLIAMS/
G.J. TROPPER

Staff Assistant
P.G. CHRISTMAN

Manager
Training
L.L. LAWYER
(Acting)

Manager
TMI Unit 1
G.P. MILLER
(Acting)

Radiological
Controls Mgr.
J.G. HERBEIN
(Acting)

Manager
Admin. & Services
P.G. CHRISTMAN
(Acting)

Manager
Plant Engineering
J.J. COLITZ

Manager
Task Management
L.L. LAWYER

- . Recovery Trng.
- . Licensed Personnel Trng.
- . Radiological Controls & Maintenance Trng.

- . Operations
- . Maintenance
- . Rad Waste
- . Emergency Plan

- . Radiological Engineering
- . Technicians

- . Security
- . Facilities
- . Doc. Control
- . Budgets
- . Office Mgmt.
- . Personnel
- . Communications

- . Nuclear
- . I&C
- . Electrical
- . Mechanical
- . Minor Projects
- . Chemistry
- . Shift Technical Advisors

- . Refueling Planning
- . 4-Day Advance Planning
- . Startup & Test
- . Productivity

TMI UNIT 2

R. F. WILSON

director

| | |
|--------------------|---|
| _____ M. Morrell | special projects |
| _____ (vacant) | Deputy <ul style="list-style-type: none">. R&D. Budget Schedule. Staff |
| _____ J. J. Barton | director Site Operations |
| _____ (vacant) | deputy <ul style="list-style-type: none">. Operations. Maintenance. Plant Engineering. Processing Support. Operations Services. Safety Reviews |
| _____ R.F. Wilson | manager, (acting) Project Operations <ul style="list-style-type: none">. Bechtel |
| _____ M.K. Pastor | manager, Administration & Services |
| _____ J.C. DeVine | manager, Recovery Engineering |
| _____ (vacant) | QA/QC manager |
| _____ E.D. Fuller | supervisor, (acting) Licensing |

11/16/79

J. J. BARTON

director

(vacant)

deputy

J.J. Barton

manager Operations

J.J. Chwastyk

supervisor Plant Operations

C.P. Deltete

supervisor Processing Operations

T.R. Block

supervisor (acting) Decontamination

G.A. Kunder

supervisor Technical Specifications
Compliance (PORC & RORC
Chairman)

(vacant)

supervisor Operations Procedures

S. Levin

manager Maintenance

R.E. Sieglitz

supervisor Corrective Maintenance

J.J. McGarry

supervisor Preventive Maintenance

(vacant)

supervisor Plant Equipment Layup

J.C. Abromitis

supervisor Utility Maintenance

(vacant)

supervisor Maintenance Planning/
Scheduling

B. Elam

manager Plant Engineering

(vacant)

supervisor Systems Support Eng.

(vacant)

supervisor Plant and Radiochemistry

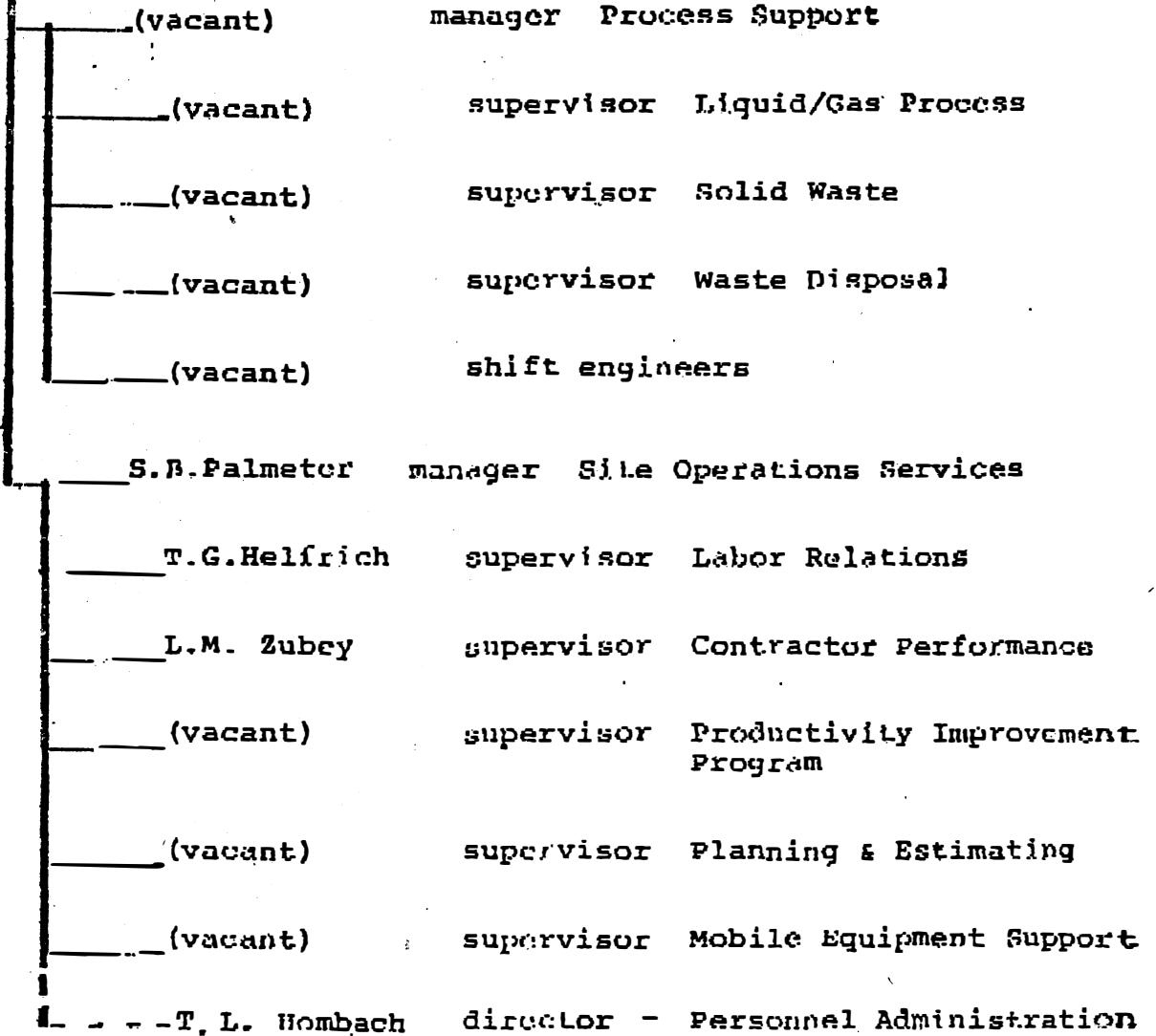
(vacant)

supervisor Startup & Testing

TMI Unit 2 Site Operations (continued)

J. J. BARTON

director



TMI UNIT 2 ADMINISTRATION AND SERVICES

| | |
|---------------------|-------------------------------------|
| <u>M. K. PASTOR</u> | manager |
| _____ D.F. Limroth | supervisor Administrative Controls |
| _____ (vacant) | supervisor Document Control |
| _____ (vacant) | supervisor Training |
| _____ (vacant) | supervisor First Aid/Medical |
| _____ (vacant) | supervisor Recovery Reports |
| _____ (vacant) | supervisor Security |
| _____ J. Troebliker | director - Personnel Administration |

Attachment C

METROPOLITAN EDISON COMPANY

Subsidiary of General Public Utilities Corporation

Subject RADIOLOGICAL CONTROLS

Location Three Mile Island

To ALL TMI EMPLOYEES AND CONTRACTORS

Date November 1, 1979

Each one of you is responsible for radiation safety for yourself as well as for your fellow workers. This is no different than the responsibility you have always had for other kinds of safety such as wearing hard hats and safety glasses.

It's mandatory that we immediately introduce a more disciplined, professional approach to radiological work.

In the past, you have not made radiological controls a key part of every job for which you are directly responsible. You have left radiological control too much to the radiological protection organization.

We must all take immediate steps to insure a high quality radiological control program becomes part of each and every job we do.

I charge each of you to follow precisely the procedures specified for radiation work and to in every case, use the proper radiological control practice for the job.

If procedures are wrong, they must be fixed before the work is performed. If you know a better way to do the job with better radiological control, you should tell the radiological control organization through your foreman or supervisor.

To increase management attention to deficiencies in radiological work practices, Peter Velez, Radiation Protection Foreman, is immediately assigned full time as "Radiological Control Inspector", reporting directly to J. G. Herbein and R. F. Wilson. Velez has the authority and is required to immediately stop any and all work not being accomplished in accordance with appropriate radiological control practices and procedures.

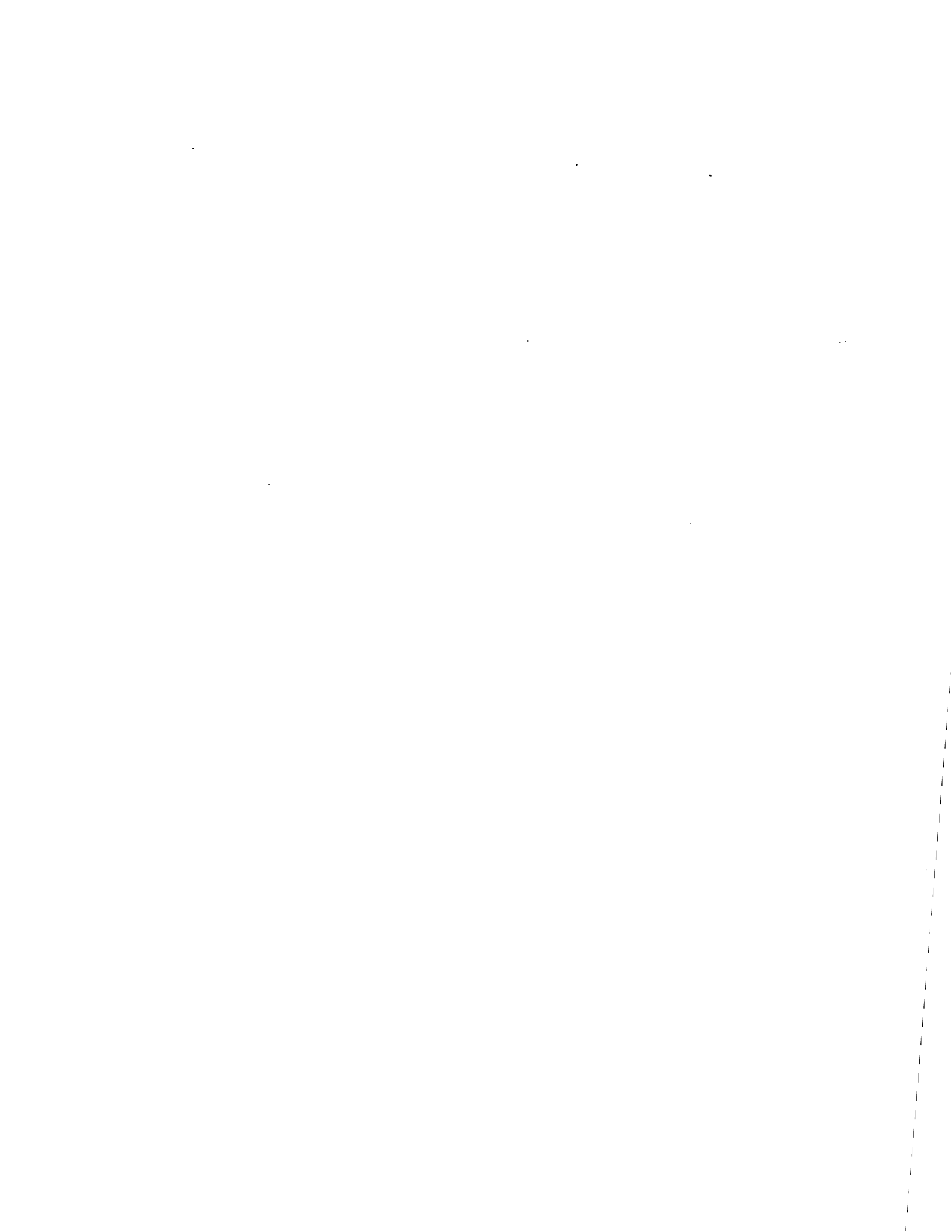


R. C. Arnold

RCA:JGH:bar



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| 9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Special Panel Office of Nuclear Reactor Regulation Radiological Assessment Branch U. S. Nuclear Regulatory Commission Washington, D. C. 20555 | | | | 5. DATE REPORT COMPLETED MONTH YEAR December 1979 | |
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| 16. ABSTRACT (200 words or less) A Special Panel was appointed by the Director of the Office of Nuclear Reactor Regulation to review the Radiation Protection Program at Three Mile Island Unit 2. The Panel confirmed several management and technical deficiencies in the radiation protection program. Recent major GPU/Met-Ed commitments and actions demonstrated a major change in management attitude. The Panel concluded that exposures to personnel can be maintained as low as is reasonably achievable while limited preparatory recovery work continues, and when further needed improvements are implemented, the radiation safety program will be able to support major recovery activities. | | | | 9. (Leave blank) | |
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