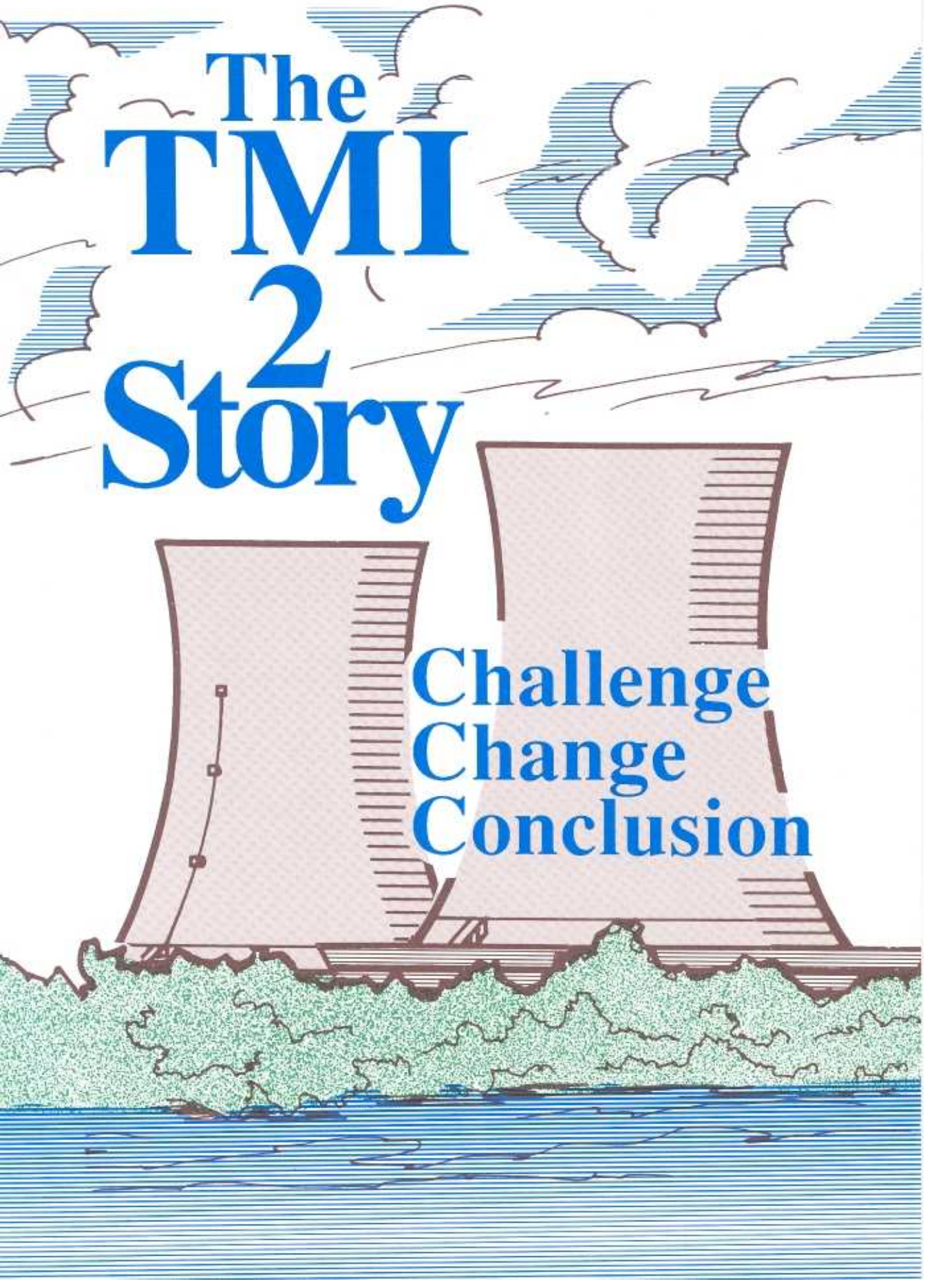
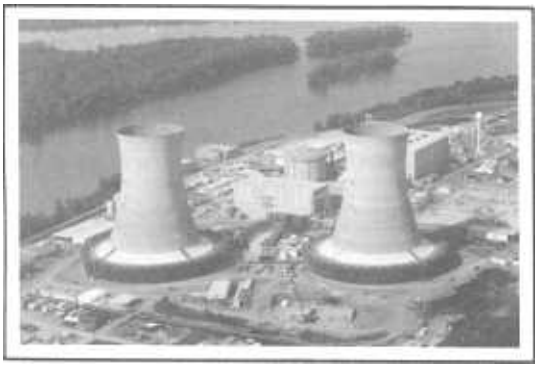
The TMI 2 Story



Challenge
Change
Conclusion

INTRODUCTION



Three Mile Island Unit 2

There was an accident at Three Mile Island Unit 2 on March 28,1979. It caused extensive damage to the plant's nuclear fuel core. Most of the plant's major systems were relatively undamaged.

Since 1979, there has been a large scale Cleanup Program to remove radiological hazards to the public from TMI-2. It's been difficult and costly because such work had never been done before. But the end is in sight and TMI-2 is moving toward Post Defueling Monitored Storage.

TMI-2 no longer is a nuclear power plant. When TMI-2 goes into monitored storage, GPU Nuclear Corporation will have completed all of the cleanup necessary to protect the public, TMI workers and the environment.

Essentially all of the nuclear fuel will have been removed from the plant. There will be no possibility of a nuclear chain reaction or hazardous radiation releases to the environment. The reactor building will be locked and will be monitored by a full-time staff that will make regular reports to the Nuclear Regulatory Commission, the Commonwealth of Pennsylvania and the public.

Making TMI-2 safe, stable and secure has been a story of step-by-step progress in the face of unprecedented challenges. Lessons learned are contributing to the safe operation of TMI-1 and to nuclear plants around the world.

The TMI-2 Accident

On March 28, 1979, TMI- 2 was operating at about 100 percent power when the plant automatically shut down due to a feedwater pump that stopped operating. Pressure and temperature increased in the reactor, causing a relief valve to open. The valve opened as designed, and water and steam began flowing out of the reactor to a tank in the basement of the reactor building.

As temperature and pressure returned to normal, the valve should have closed. But, unknown to the operators, the valve stuck open. It remained open for over 2 hours, allowing coolant water that covered the fuel core to escape from the reactor system. Eventually, this radioactive water ended up on the basement floors of the reactor and auxiliary buildings.

Without the coolant water, temperatures increased in the reactor. Eventually, temperatures became so hot that some of the uranium fuel melted.

With the valve closed, operators discovered that coolant water had been lost from the system. The reintroduction of coolant water back into the system helped cool the reactor. The cold water also shattered some of the extremely hot fuel rods. There was no other large scale physical damage to the plant.

Most of the radioactivity was contained in the plant. There was no access to the reactor building or to significant portions of the auxiliary and fuel handling buildings. Nearly a million gallons of contaminated water had collected in the basements of the reactor and auxiliary buildings.

Engineers needed access to these areas to collect vital information to develop the Cleanup Program. As work progressed and as more was learned about plant conditions, the scope of the Cleanup Program would become clearer.

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Cleanup Begins

The company assembled a cleanup organization, drawing on the expertise of its own people, contractors and nuclear experts from around the world.

Removal of contaminated water was the first major decontamination task and access to the plant's auxiliary building and vital support systems was regained. By the end of 1979, 500,000 gallons of the water had been pumped from the auxiliary building basement and processed.

The reactor building presented a more difficult challenge. During the TMI-2 accident, the building proved to be a very effective barrier against the release of radioactivity to the outside world. That had made the building's interior extremely contaminated.

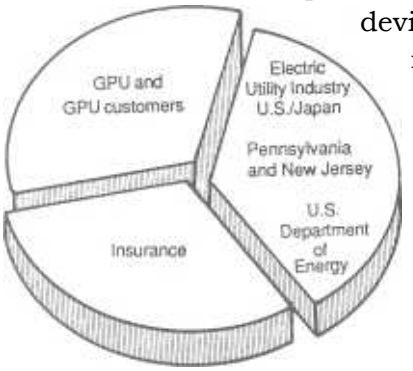
A significant amount of Krypton 85 gas had accumulated in the reactor building. This gas, which is chemically inert, would have to be removed before technicians could enter the building safely. In the summer of 1980, with approvals from the Nuclear Regulatory Commission, Pennsylvania Governor Dick Thornburgh and the scientific community, the gas was safely vented to the atmosphere. This cleared the way for manned entries into the reactor building in July, 1980.

Workers enter reactor building through an air-tight door.

TMI-2 Reactor Building

Cleanup Funding

By this time it was clear the cleanup would be a long term and expensive program. Funding the cleanup was another unique challenge. In 1981, Governor Thornburgh devised a plan that would share the estimated $1 billion cost among the company and its customers, the states of Pennsylvania and New Jersey, and the U.S. nuclear industry. The U.S. Department of Energy contributed funds for research and development. The Japanese nuclear industry also agreed to contribute toward research and development work associated with the cleanup.



TOTAL: $1,000,000,000

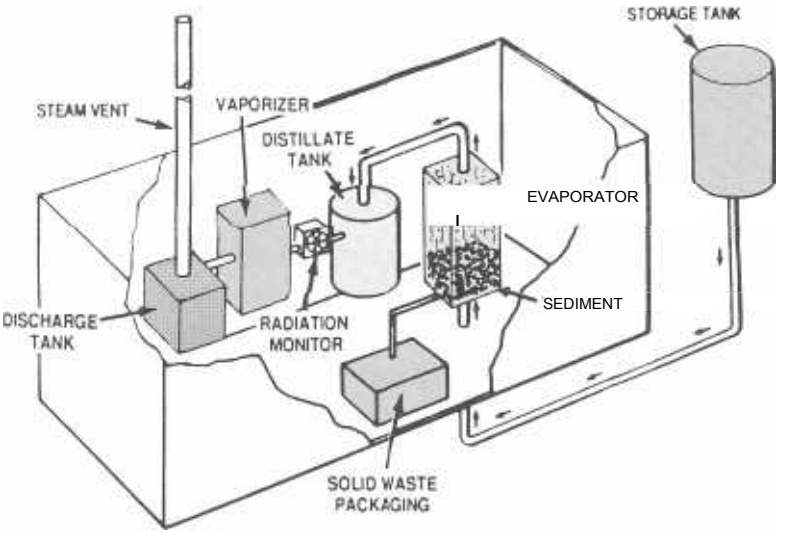
Reactor Building Basement Water

One of the early tasks facing engineers was the hundreds of thousands of gallons of highly radioactive water that had spilled into the reactor building basement. This water was a potential hazard to cleanup workers and the environment.

GPU Nuclear engineers directed the design and construction of a new water processing unit called the Submerged Demineralizer System (SDS). It worked much like a home water softener and removed most of the radioactive material from the accident water.

Solid waste produced in the processing of this water was shipped from Three Mile Island to Department of Energy research laboratories. Two specially designed tanks were built to store the processed water pending Nuclear Regulatory Commission approval to dispose of the water.

TMI-2 PROCESSED WATER EVAPORATOR



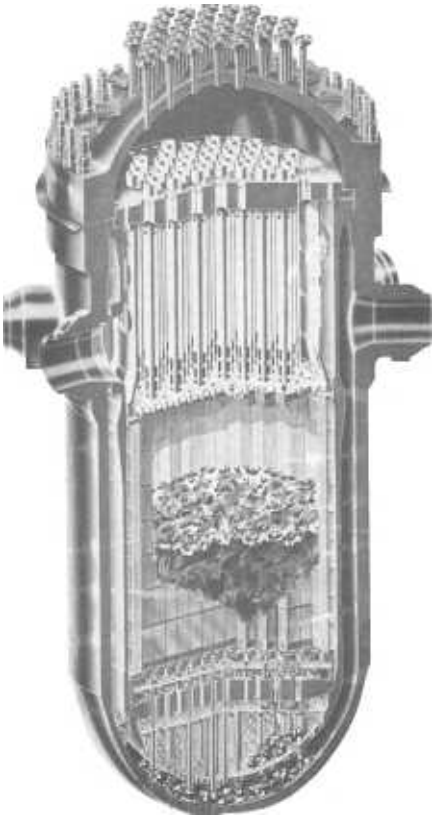
Disposal of the Processed TMI-2 Water

The processed accident water has been stored in tanks at Three Mile Island. After carefully evaluating alternatives, including river disposal, the company proposed to slowly evaporate the water over about a two year period. Federal requirements for protecting public health would be met by a wide margin. The average total additional radiation exposure to the public would be about the same as one to two hours of natural background exposure experienced in the Harrisburg area. The disposal issue is pending with the Nuclear Regulatory Commission.

Reactor Building Decontamination

Other areas of the reactor building were being cleaned. Contamination was washed from the floors, walls, pipes and other areas using high pressure water sprays. Contamination was also removed from concrete using air operated chisels and hydraulic pounding machines to break up the top layer of concrete.

Specially designed robots were sent into high radiation areas to do decontamination work and obtain information on physical and radiological conditions.



Damaged TM!-2 fuel core

Damaged Fuel Core

All of the decontamination work was in preparation for the biggest task of all - removal of the damaged fuel core from the TMI-2 reactor vessel. In the summer of 1982, camera inspections established there was a void where the top five feet of the fuel core had collapsed into a bed of rubble. Later camera inspections inside the reactor vessel confirmed the existence of another bed of rubble at the bottom of the reactor. Samples and video inspections enabled scientists to conclude for the first time that some of the fuel had melted during the accident.

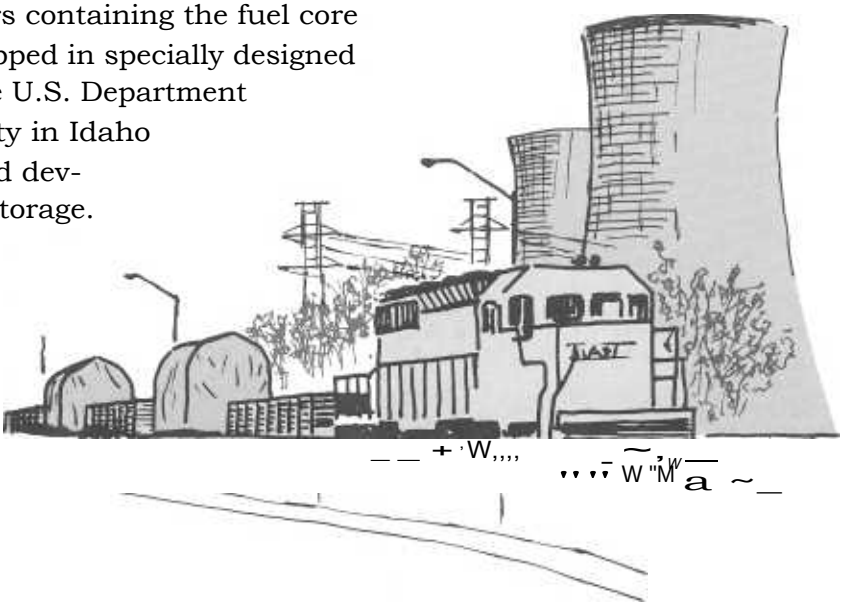
The information gathered from these inspections was also applied to the training of defueling operators and the development of new tools and equipment. Operators trained for several months on a full-scale defueling work platform constructed outside the reactor building. They practiced using 35-foot long handled tools that were made exclusively for the defueling of TMI-2.

By May, 1985, there was direct access to the damaged fuel core. While specially designed defueling equipment was being installed, operators were being trained to remove the fuel material. The training and decontamination work reduced radiation exposure to levels that compared with levels in the refueling of a normal operating plant.

Removal of the fuel core debris began in October, 1985. Like many other aspects of the cleanup, the removal of the damaged fuel core was a first-of-a-kind challenge. Using the long-handled tools, operators were guided by a television monitoring system as they remotely loaded canisters with fuel debris. For a period in 1986, defueling progress was delayed because of poor water clarity. At times, workers had less than one-inch of visibility. After extensive research, a team of engineers developed filtration methods and chemicals that cleared the water without harming the reactor system components.

Defueling operators use special tools and electronic guides to *defuel reactor vessel.*

The canisters containing the fuel core debris were shipped in specially designed rail casks to the U.S. Department of Energy facility in Idaho for research and development and storage. Important new information on the nature of the accident was produced from the evaluation of the fuel debris.



The Next Step Post Defueling Monitored Storage

When the Cleanup Program is completed, targeted for the spring or summer of 1989, TMI-2 will be placed in Post Defueling Monitored Storage (PDMS). PDMS will mark the successful achievement of the Cleanup Program goal, which is to remove any radiological hazard to the public, TMI workers and the environment.

GPU Nuclear has been submitting criteria and requirements for monitored storage to the Nuclear Regulatory Commission (NRC). During monitored storage, the reactor building will be locked, but accessible for monitoring by a full-time GPU Nuclear staff.

When PDMS is in place:

- TMI-2 will not be a hazard to the health or safety of the public, the workers or the environment.
- About 100 metric tons of damaged fuel and 50 metric tons of damaged reactor internals will have been collected and shipped off-site for research and disposal. There will be no potential for nuclear criticality or for a hazardous release of radioactivity to the environment.
- Radioactive waste will be packaged and shipped off-site for disposal at a licensed, low-level waste facility; or will be awaiting shipment.
- 0 Radioactivity will be removed or reduced to levels that permit workers safe access for maintenance and monitoring activities in all parts of the plant except the reactor building basement.

Under PDMS, TMI-2 will provide assured protection of public health and safety as a result of:

1. Inherent stability -the plant will not be prone to transients or accidents because there will be:
   - insufficient fuel to support a nuclear chain reaction
   - few combustibles
   - no water in plant systems and equipment

2. Effective containment - residual fuel and radioactivity will be isolated from the public and the environment within rugged protective structures, including:
   - closed piping systems
   - closed cubicles
   - seismic and tornado proof structures

   a enclosed and secured containment buildings

3. Positive monitoring and control including:
   - monitoring (both in plant and in environment)
   - accessibility to the plant
   - protective systems

During PDMS, trained and qualified personnel will be conducting the following maintenance and inspection activities on a regular basis:

- Inspection and monitoring
- Verification of containment systems
  Equipment surveillance
- Routine waste processing
  Waste handling and shipping
- Periodic operation of required systems
  Emergency response (e.g. fire or personnel injury)
- Radiological controls
- Environmental monitoring
- Security
- Quality Assurance
- Records management
- Licensing
- Engineering and analysis
- Communications

Lessons Learned from the TMI-2 Accident

Much has been learned from the TMI-2 accident. As a result, many changes have occurred throughout the industry. Most of the lessons have been related to people. Improved training, better human factors engineering and increased staffing are just a sampling of some of those changes.

At TMI-1 the people lessons were reflective in the formation of the GPU Nuclear Corporation in 1982 and the increase in personnel dedicated to the operation of the plant.

TMI-1 operators training on $18 million Replica Simulator

The training program has been improved and expanded. TMI-1 control room operators are on a six-shift rotating work schedule. This enables each crew to participate in training one week out of every six. Much of the training is done on an $18 million full-scale replica simulator of the TMI-1 control room.

The nuclear industry also implemented a number of technical modifications at operating reactors to increase the margin of plant safety. Emergency procedures were more sharply focused. At TMI-1, over 100 modifications were done to the plant and over $95 million was spent in response to the accident.

HEALTH STUDIES

At least 10 major official studies have assessed the radiation releases of the accident. They concluded that the releases were too small to significantly affect the people and the environment around the plant.

Major Conclusion of Studies:

Radiation exposures to the public from the TMI-2 accident were a small fraction of the annual radiation exposure most people receive each year of their lives from natural background radiation and medical treatment. For reference, people living in the Harrisburg, PA area each year receive about 360 millirems of radiation from natural and man-made sources.

- The average radiation exposure from the accident to individuals within 10 miles of TMI was about 8 millirems. (A chest x-ray is about 10 millirems.)
- The average radiation exposure to individuals within 50 miles of TMI was less than 1.5 millirems.
- Health effects, if any, from the accident have been and will continue to be too small to be measurable.

The Future of TMI-2

TMI-2 is not included in the company's present energy supply plans. No funds are presently being expended to preserve the plant or equipment for future use.

Keeping You Informed

As TMI-2 moves toward monitored storage, GPU Nuclear is committed to keeping the public informed. Speakers are available for clubs and organizations; there are plant tours for the public, and briefing programs are available at the Visitors Center.

Briefings are held daily In the auditorium of the TMI Visitors Center.

If you would like more information about TMI call (717) 948-8829.

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TMI-2 **Backgrounders - Pamphlets prepared on various subjects by GPU Nuclear Corporation:**

TMI-2 Research

TMI-2 Cleanup Funding

Radiation and Health Effects

Major Studies of TMI-2 Radiation Releases and Health Effects

Disposing of Processed TMI-2 Water

Post Defueling Monitored Storage (PDMS)

TMI-2 Cleanup Program - Update

TMI-2's Remote Machines

Lessons of an Accident - How GP U Has Responded to TMI-2

I f you are interested in receiving any o f the GPU Nuclear publications, call (717) 948-8829 or write to:

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