NUREG-0732
Revision 1

Answers to Frequently Asked Questions About Cleanup Activities at Three Mile Island, Unit 2

TMI Program Office

**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

CONTENTS

INTRODUCTION

This question-and-answer report provides answers in nontechnical language to frequently asked questions about the status of cleanup activities at Three Mile Island, Unit 2. The answers update information first prepared in 1981, shortly after the cleanup got under way. Since then, a variety of important developments in the cleanup has occurred, making an update desirable at this time. The information in the report should be read in conjunction with "Answers to Frequently asked Questions About Updated Estimates of Occupational Exposure at Three Mile Island, Unit 2" (NUREG 1060), a detailed discussion, also in nontechnical lanaguage, of increased occupational exposure estimates for the cleanup and their possible health effects on workers.

Both these publications were prepared by the staff of the Three Mile Island Program Office as part of NRC's continuing responsibility to keep the public informed about the status of and plans for the cleanup. The views expressed are those of the NRC staff.

Copies of both reports are available at NRC's Three Mile Island Program Office, 100 Brown Street, Middletown, Pennsylvania, telephone (717) 948-1150, or by calling the NRC site office at Three Mile Island, telephone (717) 948-1120.

Copies are also available at TMI-2 Advisory Panel meetings in Harrisburg. These meetings usually take place from 7 p.m. to 10 p.m. on the second Thursday of every month. NRC notifies the local news media of the time and location of each meeting.

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I. PURPOSE, SCOPE AND COMMUNITY INVOLVEMENT IN THE CLEANUP

Q.1. Has the major reason for proceeding with the cleanup changed?

A. No. The goal for the project remains the same -- to remove fuel from the damaged reactor and to clean the auxiliary and reactor buildings to ensure the long-term protection of public health and safety, as well as to prevent the Three Mile Island site from becoming a long-term or permanent waste storage facility.

Q.2. What major cleanup tasks have been accomplished to date?

A. As of March 1984, workers have --

- Decontaminated water generated by the accident in the reactor building basement (completed May 1982) and in the auxiliary building (completed March 1981)
- Shipped almost all the highest level radioactive wastes offsite, except for damaged fuel from the core
- Purged krypton from air in the reactor building through controlled releases in June and July 1980
- Located and measured radiation areas and contamination within the reactor and auxiliary buildings
- Partially cleaned contaminated surfaces and equipment in the reactor and auxiliary buildings
- Inspected, refurbished, tested, and qualified the reactor building overhead (polar) crane
- Assessed damage to the reactor vessel core by remote TV inspection and by taking samples of core debris
- Reduced radiation levels in key areas throughout the reactor building so that worker exposures are kept as low as reasonably achievable
- Characterized the radiation levels under and around the reactor vessel head in preparation for the head and fuel removal

Q.3. What major cleanup activities are currently under way?

A. At present, the following activities are under way:

- The program to reduce radioactive contamination to limit radiation exposures to workers

- The shipment of low level solid wastes to a commercial waste disposal site

- The decontamination of areas within the auxiliary building

- The detailed planning for removing the reactor vessel head (currently scheduled for August 1984)

- The design of equipment to remove, package and ship the damaged core (including fuel) from the reactor vessel

Q.4. What major cleanup activities remain to be done?

A. The following tasks remain:

- Removing the reactor vessel head (currently scheduled for August 1984)
- Removing the large structure above the fuel inside the reactor vessel (called the "plenum")
- Removing the reactor fuel, core structure and debris from the reactor vessel
- Decontaminating the reactor coolant system
- Shipping the reactor fuel offsite
- Completing building decontamination
- Completing radioactive waste shipments offsite

Q.5. What is the schedule for completion of the cleanup?

A. A firm schedule cannot be made at this time because of uncertainties in funding for the cleanup, but a mid-1989 completion date is a possibility.

Q.6. What is the ultimate goal of the cleanup?

A. At the present time, GPU Nuclear plans to remove the fuel from the reactor vessel and from other locations in the reactor coolant system; to clean the plant to the point where it does not pose a threat to the public, the workforce, or the environment; and to remove radioactive wastes from the site.

Q.7. Will the reactor building be completely free of radioactivity when the cleanup is finished?

A. No. GPU Nuclear plans to decontaminate the plant to a point where the radioactivity is reduced to levels typical for normally operating nuclear power plants.

Q.8. Is a partial cleanup being considered?

A. At the present time, GPU Nuclear is not considering a partial cleanup, although NRC did consider partial cleanup options, as noted in the following answer.

Q.9. What are the alternatives to a full-scale cleanup?

A. The five alternatives that follow were evaluated in the Programmatic Environmental Impact Statement published in 1981:

1. Full cleanup -- remove damaged fuel and salvage and clean usable equipment
2. Full cleanup -- remove damaged fuel and equipment that is not contaminated or only slightly contaminated
3. Partial cleanup -- remove the damaged fuel from the reactor
4. Partial cleanup -- do not remove the fuel from the reactor
5. Do nothing -- maintain reactor safely shutdown

Only full-scale cleanup alternatives are currently being considered.

Q.10. Has the public been involved in decisions about the cleanup?

A. Yes. The public has been involved in the following ways:

- By commenting on the Programmatic Environmental Impact Statement for the cleanup
- By participating in public meetings about cleanup issues
- By having the opportunity to attend and address all meetings of the TMI-2 Advisory Panel

The TMI-2 Advisory Panel serves in an advisory capacity to the NRC Commissioners. It is made up of citizens and local officials from the TMI area and of scientists knowledgeable in nuclear matters.

The public also has access to NRC staff members at the NRC office at 100 Brown St., Middletown, Pennsylvania--phone (717) 948-1150.

Q.11. Will opportunities for public participation continue?

A. Yes.

Q.12. Have public comments and concerns influenced cleanup decisions?

A. Yes. Direct public involvement has influenced several key issues. For example:

- The Commission lifted a restriction barring offsite shipment of waste filters used in decontaminating accident water. The go-ahead to ship these wastes off the island came as the result of a direct request from the TMI-2 Advisory Panel.

- The Commission put off its decision for disposition of processed accident water until a wide range of disposal options are examined with care. (For more information, see the answers to Questions 31 through 39.)

- The Environmental Protection Agency continues to coordinate monitoring activities around Three Mile Island.

- The Department of Energy and the Commonwealth of Pennsylvania set up a program for direct public participation in radiation monitoring when krypton was purged in 1980.

Q.13. What is NRC's role in the cleanup?

A. NRC has overall regulatory responsibility for all cleanup activities. The agency's primary objectives are to maintain the facility safely shutdown, and to ensure that cleanup operations are conducted in a way that protects the safety and health of the public and the work-force. To accomplish this objective, NRC:

- oversees actual cleanup operations to ensure that they comply with approved actions, technical specifications, and NRC orders,
- reviews cleanup alternatives for safety and environmental impacts,

- reviews and makes decisions on GPU Nuclear proposals for cleanup alternatives,
- approves the step-by-step procedures that GPU Nuclear uses for each major cleanup operation,
- coordinates NRC's TMI-2 cleanup activities with other governmental agencies as necessary, and
- informs State and local governments and the public on the status and plans for cleanup activities.

To perform these functions, NRC organized the Three Mile Island Program Office (TMIPO), whose 21 full-time and two part-time staff members are assigned at TMI and at NRC headquarters. The staff has management and technical expertise in key TMI-2 cleanup activities, such as radiation protection, radiological assessment, radioactive waste treatment, and nuclear safety. The TMIPO staff receives support from NRC experts in other areas, such as meteorology and hydrology. Contractors and consultants from the National Laboratories provide additional technical assistance when the staff considers this assistance necessary. The Three Mile Island Program Office also receives valuable technical and legal advice from other offices within NRC.

Q.14. How does NRC's role in the cleanup compare with its role at other nuclear power plants?

A. The oversight effort at Three Mile Island is much greater than at normally operating plants. For example, NRC stations one or two full-time inspectors at each operating nuclear power plant around the country. At TMI-2, NRC has 14 full-time people at the site, with another 7 people dedicated to TMI activities at NRC headquarters.

Q.15. Has NRC's role changed any during the course of the cleanup?

A. No.

Q.16. Has NRC rejected any of GPU Nuclear's cleanup procedures?

A. Yes. NRC has rejected approximately 10% of the procedures reviewed and has required GPU Nuclear officials to modify or further clarify them before approval.

Q.17. Does NRC consider the costs of the activities it oversees?

A. No. NRC evaluates each proposal on the merits of its safety and health considerations.

II. DECONTAMINATING RADIOACTIVE WATER

Q.18. What is the status of the one million gallons of highly radioactive water spilled in the reactor and other buildings during the accident?

A. All this water has been processed to remove radioactive contamination and is being stored on the island. Portions of this water have been and will continue to be used to clean areas in the reactor and auxiliary buildings. Of course, water used in the cleanup becomes recontaminated and must be reprocessed before further use. (See the answer to Question 22 for an explanation of how contaminated water is processed.)

Q.19. Does any radioactivity remain in the water after it has been processed?

A. Yes. Trace amounts of cesium and strontium remain, but at levels far too low to be harmful to anyone. The water also contains low concentrations of tritium, a radioactive form of hydrogen.

(See the answer to Questions 29 and 30 for more information about tritium.)

Q.20. Does any water remain in the reactor building basement?

A. Yes. Workers have left a few inches of water to cover the sludge on the basement floor. If the sludge dried, it could become a source of airborne contamination in the building.

Q.21. Could any of this water leak to the outside of the reactor building?

A. The chances of such a leak are extremely remote. The reactor building is made of reinforced concrete several feet thick, the entire inside of which is lined with a 3/8-inch-thick steel liner. (See the drawing on page 8.)

As a precaution, monitoring wells have been drilled around the outside of the building and are periodically sampled to provide early detection of any leaks. Leaks would be detected long before any radioactivity reached the Susquehanna River. To date, monitoring has detected no leaks.

Q.22. How is the contaminated water cleaned?

A. The water is processed by an ion-exchange method that uses a chemical filter to trap charged chemical particles. This process is based on the principle that many chemical compounds, when put into water, break up into two parts, called ions. One part carries a negative electric charge, the other a positive electric charge. For example, salt (sodium chloride) in water breaks up into a sodium (positive) ion and a chloride (negative) ion. The designers of filters can take advantage of this phenomenon by using one filter material that attracts positive ions and another that attracts negative ions. Passing salt water through such filters would remove the salt from the water.

Similarly, radioactive materials in water that carry electric charges can be removed from the water by filtering it through such filters, commonly called ion-exchange resin filters. (A home water softner is an ion-exchange resin system.)

As the water moves through the filter (or resin) it leaves the charged particles behind, and because these charged particles are the source of radiation, the radioactivity, or a good part of it, is also left behind. The more resin filters the water runs through, the fewer charged particles (or radioactive particles) remain in the final volume of processed water. The resins become more and more radioactive as they pick up more particles, and eventually are spent and must be replaced.

Q.23. What becomes of these contaminated filters?

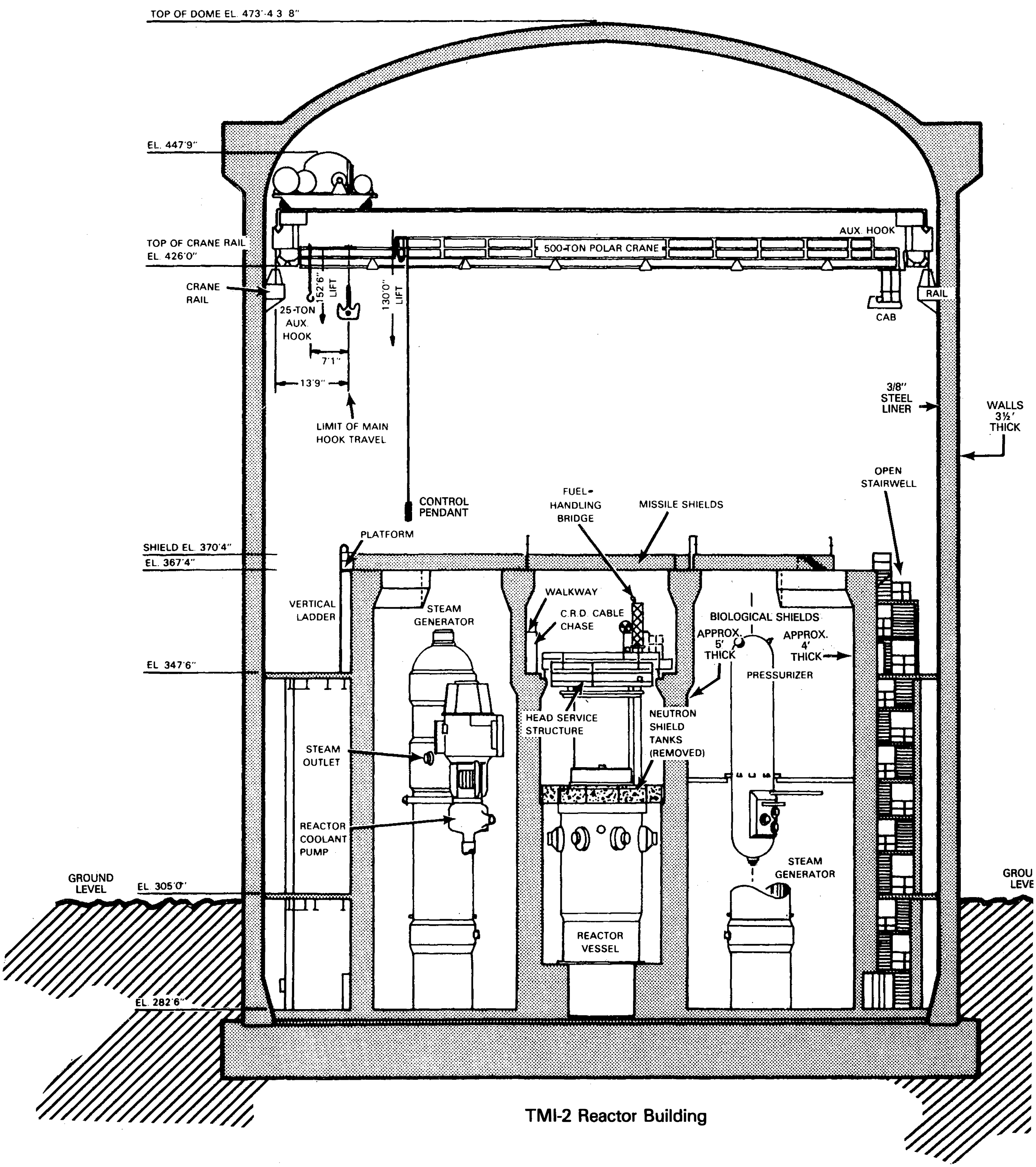
A. All are shipped off Three Mile Island, some to a commercial waste repository in Richland, Washington, and some to Department of Energy facilities for research analysis.

Q.24. Has any of this processed accident-water been released to the Susquehanna River?

A. No.

Q.25. How is the water being stored at Three Mile Island?

A. The water is being stored in a number of tanks in the plant and in two new 500,000-gallon tanks built especially for storing processed water from the accident.



TMI-2 Reactor Building

Q.26. How much more water can be stored in the tanks currently available?

A. Available storage capacity, in gallons, is as follows:

2	Processed water storage tanks	-	1,000,000
1	Borated water storage tank	-	460,000
3	Reactor coolant bleed tanks	-	232,000
1	Condensate tank	-	250,000
2	Spent fuel pools	-	690,000
2	Chemical cleaning tanks	-	219,000
			2,851,000 gallons of capacity

At the present time, the available storage reserve totals approximately 750,000 gallons.

Q.27. How would anyone know whether this water was leaking from storage tanks or from pipes leading to the tanks?

A. All tanks and pipes are visually inspected routinely. Tank capacity is also measured on gauges that are checked routinely. In addition, when water is transferred, volumes before and after the transfer are checked for possible spillage. Finally, monitoring wells drilled around TMI for detecting leaks are checked routinely.

Q.28. What would happen if storage capacity was reached?

A. This won't happen because of the additional storage capacity noted in the answer to Question 26. Moreover, not only has there been no increase in the amount of accident water, but some of the accident water is continually recycled for use in the cleanup. As a result, storage capacity is abundant.

Q.29. How long can the water be stored at Three Mile Island?

A. The water will be stored onsite until a final disposition option for this water is chosen. The radiation from tritium, the principal source of contamination in the water, does not penetrate tank walls, so onsite storage does not pose a health threat either to workers or the public.

Q.30. Can unfilterable sources of radioactivity be removed from the water?

A. The principal source of contamination, tritium, cannot be removed from water by conventional methods, either physically (through filters that trap particles), or chemically (through the ion-exchange process explained in Question 22).

Tritium is a radioactive form of hydrogen, which is why it so easily combines with oxygen to form water. In water, tritium is practically indistinguishable from regular hydrogen. The physical and chemical techniques used to remove other radioactive materials cannot distinguish between a tritium and a non-tritium water molecule.

Tritium has a half-life of approximately 12 years, which means that one-half the original amount undergoes continuous radioactive decay to a nonradioactive form of hydrogen in 12 years. Reducing undiluted tritium concentrations by radioactive decay to levels prescribed by EPA drinking water regulations would require that the water be stored for over 150 years.

Q.31. What will happen to this water eventually?

A. When GPU Nuclear submits a proposal for final disposition of this water, the NRC staff will evaluate it for health and safety considerations. Then the NRC Commissioners will make their decision on disposition of the accident water.

Q.32. What are the possible options?

A. The NRC staff has tentatively identified the following alternatives. Most can be accomplished by more than one method.

- Reuse at operating plants
- Long-term storage at Three Mile Island
- Treatment to remove tritium at Three Mile Island
- Controlled and monitored discharge to the Susquehanna River
- Ocean disposal
- Forced evaporation
- Pond evaporation
- Deep land disposal
- Near-surface land disposal
- High altitude disposal in the atmosphere

The decision about final disposition is at least several years away.

Q.33. Are present restrictions on releasing this water to the Susquehanna River going to expire?

A. No, not without a decision from the NRC Commissioners. The TMI-2 license prohibits any deliberate disposition of this water and the Commissioners, in a Statement of April 29, 1981, indicate that they, rather than the NRC staff, will make the decision about disposition of the water.

Q.34. If this water were released to the Susquehanna River, would drinking water taken from the river be harmful?

A. No. Even if releases of processed water are permitted, the water would be diluted and released at a carefully controlled rate so that levels of radioactivity in the river water would be below those permitted by EPA for drinking water.

Q.35. How will the Commission finally decide on a disposition option?

A. First, GPU Nuclear will propose to NRC its alternative for disposition of the remaining processed water. The NRC technical staff will review GPU Nuclear's alternative and other alternatives for their health, safety, and environmental impacts. The NRC staff will ask for comments from the public, interested groups, and local, State, and other Federal officials. After carefully considering this body of information, the staff will make a recommendation to the Commission, and the Commission will either approve or not approve GPU's proposal.

Q.36 Does the Susquehanna River continue to be safe for recreational activities, like boating, fishing, swimming, and use of island cottages, during the cleanup?

A. Yes.

Q.37. Is water from the Susquehanna routinely monitored for radioactivity?

A. Yes. In addition to water monitoring done by GPU Nuclear, the Environmental Protection Agency and the Pennsylvania Department of Environmental Resources jointly monitor water at City Island near Harrisburg, at the Lancaster Water Works, and at two locations on TMI. The EPA also monitors samples from five wells located on the east and west shores of the Susquehanna across from Three Mile Island.

Q.38. Have above-normal levels ever been recorded?

A. No. All releases of water from Three Mile Island, Unit 2 have been well within the guidelines in both NRC and Environmental Protection Agency regulations for radioactive materials. It should be noted that water generated by the accident has not been released.

Q.39. What kind of water continues to be released to the river?

A. Industrial waste water of the kind generated by any industrial facility of similar size and complexity. The water comes from laundry and shower facilities, from rain water in sumps, from plant drains, and from similar sources. All such water is sampled and analyzed for radioactivity levels and other possible contamination, and the results of these analyses are reported to NRC staff members on site. Any water exceeding the maximum permissible radioactivity concentrations in NRC regulations, or other pollution limits in the EPA's National Pollutant Discharge Elimination System Permits, must be diluted to below these levels before release to the river is authorized.

III. DECONTAMINATING THE REACTOR AND AUXILIARY BUILDINGS

Q.40. What are the major sources of contamination inside the reactor and auxiliary buildings?

A. In the reactor building, the major sources are the damaged fuel in the reactor vessel, the contamination on surfaces in the reactor building, and the water and other contamination in the reactor coolant system. In the auxiliary building, 80% of which has been decontaminated, a number of work cubicles remain highly contaminated.

Q.41. Do those sources pose a threat to workers and the public?

A. For workers, yes. For the public, virtually none.

(See the answers to Questions 137 through 146 for up-to-date information on worker exposures.)

Q.42. What areas in the reactor building have been decontaminated?

A. Except for the basement, an attempt has been made to decontaminate almost all areas of the building.

Q.43. What types of cleaning and decontamination techniques are being used?

A. Contaminated surfaces are being decontaminated by mechanical and, to a lesser extent, chemical methods.

Some mechanical methods are similar to those used in house cleaning: brushing, scrubbing, wiping, and wet or dry vacuuming. More complex methods include high-pressure water sprays, sandblasting, and ultrasonic removal.

Chemical decontamination involves the use of solvents in specific areas to dissolve or suspend radioactive materials.

Q.44. Can radiation inside the reactor building pass through the walls to the outside environment?

A. No, for all practical purposes. Radiation is reduced in intensity as it passes through heavy materials. (This is why you get a good image or "shadow" of dense tissues, like bone, on an X-ray film, but less dense tissues, like the heart, do not show up well.) One of the strongest sources of radiation at TMI-2 is the basement area, which is below ground level. This area is shielded not only by the building itself, which is made of reinforced concrete several feet thick, but also by the ground. In addition, the inside of the entire building is lined with a 3/8-inch-thick steel liner. Of course the biggest source of radiation in the reactor building is the damaged fuel in the reactor vessel. Multiple layers of protection shield this source from the outside environment--the 8½-inch-thick steel walls of the reactor vessel, an inner and outer wall (called the biological shield) between the vessel and the rest of the building, and finally the walls of the reactor building itself. The biological shield and reactor building dimensions are shown in the drawing on page 8.

Radioactive materials inside the upper part of the building do result in infinitesimally low levels of radiation passing through the approximately 3-1/2 feet of concrete and steel that form the reactor dome. As an example, cesium-137 gives a dose rate of 100 millirem per hour inside the dome, but this rate is reduced at least <u>10,000 times</u> to 1/100 of a millirem per hour on the outside surface of the dome. This level of radiation would be virtually impossible to measure at the plant property boundary.

Q.45. Have radioactive materials contaminated the 3/8-inch-thick steel liner inside the reactor building?

A. Yes. The surface of the liner is contaminated in some places, especially at the lower elevations inside the building. There's no indication that contamination has penetrated the liner itself.

Q.46. Will this contamination be difficult to remove from the steel liner?

A. No. The liner is one of the easier surfaces to decontaminate. It has a painted surface, which workers will strip off. They do not expect to find much contamination beneath the paint.

Q.47. Has radioactive contamination penetrated concrete surfaces inside the reactor building?

A. Yes. Unpainted concrete surfaces on internal walls within the building are highly contaminated since concrete is a semiporous material.

Q.48. How far can contamination penetrate unpainted concrete surfaces?

A. Samples of concrete from structures in the upper areas inside the reactor building are still being taken and analyzed, but workers expect contamination may have penetrated only the first few tenths of an inch. For concrete that was underwater, workers expect that contamination may have penetrated up to a few inches.

Q.49. What methods can be used to remove contamination from unpainted concrete surfaces?

A. The most effective methods are those that chip away the surface of the concrete, a process called scabbling. Machines that do this have been used successfully to clean concrete surfaces in the auxiliary building.

Q.50. Does sandblasting surfaces release contaminated particles into the atmosphere inside the reactor building?

A. Dry sandblasting is not used for decontamination without a vacuum attachment to collect particles that would otherwise spread contamination. This so-called vacuum blasting has been used only to a limited degree.

Q.51. Can these surfaces be washed down to remove contamination?

A. Yes. Various wet-blasting techniques, called hydrolasers, have been used successfully where contamination is not too deep. Water blasting involves the controlled use of water under high pressure -- up to 6,000 pounds per square inch.

Q.52. Can these contaminated particles escape to the outside environment?

A. No. Not only are particles from sandblasting collected by the vacuums, but these buildings have ventilation systems with highly efficient filters that trap 99.97% of the particles before they can escape to the environment.

(See the answer to Question 44 about reactor building integrity.)

Q.53. Have conditions in the reactor building since the accident lowered the building's capacity to prevent radiation from escaping to the outside?

A. No. The building materials at Three Mile Island and other reactors were selected, designed, and fabricated to be resistant to radiation. Normal physical processes, such as rust caused by high humidity, and degradation caused by caustic materials, may over an extended period of time weaken the capability of certain systems in the reactor building to contain the accident-generated material. This is one incentive to decontaminate the building; it should not be left indefinitely in its present condition, unless this issue is thoroughly evaluated. GPU Nuclear conducts a continuous monitoring program to confirm the building's continuing capacity to contain radioactivity.

Q.54. Has GPU Nuclear modified the reactor building since the accident to prevent radioactive material from escaping?

A. The reactor building has not been modified for the reasons listed in Questions 44 and 53. During the accident, significant amounts of radioactive materials did <u>not</u> escape directly from the reactor building. The building performed the "containment" functions it was designed to perform and it continues to do so. The radioactivity that escaped during the accident did so through the auxiliary and fuel handling building.

Q.55. Does any radioactive material escape to the outside environment when workers enter and leave the reactor building?

A. Now that essentially all krypton gas has been vented from the reactor building and the building is continually ventilated to the outside through high-efficiency air filters, there is little loose radioactive contamination within the building, except for particulate material. Practically all particles are trapped by filters in the ventilation system and cannot reach the outside environment. Some contaminated particles, however, cling to the protective clothing that workers wear. These particles leave the reactor building on the clothing and are removed when the clothing is laundered in a special process for contaminated clothing. Virtually none of this material reaches the environment outside the building because of stringent controls on how this clothing is handled in the changing area where workers remove their protective garments.

Q.56. Are explosions possible during the cleanup?

A. There is virtually no possibility of an explosion. Of course, the potential always exists that a hose under high pressure could burst or that cleaning solvents could ignite and injure workers in the immediate vicinity. GPU Nuclear enforces a strict program to minimize such a possibility. Also, there has been concern about the possibility of a pyrophoric explosion.

Q.57. What are pyrophoric explosions?

A. Pyrophoric explosions result from the extremely rapid burning of very reactive metals. For example, metallic sodium undergoes pyrophoric burning (or explosion) if wet. Less-reactive metals, such as aluminum, magnesium, and zirconium, will undergo pyrophoric reactions if they are finely powdered and exposed to air.

Zirconium metal and oxide from tubes that surround the uranium fuel could undergo pyrophoric reactions if exposed to air, although these materials are now under water and will remain there throughout the cleanup. (Wet particles may undergo pyrophoric reactions when exposed to air, but such reactions do not take place under water.) Even so, this possibility was investigated. Tests were made on samples of reactive metals taken from the structures near the top of the reactor vessel. Based on the results of these investigations and tests, such explosions are considered highly unlikely. Nevertheless, workers will perform fuel removal tasks under water to avoid any chance of such reactions.

Q.58. Has cleanup work to date resulted in the development or use of new technology, such as robots?

A. Yes. As an example, a six-wheel-drive device on a tether several hundred feet long will be lowered into the highly radioactive basement of the reactor building early this summer. The robot will visually inspect the area by closed-circuit TV, scoop sludge samples from the basement floor, and measure radiation levels. Provided that it functions as designed, the device will be used later to decontaminate portions of the basement in the reactor building. Smaller robot devices have been used in other cleanup activities.

Q.59. Is funding available for this kind of research and development work and, if so, who pays?

A. The results of this research will be applicable to work beyond TMI-2. Because benefits from this research are broadly applicable, the work is funded by the Department of Energy's research and development program for TMI-2.

Q.60. Where is robotic research and development being conducted for work at Three Mile Island?

A. Although research is underway at a variety of institutions, the principal effort for Three Mile Island is being conducted at Carnegie-Mellon University in Pittsburgh and at Franklin Research Institute in Philadelphia.

IV. REMOVING FUEL FROM THE REACTOR

Q.61. Have detailed plans been made for removing fuel from the reactor vessel?

A. To the extent now possible, yes. Special equipment for fuel removal is currently being developed. Current plans are also subject to change depending on conditions that exist when the reactor vessel head and support structures are removed.

With the head removed, workers will be able to gather additional information on conditions inside the reactor vessel that will help in the design of tools used to remove the upper structure (the plenum) and the damaged fuel.

Q.62. What is the present schedule for fuel removal?

A. Fuel removal is tentatively scheduled to begin in 1986, although financial and technical considerations could affect the present schedule. Once begun, fuel removal should take approximately one year to finish.

Q.63. What is the current status of the crane that will be used to lift the reactor head?

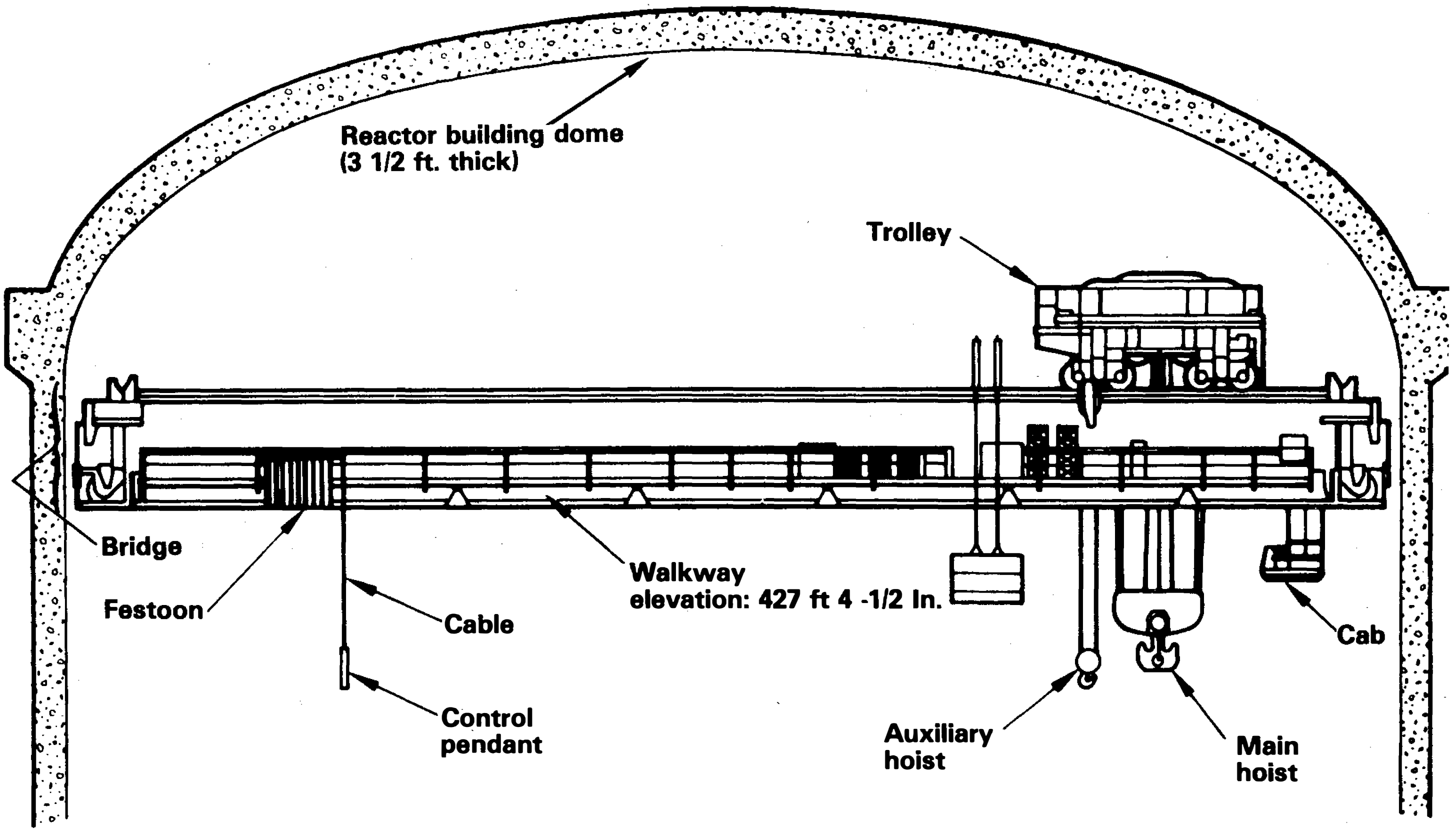
A. The crane has been refurbished and was tested and qualified (subject to NRC approval of the test results) in March 1984 for future use in the cleanup.

(For a drawing of the crane, see page 20.)

Q.64. Why was refurbishing and requalifying the crane important?

A. Without the crane in working order, the cleanup cannot go forward. The crane will lift and move to a storage stand the reactor vessel head and take out internal structures from the vessel before the fuel can be removed.

Prior to refurbishment, the crane was not in working order because of the damage it sustained during the accident as a result of the high temperatures and humidity in the reactor building. Parts of the crane were also badly corroded because of high humidity in the building since the accident.



POLAR (OVERHEAD) CRANE

Source: Adapted from drawing by EG&G Idaho, Inc.

Q.65. Who did the actual refurbishment work?

A. Working under contract to GPU Nuclear, the Bechtel Corporation did the work in conjunction with experts from the U.S. Crane Certification Bureau, Whiting Corporation (the crane manufacturer), and United Engineers and Constructors.

Q.66. What was NRC's role in refurbishing the crane?

A. After GPU Nuclear sent NRC its proposal for refurbishing the crane, NRC gathered a team with the pertinent expertise to comment on the proposal. The team included structural, electrical, and mechanical engineers, and radiation specialists. Each team member reviewed and commented on or raised questions about their areas of expertise in the refurbishment proposal. These comments and questions were then sent to GPU Nuclear. Some issues were resolved quickly, while others required numerous exchanges until issues were resolved to NRC's satisfaction. (NRC evaluates these and other such proposals and approves them only when they conform with published industry-wide codes and standards.)

The same review procedures were used in evaluating the crane for performance tests and will be used again for actual operation. The staff also evaluated possible accidents during crane operations, what their consequences could be, and how best to cope with them.

Q.67. Was the test successful?

A. Yes, although the NRC staff must review all test results before approving the crane for the head lift.

Q.68. How was the load test conducted?

A. The crane first lifted a six-ton object; then the series of weights was gradually increased until the crane lifted 40-ton objects. Because the crane performed properly, the load was increased to 212 tons in a single lift. After completing various maneuvers with this load to test all parts of the crane, the crane was qualified to lift 170 tons. Since the reactor vessel head weighs 163 tons, testing more than adequately qualified the crane for lifting the head and moving it to a stand for storage. (The reactor vessel head is shown in the drawing on page 27.)

Q.69. How much do the reactor vessel head and other components weigh?

A. As noted in the previous answer, the reactor head weighs 163 tons. The internal structure (called the plenum) weighs 55 tons.

(The plenum is shown in the reactor vessel drawing on page 27.)

Q.70. How much was the crane designed to lift?

A. The crane has an original design capacity of 500 tons.

Q.71. Will the underside of the vessel head be contaminated with radioactive material?

A. Yes. During head lift, however, a special plastic covering may be placed on the underside of the head if required to prevent the spread of contamination.

Q.72. Has sampling been done to measure radiation levels under the vessel head?

A. Yes. Radiation detection devices provide detailed readings (in rads per hour) from the top of the reactor vessel head through the upper plenum to the top of the fuel rubble. In addition, samples of reactor coolant water are taken regularly to measure the types and amounts of radioactive materials in the fuel. There is also an ongoing program to sample the fuel rubble in the core.

Q.73. What are current radiation levels under the head?

A. Radiation levels below the reactor vessel head are about 200 to 1,000 rads per hour. Remember that these are radiation levels inside the reactor vessel. They do not represent readings in areas where workers will be positioned to remove the head and fuel. These tasks will be performed in areas with considerably lower radiation levels.

Q.74. How will workers be protected from radiation when they remove the head?

A. When the head is removed, the fuel will be under at least 10 feet of water, which will shield the workers. Also, workers will be using remote-control machinery, which will permit them to control operations in a shielded area 45 feet above the open reactor vessel. Of course, workers will be wearing protective clothing.

Once the head is removed, it will be stored on a special stand and the underside, which will be a source of radiation, will be shielded from workers with special shielding materials. The underside may also be enclosed by a special plastic cover

Q.75. Would flooding the area around the reactor vessel reduce exposures to the workers during the head lift?

A. Flooding the area around the reactor vessel could potentially reduce worker exposures. However, flooding this area would require several time-consuming modifications. As one example, a high-volume water decontamination system would have to be installed to prevent the flood water from itself becoming a major source of radiation. Even with extensive modifications, the potential reduction in worker exposure would be too small to justify flooding the area.

Q.76. After the head is removed, will any modifications be made to further protect workers?

A. Yes. A cylinder will be added to allow the upper portion of the reactor vessel to be flooded. Also, portable shields will be positioned to reduce radiation as conditions warrant.

Q.77. Will there be any danger to the public when the head is removed?

A. No.

Q.78. Could there be any releases of radioactivity to the environment?

A. No. In case of a leak or other abnormal occurrence, the reactor building can be sealed to trap any release of radioactive material. Sealing the building would keep this radioactivity away from the environment and the public.

The building has a filtered exhaust system made up of two series of special filters that prevent 99.97% or more of airborne particulate radioactivity from leaving the building. In addition to these filters, the building is designed to shut down ventilation to the outside automatically when preset radiation limits are reached within the ventilation system.

(Also, see the answer to Question 44 about whether radiation can penetrate the walls of the reactor building.)

Q.79. Will any special environmental monitoring be conducted during the head lift?

A. The Environmental Protection Agency will be sampling prior to the head lift to better characterize their readings of background radiation levels. They will also conduct continuous monitoring when the fuel is removed. The results of this sampling, like all monitoring results, will be made available to the public. (See the answer to Question 148 on public availability of monitoring results).

In addition to this monitoring, NRC will ensure that workers onsite closely monitor all potential pathways for radioactive releases to the environment.

Q.80. Will the damaged fuel be exposed to air while it's being removed from the reactor vessel?

A. No. The fuel will be kept under water at all times to shield the workers from radiation. The canisters into which the fuel will be placed will also be kept under water, not only while they are filled, but continuously until they are placed in shielded, crash-resistent casks for shipment.

Q.81. How will the public be protected from possible exposure when the reactor head is removed?

A. The answer to Question 78 describes how the reactor building's high-efficiency filters prevent airborne particles from reaching the outside environment. Also, as noted in Question 74, the fuel will be under at least 10 feet of water throughout fuel removal operations.

Q.82. What's the condition of the fuel?

A. A remote-control television inspection of the core reveals that no more than 42 of the 177 fuel assemblies may have full-length fuel rods remaining. The bottom of the vessel is covered with a bed of fuel rubble.

Q.83. Given this condition, how will the fuel be removed?

A. The technology for removing damaged fuel and core components is available and a variety of methods for removing the fuel are under consideration. Lessons learned from defueling reactors with damaged fuel point to the need for detailed planning and the use of mockups for training to reduce radiation doses to workers. When the reactor vessel head is removed, equipment and procedures now being developed will be used to safely remove the damaged fuel and components.

Q.84. How will workers remove crumbled or particle-sized fuel?

A. Fuel in this condition will be removed with suction and scooping apparatus.

Q.85. Could the fuel undergo a chain reaction during fuel removal?

A. The potential for such a reaction, called "recriticality," will be offset by workers ensuring that water covering the damaged fuel contains adequate concentrations of boron in solution to prevent a chain reaction from beginning. In addition, the core will be monitored continually and standby controls are available to ensure that recriticality does not occur.

(Boron is added to the water because it absorbs the neutrons--atomic particles--necessary for the uranium fuel to sustain a chain reaction.)

Q.86. What will happen to the fuel when all of it is removed?

A. All fuel assemblies and pieces of fuel will be packaged and sealed in special spent-fuel canisters and stored underwater in storage racks in the spent-fuel pool. They will then be transferred via a shielded transporter to a specially designed fuel-shipping cask and shipped to a Department of Energy facility in Idaho.

(A fuel assembly is a bundle of tubes -- fuel elements -- containing the nuclear fuel. Each assembly is 8½ inches square and 170 inches long. There are 177 of these assemblies in the reactor core of TMI-2, most of which are probably damaged.)

For a cutaway drawing showing the likely extent of fuel damage, see page 27. This drawing is based on sonar mapping of the core done by the topography measuring tool shown.

Q.87. Is there any concern that fuel could escape through a damaged or deteriorated base at the bottom of the reactor vessel?

A. Deterioration of the bottom to that degree is unlikely. Although the damaged fuel generated high temperatures and radiation levels during the accident, the bottom of the steel reactor vessel, which is 9 inches thick, was covered with water at all times. Even at the upper portions of the vessel where water boiled off during the accident, investigators have observed very little damage to the vessel walls.

Workers plan to visually inspect the vessel bottom with closed-circuit TV when the vessel head is removed and prior to removing the fuel. Should this inspection reveal deterioration, workers will modify fuel removal techniques to ensure that no leakage occurs.

Q.88. If fuel leaked from the base, could it be recovered?

A. Yes, but a leak would made the cleanup more complicated.

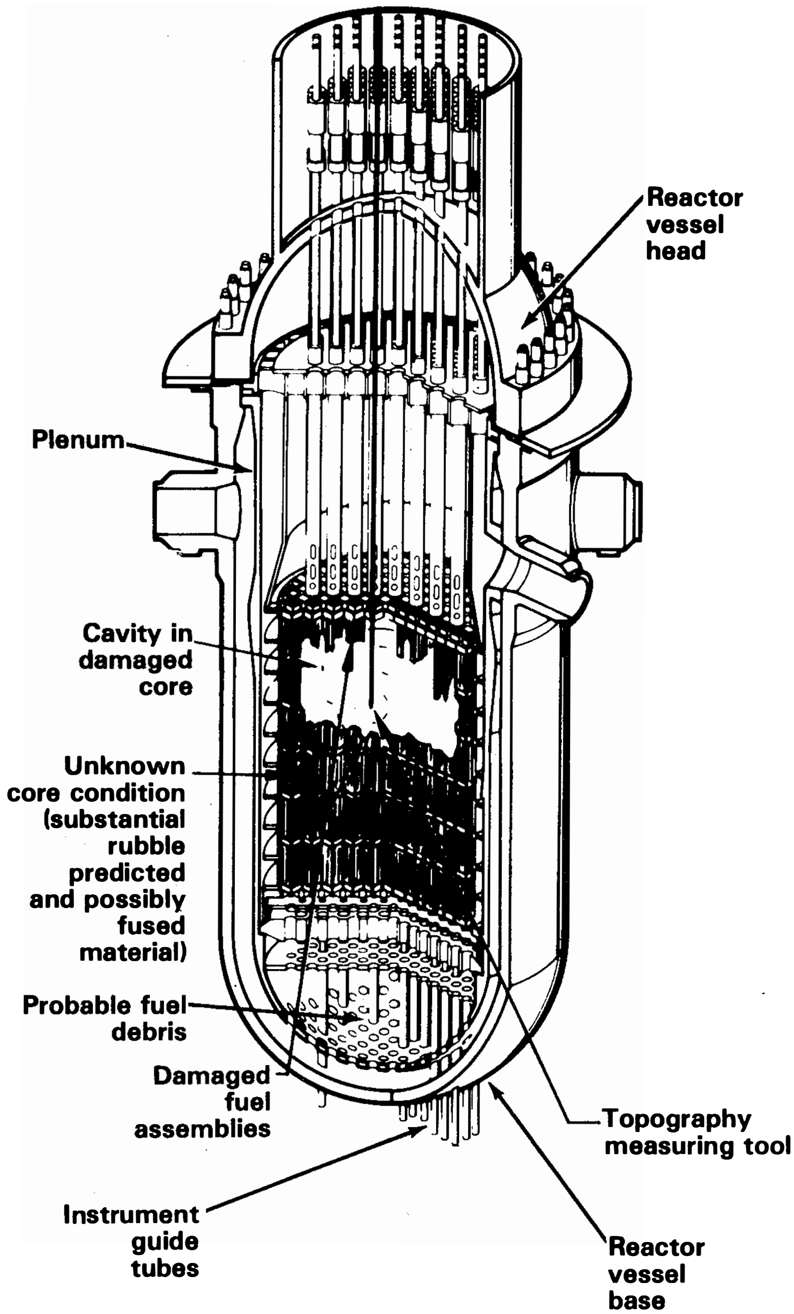
Any leakage, though unlikely, would probably occur through a broken instrument guide tube at the bottom of the reactor vessel. (These tubes are shown in the drawing on page 27.) These guide tubes, through which monitoring instruments are inserted, are not large enough in diameter to allow anything but fine particles of fuel and water to pass through. After some leakage, the opening would probably clog, preventing any further loss. Any fuel and water that leaked would be sealed in the reactor building and could be vacuumed up for disposal.

Q.89. Would any danger be posed if the fuel leaked from the base and could not be recovered?

A. Not much. The high concentrations of boron in any water that leaked would prevent criticality in any fuel that leaked. In addition, any fuel that leaked would be isolated from the environment in the same way that highly radioactive water from the accident was isolated from the environment until all of it was processed and removed from the basement. Like water, the fuel would then be removed.

Q.90. If a large-scale release occurred, would the public be adequately protected?

A. Yes. The means for protecting the public and the environment are detailed in the answer to Question 78.



REACTOR VESSEL SHOWING DAMAGED FUEL AND CAVITY

Source: Adapted from drawing by EG&G Idaho, Inc.

V. PACKAGING AND TRANSPORTING RADIOACTIVE WASTES

Q.91. What are radioactive wastes?

A. Any material -- solid, liquid, semisolid, gas -- that is contaminated with radioactivity

Q.92. What kinds of radioactive wastes did the accident produce?

A.
- liquids,
- gases,
- sludge (a mixture of solids that settle from suspension in water),
- spent-fuel assemblies and debris, and
- contaminated equipment (tools, pumps, electric motors, etc.) and concrete building surfaces.

Q.93. What kinds of wastes has the cleanup produced?

A.
- contaminated water,
- chemical decontamination solutions,
- contaminated equipment,
- contaminated trash and rubbish.
- contaminated filters and ion-exchange resins

Q.94. What does "waste disposal" mean as it pertains to radioactive materials?

A. Waste disposal refers to the process by which radioactive materials not intended for further use are put in a permanent waste disposal site.

Waste disposal should not be confused with the storage of used nuclear materials. When radioactive materials are stored, they are put aside in a retrievable form for future processing or later disposition. Materials disposed of are not intended to be retrievable.

Q.95. Can radioactive wastes be disposed of as is or do they have to be processed in some way before disposal?

A. For solid wastes, the processing alternative chosen would depend on the physical form of the waste material. Trash is reduced in volume for packaging by special compacting machinery. Contaminated equipment and hardware are taken apart for easier packaging.

Processing radioactive liquids produces contaminated filters, contaminated resins, and sludge. Sludges are solidified. Filters that physically trap particles are packaged for disposal. Resins have the water pumped or drained from them before they are shipped offsite in shielded containers for disposal.

Q.96. How are solid radioactive wastes currently disposed of?

A. At present, solid wastes with low concentrations of radioactivity are routinely shipped to the commercial low-level waste disposal facility at Richland, Washington.

Abnormal wastes from TMI-2, which are more radioactive than materials from normally operating reactors, along with the entire damaged core, are being shipped to Department of Energy facilities either for research or for storage.

Ultimate waste disposal sites for radioactive materials with high concentrations of radioactivity are still under consideration by the Federal government.

Q.97. Will some solid wastes continue to be held at Three Mile Island?

A. Except for processed accident water, all wastes will be sent either to low-level waste sites or to Department of Energy facilities. Some materials are stored onsite temporarily as they await shipment.

Q.98. How are wastes packaged before temporary storage or shipment for disposal?

A. Materials with very low concentrations of radioactivity (such as clothing, tools, and trash) do not need shielding and are held in special 55-gallon drums or steel boxes. The drums and boxes are transferred manually to special holding facilities at Three Mile Island to await shipment.

Materials with high concentrations of radioactivity, such as used filters, resins, and sludges, are packaged in steel containers or specially designed canisters. Damaged fuel and fuel debris will be packaged and held under water in the spent-fuel pool until offsite shipments are completed. The water shields the radiation by acting as a barrier that reduces the intensity of radiation.

Q.99. Is the interim waste-storage facility at Three Mile Island constructed to prevent radiation leaks?

A. Yes. The facility, built specifically for interim storage of highly radioactive wastes, is composed of reinforced-concrete bunkers, which are divided into cells. Each cell consists of a galvanized, corrugated steel cylinder with welded steel base plates, surrounded by concrete. Each cell's interior surface is painted with a removable coating which would facilitate decontamination, if necessary. The facility, designed to protect stored materials from freezing, also has a sump area to collect and monitor any liquid leakage.

Q.100. Is this storage facility designed to withstand Susquehanna River floods?

A. Yes. The facility, located south of the Unit 2 cooling towers, is protected by a flood dike. The dike will withstand a river flow of 1.1 million cubic feet per second, a flow rate greater than any recorded or anticipated for the Susquehanna River. The 1972 tropical storm Agnes, for example, resulted in a flood volume of one million cubic feet per second.

Q.101. Will damaged fuel from the core be stored on the island?

A. The fuel will be kept on site only temporarily until sufficient quantities are accumulated to fill available shipping casks. Then it will be shipped offsite.

Q.102. Why can't radioactive wastes be stored permanently at Three Mile Island?

A. This site is not considered suitable as a permanent waste repository because of its location in the river and because of the large surrounding population.

Q.103. Are wastes continuing to be shipped off the island only by truck?

A. Yes. NRC still inspects all truck shipments of abnormal wastes before they leave the site.

Q.104 How many waste shipments have been made?

A. As of December 1983, 240 shipments have been made.

Q.105. What's the destination of these wastes?

A. Most materials are shipped to the commercial low-level waste burial facility at Richland, Washington.

Wastes with higher levels of radioactivity are shipped to Department of Energy facilities in Idaho and in Richand, Washington.

Q.106. What route do truck shipments take through the Middletown-Harrisburg area?

A. Currently the trucks go north from Three Mile Island on Pennsylvania Route 441 to Middletown, northwest on Ann Street to Airport Drive, north to I-283, west to I-83, north to I-81, northeast and north to I-80, then west on I-80.

Q.107. Are there any time-of-day restrictions for shipments leaving the site?

A. No. However, shipments almost always leave the site during the day shift, following NRC inspection and approval.

Q.108. Does NRC still regulate these shipments in conjunction with the Department of Transportation?

A. Yes. NRC has basic responsibility for regulating the packaging of nuclear materials so the radiation is adequately controlled.

The Department of Transportation has basic responsibility for all facets of transportation, such as truck safety, schedules, and other rules governing materials in transit, whether shipments are made by GPU Nuclear or the Department of Energy.

Q.109. What are NRC requirements for packaging nuclear wastes?

A. The regulations require that when radioactive materials are transported, they must be packaged (1) so that radiation emitted by the material is properly shielded, (2) so that heat generated by the material has a proper outlet, (3) so that the material does not begin to undergo a chain reaction, and (4) so that the radioactive materials are protected should certain accidents occur. The regulations also specifiy requirements for quality-assurance, testing, and record-keeping.

Q.110. Are appropriate state and local officials notified ahead of time about waste shipments made by GPU Nuclear?

A. Yes. Truck routes are clearly identified and all states along the way are notified prior to shipments by GPU Nuclear. In some states, Pennsylvania and Ohio, for example, the state police escort trucks through the state.

Q.111. How much radiation could members of the public be exposed to during routine truck shipments?

A. Three groups from the public could be exposed to extremely low levels of radiation from TMI waste shipments: people who live along the shipping route, people in other vehicles along the route, and bystanders near stopped trucks. Assuming maximum exposures, NRC estimates that people who live along a waste-shipment route could receive between 0.002 and 0.006 of a millirem; a person standing three feet from a loaded truck for three minutes could receive 1.3 millirem.

Naturally occurring background radiation in the U.S. ranges between 70 and 310 millirems per year, or many times higher than potential exposure from these shipments.

Q.112. What are the risks that an onlooker next to a stopped truck will develop fatal cancer or pass on genetic defects to offspring?

A. These risks are so small that they can only be estimated theoretically. The only way to assess the possible health risks to people exposed to radiation levels this low is to make statistical estimates based on health risks for radiation exposures at higher levels. These estimates, based on data in a 1980 report of the National Academy of Sciences, indicate that the probability that this exposure would cause death by cancer is approximately 1 in 6 million. This probability should be compared with public health statistics which indicate that 1,200,000 of every 6 million people in the U.S. will probably die of cancer from causes other than radiation from nuclear power plants.

The probability of genetic defects appearing in the offspring of exposed individuals is about 1 in 3 million. In the U.S. the natural occurrence of hereditary disease in offspring is about 180,000 in 3 million.

Q.113. What radiation dose do truckers receive who haul waste from Three Mile Island to waste disposal sites?

A. Truck drivers who haul radioactive waste are radiation workers and are subject to the same NRC dose limitations as other radiation workers. In addition, the U.S. Department of Transportation limits the dose rate in the driver's seat of any vehicle hauling radioactive material to 2 millirem per hour. For a trip of 2300 miles from Three Mile Island to Richland, Washington, the driver might spend up to 60 hours in the truck cab, thereby receiving a maximum of 120 millirem on the trip. The return trip most likely would not involve the transportation of radioactive material.

For an extreme case, consider a truck driver who spends 2000 hours per year driving, half of that hauling radioactive material, with the maximum allowable dose rate of 2 millirem per hour in the cab. The driver would receive at most 2,000 millirem (2 rem) per year, a dose well below the NRC guideline of 5 rem per year for radiation workers.

Q.114. What are the possible health risks to truck drivers hauling these wastes?

A. The risk to a truck driver receiving 2 rem per year for 9 years would be about a 1 in 420 chance of premature death from cancer.

Q.115. Are truck accidents likely to occur?

A. Accidents are possible. By using accident-rate statistics that assume unfavorable driving conditions, NRC estimates that one accident could occur every 250 shipments. However, because of precautions taken during these shipments, the likelihood of a serious accident is very low.

Q.116. Have any truck accidents occurred for any of the 240 shipments already made?

A. Drivers are required to report accidents that involve spillage or suspected radioactive contamination, in addition to accidents involving injury or death. No accidents of these kinds have occurred.

Q.117. Have there been any other significant problems during shipments?

A. No. During one shipment, however, as the driver pulled a short distance from a stop light, he realized that the trailer had become detached. He stopped, backed up, reattached the trailer, and finished the trip with no additional problems.

Q.118. Could radioactive materials escape to the environment in the event of a truck accident?

A. No releases are anticipated for most types of accidents that could occur. However, releases are possible. NRC calculated the consequences that might occur from a "worst-case" accident. In making calculations for a "worst-case" accident, NRC assumed that a container of radioactive materials ruptured and that a fire or explosion followed, releasing 1/100,000 of the contents to the atmosphere, where it could be inhaled. Such a small fraction would become vaporized and airborne, where it could be inhaled, because these wastes are shipped as solids.

Q.119. What are the possible health consequences to the public of this type of "worst-case" truck accident?

A. A person several hundred feet away would receive about 100 millirem of whole-body radiation. This dose should be compared with naturally occurring background radiation of about 116 millirem a year in the area around Three Mile Island.

VI. ENVIRONMENTAL IMPACT OF THE CLEANUP ON THE PUBLIC

Q.120. What is the maximum amount of radiation that people offsite could receive during the entire cleanup?

A. The maximum whole-body dose from atmospheric releases to any individual who lives near the site could be in the range of 0.8 to 2.3 millirem distributed over the entire cleanup period of eight to ten years. ("Whole-body" refers to radiation exposure in which the entire body rather than an isolated part--an arm or a leg--is exposed.) During that same period that person would receive about 930 to 1160 millirem from natural background radiation. (Natural background radiation in the Middletown area is approximately 116 millirem per year--about 36% from cosmic radiation, 39% from terrestrial radiation, and 24% from radioactive materials within our bodies.)

The total cumulative dose to 2.2 million persons within a 50-mile radius of TMI could range from between 10 and 30 person-rem. This is an insignificant amount compared to 2 to 2.5 million person-rem that will be received by the same population over the cleanup period of eight to ten years from naturally occurring background radiation.

(For a definition of person-rem, see the answer to Question 146.)

Q.121. What quantity of radioactive emissions is being released from Unit 2?

A. At present, small quantities of krypton gas are being vented from the reactor building at the rate of approximately 6 curies a month.

Q.122. What is the projected accumulated dose that could result from venting at the present rate for the duration of the cleanup?

A. The projected cumulative dose that a person standing at a point of maximum exposure offsite for the duration of the cleanup could receive is a skin dose of 0.05 of a millirem and a whole-body dose of 0.00005 of a millirem.

Q.123. Is there a carefully researched standard for accumulated dosage for workers and the public?

A. All such doses and their possible health effects are based on principles developed by internationally recognized authorities on the health effects of harmful radiation. The data used to predict health effects for cleanup workers are those recommended by the U.S. National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation; the United Nation's Scientific Committee of the Effects of Atomic Radiation; the National Council on Radiation Protection in the U.S.; and the International Commission on Radiological Protection.

Q.124. Will the amounts released be harmful to children or fetuses?

A. The amounts that could be released are not considered harmful to anyone. The calculations used to arrive at the possible adverse health effects take into account the fact that children and fetuses are more sensitive to radiation than adults.

Q.125. Will the amounts released be harmful to farm animals or pets?

A. No, and for the same reason given in the previous question. Furthermore, all scientific evidence to date indicates that farm animals and pets are less sensitive to doses of radiation than humans.

Q.126. Could the amounts released affect plants in the area that are eaten by animals and people?

A. All possible products in the human foodchain (drinking water, fish, meat, farm produce, milk, etc.) are considered in the dose calculations detailed in Question 127.

Q.127. What are chances of fatal cancer and genetic abnormalities occurring to a member of the public from cleanup activities?

A. For an individual offsite who receives the maximum expected whole-body dose of 2.3 millirem, the lifetime additional risk of fatal cancer (that is, the risk over the normal rate of fatal cancer) is about 17 in 10 million and the risk of genetic effects to offspring of the exposed individual is about 100 in 10 million. These risks are small compared with public health statistics which indicate that 2 million of every 10 million people in the United States will probably die of cancer (from causes other than radiation from nuclear power plants) and that the natural occurrence of hereditary disease in offspring is about 600,000 in 10 million.

Q.128. How does the NRC ensure that public health and safety are protected during the cleanup?

A. NRC vigorously carries out the oversight duties spelled out in the answer to Question 13. Independently of these activities, the Environmental Protection Agency and the Commonwealth of Pennsylvania monitor the area around Three Mile Island for radioactive releases.

Q.129. Is a large-scale release of radioactive material to the environment around Three Mile Island possible during cleanup?

A. The chance of such a release is extremely remote because of the precautions listed in the answer to Question 78.

Q.130. Would the public be protected if a large-scale release of radioactivity occurred in the reactor building?

A. Yes. See the answer to Question 78.

Q.131. Are offsite emergency plans adequate in case an emergency occurs?

A. Basically, these plans are adequate. However, based on emergency preparedness exercises conducted in August 1982 and November 1983, the Federal Emergency Management Agency (FEMA) found some deficiencies in the responses of Dauphin and Lancaster counties. FEMA informed the Commonwealth of Pennsylvania about those deficiencies and corrections are under way.

VII. SOCIAL AND ECONOMIC EFFECTS OF THE CLEANUP

Q.132. Could agriculture be adversely affected during the remainder of the cleanup?

A. If the cleanup proceeds as it has, the direct effect of decontamination activities on farmers should be nonexistent. However, an accidental radioactive release, whether or not it actually affected land areas, could result in a sustained period of consumer resistance to dairy products and produce from the area. The staff rates the probability of such releases as remote.

Also, see the answer to Question 125 about farm animals.

Q.133. Has the influx of cleanup workers affected the services and facilities of area local governments?

A. The maximum number of additional workers associated with the cleanup at any one time is in the range of 600 to 800, a number that varies with the kind of work under way. The NRC staff is not aware of any significant problems to local governments arising from the additional people associated with the cleanup effort.

Q.134. Has tourism in the area been adversely affected by the cleanup?

A. Actually, Three Mile Island has itself become a tourist attraction for people visiting the Gettysburg-Harrisburg-Hershey area. Approximately 350,000 people have visited the Visitor's Center or toured the site in the four and one-half years since the accident. Of course, an accidental release of radioactivity during cleanup could possibly cause tourism in the area to decline. However, there has been no such release and the chances of one are remote.

Q.135. Has the cleanup affected real estate values in the area?

A. A survey of real estate values conducted in 1981 found no relative change in property values attributable to the accident. NRC is unaware of any changes since that survey.

Q.136. Has the cleanup adversely affected recreational use of the Susquehanna River?

A. No. See the answers to Questions 34 and 36.

VIII. WORKER EXPOSURES AND SAFETY

Q.137. Has any new information come to light about worker exposure and possible health effects?

A. Yes. NRC has issued Supplement 1 to the Programmatic Environmental Impact Statement that updates information about worker exposures. In it, the NRC staff raises estmates of the collective radiation dose workers are likely to receive during the cleanup. The staff also reconsiders what these increased estimates could mean to worker health.

Q.138. What are the revised estimates of radiation doses workers could receive?

A. When the original estimates were made in March 1981, the radiation dose to the workforce was estimated to be between 2,000 and 8,000 person-rem. According to revised estimates, cleanup workers are likely to receive a total collective radiation dose of between 13,000 and 46,000 person-rem for the entire cleanup project.

(For an explanation of person-rem, see the answer to Question 146.)

Q.139. How could this increased dose range affect worker health?

A. Statistically, these increased dose estimates slightly raise the chances of cancer for the group as a whole. It is possible that this radiation dose could result in two to six fatal cancers in the worker population.

Q.140. Would nonfatal cancers also result from the level of radiation dose workers could receive?

A. Yes. Statistically, the number of nonfatal cancers could be approximately one and one-half to two times the number of fatal cancers, according to the best scientific estimates. That is, in addition to the possibility of fatal cancers, there could be 3 to 12 nonfatal cancers. (The basis for these estimates comes from a 1980 report of the National Academy of Sciences Advisory Committee on the Biological Effects of Ionizing Radiation.)

Q.141. Would there be other adverse health effects?

A. Yes. There could be from 3 to 12 genetic effects in the offspring of the workers. Should genetic effects occur, it is possible that they could occur in more than one generation of offspring.

Q.142. Do these new estimates mean that individual workers will be exposed to larger amounts of radiation than was previously thought?

A. No. NRC regulations strictly limit the amount of radiation that an individual worker can receive. These regulations have been and will continue to be strictly enforced.

The additional radiation estimated may be distributed among a larger number of workers, so that an individual worker will still receive no more than the regulations permit.

Q.143. How does the potential for fatal cancer to cleanup workers compare with risks of fatal cancer to the entire U.S. population?

A. The average member of the U.S. population has about a 1-in-5 chance of developing fatal cancer. That is, for every 10,000 people living in the U.S., approximately 2,000 will die of cancer. For a member of the cleanup workforce active in decontamination work over the course of the cleanup, the chances are about 1 in 4.9, based on statistical estimates.

Q.144. How do health risks to workers at TMI-2 compare with risks for other occupations?

A. The following table gives statistical estimates of the extent to which working in certain occupations shortens the life of a 40-year old person.

Reduced Lifespan in Days for Occupations Listed

Occupation	For 1 year of Working Life (Person Aged 40)
Deep-Sea Fishing	31.9
Coal Mining	3.6
Oil Refinery	2.6
Railways	2.2
Construction	2.1
Industry (Average Value)	0.5
Radiation Workers	
Exposure at 5 rems/year	1.3
Exposure at ½ rem/year	0.1

Source: New Scientist, Sept. 13, 1979.

Q.145. Where can I get more detailed information about recent estimates of worker exposure?

A. For detailed information about revised estimates for worker exposures, see draft Supplement 1 to the "Programmatic Environmental Impact Statement Related to Decontaminations and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident, Three Mile Island Nuclear Station, Unit 2" (NUREG-0683, Supp. 1).

For an easy-to-read version of the information in the Supplement, see "Answers to Questions about Updated Estimates of Occupational Radiation Doses at Three Mile Island, Unit 2" (NUREG-1060).

See the introduction to this question-answer report for information about where to obtain copies of NRC documents.

Q.146. What does person-rem mean?

A. Person-rem refers to the sum of individual radiation doses that may be received by members of a certain group. Person-rem is calculated by multiplying the average dose per person by the number of persons in a group. For example, 1000 people each exposed to 1 millirem of radiation would have a collective dose of 1000 millirem, which is 1 person-rem.

IX. RADIATION MONITORING OF THE ENVIRONMENT DURING THE CLEANUP

Q.147. Is radiation monitoring still being conducted offsite?

A. Yes. Monitoring is currently being conducted by NRC and the Environmental Protection Agency, by State agencies from Pennsylvania and Maryland, and by GPU Nuclear. Staff members from the Food and Drug Administration of the U.S. Public Health Service routinely review results of the milk and food surveillance program conducted by the Pennsylvania Department of Environmental Resources (DER).

In addition to monitoring done by the Commonwealth's DER, the Department of Natural Resources from the State of Maryland takes fish, vegetation, and sediment samples from the lower Susquehanna River and the upper Chesapeake Bay.

Q.148. Is the monitoring information available to the public?

A. Yes. EPA makes monitoring results available for public inspection at its Middletown office. Monitoring results are also published by EPA in a monthly newsletter that is also made available to the news media. NRC publishes monitoring results obtained by NRC, EPA, and GPU Nuclear in the "NRC TMI Program Office Weekly Status Report." This report is mailed routinely to public and private interest groups, public officials, medical societies, private citizens, and the news media.

GPU Nuclear also issues news releases on its monitoring activities.

Q.149. Do any of these organizations oversee GPU Nuclear's monitoring program?

A. Yes. NRC conducts an annual in-depth inspection of GPU Nuclear's monitoring programs and audits on-going monitoring monthly and, in some cases, daily. During the annual inspection, NRC independently verifies the accuracy of GPU Nuclear instruments, independently analyzes the same samples taken by GPU, and provides GPU with blind samples to confirm the accuracy of their equipment and reporting procedures.

NRC routinely verifies sampling methods by observing as samples are taken. NRC also frequently evaluates some instruments and sample results. Finally, NRC evaluates any results that are not consistent.

Q.150. Is the Environmental Protection Agency still responsible for coordinating offsite environmental radiation monitoring?

A. Yes. President Carter directed EPA to fill this role following the accident in March 1979.

Q.151. Are private citizens from the Three Mile Island area still involved in the monitoring?

A. Yes. People from five townships within a 5-mile radius of TMI participate in daily monitoring under a program sponsored by the Department of Energy and the Commonwealth of Pennsylvania.

Q.152. Can members of the public and local officials make special requests for radiation sampling?

A. Yes. NRC will honor such requests at no cost to the public.

Q.153. Where can such a request be made?

A. You can call the NRC staff at the Three Mile Island Program Office on Three Mile Island (717-948-1150) or come in to the NRC Middletown office, 100 Brown Street.

Q.154. What kinds of samples can be taken?

A. NRC can sample solids (such as soil) and liquids (such as water and milk).

Q.155. How soon are results available?

A. Most analyses take approximately a week.

Q.156. Is there any truth to the rumor that the Environmental Protection Agency will discontinue its monitoring activities at TMI?

A At a public meeting of the TMI-2 Advisory Panel on February 9, 1984, in Harrisburg, an EPA official suggested that the organizations involved in offsite monitoring meet to reevaluate the entire program with the aim of reducing or eliminating duplicate or inappropriate monitoring.

Q.157. What organizations are monitoring the radiation workers receive?

A. Worker doses are monitored by GPU Nuclear. In addition, NRC has a fulltime professional staff of radiation specialists at Three Mile Island. They conduct ongoing reviews of the GPU Nuclear radiation protection program and the methods that GPU uses to monitor worker doses. NRC also keeps records of worker exposures at each operating nuclear power plant in the U.S.

Q.158. What kinds of instruments are being used to measure worker exposure?

A. GPU Nuclear has a number of options as to the kind of radiation-monitoring instruments it can use. A device called a dosimeter is used to record the radiation dose a worker receives. GPU Nuclear assigns each radiation worker a thermoluminescent dosimeter (TLD). This device, which registers a worker's accumulated dose from ionizing radiation, is analyzed or "read" every month. Any dose indicated is added to previous readings for that individual.

GPU Nuclear also provides a direct-reading, or self-reading, dosimeter for each worker who enters a radiation area. Workers can read this dosimeter during work to know how much dose they have received from the time they enter a radiation area. Workers are required to read these devices before, during, and after work and report the results of their readings. These devices allow workers to tell immediately if a dose is larger than expected. If it is, workers are to leave the area at once. These devices also allow GPU Nuclear to keep track of worker doses and to determine how much dose is being received for each job. All doses then become part of the worker's cumulative exposure record. Both NRC and GPU officials review these records for their compliance with NRC regulations governing dose limits.

Other instruments, some in fixed locations and some carried by workers, are used to locate sources of radiation, to estimate the dose workers could receive, to determine the concentration of radioactive substances in air, and to take other specific measurements.

Filtered ventilation systems and respirators are in use to minimize the possibility that workers could inhale or swallow radioactive materials. To monitor for such a possibility, GPU Nuclear requires all workers to be measured for internal radiation before they are employed and at least once a year thereafter. A worker suspected of internal contamination is examined in a special radiation-detection device for this purpose (a "whole-body counter") and, depending on the results, may also have urine or fecal samples analyzed.

X. THE POTENTIAL FOR ACCIDENTS DURING THE CLEANUP

Q.159. Have there been any accidental releases of radioactivity since the cleanup began that have adversely affected the public?

A. No.

Q.160. Have there been any accidental spills of water generated by the accident or of any other radioactive water into the Susquehanna River?

A. No.

Q.161. Have there been any accidents involving the transportation of radioactive wastes?

A. No.

XI. CLEANUP SCHEDULE AND FUNDING

Q.162. The cleanup schedule published in March 1981 stated that the cleanup would take five to seven years. Can this schedule be met?

A. No. The answer to Question 171 outlines cleanup goals for 1984. Beyond 1984, the schedule is not firm because of funding uncertainties.

Q.163. Is the cleanup on schedule now?

A. No.

Q.164. What are the reasons for the delay?

A. Delays occurred for essentially three reasons. First, the lack of adequate funds has caused a considerable delay in the cleanup. Second, certain technical problems, such as decontaminating buildings and equipment, were more difficult than originally thought. Then, estimates of occupational exposures had to be revised upwards to reflect actual conditions in the reactor building. Third, several exhaustive--and time-consuming--investigations were necessary in response to allegations concerning refurbishment of the polar crane. These allegations had to be (and were) resolved to the satisfaction of NRC before refurbishment of the crane, a key step in the cleanup, could be taken.

Q.165. Would you outline the Thornburgh Plan to finance the cleanup and show how much of the money proposed has been committed?

A. Governor Thornburgh recommended that cleanup operations at TMI-2 be financed according to the following cost-sharing formula listed in the left-hand column. Funds firmly committed are shown in the right column.

Organization	Thornburgh	Firmly Committed
• GPU Nuclear (ratepayers)	$245 (million)	$204 (million)
• Nuclear industry	190	(see below)
• Federal government (Dept. of Energy)	190	approx. 80
• Insurance payments	90	90
• Pennsylvania	30	30
• New Jersey	15	12
• Sources not in the Thornburgh Plan		
• Babcock & Wilcox settlement		30
• Japanese contributions		18
• Electric Power Research Institute		9
	$760 (million)	$473 (million)

The investor-owned electric utility industry has pledged $77 million, but a minimum of $100 million must be pledged before funds will be available for the cleanup. The Department of Energy research budget for TMI-2 is $159 million, about one-half of which is committed to cleanup activities. The Electric Power Research Institute will also spend approximately $9 million in research and development activities directly related to the cleanup.

Q.166. What is the current outlook for funding?

A. Funding for 1984 is firmer than for later years. Complete funding plans must await further commitments from contributors.

For example, in December 1983, the U.S. Internal Revenue Service ruled that those utilities that applied would be permitted to deduct against corporate income taxes their contributions to the TMI-2 cleanup fund. Since that time, utility pledges have increased from $65 million to $77 million. It is hoped that this ruling will encourage further utility contributions to the cleanup fund.

Q.167. If funding was unlimited, could the cleanup go more quickly?

A. Yes. The pace of the cleanup is in large part controlled by funding, but there are technical constraints, such as the sequence in which the work is completed. Furthermore, as each step of the cleanup is completed, it provides information essential to proceeding with the next step.

Q.168. Does the current pace of the cleanup pose any threats to public health or safety?

A. No. Nevertheless, funding uncertainties after 1984 could complicate technical problems and further lengthen the cleanup. NRC plans to assess GPU Nuclear's schedule and to evaluate their ability to continue the cleanup in 1985 and beyond in a manner that will adequately protect public health and safety.

Q.169. Since funding is currently a problem, are cleanup decisions being made solely on the basis of cost?

A. No.

Q.170. Does NRC review GPU Nuclear's financial ability to complete cleanup operations to assure that once an operation has begun it can be completed without jeopardizing worker and public health and safety?

A. Yes. NRC does take this into consideration.

Q.171. What are cleanup goals for 1984?

A. GPU Nuclear plans to continue decontamination work while going forward with implementation of the dose reduction program to lessen worker exposure to radiation. The processing and shipment of radioactive wastes will also continue. In the meantime, research and development work for the design and preparation of tools to remove the core and damaged fuel continues. Work is also going forward on the refueling canal in preparation for the transfer and packaging of the damaged fuel.

Q.172. How much money is available for 1984?

A. GPU Nuclear has committed $75 million to cleanup activities in 1984.

Q.173. How many entries per week are workers currently making?

A. Two to four per week.

Q.174. Can the cleanup goals for 1984 be accomplished at this level of activity?

A. Yes. Groups of workers can accomplish a variety of tasks toward meeting the cleanup goals during each entry.

Q.175. Does GPU Nuclear plan to call back workers laid off in late 1983?

A. GPU Nuclear has already called back more workers than those laid off.

Q.176. If GPU Nuclear goes bankrupt before the cleanup is finished, has NRC considered alternatives to ensure that public health and safety are protected?

A. Yes. In a 1980 report on this topic, the NRC staff noted that two options existed for completing the cleanup should GPU Nuclear go bankrupt. The first option would be for a Federal agency to contract for the cleanup work with (1) former GPU Nuclear employees, their contractors, or other contractors, (2) other Federal agencies or national laboratories, or (3) state agencies. The second option would be for a Federal agency to finish the cleanup work with its own employees.

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