NUREG-0732

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

(U.S.) Nuclear Regulatory Commission
Washington, DC

Sep 80

U.S. Department of Commerce
National Technical Information Service
NTIS

NRC FORM 335 (7 77)

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER (Assigned by DDC)

NUREG-0732

4. TITLE AND SUBTITLE (Add Volume No., if appropriate)

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

2. (Leave blank)

3. RECIPIENT'S ACCESSION NO.

7. AUTHOR(S)

5. DATE REPORT COMPLETED

MONTH	YEAR
September	1980

9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

Three Mile Island Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

DATE REPORT ISSUED

MONTH	YEAR
September	1980

6. (Leave blank)

8. (Leave blank)

12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)

Three Mile Island Program Office
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

10. PROJECT/TASK/WORK UNIT NO.

11. CONTRACT NO.

13. TYPE OF REPORT

Public Information

PERIOD COVERED (Inclusive dates)

15. SUPPLEMENTARY NOTES

14. (Leave blank)

16. ABSTRACT (200 words or less)

This document presents answers to frequently asked questions about plans for cleanup and decontamination activities at Three Mile Island, Unit 2. Answers to the questions asked are based on information in the NRC "Draft Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979, accident, Three Mile Island Nuclear Station, Unit 2" NUREG-0683

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS

17b. IDENTIFIERS/OPEN-ENDED TERMS

18. AVAILABILITY STATEMENT

Unlimited

19. SECURITY CLASS (This report)

21. NO. OF PAGES

20. SECURITY CLASS (This page)

22. PRICE

NRC FORM 335 (7 77)

NUREG-0732

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TMI Program Office

Office of
Nuclear Reactor Regulation

U.S. Nuclear Regulatory
Commission

Available from

GPO Sales Program
Division of Technical Information and Document Control
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Printed copy price:

and

National Technical Information Service
Springfield, Virginia 22161

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Manuscript Completed: September 1980
Date Published: September 1980

TMI Program Office

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PREFACE

This document presents answers to frequently asked questions about cleanup activities at Three Mile Island, Unit 2. The answers, prepared by the staff of the NRC Three Mile Island Program Office, are based principally on information in the NRC "Draft Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from the March 28, 1979, Accident at Three Mile Island Nuclear Station, Unit 2" (PEIS), NUREG-0683.

The purpose of this question and answer report is to provide a clear, readily understandable explanation of alternative methods for conducting cleanup activities and their possible environmental impacts on the public in the vicinity of the Three Mile Island and on workers. Cleanup operations consist of decontaminating the facility, removing the damaged fuel from the reactor, and disposing of waste resulting from the accident and from decontamination activities.

A more detailed discussion of the various alternatives being considered, along with the NRC staff assessment of their effects on the environment, are given in the draft PEIS, NUREG-0683. Copies of the PEIS are available for public inspection at the NRC Public Document Room, 1717 H Street, N.W., Washington, D.C., and at the TMI-2 Local Public Document Rooms at the Government Publications Section, State Library of Pennsylvania, Education Building, Commonwealth and Walnut Streets, Harrisburg, Pennsylvania, and at York College of Pennsylvania, Country Club Road, York, Pennsylvania. The PEIS has been circulated for comment to other federal agencies, to the Commonwealth of Pennsylvania and State of Maryland, and to local and municipal governments in the area around Three Mile Island. Comments on the draft PEIS are due to NRC by November 20, 1980. They should be sent to Dr. Bernard J. Snyder, Program Director, Three Mile Island Program Office, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Requests for single copies of the PEIS should be addressed in writing to the Director, Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555.

The views expressed in this report are those of the NRC staff. The NRC Commissioners have not decided on which alternatives will be acceptable for going forward with cleanup activities at Three Mile Island, Unit 2. Comments sent to NRC will be analyzed, after which the staff will prepare a final version of the PEIS and brief the Commission. The Commission will determine appropriate actions to be taken.

Dr. Bernard J. Snyder, Program Director
Three Mile Island Program Office
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

PURPOSE, SCOPE, AND PUBLIC PARTICIPATION IN THE PEIS

Q.1. What is the purpose of the Programmatic Environmental Impact Statement (PEIS)?

A. The PEIS was prepared by the NRC staff to assist the Commission in carrying out its responsibilities to protect public health and safety as essential cleanup work at Three Mile Island Unit 2 progresses, and to involve the public, and local, state, and federal officials in Commission decisions before specific cleanup choices are made.

The PEIS provides the following information:

- o the current status of contaminated facilities
- o a review of alternative methods available for cleanup
- o the impacts various cleanup alternatives and potential accidents could have on the environment, members of the public, and station workers.

Q.2. How will NRC make decisions on the various cleanup alternatives discussed in the PEIS?

A. The PEIS was written to address various cleanup alternatives. These assessments, as well as comments and suggestions from the public, interested groups, and various local, state, and federal officials, will serve as the bases for some Commission decisions on licensee* proposals throughout the cleanup process. The PEIS does not include NRC staff recommendations on which cleanup alternatives should be implemented.

The licensee will submit specific cleanup proposals to NRC. The staff will evaluate each proposal using the PEIS to the extent that it covers the proposal. The staff will follow existing NRC regulations in implementing its approval actions.

Q.3. Why doesn't the PEIS contain recommendations for which cleanup alternatives should be chosen?

A. Because its purpose is to provide information on the range of reasonable cleanup alternatives upon which Commission decisions regarding specific licensee proposals may be based.

*The term "licensee" refers to Metropolitan Edison Company, principal owner (50%) and operator of the plant, Pennsylvania Electric Company, and Jersey Central Power and Light Company, each of which owns 25% of the Plant.

Q.4. Does Unit 2 have to be cleaned up?

A. Yes. The facility contains sources of radiation that are hazardous to workers and are potentially hazardous to members of the public who live near TMI.

Q.5. What are these sources of radiation?

A. The primary sources are water contaminated by radioactive materials during the accident and the nuclear fuel. Other sources include contamination on walls, floors, and equipment surfaces in the reactor building. Similar contamination of surfaces within the auxiliary and fuel handling building has been essentially cleaned at this time.

Q.6. How do these sources of radiation pose a potential hazard to workers and the public?

A. The sources of radiation listed in the preceding answer will not have a significant impact on the public. However, the large volume of contaminated water in the reactor building basement (or sump) is a direct source of radiation exposure to workers who enter the building to maintain and repair equipment.

Although the reactor has been safely shut down since April 1979, the staff believes that a remote possiblity exists that the fuel could accidently begin a chain reaction again. Such a reaction could release radioactive materials to the reactor building and, over a long period of time, possibly even to the outside environment. Removing the fuel to safe storage is therefore a major objective of the cleanup.

Q.7. What overall cleanup alternatives did NRC evaluate?

A. The staff evaluated five major alternatives:

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, and

5. Do nothing - maintain reactor safety shut down.

Q.8. Would partial cleanup alternatives be feasible?

A. Both partial cleanup alternatives would require that TMI be used as a permanent waste repository. TMI is not a suitable site for the permanent disposal of either spent nuclear fuel or radioactive wastes because of factors such as its location in the Susquehanna River and population density in the vicinity of the site. To use TMI as a permanent waste repository is neither compatible with current national policies or NRC regulatory guidelines for radioactive waste disposal.

Q.9. Is doing nothing a real alternative?

A. No, because that would amount to leaving the facility as is, except for necessary maintenance. Under these conditions, maintaining or repairing equipment would be extremely difficult inside the reactor building because of high radiation levels there. At present, because of leaks, for example, water levels in the building are only a few inches below two motors that operate valves on pipes carrying water to cool the reactor. Maintenance must be performed on such equipment to maintain the reactor safely shut down.

Leaving the facility as is would in effect turn TMI into a long-term nuclear waste disposal facility. The reactor building was not designed for this purpose and would eventually leak radioactivity to the environment if it were left as is for a long time.

Q.10. Why can't the facility be sealed up or entombed as is?

A. Sealing the facility would amount to establishing a permanent waste repository in the middle of the Susquehanna River. Even if the building were sealed, the possibility exists that radioactive water from the plant might eventually leak to groundwater and subsequently to the Susquehanna River. Moreover, entombing the facility would still require a partial decontamination of the reactor building so that workers could fix the reactor core to prevent the fuel from undergoing a chain reaction again.

Q.11. Should the cleanup be done as quickly as possible?

A. The cleanup does not have to be done in haste. It should be done without further delay, however, to eliminate the potential health hazards and to minimize public anxiety associated with the radioactive wastes.

Q.12. Since this was the first large commercial reactor accident in the U.S., how does NRC know that methods exist to perform all cleanup operations with minimal releases of radioactivity to the environment?

A. The techniques and technology are available and a substantial amount of decontamination experience has been gained since the 1940s at test reactors and other facilities within the U.S. and abroad. NRC concludes in the PEIS that available techniques can be modified to suit conditions at Three Mile Island, where necessary.

Q.13 How long will it take to decontaminate Unit 2?

A. The staff estimates that at least five to seven years will be necessary. Actual cleanup operations began in April 1979, so the schedule begins at that date.

Q.14. Why has the cleanup been delayed for so long?

A. Essential cleanup operations have not been delayed. As noted in the previous question, the cleanup began in April 1979, shortly after the accident. At present, a number of cleanup activities have been completed or are well under way. For example, essentially all the contaminated water in the auxiliary and fuel handling building (AFHB) has been processed (cleaned) and is stored on site. About 75% of surfaces and equipment in the AFHB has been decontaminated, with the remaining cleaning to be completed in the near future. Removal of the krypton gas from the reactor building was completed in July. Workers have also made three entries to the reactor building to conduct damage assessments, equipment maintenance, and radiation surveys.

Q.15. Does NRC, in the PEIS, take the position either that Unit 2 will be returned to operation or never used again to generate electricity?

A. No. The NRC staff takes no position in the PEIS on whether or not Unit 2 will be returned to service because that issue is outside the scope of the Commission order that directed the staff to prepare the PEIS. In either case, cleaning the plant will be required. (See also answers to questions 2 and 3.)

Q.16. Can the plant be cleaned more quickly if no attempt is made to salvage facility equipment?

A. Equipment will need to be decontaminated to safe levels whether or not it is salvaged. Destructive cleaning would be undesirable, because it would cause the loss of information about the accident that could be valuable for the safety of other nuclear plants.

Q.17. Will cleanup activities at Unit 2 have any effect on Unit 1?

A. No. The two units are physically separate. Actual cleanup activities will not affect Unit 1

Q.18. What is NRC's role in the cleanup?

A. NRC has overall responsibility for regulatory oversight of cleanup activities. The primary objective is to assure that the cleanup, storage, and disposal of radioactive wastes from cleanup operations are conducted so that radiation exposures to workers and the public do not exceed limits in NRC regulations and are as low as reasonably achievable. 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 licensee proposals for cleanup alternatives, and
- approves the step-by-step procedures that the licensee uses for each operation.

Q.19. How does NRC oversee cleanup operations?

A. The NRC Three Mile Island Program Office has a professional staff permanently located at the TMI site. This staff is responsible for reviewing cleanup operations to ensure that they are being carried out according to NRC regulations and orders, the facility operating license, facility technical specifications, and NRC-approved procedures for each detail of the cleanup.

The Environmental Protection Agency has oversight responsibility for radiological monitoring activities around TMI. (See the answers to Questions 141-145.)

Q.20. How many NRC staff members will oversee cleanup activities?

A. The NRC Three Mile Island Program Office has 30 professional staff members assigned at TMI and at NRC headquarters to oversee cleanup activities. The staff has expertise in reactor safety, radioactive waste management, radiation health and protection, and environmental effects. The Three Mile Island Program Office can also draw expert support from within NRC and from its contractors in numerous specialized technical fields, as needed.

Q.21. Does NRC consider the costs of the various cleanup alternatives in the draft PEIS?

A. Costs for proposed cleanup activities were not available in time to be included in the draft PEIS. To the extent possible, estimated relative costs among various alternatives will be provided in the final PEIS. NRC will not attempt to make an overall cost estimate for the total cleanup.

Q.22. Who is responsible for paying for cleanup costs?

A. The licensee. The Pennsylvania Public Utility Commission has ruled that costs for the accident cannot be passed on to utility customers. (Costs to replace power lost because of the accident can be, however.)

The precise method the licensee will use to finance the cleanup, aside from insurance coverage, has not yet been determined. The licensee's ability to pay for the remainder of cleanup costs will depend upon decisions made by the Pennsylvania Public Utility Commission and on the credit status of the utility.

Q.23. What would happen if the licensee went bankrupt before the cleanup was complete?

A. NRC has the authority under existing law to act to ensure that public health and safety are protected should the utility be unable to complete the cleanup. NRC is currently preparing a contingency study considering this possibility.

Q.24. Will any cleanup alternatives be chosen solely on the basis of cost?

A. No. NRC reviews of licensee cleanup proposals will be based on their safety and environmental impacts.

Q.25. What course of action is recommended in the PEIS?

A. The staff does not recommend specific methods for performing various parts of the cleanup, although it does recommend completing the cleanup as quickly as safety permits, rather than maintaining the facility shut down without finishing the cleanup. The intention of the PEIS is to determine which cleanup alternatives are feasible and to evaluate the environmental impacts likely to result from each alternative.

Specific cleanup methods will be proposed to NRC by the licensee. Each proposal will be reviewed and approved or not approved by NRC.

Q.26. Was the public consulted on the cleanup alternatives discussed in the PEIS?

A. Yes. NRC held four public meetings to discuss the scope of information included in the draft PEIS. These meetings were held in

o Harrisburg, Pennsylvania (January 14, 1980)
o Middletown, Pennsylvania (February 12, 1980)
o Baltimore, Maryland (February 15 and March 20, 1980)

Q.27. If one of the purposes of the draft PEIS is to involve the public in NRC decisions, why has NRC already listed alternative cleanup methods in this document?

A. The staff has selected what it believes to be the most technically feasible and environmentally safe cleanup methods from those available. The PEIS describes these alternative methods and gives the reasons why they were chosen. These may or may not be the alternatives from which final choices are made. By focusing discussion on these alternatives, the staff provides the basis for informed suggestions of other possible alternatives for future decisions.

Q.28. How can the public influence NRC decisions about the choice of cleanup alternatives?

A Members of the public have the opportunity to participate in several ways:

- NRC staff members are meeting with numerous groups in the area around Three Mile Island and in Maryland to seek their comments on the draft PEIS. For information about the times and locations of those meetings, call the NRC Middletown Office in the Downtown Mall in Middletown (717) 782-4014. You also may discuss any portion of the PEIS with NRC staff by visiting the TMI Middletown Office. Staff members are available from 11 a.m. to 3 p.m. on Mondays, from 11 a.m. to 8 p.m. on Wednesdays, and from 9 a.m. to 3 p.m. on Thursdays.

- NRC is providing a 90-day comment period for interested individuals and groups to submit their comments on the draft PEIS in writing. Comments are due by November 20, 1980, and should be sent to this address:

  Dr. Bernard J. Snyder, Director
  Three Mile Island Program Office
  U.S. Nuclear Regulatory Commission
  Washington, D.C. 20555

Q.29. Will alternatives from the public be seriously considered?

A. Yes. In complying with the National Environmental Policy Act, which requires that environmental impact statements be published for public comment, NRC hopes to obtain comments and suggestions from the public. NRC will carefully examine all comments and suggestions received on the draft PEIS, evaluate their feasibility, and address all pertinent comments in the final PEIS.

Q.30 Can I obtain a clarification from NRC about any portions of the draft PEIS?

A. Yes. You can call or visit the NRC Office in Middletown, Pennsylvania. The address, telephone number, and hours are listed in the answer to Question 27. You can also call the Environmental Project Managers for the PEIS, Paul Leech or Oliver Lynch, at NRC headquarters at (301) 492-7258.

Q.31 When will the comment period for the PEIS end?

A. On November 20, 1980.

Q.32. Will copies of the draft PEIS be provided free to the public?

A. Yes. Free copies of the PEIS can be picked up at the NRC Office in Middletown, Pennsylvania.

Single copies can also be obtained by writing to the Director, Division of Technical Information and Document Control, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555. Please ask for NUREG-0683 in your request.

Q.33. What procedure will NRC use in evaluating and responding to comments from the public and interested groups?

A. All comments on the draft PEIS will be carefully considered by the staff when it prepares the final PEIS. These comments will be addressed either in text changes or in an added chapter that contains responses to comments, or both.

Q.34 Will comments on the draft PEIS be made available for public examination?

A. Yes. Copies of all comments received will be printed in the final version of the PEIS. Comment letters can also be examined at NRC public document rooms at the following addresses:

- o 1717 H Street, N.W., Washington, D.C.
- o State Library of Pennsylvania, Government Publications Section, Education Building, Commonwealth and Walnut Streets, Harrisburg, Pennsylvania
- o York College of Pennsylvania Library, Country Club Road, York, Pennsylvania

Q 35. Will state and federal government agencies or other organizations evaluate the draft PEIS?

A Yes. In addition to members of the public, many independent organizations and governmental agencies will evaluate and provide NRC comments on the draft PEIS. The federal agencies include, among others, the Environmental Protection Agency, Department of Transportation, U.S. Geological Survey, Department of Energy, Department of the Interior, and Department of Health and Human Services. NRC also anticipates receiving comments from the Commonwealth of Pennsylvania and the State of Maryland.

Q.36. Will NRC establish a Citizens Advisory Group to examine and comment on cleanup activities?

A. Congress is currently considering a bill that would establish a 12-member Three Mile Island Advisory Panel. As proposed, the Panel would consult with and make recommendations to NRC on matters pertaining to the cleanup of Three Mile Island, Unit 2.

The Panel would consist of not more than 12 members selected by the Commission from the following groups:

(1) three members from Pennsylvania State governmental agencies,
(2) three members from local governments in the vicinity of Three Mile Island,
(3) three members from the scientific community, and
(4) three members of the public who live in the vicinity of Three Mile Island.

Even if the Congress does not pass the bill requiring a TMI Advisory Panel, NRC is committed to establishing a panel under its existing authority.

Q.37. What would happen if new information not addressed in the PEIS came to NRC's attention?

A. If conditions in the reactor building are found to be significantly different from those assessed in the PEIS, or if the licensee proposes cleanup alternatives significantly different from those in the PEIS, NRC will evaluate them and issue a supplement to the PEIS.

Q.38. Who wrote the draft PEIS?

A. The draft PEIS was developed by the NRC Three Mile Island Program Office with assistance from the NRC Waste Management Division. Argonne National Laboratory (Argonne, Illinois and Idaho Falls, Idaho), under contract to NRC, was a major participant in preparing the draft PEIS.

Q.39. Why was Argonne National Laboratory chosen to assist in preparing the PEIS?

A. The staff of scientists and engineers at Argonne has the expertise and experience with the types of cleanup procedures and with environmental impact assessments necessary for Three Mile Island and was therefore the organization suitable for assisting NRC in the preparation of the draft PEIS.

Q.40. Why didn't the U.S. Environmental Protection Agency prepare the draft PEIS, since the report discusses environmental impacts?

A. Each federal agency must prepare environmental assessments or impact statements for projects over which it has authority. NRC has regulatory authority over the Three Mile Island facility. The Environmental Protection Agency will thoroughly review and comment on the PEIS, however.

Q.41. What are the major steps involved in the cleanup?

A. The cleanup will consist of four major steps:

- o decontaminating the radioactive liquids,
- o decontaminating the reactor building and equipment,
- o removing the damaged fuel from the reactor and decontaminating the cooling system, and
- o packaging and transporting radioactive wastes for storage and/or disposal.

DECONTAMINATING RADIOACTIVE LIQUIDS

Q.42. How many gallons of water were spilled during the accident?

A. About one million gallons of highly radioactive water were released when the reactor pressurizer relief valve stuck open early in the accident and the coolant was released from the overflow tank.

Q.43. Where is this water now?

A. About 450,000 gallons of this water were transferred to the auxiliary and fuel handling building (AFHB). The water in the AFHB has been cleaned and is currently stored in tanks at TMI. Approximately 700,000 gallons are standing eight feet deep in the reactor building sump (or basement). In addition to water which was spilled, there are approximately 90,000 gallons circulating through the reactor core primary coolant system, which are also contaminated from the accident.

Q.44. Why is it necessary to clean the water in the reactor building sump?

A. The sump water is highly contaminated with radioactive materials. This contamination produces high levels of radiation, which limit the amount of time workers can stay in the building.

Additionally, because of small but continuous leaks from the reactor coolant system, the water level is rising gradually and will eventually threaten equipment essential to cooling the reactor. (See the answer to Question 9.) The water also creates high humidity in the building, a condition that could cause vital equipment to fail.

Q.45. What methods have been evaluated for decontaminating water in the reactor building sump?

A. Five methods have been evaluated.

- o a zeolite and resin system,
- o an evaporation and resin system,
- o direct bituminization,
- o solidification with Portland cement, and
- o filtration followed by storage.

Q.46. Are these methods similar to one another?

A. No. They can be divided into three basic categories or techniques. In one, the water would not be processed (to remove or immobilize contaminants), but instead would be removed from the sump and mixed in its present form with Portland cement and solidified for eventual shipment and disposal.

The other two basic techniques involve removing radioactive materials from the water either physically (through filtration or evaporation) or chemically (through ion exchange using zeolite and/or resin demineralizers).

Q.47. Wouldn't solidifying the water with Portland cement be the simplest method for preparing it for disposal?

A. Yes, but the amount of water involved is so large that the end product of the solidification process would weigh 11,000 tons and occupy 10,000 cubic yards. It would fill 36,000 55-gallon drums, each weighing 610 pounds. Because of the radioactivity, shielded storage facilities might have to be constructed at TMI for the drums as they were awaiting shipment to a disposal facility. Similarly, the drums would probably require shielding while they were being shipped. Shielding would cut down on the number of drums per shipment, thereby increasing the number of shipments required. Because of the volume, weights, and number of shipments needed for disposal, solidification with cement seems a less desirable alternative compared with other methods available.

Q.48. Would physically filtering the water be effective?

A. Not by itself. Filtering the water would remove from it any solids, but the concentrations of radioactivity in the filtered water would still be relatively high. Accordingly, the filtered water would require additional processing or long-term retention in shielded facilities at TMI.

Q.49. What are the evaporation processes?

A. In one evaporation process, the water would be reduced to 1/30 its original volume and the radioactivity would be reduced to 1/1000 its original concentration (except for the tritium). The sludge remaining from this technique would be highly radioactive and would also require processing.

In another evaporation method, a flammable tar-like material (bitumen) would be mixed with the water before it is processed by evaporation. The liquid left over from this process would be filtered and passed through an ion-exchange process. (See the next question for an explanation of the ion-exchange process.) The solids left over from this evaporation process would be ready to ship to a long-term storage facility. The water, still about its original volume, would then have only 1/1000 its original concentration of radioactivity.

Q.50. What is the ion-exchange process?

A. It is a process that uses a chemical filter to trap charged chemical particles. 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 a filter would remove the salt from the water. Similarly, those radioactive materials in the contaminated water at Three Mile Island 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 softener 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. The used (or spent) resins would be placed in a special temporary storage facility on the Island.

Q.51. What is the submerged demineralizer system (SDS)?

A. The SDS is a demineralizer that operates under water using a mixed zeolite-resin system. The licensee is currently constructing such a system. It should be noted, however, that the licensee is presently proceeding at his own risk, since the operation of this or any other system has not received NRC approval and will not, pending evaluation of alternatives in the fuel PEIS.

Q.52. What alternatives has NRC evaluated for disposal of the processed water?

A. Eight basic alternatives have been considered.

- o retaining the water in tanks at TMI for approximately 60 years - the tritium would decay by more than 95% in 60 years,
- o releasing the processed water to the river after diluting it on site,
- o releasing the water to the air through natural evaporation from a pond on site,
- o releasing the water to the air through controlled forced evaporation,
- o releasing the water to the ground by injecting it into wells deep in the ground (deep-well injection),
- o solidifying the water with cement for shipment to a licensed burial ground,

- o shipping the contaminated liquid offsite for processing or disposal, and
- o solidifying the water with cement and retaining the solidified form on site.

Q.53. Are all the water disposal alternatives evaluated by NRC viable?

A. No. Only four are considered valid alternatives at this time:

- o holding the processed water in tanks at TMI for approximately 60 years,
- o releasing the processed water to the river at TMI,
- o releasing the processed water vapor to the air by forced evaporation, and
- o releasing the processed water vapor to the air by natural evaporation.

Q.54. Will NRC permit any of the processed (clean) water to be released to the Susquehanna River?

A. At present, NRC does not permit the release of any processed water from TMI-2 to the river. The Commission will evaluate information in the final PEIS before it makes a decision on how to dispose of the processed water.

Q.55. Are facilities available at TMI to hold the 700,000 gallons of water from the reactor building basement after it has been processed?

A. Yes. Two 500,000-gallon tanks have recently been constructed on site. Several other tanks are also available, if needed. The remaining capacity in these tanks should accommodate any additional water required for cleanup operations.

Q.56. Could the processed water be used in the cleanup of building surfaces and equipment?

A. Yes. Some processed water has been used to clean portions of the auxiliary and fuel handling building and could be used to clean the reactor building. However, water used in the cleanup, which becomes contaminated again, must ultimately be processed and disposed of.

Q.57. If processed water were released to the Susquehanna River, would it be harmful to communities that get drinking water downstream from TMI?

A. No. Before release, processed water would be diluted on site. Further dilution by river water would occur after release. Twice diluted, the water at the nearest drinking-water intake downstream would meet drinking-water standards established by the Environmental Protection Agency.

Q.58. Would any of these techniques remove tritium from the water?

A. No.

Q.59. What is tritium?

A. Tritium is a radioactive form of hydrogen. It has a half-life of approximately 12 years, which means that one-half of the original amount will undergo radioactive decay to a nonradioactive form of hydrogen in 12 years. This process occurs continuously.

Q.60. Why can't these cleanup techniques remove tritium?

A. As a hydrogen isotope, tritium has the same chemical properties as hydrogen, which is why it so easily combines with oxygen to form water. In water, tritium is virtually indistinguishable from regular hydrogen. The physical and chemical techniques used to remove radioactivity do not remove water and, since tritium is a part of the water molecule, it goes through with the water.

Q.61. If processed water were released to the river would it be harmful to fish and other life in the river?

A. If any releases of processed water were made to the river, the radioactive materials in these releases (essentially all tritium) would be taken up in varying degrees by fish and other life in the river and by sediment in the river bottom. Even if the tanks holding the processed water ruptured, spilling water into the river before additional dilution on site, the maximum dose to river life at the point of discharge would be less than 15% of the radiation exposure these organisms receive from natural background radiation in one year.

Q.62. Wouldn't tritium in the processed water be harmful to fish in the river?

A. No. Although tritium may be present at low concentrations in some fish, the fish would not be harmed. The exposed fish would absorb little tritium and would lose it in a few hours to a few days after exposure stopped.

Q.63. Would these fish be harmful to eat?

A. No. The exposed fish would not be harmful to eat.

Q.64. If tanks holding processed water ruptured, spilling water into the river before it was diluted on site, would radiation released to the water be harmful to communities that get drinking water down river?

A. The only radioactive isotope that might exceed proposed EPA drinking-water standards at the intake nearest TMI is tritium. Standards would be exceeded for a few hours to a few days, depending on river flow rates. During this period, drinking-water intake valves down river could be closed, if necessary.

Q.65. Would the Susquehanna River be safe for recreational use (boating, swimming, fishing, island cottage use) during the lengthy cleanup process, and especially if releases of diluted processed water to the river are permitted?

A. Yes. Even if releases of processed water are permitted, levels of radioactivity in the river water would be below EPA drinking-water standards. Considering levels of radioactive materials only, this water would even be safe for drinking.

Q.66. If planned releases are approved during cleanup, would they affect the major fish spawning areas of York Haven Pond (Lake Frederic) of the Susquehanna River?

A. No. Biological effects from releases into the river are not expected. The most productive spawning areas and nursery areas for important fishes in York Haven Pond are located in the east channel of the river behind Red Hill Dam and in the west channel between Goldsboro and Hill Island and Shelley Island. Releases from TMI 2, if approved, would be discharged to the River on the west shore of Three Mile Island. From that point, the released water would flow downstream and be confined largely to within 100 to 200 feet of the west shore of the Island. It would then proceed downstream and exit the pond either over York Haven Dam or through the hydroelectric station, where it would be thoroughly mixed with river water. Released water, therefore, would not interact with the prime spawning areas of the pond.

Q.67 Would planned releases during the cleanup interrupt sport fishing on York Haven Pond?

A. No. Anglers would not need to avoid the area or change their fishing habits following planned releases.

Q.68. If processed water were released to the Susquehanna River, what effects would it have on the Chesapeake Bay?

A. The radiation doses absorbed by fish and shellfish in the bay from either controlled or accidental releases of processed water from TMI would amount at most to an exposure of less than 1% of natural background radiation for one year for these organisms. Exposures at these levels are not harmful to fish life or to man.

Q.69. Several types of Chesapeake Bay fish have become severely reduced in numbers during recent years, notably American shad, river herring, and striped bass. Will releases of processed water from TMI further reduce these fish populations?

A. No. Adverse biological effects to river and bay fish or other aquatic life are not expected to occur because of liquid wastes that might be discharged from TMI cleanup activities. In the absence of such effects, the present or future populations of these species should not be affected.

Q.70. Will fish and other aquatic life in the Susquehanna River and the Chesapeake Bay be monitored for radioactivity should water from TMI be released to the river?

A. Yes. Monitoring during cleanup activities will be conducted by the Environmental Protection Agency, the Commonwealth of Pennsylvania, the State of Maryland, the Department of Energy, the NRC, and Metropolitan Edison Company. Samples of air, soil, vegetation, milk, fish, aquatic plants, river sediment, and water will be collected and analyzed. The Environmental Protection Agency is responsible for coordinating all monitoring activities and for compiling and making available all monitoring results. (See Questions and Answers 141-145.)

Q.71. Would the public be notified if potentially harmful water were accidentally released to the river?

A. Yes. If accidental releases were made that were potentially harmful, you would be notified quickly by the Environmental Protection Agency, the Nuclear Regulatory Commission, and appropriate state authorities.

Q.72. Would releases to the Susquehanna River in any way be harmful to the ecology of the river or the Chesapeake Bay?

A. No. Radiation exposures to river and bay life from either planned or accidental releases of processed water would be a small fraction of natural background levels. Exposures at these levels would have no adverse effect on life in the river or the bay.

Q.73. Would state and local officials be notified if releases of processed water to the Susquehanna were to be made?

A. Yes. The NRC Three Mile Island Program Office at the site is responsible for notifying these officials.

Q.74. Will the public be given advance notice if liquid wastes are to be released to the Susquehanna River?

A. Yes. The local press, as well as television and radio stations, will be notified and NRC will issue press releases.

Q.75. Could water from TMI get to the Susquehanna River other than through planned releases or the accidental rupture of a storage tank?

A. Although unlikely, contaminated water in the reactor building sump might leak out of the building and into ground water, eventually working its way through the soil to the river.

Q.76. How would anyone know whether or not water was leaking from the reactor building?

A. Monitoring wells have been drilled around the building and are periodically sampled to provide early detection of any leaks. Leaks would be detected long before any radioactivity reached the river.

Q.77. How long would it take for this radioactive water to reach the river?

A. At least 1½ years if nothing were done to stop the leak.

Q.78. What could be done to stop such leaks?

A. First, the remaining sump water could be transferred to tanks within the plant. A contingency plan for this purpose is now being developed. Then, a buried dam (a grout curtain) or some other means could be used to surround the leak and the entire reactor building down to bedrock.

DECONTAMINATING THE REACTOR BUILDING AND EQUIPMENT

Q.79. What is the most important reason for decontaminating the reactor building?

A. The building must be decontaminated and sump water processed so that workers can remove the fuel from the reactor vessel, remove damaged reactor components, and decontaminate the reactor cooling system and water.

Q.80. Have any areas in the plant been decontaminated yet?

A. Yes. Cleanup of the auxiliary and fuel handling building (AFHB) began in April 1979 and should be completed in the near future. The cleanup is proceeding from lightly contaminated areas to areas more heavily contaminated. Contaminated water that leaked to the AFHB during the accident has been processed to remove contamination and is currently stored on site.

Q.81. What kind of decontamination methods can be used?

A. Contaminated surfaces can be decontaminated either by mechanical or chemical methods.

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

Chemical decontamination methods employ solvents to dissolve or suspend the radioactive materials.

Q.82. Will cleanup operations for the reactor building be similar to those used in the AFHB?

A. Many of the same basic cleanup techniques will be used. However, contamination in the reactor building is much more severe and widespread than in the AFHB. The reactor building, with its large open regions and bulky, complex equipment, makes cleanup efforts more demanding and time consuming and will require more stringent measures to protect workers.

Q.83. How long will cleanup of the reactor building take?

A. Approximately two to three years.

Q.84 What preliminary tasks are necessary before cleanup work in the reactor building can begin?

A. Workers will have to make numerous short entries into the reactor building to maintain vital equipment and to determine radiation levels for planning future work. Other preliminary tasks are to drain and process water in the building sump, and possibly to decontaminate water circulating through the reactor cooling system. Workers will also have to construct a service building that connects with the reactor building to allow workers access to the building and to permit equipment to be removed from the building.

REMOVING FUEL AND DECONTAMINATING THE COOLING SYSTEM

Q.85. How will fuel be removed and the reactor system decontamination be accomplished?

A. Detailed plans for these activities cannot be made at this time because the exact condition of the reactor vessel, fuel elements, and other parts will not be known until a thorough inspection has been completed. However, a broad overall plan has been drawn up. After the area around the reactor has been cleaned, a system will be set up that continuously decontaminates the reactor cooling system water. Then, after taking the top (or head) off the reactor vessel, workers will:

o make a detailed inspection of the reactor core,

o remove any loose debris, and

o remove the fuel assemblies.

Q.86. What do workers expect to find when they remove the reactor vessel head?

The expectations, from the best to the worst, include: Under favorable conditions, warpage and damage to parts would be minor and cleanup activities should go with relative ease.

Under unfavorable conditions, warpage and mechanical damage would be significant. Such conditions could cause a considerable amount of difficulty and require underwater cutting and machine operations.

Q.87. What will prevent fuel in the reactor vessel from begining a chain reaction when the reactor vessel head is removed?

A. Boric acid has been added to the reactor cooling water, which circulates around the fuel continuously. The boron in the boric acid acts as a neutron absorber that reduces the number of neutrons in the fuel to levels below those necessary to sustain a chain reaction.

Q.88. Since fuel damage may be extensive, would this condition present any especially difficult technical problems?

A. The technology for removing damaged fuel and core components is available. Lessons learned from defueling reactors with damaged fuel point to the need for detailed planning and use of mockups for training to reduce radiation doses to workers. When the reactor vessel head is removed and the extent of the damage has been assessed, equipment and procedures will be developed for the safe removal of damaged fuel and components.

Q.89. How would workers remove crumbled pieces of fuel or other debris that may have collected within the reactor vessel?

A. These pieces could be removed from the reactor vessel with hydraulic suction and scooping apparatus.

Q.90. How will the reactor fuel be disposed of after it is removed?

A. Undamaged fuel assemblies will be decontaminated and then stored underwater in the spent fuel pool in the auxiliary and fuel handling building (A fuel assembly is a bundle of tubes (fuel elements) containing the nuclear fuel, 8½ inches square and 1/0 inches long. There are 177 of these assemblies in the reactor core of TMI-2.) Following interim storage at TMI, they will be shipped to either a commercial spent-fuel storage facility or to a government facility for storage and/or examination.

Damaged fuel assemblies will be packaged in special spent-fuel cannisters and stored in the spent-fuel pool. Following interim storage at TMI, they will be shipped to a facility for storage.

PACKAGING AND TRANSPORTING RADIOACTIVE WASTES

Q.91. What are radioactive wastes?

A. Any materials, in the form of solids, liquids, semisolids, and gases, contaminated with radioactive materials.

Q.92. What kinds of radioactive wastes have been produced by the accident?

A. The accident has produced the following types of radioactive wastes:

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

Q.93. What kinds of wastes have been (and will continue to be) produced by decontamination activities?

A. Four basic types of waste will result from the cleanup:

- o contaminated water,
- o chemical decontamination solutions,
- o contaminated equipment,
- o contaminated trash and rubbish.

Q.94. Have any wastes from either the accident or decontamination activities already been disposed of?

A. In addition to the krypton-85 released to the atmosphere under controlled conditions between June 28, 1980 and July 11, 1980, some radioactive trash and resin wastes used to decontaminate areas and water in the auxiliary and fuel handling building have been shipped to the commercial low-level waste disposal site at Richland, Washington.

Q.95. Will additional krypton be released from the building?

A. Periodic releases have and will take place to remove minute amounts of krypton coming from water in the reactor building sump.

Q.96. Can radioactive wastes be disposed of as is, or do they have to be changed to a different form or in some way processed?

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

The processing of contaminated liquids produces used filters, used resins (also a type of filter), and sludge. Resins and sludges will be solidified. Filters that physically trap particles will be packaged for disposal.

Q.97. Will some of the wastes from decontamination activities be held at TMI?

A. Yes. Some wastes will be held at TMI temporarily.

Q.98. Why?

A. Holding them temporarily provides time for those radioactive materials with short half-lives to decay and permits cleanup activities to continue while strategies for how the wastes are finally to be disposed of are formulated. Temporary holding also provides a buffer period for such contingencies as the unavailability of offsite storage facilities and embargoes against disposal (or burial) of certain types of wastes.

Q.99. How will wastes be packaged before they are shipped for disposal or held temporarily at TMI?

A. Materials with low concentrations of radioactivity (such as clothing, tools, and trash) that do not need shielding will be held in special 55-gallon drums or wooden boxes. The drums and boxes will be transferred manually to unshielded holding facilities at TMI to await shipment.

Materials with high concentrations of radioactivity, such as fuel assemblies, used filters, resins, and sludges, will be packaged in steel containers or specially designed cannisters. Undamaged fuel assemblies, damaged fuel, and fuel debris will be packaged and held underwater in the spent-fuel pool. (See the answer to Question 90.) The water shields the radiation. (A shield is a barrier that reduces the intensity of radiation.)

Q.100. Are waste-handling facilities at TMI constructed to prevent radiation leakage?

A. Yes. The facility 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. On top of each cell holding a liner (or liners) is a ?-ft-thick, rectangular concrete plug, weighing 16 tons. The facility will also protect stored materials from the freeze-thaw cycle and has a sump area to collect any leaks of liquid materials.

Q.101. Are the temporary waste-storage facilities able to withstand floods?

A. Yes. The facility is located south of the Unit 2 cooling towers and 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.102. What is <u>waste disposal</u> 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 repository.

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.103. Why can't radioactive wastes be stored permanently at TMI?

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.104. What disposal options are available for solid radioactive wastes from TMI?

A. At present, solid wastes with low concentrations of radioactivity are routinely shipped to the commercial low-level waste disposal facility at Richland, Washington. Waste disposal sites for radioactive materials with high concentrations of radioactivity are still under consideration by the Department of Energy and the U.S. Congress. Spent-fuel assemblies and other high-level radioactive materials will be stored temporarily at TMI until other storage facilities are constructed or until a high-level waste repository is licensed.

Q.105. How many truck shipments will be necessary before the cleanup is finished?

A. NRC estimates that from 660 to 1700 shipments of solid radioactive wastes will be necessary. These estimates assume "best-case" (660 shipments) and "worst-case" (1700 shipments) conditions.

Q.106. How have wastes been shipped off site up to this time?

A. All waste shipments from TMI have been by truck. We anticipate that future shipments will be made by truck also.

Q.107. Would rail transportation ever be used?

A. Rail shipment probably would be preferable when shielding for materials with high concentrations of radioactivity requires large, heavy shipping containers and when rail spurs for unloading are located near the storage or disposal facility.

Q.108. What is the destination of these wastes?

A The commercial low-level waste disposal facility at Richland, Washington.

Q.109. How long is the route from TMI to Richland, Washington?

A. Approximately 2300 miles.

Q.110. What route is being used for trucks transportng radioactive wastes through the Middletown-Harrisburg area?

A. Currently the trucks go north from TMI 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. The map on the following page shows this route.

Q.111. Is NRC the only federal agency responsible for the safety of radioactive waste shipments?

A. Transportation of radioactive materials within the United States is regulated by both NRC and the U.S. Department of Transportation.

Q.112 How are responsibilities for shipments divided between these agencies?

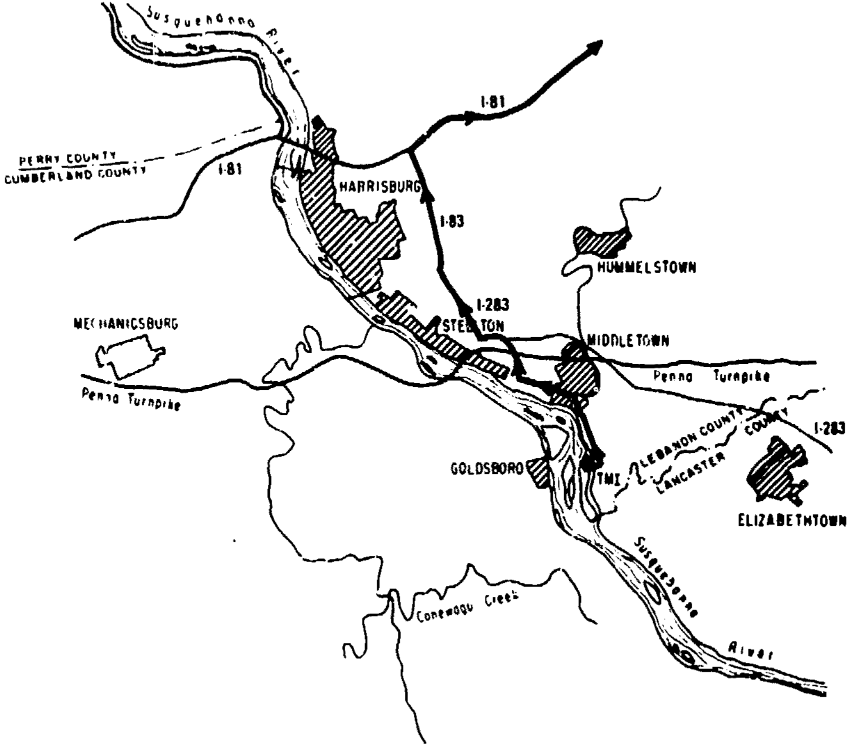
A. NRC has basic responsibility for packaging nuclear materials so the radiation is adequately controlled.

The Department of Transportation has basic responsibility for all facets of transportation, such as truck safety, schedules, and other rules governing materials in transit.

Q.113 What basic NRC requirements must be met for packaging nuclear materials.

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 specify quality-assurance, testing, and record-keeping requirements.

TRANSPORTATION ROUTE FROM TMI THROUGH HARRISBURG AREA



Q.114. What notification will be given of routes to be taken by trucks transporting nuclear wastes?

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

Q.115. How much radiation will members of the public be exposed to during routine truck shipments of wastes from TMI?

A Three groups from the public would be exposed to 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 2/1000 (0.002) and 6/1000 (0.006) millirem; persons in other vehicles along the route could receive 1/10 millirem; a person standing three feet from a loaded truck for three minutes could receive 1-1/3 (1.3) millirems.

Naturally occurring background radiation in the U.S. ranges between 70 and 310 millirems per year.

Q.116. Would the most-exposed member of the public, the onlooker next to a stopped truck, be likely to die of cancer or pass on genetic defects to offspring as a result of this exposure?

A. The probability or risk that this exposure (or dose) would cause death by cancer is approximately 17/100 (0.17) in one million. This probability should be compared with public health statistics which indicate that one person in five 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 34/100 (0.34) in one million. In the U.S. the natural occurrence of hereditary disease in offspring is about one in 17.

Q.117. Are accidents likely to occur if between 660 and 1700 shipments are made?

A. Accidents are possible. By using accident-rate calculations that assume unfavorable driving conditions, NRC estimates that one accident could occur every 250 shipments.

Q.118. Could radioactivity be released as a result of a shipping 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 this type of accident, NRC assumed that a container of radioactive materials would be ruptured and that a fire or explosion would follow, releasing 20% of the contents to the atmosphere.

The amount of radioactivity released would depend on the type of container involved in the accident. In the "worst-case" accident calculated, 20% of one curie would be released (200 millicuries).

Q.119 How much radiation would the public be exposed to from this "worst-case" accident?

A. A person several hundred feet away would receive about 8.5 millirems of total-body radiation. This dose should be compared with naturally occurring background radiation of about 116 millirems in the area around Three Mile Island.

Q.120. Will shipments of nuclear wastes be blocked by state or local regulations?

A. Carriers of nuclear wastes are required to comply with all pertinent state and local regulations that apply to the transportation of nuclear materials. At present, such regulations do not hinder waste shipments to Richland, Washington.

POTENTIAL ENVIRONMENTAL IMPACTS ON THE PUBLIC

Q.121. What amounts of radioactive gases and airborne particles may be released to the environment during the cleanup?

A. In addition to approximately 43,000 curies of krypton-85 already released from the reactor building, the maximum estimated amounts of airborne gases and particles that could be released over the total cleanup period, which is estimated to last at least five to seven years, are: 560 curies of tritium; 0.0047 curies of cesium-134; 0.052 curies of cesium-137; 0.01 curies of strontium-89; and 0.025 curies of strontium-90. These quantities do not exceed those commonly released annually by a light-water power reactor of this size during normal operations.

Q.122. How will the public be exposed to radiation from cleanup operations?

A. Individuals off site could receive very small doses through inhalation (breathing), eating fish and agricultural products, drinking water, swimming, and direct radiation. The most likely offsite doses from cleanup operations would come from breathing or skin contact with radioactive gases.

Members of the public could also received small doses by direct radiation from trucks carrying radioactive wastes to disposal sites.

Q.123. What is the maximum radiation dose that could be received offsite from anticipated releases during decontamination activities?

A. The maximum total-body dose to any individual who resides near the site would be in the range of 0.96 to 1.6 millirems over the entire cleanup period of five to seven years. During that period the person would receive about 580 to 812 millirems from natural background radiation. (Natural background radiation in the Middletown area is approximately 116 millirems per year - about 36% from cosmic radiation, 39% from terrestrial radiation, and 24% from materials within our bodies.) The average dose received by individuals within 50 miles of TMI would be approximately 0.0027 millirem, and the total cumulative dose to 2.2 million persons within a 50-mile radius of TMI is anticipated to be about 6 person-rems. (See the answer to Question 134 for an explanation of person-rem.) This is an insignificant amount compared to 1,275,000 to 1,785,000 person-rems that will be received by the same population over the cleanup period of five to seven years from naturally occurring background radiation.

Q.124. Since children may be more sensitive to radiation than adults, will these amounts be more harmful to children?

A. These amounts are not harmful to anyone. The calculations used to arrive at these risk estimates take into account the fact that children and fetuses are more sensitive to radiation than adults.

Q.125 What are the chances of cancer fatalities and genetic abnormalities from decontamination activities?

A. For an individual offsite who receives the maximum expected total-body dose of 1.6 millirems, the lifetime additional risk of fatal cancer is about 2.2 in ten million and the risk of genetic effects to offspring of the exposed individual is about 4.2 in ten million. These risks are small compared with public health statistics which indicate that one person in five 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 one in 17.

Q.126. How does NRC ensure that public health and safety are protected during the cleanup?

A. NRC is responsible for the regulation all TMI-2 cleanup operations to assure the health and safety of the public. The NRC staff performs the following functions to carry out this duty:

- o oversees day-to-day licensee activities to ensure that operations are implemented according to plans approved by NRC.

- o analyzes and reviews licensee-proposed actions and procedures,
- o approves or disapproves licensee-proposed actions and procedures,
- o informs state and local governments and the public on the status and plans for cleanup activities,
- o obtains information about and evaluates current facility status,
- o prepares technical review documents on the safety and environmental impact of proposed licensee cleanup actions,
- o advises the NRC Commissioners on major cleanup actions that require Commission decisions.

Independently of these actions, the Environmental Protection Agency monitors the area around Three Mile Island for radioactive releases. (See the answers to questions 141-145.)

POTENTIAL PSYCHOLOGICAL, SOCIAL, AND ECONOMIC EFFECTS

Q. 127. What are the probable psychological consequences of cleanup activities at TMI Unit 2?

A. The overall stress associated with cleanup activities should be well below that experienced by residents during the March 28, 1979 accident. Fears of accidental releases of radioactive gases from the reactor building should be relieved now that most of the krypton has been released from the building. Low levels of stress will probably continue to exist during the remaining cleanup activities, although no long-term psychological effects on the majority of people in the community are anticipated. However, the long-term nature of the cleanup may have chronic stress consequences for some people.

Q. 128. How could agriculture be affected by cleanup activities?

A. If the cleanup proceeds as expected, the direct effect of decontamination activities on farmers should be nonexistent. However, accidental radioactive releases, whether or not these releases actually affect 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.

Q. 129. Will local government services and facilities be affected by people moving into communities to work on the decontamination of TMI-2?

A. With the exception of traffic and road conditions, community services appear to be adequate if incoming workers avoid concentrating their households in a single jurisdiction or service district. Increased road use by commuting workers and trucks would accelerate deterioration of road beds and surfaces and might require additional personnel for traffic control.

Q.130. Could tourism in the region be adversely affected by the cleanup?

A. Tourism, which is important to the region's economy, might be harmed by the cleanup in two ways. First, competition by transient workers for temporary quarters during the tourist season could adversely affect both price and availability of hotel and motel rooms. Second, a release of radioactive material perceived to be threatening to human health and safety during the tourist season could have a negative effect for the remainder of the season. NRC considers such a release to be a remote possibility.

Q.131. Will the cleanup affect real estate values near TMI?

A. By August 1979, real estate values had improved from their depressed level of the preceding four months and this improvement has continued to the present. The staff believes that incoming cleanup workers will have a positive effect on sales and prices. Barring an accidental release of radioactive material or a planned release which is perceived to be lifethreatening, the local real estate market should continue to reflect the positive effects associated with relocating cleanup workers and their families.

POTENTIAL ENVIRONMENTAL IMPACTS ON WORKERS

Q.132 Will workers doing the actual cleanup receive any radiation doses?

A. Yes. Occupational doses received by the TMI work force are the major environmental impact associated with the cleanup.

Q.133. Which portion of the routine cleanup could result in the highest risk of radiation exposures to workers?

A. Decontamination of the reactor building would contribute the greatest fraction of the total dose workers receive. Estimates are that decontaminating the reactor building will result in cumulative doses to workers ranging from 1400 to 7000 person-rems.

Q.134. What is a person-rem?

A. Person-rem refers to the sum of individual radiation doses received by members of a certain population group, in this case workers involved in the cleanup. It is calculated by multiplying the average dose per person by the number of persons in a group. For example, a thousand people each exposed to 1 millirem (1/1000 rem) would have a cumulative dose of 1 person-rem.

Occupational exposures at TMI will be spread among a large number of workers over the course of cleanup activities.

Q.135. Do NRC regulations spell out how much radiation a worker can receive?

A. Yes. NRC Regulations (Title 10, Code of Federal Regulations, Part 20 "Standards for Radiation Protection") state that individual workers can receive no more than 3 rems over a three-month period.

Q.136. Will NRC make exceptions to its regulations to allow workers to receive higher exposures during cleanup activities?

A. No.

Q.137. Does the licensee also have radiation-exposure limits for workers?

A. Yes. The licensee has established administrative limits to ensure that NRC regulations are not violated. Essentially all individual workers will be limited to 1 rem every three months, or 1/3 the limit permitted by NRC. Those workers whose jobs require exposures of 1 or 2 rems in three months must obtain written authorization from the radiation protection supervisor (RPS). In very rare cases where workers could receive 2 to 3 rems for a three-month period, written authorization must be obtained from the RPS and unit supervisor. The licensee must also comply with NRC regulations that radiation exposures to workers be kept as low as reasonably achievable and that detailed exposure records be maintained.

Q.138. What are the added health risks from radiation exposures to an individual worker present for the entire cleanup who received the maximum allowable dose?

A. The most a worker could receive would be 84 rems, based on the regulatory maximum of 3 rems per quarter and estimating a seven-year cleanup period. At this dose, the chances of contracting fatal cancer are 1 in 100 and the chances one's offspring will have a genetic defect are 2 in 100. However, it is not likely that an individual worker would receive this total dose. Because of licensee restrictions and "as low as reasonably achievable" practices regarding radiation exposures, such an individual would be more likely to receive a maximum total dose of 28 rems over seven years, or one rem per quarter. At these exposure levels, the chances of cancer are 3 in 1000 and of genetic effects 7 in 1000.

To put these risks in perspective, public health statistics indicate that one person in five in the United states will probably die of cancer (from causes other than radiation from nuclear power plants) and that the natural occurrence of genetic effects is about 1 in 17.

Q.139. What are estimated health risks for the total work force involved in the cleanup?

A. Health risk estimates are based on radiation exposures that would range from 2,700 (minimum) to 12,000 (maximum) person-rems over the length of the cleanup. (This range of exposures is large because of the lack of precise information about levels of radiation throughout the reactor building and because actual cleanup alternatives have not yet been selected.) Assuming the minimum dose (2,700 person-rems), less than one cancer fatality (0.35) and less than one genetic effect would be likely to occur. Assuming the maximum dose (12,000 person-rems), 1.6 additional cancer fatalities and 3.1 additional genetic effects could be expected to occur in the worker population and their offspring, respectively.

These estimates are based on a 1972 report of the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation (BEIR). The BEIR committee recently revised these risk estimates downward by 50 to 60%. Accordingly, the estimate of maximum cancer fatalities would be reduced from 1.6 to somewhat less than 1.

Q.140. Have recent entries into the reactor building provided information that would show potential exposure estimates to workers are too high or too low?

A. The first three entries to the reactor building indicated that radiation exposures were lower than estimates used in the PEIS. However, certain crucial areas in the building that are expected to be difficult to decontaminate have not yet been surveyed. Thus, revising the exposure estimates either up or down at this time would be premature. All available sampling information will be used to calculate potential occupational exposures as the final PEIS is being prepared.

RADIATION MONITORING DURING THE CLEANUP

Q.141 Will radiation monitoring be conducted around TMI during cleanup activities?

A. Yes. The licensee's comprehensive radiological monitoring program includes sampling of air, milk, water, fish, aquatic plants, sediments, miscellaneous food products, and exposure rates in the areas away from the site to a distance of 15 miles. Additional monitoring in the area is performed by the U.S. Environmental Protection Agency, the Commonwealth of Pennsylvania, the state of Maryland, the U.S. Nuclear Regulatory Commission, and the U. S. Department of Energy. EPA operates a network of 18 continuous air-monitoring stations within a seven-mile radius of TMI. Samples from these stations are analyzed typically three times a week.

Beginning in early April 1979, the State of Maryland, Department of Natural Resources, began monitoring fish and sediment from the Susquehanna River at Falmouth (one mile downstream from TMI), at several locations near and downstream from Safe Harbor Dam and Holtwood Dam, and in the Conowingo Pond. They have also monitored the Chesapeake Bay at several locations from the mouth of the Susquehanna River to about Worton Point south of the Sassafrus River.

Q.142. Why are all these agencies involved in the monitoring?

A. At the time of the accident, various agencies were called upon to provide their expertise in analyzing the resulting situation. Those agencies still involved have continuing responsibilities to determine long-term effects. Their monitoring programs are coordinated to assure that all necessary data are collected and analyzed.

Q.143. Will a central agency correlate all air, water, and biological monitoring data.

A. Yes. As directed by the President, the U.S. Environmental Protection Agency (EPA) has that responsibility.

Q.144. Will monitoring information be available to the public?

A. EPA makes monitoring information available for inspection at its office in Middletown, Pennsylvania. The results of the monitoring program are reported weekly by EPA to the news media. News releases on monitoring activities are also issued by Metropolitan Edison Company and NRC.

Q.145. Are private citizens involved in the monitoring?

A. Yes. The U.S. Department of Energy and the Commonwealth of Pennsylvania sponsor a monitoring program by 50 citizens in 12 communities within an approximate five-mile circle around TMI. During the purging of krypton gas from the reactor building, the readings made by these persons were collected daily. Currently, these readings are made twice a week, and the Pennsylvania Department of Environmental Resources is informed of the results.

ACCIDENTS THAT COULD OCCUR DURING THE CLEANUP

Q.146. **What types of accidents could occur during the cleanup which would affect the public?**

A. The accidents identified by NRC that could occur during the cleanup range from a leak in the reactor vessel (extremely unlikely) to a fire in a barrel of contaminated trash (somewhat more likely). Other types of accidents that could occur include the failure of a filter in the ventilation system, a leak in a tank of contaminated liquid, a leak in a tank of processed water in which tritium is essentially the only radioactivity, and a leak of contaminated water from the reactor building through ground water to the Susquehanna River.

Q.147. **What would occur if a truck containing radioactive materials were to have an accident?**

A. Most transportation accidents would not result in doses to the public because of stringent packaging requirements for transport of radioactive materials. For a worst-case situation, a container with radioactive materials was assumed to rupture in a fire or explosion resulting from the accident. The chance of such an accident is about one in one million. An adult located several hundred feet away would receive a total-body inhalation dose of 8.5 millirems.

Q.148. **What kind of accident would expose the public to the greatest amount of radiation if it occurred?**

A. For the worst-case accident, NRC assumed that all contaminated water in the reactor building leaked into groundwater and reached the river. Under these conditions, the water would not reach the river for 1½ years and, while in the ground, absorption, filtration, and other natural processes would remove a large portion of radioactive materials from the water. As it reached the river, the water would be diluted as it moved downstream. Persons who drank about two quarts of this water daily for a year after it entered the drinking water intake nearest TMI would receive an accumulated dose of 31 millirems per year. A person who consumed about 46 pounds of fish per year taken from this section of the river could receive an accumulated dose of 27 millirems.

The likelihood that this volume of water would ever reach the river is extremely low, since most of the water in the reactor building could be transferred to tanks if a leak were detected. If necessary, an underground dam (a grout curtain) could be installed down to bedrock between the reactor building and the river to stop the leak.

Q.149. What doses to the public could result from other types of accidents?

A. A leak from the reactor vessel into the reactor building could lead to slowly uncovering and overheating the core while the reactor coolant system is open. Melting of about 20% of the core might occur, but the building would be isolated during the long time that would be available to take action. Consequently, essentially all the fission products would be retained in the building.

This sequence of events would lead eventually to the need for controlled purging of krypton-85 gas from the building to the environment, as occurred in July 1980. If all the krypton remaining in the core (about 51,000 curies) were released, the estimated skin dose to the most-exposed individual off site would be approximately 10 millirems and the total-body dose would be approximately 18/100 (0.18) millirem. The krypton is contained in metal-clad fuel assemblies which would have to be ruptured before the krypton was released.

STAFF CONCLUSIONS ABOUT BENEFITS AND RISKS

Q.150. Has the staff concluded that the benefits of the cleanup outweigh the risks?

A. Yes. The staff has concluded that, on balance, the benefits of full decontamination, fuel removal, and disposal of the radioactive wastes greatly outweigh the environmental costs of the cleanup.