A REPORT

TO THE MET-ED COMMUNITY

Rec'd 10/25/79

ENTRY AND DECONTAMINATION OF THE REACTOR CONTAINMENT BUILDING

AT THREE MILE ISLAND UNIT 2

Highlights of a "Planning Study"

conducted by

BECHTEL POWER CORPORATION

for

GPU SERVICE CORPORATION, INC.

Presented at Briefings
August 13, 1979

Metropolitan Edison Company
Reading, Pennsylvania
August 27, 1979
Report Number Four

Dear Neighbor,

Here is infomation that will help you to understand some aspects of that will be involved in the recovery of Three Mile Island Unit 2 as a result of the accident of March 28, 1979.

What is presented here is a summary of a planning study conducted for us by the Bechtel Power Corporation. The plan is really a preliminary study designed to help us prepare for entry into the Reactor Containment Building and the decontamination of the facility. It must be recognized that this is a preliminary study and that further investigation and planning will be required before action is taken.

We sincerely hope that this information will help build a greater understanding. Met-Ed wants to be responsive and we urge you to write to let us know of your special interests. We plan to continue this series of reports to the community and we can assure you that Met-Ed will make every effort to address your concerns in future communications.

Sincerely,

Metropolitan Edison Company

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THE PLAN: A PRELIMINIARY STUDY

Following the March 28 accident at Three Mile Island (TMI) Unit 2, GPU Service Corporation (GPUSC) retained Bechtel Power Corporation, a leading engineering and construction firm in the nuclear power industry, to prepare recovery plans for the re-entry and decontamination of the Unit 2 reactor containment building.

A top priority in developing the plan was to analyze, without benefit of building entry, the radioactive content in the water on the building floor (the sump water), in the air inside the building, and on the various surfaces. This analysis was required to plan for the decontamination of the building and equipment, a prerequisite to the eventual recovery of the plant.

The Bechtel study also describes:

* An assessment of the physical condition of the containment building and the degree of damage.
* Preliminary plans for entering the containment building for the first time since the accident and completing its decontamination.
* Conceptual design for new systems and modifications to existing systems that will be needed for re-entry and decontamination.

The re-entry and decontamination work will be directed by engineers and technicians, who have been appropriately trained in decontamination and in the practices that are essential to protect the public, themselves and those working with them.

The Bechtel study does not specifically address ~~several~~ areas related to Unit 2 recovery efforts such as removal of the water in the containment building, disposal of contaminated materials or removal of the fuel from the reactor vessel. These and other areas are or will be the subjects of other studies and evaluations. To the extent we may know the preliminary plans, some of these areas are covered in these summary highlights.

The Bechtel study also outlines in a separate assessment a preliminary estimate of costs and a schedule related to the recovery effort. They caution that since no entry has been made into the Containment Building the cost estimate is highly speculative.

The scope of the estimate includes efforts related to re-entering and cleaning up of the containment, including waste disposal; removing and disposing of the fuel; refurbishing or replacing in-containment systems, structures and components, and preparing the unit for restart.

A copy of the July 16 New Release announcing the Bechtel Study (included in this information kit) outlines cost parameters.

Important Note:

Bechtel and GPUSC caution that since the containment building has not been entered since the accident, there are uncertainties about levels of radiation and the condition of the facilities within structure. As knowledge of these factors improves, changes undoubtedly will be made in the preliminary planning. New studies already are in process and still others will be made.

For these reasons, GPUSC and Bechtel identify the study as preliminary and recognize that further investigation and planning must precede initial entry.

COSTS AND SCHEDULE

Bechtel estimates that decontamination and reactivation of TMI-2 will take about four years, but that this schedule could vary by as much as six months.

The Bechtel study estimates that the decontamination and reactivation of the plant will cost about $320 million. This figure includes a contingency fund of $80 million.

The Bechtel estimate does not include the cost of replacing the reactor core. GPUSC's investment in the core at the time of the accident was about $35 million. With increases of uranium, enrichment and fabrication prices, a new core will cost between $60 million and $80 million.

Additionally, GPUSC has added $25 million to the Bechtel estimate to cover possible further unforeseen contingencies. This brings the estimated cost of decontaminating and restarting TMI-2 to about $400 million.

The schedule of major milestones in the TMI-2 recovery effort is difficult to estimate because of uncertainties in the timing of regulatory approvals and because information or developments in an earlier effort may effect the planning for subsequent efforts. The following generalized schedule should be considered in that context and may be subject to significant later changes:

1. Back up reactor decay heat removal systems and other safe shutdown mechanisms in place. Summer 1979

2. Auxiliary Building water treated and building decontamination completed. Fall 1979

3. Reactor containment building (RCB) water removed from RCB and treated. Winter 1980

4. Remote deontamination of RCB and RCB equipment completed. Spring 1980

5. Re-entry of work personnel into the RCB, followed by hand-on decontamination work in RCB. Spring 1980

6. Reactor vessel opened, head removed, fuel damage assessed. Spring 1981

7. Fuel core removed. Fall 1981

8. Reactor coolant system decontamination completed. Summer 1982

9. Component Systems inspected, analyzed and prepared for requalification. Fall 1982

10. Evaluation completed on the feasibility/advisability of return to commercial operation. Fall 1982

This schedule does not include consideration for a number of potential delaying factors. Among the more important are extraordinary legal or political hindrances, major changes in existing regulations, or wide variations from anticipated conditions in the containment building or reactor coolant system. Any of these or other factors could significantly increase the time and budget requirements for safe cleanup and recovery.

For planning purposes, Unit 2 restart, if approved, is schedule for mid-1983.

INITIAL HUMAN ENTRY OF THE CONTAINMENT BUILDING

Using the Bechtel plan, human entry into the containment building would be attempted only after remote decontamination, removal of radioactive gases from the air and draining of the water from the floor.

During the entry, worker safety precautions must be taken and release of airborne radiation and contamination to the control and service building must be minimized. To accomplish this, a temporary contamination control envelope would be built around the existing personnel airlock through which the initial entry would be made. This would close off the area around the entry point with two or more barriers. Each control zone would be vented to temporary filters to remove any escaped contamination.

The initial entry would be made by a team of three well trained engineers and technicians who would know what to look for once inside, what to do and how to guard themselves from over-doses of radiation. A standby team of three other qualified workers would be ready outside the airlock in case of emergency need.

Those inside the containment building would be in constant radio communications with their supervisors in the containment service building.

The initial re-entry personnel would wear several layers of protective clothing, including hard hats, three to five layers of full anticontamination clothing with surgical caps, hoods, rubber boots, outer layer plastic suits and full rain gear, including hat and coat.

The gear they would carry would include breathing apparatus, devices for measuring gamma and beta radiation, air and gas samplers, explosive gas meters, beam flashlights and two-way radios.

The length of time the re-entry team could spend in the containment building would depend upon the level of radiation, but could be as long as an hour.

The re-entry team would have two basic assignments; to map the radiation levels and "hot spots" in as much of the building as practical under the conditions they find; and to assess the physical condition of the inside of the containment building and its contents.

Bechtel also considers the use of robots if radiation levels are found to be too high for human entry. The report states that robots would be capable of making the entry and performing radiation surveys, dose rate assessment evalutions and observations of the general condition of the containment building at the point of entry. However, a robot would not be as mobile, flexible or "intelligent" as a human team.

GPUSC is also considering the possibility of sending a specially equipped and trained man into the containment building before remote decontamination or removal of the sump water. This re-entry, using essentially the same techniques as proposed by Bechtel, would be made through the same airlock recommended by the Bechtel report. The goal of such an early entry would be to obtain more detailed data on conditions within the building before deciding on the various decontamination techniques or planning subsequent recovery efforts.

DECONTAMINATING THE AIR

The air in the containment building contains high levels of radioactive gases, particulates and iodine that must be reduced to minimize exposure of workers during the decontamination program. The principal contaminants, stemming from the reactor cooling system water that spilled into the containment building, are miscellaneous fission products, noble gases, iodine, cesium and tritium, all of which must be disposed of in a manner that will not jeopardize the public health.

Purging of the containment building atmosphere would be done after the remote decontamination sequence, but before human entry. The basic objectives would be:

* To minimize the impact on public health and safety of containment building clean-up.
* To assure the lowest reasonable possible exposure of workers to radioactivity.
* To assure that there is no danger to the health or safety of the public, by keeping any releases well within all applicable Federal limits.

Several techniques for decontaminating the containment building atmosphere were surveyed by Betchel. One, known as the filtration and purge method, involves circulating the contaminated air through filters to remove radioactive particulate matter and through charcoal to remove iodine. The air would then be exhausted in controlled amounts into the atmosphere through a vent stack after going through a second filter and charcoal sequence. Some radioactive gases, mainly krypton, would be released, but in concentrations within Federal discharge limits.

The Bechtel study indicates this process would take about 51 days, after which the air in the containment building should be breathable in accordance with Federal standards.

Bechtel estimates that at the end of the 51 days, the total off-site dose due to radioactive gases from the filtration and purge process would not exceed 0.14 millirems of gamma radiation and 14.8 millirems of beta radiation at the site boundary and would be less as distance from the site increases. In both cases, the emissions would be within technical specifications, legal limits and Federal guidelines for normal plant operation.

The study also points out that the filtration and purge method can meet any off-site dose objective other than absolute zero. It is simply a matter of reducing the purge rate to comply with the goal. Existing meteorological conditions (wind speed, etc.) would be taken into consideration to further minimize dosages.

Three other methods are also being evaluated:

* Compression and storage of the contaminated air in tanks.
* Cooling the air to very low (cryogenic) temperatures at which the radioactive gases liquify and can be separated from the air and stored.
* Absorption of the radioactive gases as they are passed through a charcoal bed at very low temperatures.

While preliminary evaluations indicate the filtration and purge method is the best all around alternative, GPUSC is conducting further studies to determine the safest and most effective way of handling the contaminated air in the containment building. This work includes:

* A more thorough investigation of the filtration and purge system. Work already completed in this area shows that Bechtel's estimates of the amount of radiation that would be released into the atmosphere and the resulting dose rates are correct and, therefore, would qualify under Federal regulations.
* The feasibility of each of the alternate methods is being studied in depth.

No final decision has been made at this date as to which of the available methods of disposing of the radioactive gases in the containment building will be used.

DECONTAMINATION BEFORE HUMAN ENTRY

So-called "remote decontamination" of the containment building is planned before entry by workers to complete the job by manual methods. The procedure is intended to reduce human exposure to radiation during initial entry and hands-on decontamination. Bechtel has identified four basic remote decontamination techniques:

1. Flushing with clean water.
2. Use of steam to induce condensation on surface.
3. Flushing with detergent solutions.
4. Flushing with chemical solutions.

Each of these would use the containment building spray system, which was built into the containment building for emergency use to remove iodine from the air in the event of an accident.

The sequence of remote decontamination events as described by Bechtel is as follows:

1. A flush with some 250,000 gallons of clean water.
2. Injection of a small steam flow while draining the flush water from the floor to prevent chemicals now dissolved in the water from precipitating and adhering to drained surfaces.
3. Multiple steam cycles to help remove contamination clinging to walls, ceilings and unfloodable surfaces.
4. Evaluation of the effectiveness of the water and multiple steam flushes. If these have been effective, the recommendation is to repeat the water flush. Since the steam flush already will have been repeated several times, it need not be done again. If neither the water nor steam flushes have been effective, the proposal is to proceed to Step 5.
5. A flush with 250,000 gallons of a detergent solution.
6. A flush with 250,000 gallons of clean water.
7. Again evaluate effectiveness of Steps 5 and 6 and repeat if effective or proceed to Step 8.
8. Use of chemicals, beginning with those chemicals least likely to be harmful to equipment within the containment building, proceeding to stronger chemicals as required. The use of chemicals will be followed by a 250,000 gallon flush with clean water. When it is determined that the radiation levels are sufficiently low for human entry, there will follow a 200,000 gallon flush with water containing corrosion inhibitors. This water would remain in the containment building sump during the initial periods of manual decontamination to minimize airborne tritium and help shield workers from radiation caused by contaminants remaining on the floor.

This sequence of flushes should reduce the contamination on those areas and equipment directly contacted by the various sprays to a level one hundredth or less of current levels. However, some areas not directly sprayed will be less thoroughly cleaned and will require greater care during manual clean-up.

Bechtel identified about 10 chemicals that might be used in the remote decontamination process without harming components of the containment building, but these and even stronger chemicals would only be used as a last resort in the event the earlier remote decontamination steps failed to achieve the desired results.

GPUSC agrees that the water and steam flushes should be used and that chemicals would be used only if radioactive levels are found to be too high for safe human entry for manual decontamination, and then only if we are assured that the chemicals will not harm the nuclear steam supply system.

MANUAL DECONTAMINATION

Manual decontamination will be the final step in the TMI-2 clean-up. The plan generally calls for starting the clean-up at the entry hatch and working outward until the entire building has been cleaned.

The job falls roughly in two parts: general overall decontamination and decontamination of specific hard-to-get-at areas that may contain "hot spots."

The overall area decontamination will be accomplished by flushing with water the detergent solutions applied with spray apparatus. Fire hoses and portable tanks with spray attachments will be used.

Steam cleaning will be used on specific area contamination. Hard-to-reach "hot spots" will be scrubbed manually with detergents.

Protection of the technicians working in the containment building will be of paramount importance. Before they begin their job, general area and airborne radiation monitors must be installed to alert the workers when danger of over-exposure exists.

Workers will wear breathing apparatus and anti-contamination clothing while performing manual clean-up work.

Allowable work periods will be dictated by existing radiation levels. In no case will workers be allowed to get radiation doses exceeding legal limits as set forth in Federal standards.

As will be the case in the remote decontamination procedures, special care will be taken in manual decontamination to protect the nuclear steam supply system because of its importance to future operation of the plant.

OPENING OF REACTOR HEAD & REMOVAL OF FUEL CORE

Following decontamination of the containment building, the reactor coolant system will be flushed and remotely decontaminated. The overhead polar crane will be placed into serviceable condition and the refueling cavity around the reactor flooded to cover the reactor vessel and permit the removal of the reactor head with minimal recontamination of the surrounding area.

Because we expect there is significant core damage, the fuel will be removed using specially designed tools and eventually shipped to a processing/storage depository in spent fuel casks. The fuel will be temporarily held in TMI-2's spent fuel pool, which will be modified for the operation. For planning purposes we are assuming that at least half (about 60%) of the fuel assemblies have been damaged.

Following removal of the fuel assemblies, the balance of the reactor coolant system will be decontaminated. GPUSC assumes that some fuel pellets and other core debris have been distributed to other parts of the system. Because of this, it will be necessary to remove the reactor vessel's lower internal parts and cleanup the bottom, remove the pumps, inspect and repair if necessary the steam generator tubing, and chemically decontaminate the Reactor Coolant System.

REMOVAL AND TRANSPORTATION OF RADIOACTIVE WASTE FROM THREE MILE ISLAND

The removal and transportation of radioactive wastes from Unit 2 at Three Mile Island has begun, with refuse moving by tractor-trailer units to the Hanford Reservation in the state of Washington.

The Auxiliary Building clean-up and decontamination of water will result in about 250 shipments over a four year period. Bechtel has projected that decontamination of the Containment Building and Reactor Cooling System may require in the range of 2,000 to 2,500 shipments.

For protection of the public health and safety, a series of routine but rigorous inspections precedes dispatch of each shipment. Teams from two federal agencies, one Pennsylvania state agency, and numerous operating units of Metropolitan Edison Company are involved in the process of checking and certifying a shipment in compliance with standards for radiation control and physical condition of the vehicle and its cargo.

Current shipments consist of 150 to 160 steel, 55-gallon drums containing dry, compacted solid refuse from Unit 2 clean-up operations. Included are radioactively contaminated work clothing, shoe covers, small tools, rags, paper, and other debris. Some 600 drumloads has accumulated when shipments began on August 7, 1979. In addition, there are a number of wooden boxes, about four by four by eight feet, containing non-compactible debris.

To some segments of the public, waste from Three Mile Island has a special stigma, regardless of the routine level of radiation. Accordingly, TMI management has undertaken a special public affairs program. State officials along the shipping itineraries were individually briefed, and company representatives are accompanying the initial shipments to handle any inquiries.

Maximum permitted radiation levels on the exterior of the shipment are considered conservative. Radiation readings for the first shipment were substantially lower than the permissible maximums. For example, readings six feet from the trailer were 1.5 millirems per hour in contrast with a permitted level of 10.0.

When each shipment is dispatched, designated officials in states along the itinerary are notified of the route, contents and estimated time of arrival in that state.

Shipments of somewhat higher level radioactive wastes will begin. Some of these may require somewhat lengthier routing because of the extra weight of containers used. Routing is a result of piecing together in sequence, states in which necessary permits for overweight shipments can be procured.

The heavy casks to be used for these shipments will contain a dewatered resin used in a chemical process for absorbing radioactive materials now dispersed in the water held captive since the accident in March.

After the reactor vessel is opened and the fuel removed, GPUSC expects to ship the fuel to a depository off-site in spent fuel casks specifically designed for such purposes.

The number and type of shipments required to remove contaminated materials from the Island will depend on the nature of the decontamination system used at each stage and the amount of radioactive materials. An estimate of such shipments will be made prior to the initiation of each decontamination effort.

CALCULATING RADIATION LEVELS IN THE CONTAINMENT BUILDING

One of the first steps that must be taken before re-entry and decontamination work can begin is to determine how much radioactivity exists in the containment building. While levels cannot be determined exactly until re-entry has been accomplished, Bechtel has made a range of calculations based on existing data. What is presently known is derived from samples of the reactor cooling water, samples of air from the containment building and radiation measurements made by detectors both inside and outside the building.

Four major sources of radiation are involved:

* General area levels from radioactivity deposited on walls and floors.
* Airborne sources.
* Concentrations in the sump water, which is about seven feet deep on the building's floor.
* Local areas of heavy contamination known as "hot spots".

Using available measurements from these sources, Bechtel estimates a range of three probable radiation levels--the lowest, the median and the highest.

Bechtel's airborne radiation estimates range from 0.73 to 1.3 microcuries per cubic centimeter. A microcurie is a measure of the rate of disintegration of radioactive material. The major contributor to this airborne radiation is krypton 85, one of the radioactive gaseous fission products.

Radioactive content of the sump water ranges from 222 to 961 microcuries per cubic centimeter, largely due to barium 137m and cesium 137 in the water. Bechtel estimates that the sump water also contains 0.5 to 1.5 microcuries per cubic centimeter of tritium, a radioactive form of hydrogen that cannot be readily removed from the water by commercially available techniques. Tritium has a relatively small biological effect which can be further reduced by dilution.

The Bechtel report has estimated general area radiation levels for December 1979 and assumes that the water on the floor of the building has been removed, but that no attempt at remotely decontaminating the building has been made. On this basis, general area radiation level estimates within the containment building, measured in terms of gamma dose rates, range from 6.7 rems per hour at a floor 23 feet above the bottom of the containment of 2400 rems per hour at a higher floor (about 66 feet above the bottom of the containment). Rems are a measure of the biological effect of radiation dose absorbed in human tissue.

Due to the location of the existing airlocks, re-entry is planned at a floor 23 feet above the bottom of the containment, where the radiation dose rate estimates prior to cleanup range from 6.7 to 46 rems per hour.

The Bechtel radiation estimates are believed to be the best currently available and are based on sophisticated techniques for calculating radiation levels with the presently available data.

Final decisions await direct measurements that can be made by inserting probes into the containment building atmosphere and by obtaining samples of sump water from the floor of the building. Engineers are now working on procedures to execute these measurements.

NEW AND MODIFIED FACILITIES PLANNED FOR SAFE AND EFFECTIVE DECONTAMINATION

Contemplated by Bechtel, before re-entry and decontamination of the containment building, will be installation of a number of new facilities, equipment and systems, as well as modifications to existing facilities.

The largest single addition recommended by Bechtel is a containment service building and associated facilities to be erected outside but contiguous with the containment building.

This building will be designed to limit the escape of radioactivity during the decontamination process.

The service building also will:

* Provide personnel access to and from the containment building during all phases of decontamination.
* Allow passage of large pieces of equipment and removal of bulk radioactive waste without opening the containment building directly to the atmosphere.
* Serve as a staging area to decontaminate and package contaminated equipment removed from the containment building.
* Serve as an area for holding of high-level radioactive waste for shipment to off-site storage.
* Provide space for a dry cleaning facility for contaminated clothing.

Since as many as 100 people per shift may be working on the decontamination project, the service facility will house a "health physics" office, which will serve as a control point for personnel entry and processing of radiation work permits.

The service building will be equipped with radiation monitors and alarms as a further protection for workers and the general public. The service building will also be equipped to filter all incoming air to remove dust and outgoing air to remove particulate radioactive material.

Other new equipment to be provided for the decontamination project will include temporary lighting and power for the containment building and breathing air systems for workers inside the building. The latter will consist of self-contained breathing apparatus carried by the workers and air from compressed air tanks provided through hoses to masks worn by the operators.

A visual communications system will be available to allow workers to see the actual work area and existing conditions before entering for their assignments.

This system along with a two-way audio control will augment supervision and monitoring or work inside the containment building.

Other new equipment will include a commercial steam generator capable of providing steam at 300 pounds per square inch for decontamination purposes, a water supply and water recycling system, and several large industrial strength vacuum cleaners.

Use of steam is expected to be one of the major tools in reducing contamination within the containment building. The water treatment system will decontaminate water already in the containment building for re-use in the decontamination process, supply and purify any new water that may be required and continually recycle the water used in the decontamination effort. This procedure will greatly reduce the amount of water used in the clean-up.

Key facilities for decontamination of the containment building before human entry will be the existing spray and ventilation systems. The use of these two systems is discussed elsewhere in this report.

Ed Case
Miki Parsont

OFFICE OF THE COMMISSIONER

October 1, 1979

The Honorable Gary Hart, Chairman
Subcommittee on Nuclear Regulation
Committee on Environment and Public Works
United States Senate
Washington, D. C. 20510

Dear Mr. Chairman:

This responds to a letter dated September 27, 1979 from you and a number of your colleagues on the Senate Committee on Environment and Public Works concerning Three Mile Island Unit 2 recovery operations. Your letter dealt with two important aspects of these operations - the contaminated water now stored at the site and the licensee's radiation protection program. Shortly after receipt of your letter, the Commission requested and received a staff briefing on these issues at a public meeting of the Commission held on September 28.

Enclosure 1 to this letter discusses in some detail the current status of the contaminated water at the site and the options for processing and storage now under active consideration. Of principal importance in this connection is the fact that under no foreseeable circumstances do we plan nor will it become necessary to put unprocessed contaminated water into the Susquehanna River. There continues to be sufficient waste storage capacity at the Three Mile Island site (including that currently available at both Units 1 and 2) for about 9 more months, assuming the amount of contaminated water continues to increase at the present rate. Notwithstanding this extensive storage capacity, there is a need to begin processing of the contaminated water in order to remove and immobilize the contained radioactivity as soon as a careful consideration of the related safety and environmental considerations by the staff and the Commission will permit. The staff has already prepared and issued an environmental assessment of the use of "EPICOR II" to process the contaminated water now contained in tanks in the auxiliary building. The period for public comment on these staff reports has recently expired and the staff currently plans to make its final recommendations to the Commission later this week concerning the use of this system. It is important to note that while the potential risk to the public offsite from continued storage of the contaminated water cannot be completely discounted, the principal safety concern pending processing of this water involves the increased likelihood of worker overexposure.

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With regard to a related matter, your letter of September 27 correctly points out that the staff has in the past identified a number of deficiencies in the licensee's radiation protection program which, as yet, have not been corrected. As discussed in more detail in enclosure 2, the staff has been pursuing these matters over the past several months and will continue to do so. Neither they nor the Commissioners will permit expansion of the recovery program until these important issues are suitably resolved. Again, the principal concern related to these deficiencies is in providing adequate protection for the workers on the site.

Please be assured that my fellow Commissioners and I have been actively following and will continue to follow these and other issues related to management of the radioactive water at the Three Mile Island site, and are being periodically briefed by the staff, both orally and in writing. We will intervene at any time we or the staff believe such action is necessary to maintain adequate protection for the workers at the facility. You may also be assured of prompt NRC action if needed to protect the health and safety of the general public in the vicinity of the Three Mile Island site.

Sincerely,

/S/ Richard T. Kennedy

Richard T. Kennedy
Acting Chairman

Enclosures:
1. Staff Report on Contaminated Water at Three Mile Island Site dated September 30, 1979
2. Staff Report on Licensee's Radiation Protection Program at Three Mile Island dated September 30, 1979

Note: Identical letters sent JRandolph, DPMoynihan, PVDomer RTStafford, AKSimpson, and HBa Jr.

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SURNAME ►				R. T. Kennedy		
DATE ►				10/1/79		

Enclosure 1
September 30, 1979

CONTAMINATED WATER AT THREE MILE ISLAND SITE

Currently there are three major volumes of contaminated waste water resulting from the accident at the TMI-2 facility. They are:

1. water contained in the lower level of the reactor building,
2. water contained in the reactor coolant system,
3. contaminated water contained in the auxiliary building tanks.

This water inventory is summarized in Table 1 and depicted in Figure 1.

The water in the reactor building is a result of water discharged to the lower levels of the building during the accident, as well as the accumulation of normal leakage from the reactor coolant system following the accident and sources of uncontaminated secondary water that have mixed with the contaminated water. The volume of water in the reactor building is about 630,000 gallons, which is a level of about 7-1/2 feet above the basement floor in the reactor building. The current leakage rate, principally of water from the primary reactor coolant system, results in an increase in volume of about 430 gallons per day and a level increase of about 2 inches per month as shown in Table 2. Since this amount of leakage is to be expected, this source of inleakage will continue. The principal isotopes and activity level in this water is presented in Table 3.

The reactor coolant system is another volume of contaminated water. The fixed system is composed of the reactor vessel, steam generators and associated pumps, piping, and valves, and has a volume of about 85,000 gallons. The principal isotopes and activity level in this water is presented in Table 3. Since it is a fixed system its volume does not increase but there is leakage out of the reactor coolant system into both the reactor building and the auxiliary building. As leakage occurs from the primary cooling system, replacement water is added to keep it full at all times.

The contaminated water in the auxiliary building is contained in tanks having a total capacity of about 415,000 gallons. Currently 387,000 gallons of contaminated water is stored in these tanks; thus, the remaining capacity is about 29,000 gallons. With the current inleakage rate of about 800-1000 gallons per day, a margin of about 30 days (from September 29, 1979) remains until these tanks are filled. The details on the tank volumes and remaining capacities as well as the radioactivity levels in these tanks are given in Tables 4 and 5.

The dominant sources of leakage in the auxiliary building are from the component cooling system, demineralized water system, reactor building evaporator cooling system and from the recirculation of tanks prior to sampling. Most of this leakage is non-contaminated water but it becomes contaminated while passing through floor drains and sumps which are provided to collect the leakage. Another source of water, although minor in volume (approximately 10%) is from leakage in the reactor purification and makeup system which is also located in the auxiliary building and contains primary coolant water. This leakage is likewise to be expected, and is from pumps and valves.

In summary the leakage of water from various sources which results in an increase in the amount of contaminated water is from normal leakage paths. The current inleakage rate to the reactor building poses no threat to the public health and safety. Although the inleakage rate to the auxiliary building is contained in tanks, it does contribute to occupational exposure. However, since the tank volumes remaining at TMI-2 are limited, a decision regarding which option to be exercised to accommodate water about 30 days hence needs to be made. These options are addressed in the following pages.

Options for Accommodating Leakage of Contaminated Water

The options available for accommodating the increase in the amount of contaminated liquids at the Three Mile Island site are basically as follows:

1. The use of EPICOR-II to decontaminate the water so that it can be placed in available tanks;
2. The transfer of contaminated water from TMI-2 into the TMI-1 facility where tank capacity is available in the auxiliary building;
3. Placement of contaminated water into the reactor building; and
4. Construction of new tanks onsite which would be capable of storing highly contaminated liquids.

EPICOR-II

The use of EPICOR-II for the processing of auxiliary building water has been evaluated in detail in the staff's environmental assessment, a copy of which is enclosed. The EPICOR-II system is a demineralization process which removes radioactive ions from the water stream as it is passed over filters and resins. This technique is well-proven through many years of use in commercial and military nuclear applications. The EPICOR-II system was designed and built following the TMI-2 accident for the purpose of processing the contaminated water generated by the accident currently being stored in the auxiliary building. This design and construction activity received close review and evaluation by the NRC staff, onsite as did the training of operating personnel and in the preparation of operating procedures. The actual use of the system, however, has been deferred pending resolution of objections to use of the EPICOR-II system by the City of Lancaster and the Susquehanna Valley Alliance. As a result of these objections and court actions the Commission directed the staff on May 25, 1979 to prepare an environmental assessment and allow a period for

for public comments. An approved draft of the environmental assessment was released for public comment on August 20, 1979 and 38 public comments were received by the close of the 30-day comment period on September 19, 1979. Of these 38 comments only three were substantive in nature. The City of Lancaster and the Susquehanna Valley Alliance were opposed to the use of EPICOR-II based on extensive technical and legal comments, which the staff currently has under consideration. The staff does not believe that any of these will alter its previous conclusion concerning the acceptability of using EPICOR-II. The Commonwealth of Pennsylvania had comments which are being incorporated into the environmental assessment by the staff, the Commonwealth is in agreement with the staff that the EPICOR-II system should be used to decontaminate the auxiliary building water. A summary of these comments, along with a revised environmental assessment and the staff's recommendation, will be presented to the Commission on October 4, 1979.

It is important to note that the use of EPICOR-II does not involve the discharge of any processed water into the Susquehanna River. The use of EPICOR-II, as described in the environmental assessment, is only for the decontamination of the water and does not consider or permit disposal of the cleaned up water. The cleaned up water will be such that it could be discharged under existing Federal and state regulations, but since various options exist for the water disposal, approval is being withheld until the disposal alternatives can be evaluated. Among the disposal alternatives are evaporation at the site, transport of the decontaminated water off-site, discharge at another location, re-use at the facility, and discharge into the river. As was indicated above, if the alternative of discharge into the river were to be used, this option would meet all standards, including the conformance at public drinking intakes to the EPA Safe Drinking Water Act. To date since the accident, the activity in the Susquehanna River at drinking water inlets has been indistinguishable from normal background levels as measured by a number of Federal and state agencies.

Storage in TMI-1 Tanks

A second option for handling the increase in the amount of contaminated water is the placement of such water in TMI-1 tankage which has been available for contingency purposes. The tanks for storage of liquid in TMI-1 are in the TMI-1 auxiliary building and have generally the same capability and safeguards as the current storage of liquid in TMI-2. Currently available storage in TMI-1 is about 225,000 gallons. However, there are several reasons why the placement of water in TMI-1 is not considered as the best alternative. First, putting contaminated water into additional tanks extends the scope of the potential problem of exposures of operators and does not reduce the mobility of the contamination. Further, the placement of contaminated TMI-2 water into TMI-1 tanks may require clarification of the Commission's May 25, 1979 statement which allows continued processing and discharge of TMI-1 water put prohibits processing and discharge of TMI-2 water. If TMI-2 water were to be transferred to the TMI-1 tanks through existing piping interconnections between the two units, it is likely that trace amounts of TMI-2 contamination would be deposited on some of the piping used for processing or discharge of TMI-1 water. Consequently, subsequent processing and discharge of TMI-1 water under these circumstances could be inconsistent with the Commission's May 25 statement. In addition, public perception might be that TMI-2 water was being processed through the TMI-1 facility.

In summary, although the placement of TMI-2 water into TMI-1 tanks affords substantial additional capacity and protects the public health and safety, it does not appear to offer a suitable permanent solution to the problem.

Storage of Water in the Reactor Building

Storage of water in the reactor building is another option for alleviating the storage problem. The reactor building currently contains about 630,000 gallons of contaminated water and could accommodate additional water. However, the reactor building contains equipment which is vital to the continued safe shutdown of the damaged TMI-2 reactor and the addition of water into the reactor building would place some of this equipment into a situation whereby non-operability would be made more likely. Storage of water in the reactor building presents no undue risk to public health and safety since no paths of leakage to the outside have been identified. Notwithstanding this, the licensee has been asked to develop and implement a program whereby groundwater under the TMI-2 reactor building will be sampled for potential radioactive contaminants. We expect this program would heighten assurance that none of the reactor building water is escaping.

In summary, the storage of TMI-2 water which is leaking into the auxiliary building, in the basement of the reactor building does not permanently solve the contaminated water problem and would also lessen the contingency available in the reactor building for the protection of vital equipment which might fail if submersed in water.

Construction of Additional Tanks

A third option is the construction of additional tanks. Tanks for storage of radioactive liquids would be required to meet regulatory requirements that provide substantial assurance of long term integrity, as well as for the detection of possible leakage. The construction of new tanks at the facility would pose a problem of time as well as location. As previously discussed, contingency tankage of 110,000 gallons was built after the accident in the spent fuel pool where space was available by removal of the spent fuel storage rack. However, at this time it would be difficult to find another plant location where tanks would be constructed that would provide that same degree of public environmental protection of the current tanks that are installed in a seismically qualified auxiliary building. In addition the same drawbacks exist as were discussed for options 2 and 3 that the creation of additional storage capacity extends the scope of the potential operator exposure problem and does not immobilize the contained radioactivity. Therefore, although this option could provide adequate public health and safety protection, it would not provide a permanent solution to the problem.

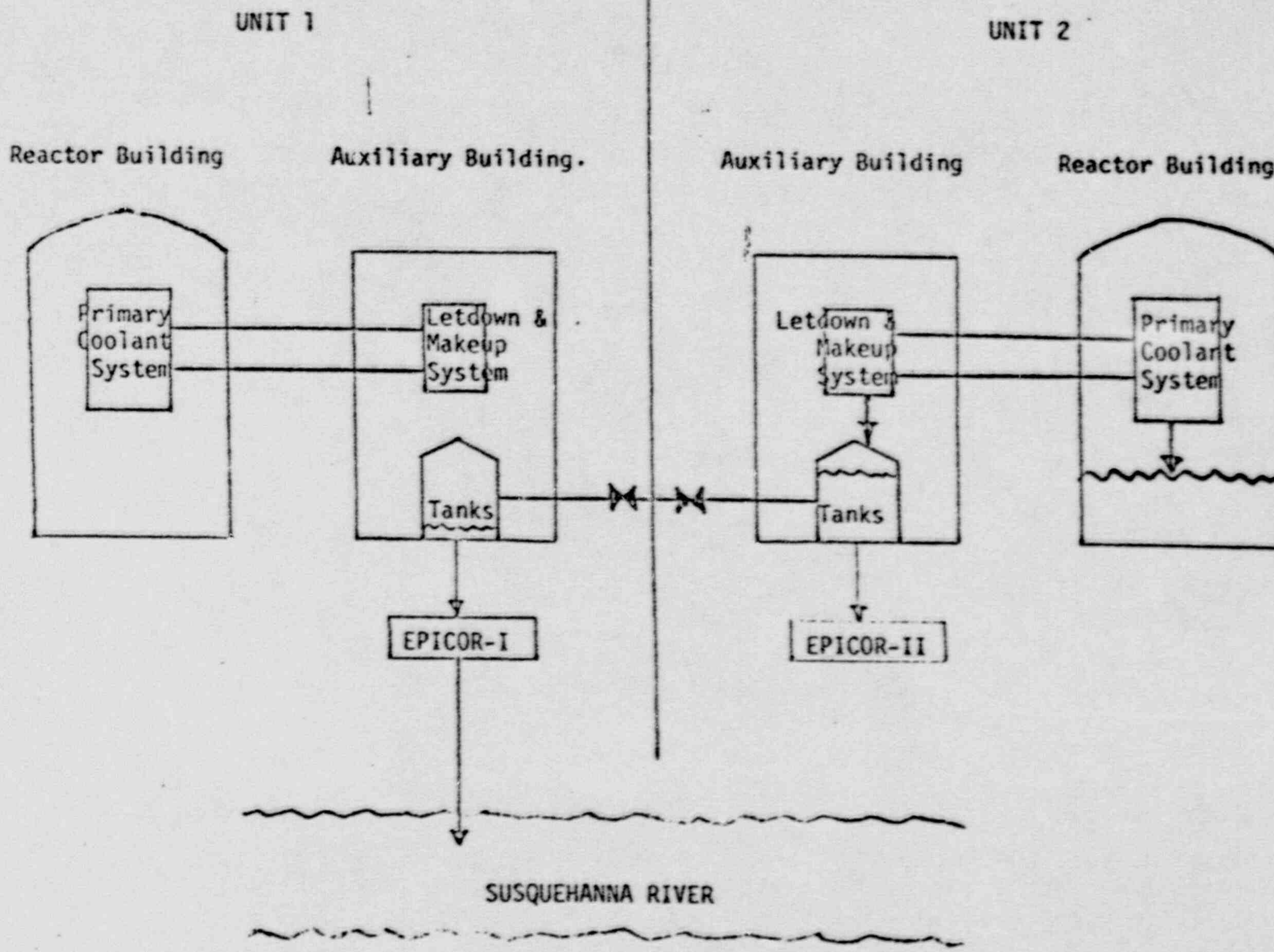
UNIT 1
UNIT 2
Reactor Building
Auxiliary Building.
Auxiliary Building
Reactor Building
Primary Coolant System
Letdown & Makeup System
Letdown & Makeup System
Primary Coolant System
Tanks
Tanks
EPICOR-I
EPICOR-II
SUSQUEHANNA RIVER

FIGURE 1

TABLE 1

TMI-2 RADIOACTIVE WASTE WATER INVENTORY

Sources	Usable Capacity (gallons)	Waste Water Volume (gallons)	Remaining Capacity (gallons)	Inleakage Rate (gallons per day)	Remarks
Reactor Building Waste Water	N/A	630,000	N/A	430	See Tables 2 and 3 for detail
Reactor Primary Coolant	85,000	85,000	0	N/A	
Auxiliary Building Tanks	415,190	386,500	29,000	800-1000	See Tables 4 and 5 for detail

Summary - Remaining days prior to filling all tanks at TMI-2 based on past seven (7) day average leakage rate are 30 days.

TABLE 2

TMI-2 REACTOR BUILDING WASTE WATER INVENTORY

Total Waste Water Volume	:	630,000 gallons
Current Leak Rate	:	0.3 gallons per minute or 430 gallons per day
Leak Sources	:	(1) Reactor Primary Coolant System (valves, flanges and pumps)
		(2) Containment Building Normal Coolers
Rate of Level Increase Based on Current Leakage	:	Approximately 2 inches per month
Water Activity	:	See Table 3

TABLE 3

RADIOACTIVITY CONCENTRATIONS OF PRINCIPAL NUCLIDES IN REACTOR BUILDING WASTE WATER

(Average Value of Three Samples)

(μCi/ml)

Cs-137	176
Cs-134	40
H-3	1.0
I-131	0.012
La-140	0.1
Sr-89	42
Sr-90	2.8

RADIOACTIVITY CONCENTRATIONS OF PRINCIPAL NUCLIDES IN REACTOR PRIMARY COOLANT

(μCi/ml)

I-131	<0.4
Cs-134	16
Cs-137	78
Sr-89	201
Sr-90	15.8
Ba-140	1.2
H-3	0.22

TABLE 4

TMI-2 AUXILIARY BUILDING WASTE WATER INVENTORY

Tanks	Maximum Capacity (gallons)	Waste Volume (gallons)	Remaining Capacity (gallons)	Activity Concentration (μCi/ml)
1. Reactor Coolant Bleed Tank "A"	77,250	77,250	0	Table 5
2. Reactor Coolant Bleed Tank "B"	77,250	77,250	0	Table 5
3. Reactor Coolant Bleed Tank "C"	77,250	77,250	0	Table 5
4. Miscellaneous Waste Holdup Tank	19,600	9,200	10,400	<0.1
5. Concentrated Waste Tank	9,000	9,000	0	<0.1
6. Neutralizer Tank "A"	8,780	8,780	0	Table 5
7. Neutralizer Tank "B"	8,780	8,780	0	Table 5
8. Auxiliary Building Sump	7,000	3,000	4,000	<0.1
9. Auxiliary Building Sump Tank	3,200	2,600	600	<0.1
10. Miscellaneous Waste Storage Tank - TMI	18,500	18,470	0	7.0
11. Tank Farm				
Upper	60,000	53,700	6,300	
Lower	50,000	41,700	8,300	
TOTAL	415,190	386,500	29,000	

TABLE 5

RADIOACTIVITY CONCENTRATIONS OF PRINCIPAL NUCLIDES IN REACTOR BLEED TANKS

(μCi/ml)	
I-131	0.011
Cs-134	7.8
Cs-137	37

RADIOACTIVITY CONCENTRATIONS OF PRINCIPAL NUCLIDES IN NEUTRALIZER TANKS

(μCi/ml)	
I-131	0.002
Cs-134	1.5
Cs-137	7.0

LICENSEE'S RADIATION PROTECTION PROGRAM AT THREE MILE ISLAND

Subsequent to the March 28, 1979 accident, the licensee's radiation protection program has been unable to respond in a consistently adequate manner to the many unique radiation protection problems which the recovery operations present. Onsite, daily inspection and monitoring by the NRC have identified discrepancies and areas where improvements were needed to assure a greater degree of plant worker protection. Six major areas were identified which required remedial action:

- Delineation of Radiation Protection Organization and Responsibilities
- Establishment of an augmented Quality Assurance Program
- Control of High Radiation Areas
- Evaluation of Airborne Activity
- Implementation of an Effective Bioassay Program
- Development of an Upgraded Respiratory Protection Program

During the period February 26 through March 2, 1979, at the request of Metropolitan Edison, the NUS Corporation conducted a review of the radiation protection program at Three Mile Island (TMI). The report of this review was obtained by the NRC staff on June 20, 1979. This report is critical of certain portions of the TMI radiation protection program and addresses the same general problem areas which had been identified by the NRC staff.

NRC efforts to resolve the past and current problems and obtain adequate corrective action by the licensee have been continuous. The onsite NRC staff has met frequently with various representatives of licensee management to identify specific concerns and obtain commitments for corrective action by the licensee. These meetings culminated on July 13, 1979, when the NRC staff discussed its intent to issue an Immediate Action Letter (IAL) to Metropolitan Edison; this discussion was held with Mr. R. Arnold, Vice President-Generation, General Public Utilities Service Company/Manager, TMI Site Operations and Mr. J. Herbein, Vice President-Generation, Metropolitan Edison Company, and members of their staffs. At that meeting the licensee agreed to take action on all of the issues identified by the NRC and in a letter dated July 18 confirmed the actions which would be taken and specified expected completion dates; therefore the IAL was not issued.

Since July 18 the licensee has submitted reports (in letters dated August 6, 13, 16 and September 10) of the actions taken in followup of the commitments. Continuing NRC observations and inspections have shown, however, that improvements in the program have been and continue to be slow.

The following discussion identifies the six major programmatic areas which required remedial action and summarizes the deficiencies and current status of corrective actions.

DELINEATION OF RADIATION PROTECTION ORGANIZATION AND RESPONSIBILITIES

In the immediate post-accident period, the delineation of specific areas of responsibility for radiation protection activities were not sufficiently definitive to assure that all matters important to worker protection were adequately managed and implemented. The licensee has subsequently better defined and assigned the responsibilities associated with matters important to worker protection. The adequacy of implementation of the assigned responsibilities is being monitored and evaluated by onsite NRC personnel on a continuing basis. The staff is not yet completely satisfied with the overall coordination of the total worker protection program at the site. The licensee was to establish a means for overall coordination of worker protection and delineate the specifics in its Radiation Protection Plan which was submitted for NRC review and approval on September 28. The staff has not yet completed its evaluation of the Plan.

ESTABLISHMENT OF AN AUGMENTED QUALITY ASSURANCE PROGRAM

The magnitude of the radiation protection challenge during the recovery operations required that the licensee institute an augmented Quality Assurance Program which would provide a comprehensive overview of the effectiveness of the radiation protection program and verify that necessary corrective measures are implemented. The new Quality Assurance Program was instituted by the licensee on September 10. The program is being implemented by licensee and contractor personnel who are not responsible for the conduct of the day-to-day radiation protection activities. Audit results from the program are not yet available for NRC review. As soon as they become available, they will be reviewed by the NRC onsite staff.

CONTROL OF HIGH RADIATION AREAS

The accident produced many high radiation areas within the plant. Identification of these areas and control of worker access to these areas during the recovery operations was and continues to be an item which demands continuous licensee attention. On September 10, the licensee completed development of procedures for identification and control of high radiation areas. NRC has reviewed and approved the procedures. Our overview indicates a lack of effectiveness of the licensee's implementation of the procedures; there are still some problems in implementing the "key control" aspects of controlling worker access to high radiation areas in Unit 2, and the procedures have not yet been implemented in Unit 1. The NRC onsite staff is interfacing with the licensee to resolve this problem.

EVALUATION OF AIRBORNE ACTIVITY

The isotopic distribution of airborne radioactivity within the plant and the changing nature of this distribution during the recovery operation was not fully appreciated. Consequently, the procedures and methods utilized for determining the concentration of airborne radioactivity within the plant were not always correct. On September 4, the licensee issued temporary procedures for evaluation of air samples. The NRC onsite staff has reviewed the procedures and found them to be adequate. Our onsite staff is monitoring the licensee's implementation of the temporary procedures. The licensee is scheduled to issue permanent procedures for evaluation of air samples by October 7. The NRC will review the procedures for adequacy.

IMPLEMENTATION OF AN EFFECTIVE BIOASSAY PROGRAM

Subsequent to the accident, the bioassay program in effect at the plant was found to be inadequate, especially as related to the determination of suspected acute and chronic exposures to isotopes that are not expected to exist at nuclear power plants in normal operations (e.g., Sr-89 and Sr-90). The NRC onsite staff reviewed the licensee's revised procedures for the bioassay program on August 17, and was not satisfied that they were adequate. The licensee was provided with comments from our onsite staff and is scheduled to have new procedures submitted for NRC review by October 10.

DEVELOPMENT OF AN UPGRADED RESPIRATORY PROTECTION PROGRAM

The levels of airborne activity experienced in the auxiliary building subsequent to the accident and the potential for airborne activity during recovery operations dictated the need for an upgraded respiratory protection program. The need was identified for action levels for Sr-89 and Sr-90 analysis, for improved "staytime" calculation procedures, and improved procedures for the testing, use and cleaning of respirators. The necessary procedure improvements were completed and found acceptable by the NRC onsite staff on September 24. The licensee is presently training personnel regarding the use of the procedures. The revised program is scheduled for full implementation by October 7. The effectiveness of the implementation will be monitored by the NRC onsite staff.

SUMMARY

The licensee has upgraded and continues to upgrade and improve the radiation protection program, but these improvements have been and continue to be slow. Our onsite inspectors have been and will continue to monitor the progress of the licensee in meeting his commitments for improvements in the operational aspects of worker protection. The August 21 report from Messrs. Neely and White demonstrates the diligence of our inspectors in accomplishing this function.

"The radiation protection program that presently exists at Three Mile Island, in conjunction with the NRC health physics overview, is adequate to provide for protection of the general public and for worker protection at the present level of recovery activity. As the licensee undertakes additional operations (e.g., processing of the highly radioactive Unit 2 water, entry into the Unit 2 containment, and possible defueling of Unit 1), we will need to continue to be vigilant to assure that the radiation protection program is implemented in a manner that provides for continued worker protection. To provide additional assurance that both the licensee and the NRC have considered all facets of the radiation protection challenge that exist during the recovery operations, a five member "Blue Ribbon" panel will be convened by the NRC staff to perform an independent assessment of the potential radiation protection problems that may be experienced during the recovery operations. A majority of the panel, including the Chairman, will be composed of experienced health physicists from outside the NRC. A report to the NRC of their assessment is expected to be completed within one to two months.
