TMI Unit-2 Technical Information & Examination Program

UPDATE

April 15, 1980

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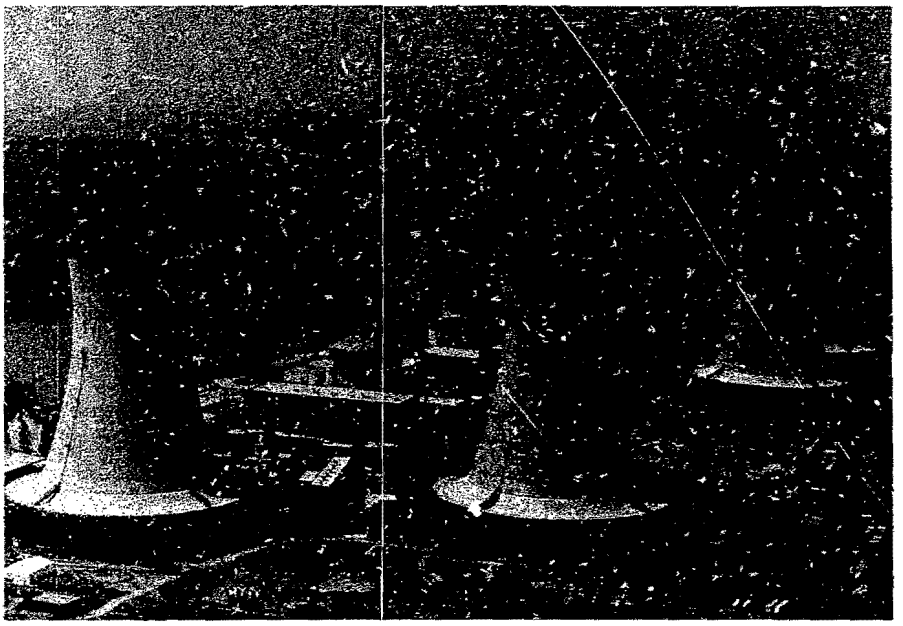
TMI Offers Unique Opportunity

Researchers are taking advantage of the unique opportunities offered by the TMI Unit-2 accident that occurred on March 28, 1979. Damage to the reactor core and the release of fission products within the system give researchers the opportunity to:

- measure the performance of instrumentation, electrical, and mechanical equipment within the reactor containment building during and after the accident,
- determine physical damage to surfaces, components, and equipment resulting from radiation exposure,
- assess core damage for metallurgical and physical behavior of fuel, clad, and core components during and after the accident, and
- assess new technological developments for decontamination and the disposal of radioactive waste.

These activities will add to current knowledge on light-water-reactor behavior following accidents involving core damage. The results could lead to improvements in plant safety, reliability, regulation, and operation. Also, the information will benefit those engaged in the design, construction, operation, and maintenance of nuclear power plants.



Three Mile Island—Location of the nation's most severe commercial nuclear power plant accident.

TMI Unit-2 Technical Information and Examination Program Update

This first publication of the *TI & EP Update* introduces the TMI-2 Technical Information and Examination Program.

The *Update* is specifically designed to highlight data and information obtained as a part of the TMI-2 Information and Examination Program. Since this is the initial *Update*, our intent is to provide an introduction of the program. The *Update* will be issued as sufficient data or information is obtained to justify publication. Only summaries will be provided in the *Update*; however, more detailed information will be available in a data bank which is currently under development. In a later *Update*, a procedure for obtaining this information will be outlined. We hope these mechanisms satisfy requirements of all interested individuals and organizations for data and information from this program.

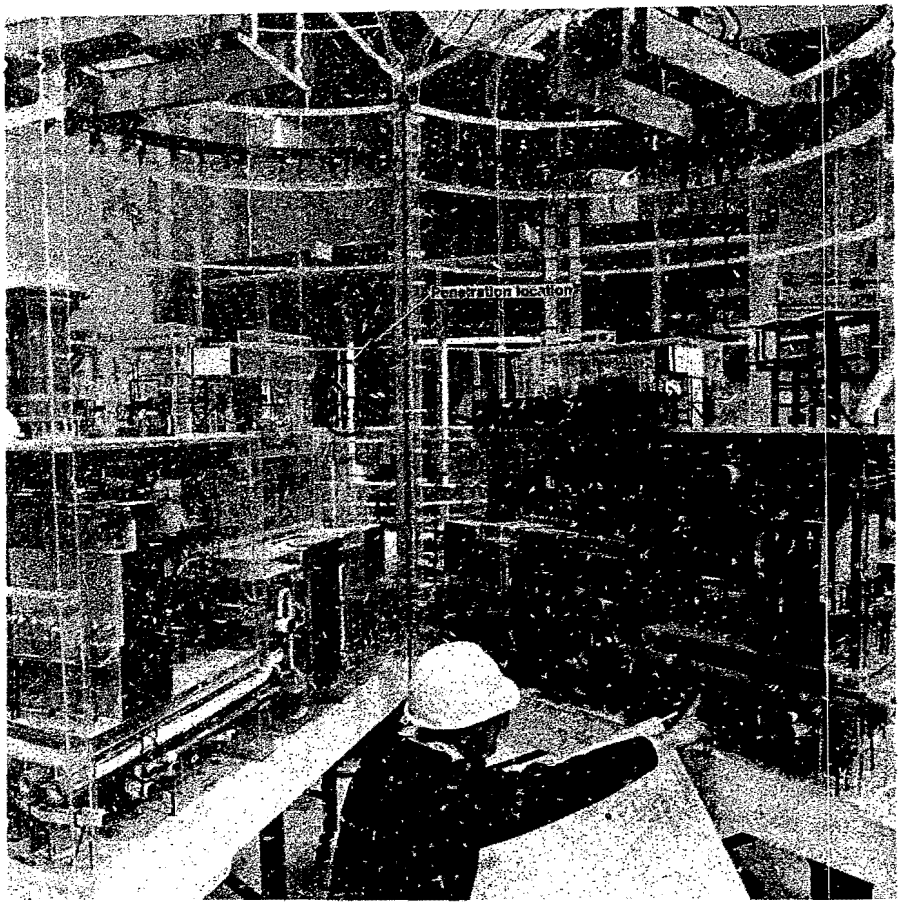
Interested individuals and organizations can obtain a complimentary subscription by filling out the form on the inside pages and mailing it to *TI & EP Update*, EG&G Idaho, Inc., P.O. Box 88, Middletown, PA 17057.

Participants Form Information and Examination Program; Seek Generic Data from Unit-2 Accident

Four groups, with a common interest in obtaining valuable generic information from the TMI Unit-2 accident, jointly established the TMI Unit-2 Information and Examination Program. The Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), the Electric Power Energy Research Institute (EPRI), and the General Public Utilities Company (GPU) signed a coordination agreement on March 26, 1980, which documents these common interests.

EG&G Idaho, Inc., has staffed the Technical Integration Office (TIO) which reports to Dr. Willis W. Bixby, the DOE Manager of the TMI Site Office. The TIO is responsible for the day-to-day management of the Information and Examination Program.

The TIO staff and their respective areas of responsibility are as follows: Harold M. Burton, EG&G Program Manager; Gregory R. Eidam, Radiation and Decontamination Technical Coordinator; Robert E. Holzworth, Mechanical Systems and Rad Waste Technical Coordinator; James W. Mock, Instrumentation and Electrical Systems Technical Coordinator; Dennis E. Owen, Fuels Technical Coordinator; Frank J. Kocsis, Configuration and Document Control Technical Coordinator; Joseph R. Kerscher, Planning, Scheduling, and Budgets Coordinator; Donna L. Morris, Material and Contracts Coordinator; and Marilyn R. Rehbogen, Secretary.



Model of TMI Unit-2 containment building shows penetration location.

Camera, Radiation Probe Explore Containment

Since the accident, the TMI Unit-2 containment building has been dark and inaccessible except through the eye of a small video camera.

On November 10, 1979, a nine-inch diameter hole was drilled through an inner flange of an existing spare penetration (see the photograph above), and a video camera, an associated strobe light, and a radiation probe were inserted into the containment through the opening. During that day, more than two hours of video taping was done. The camera, equipped with a zoom lens and capable of scanning 360 degrees, relayed good quality video tape information, but was limited in range and did not permit inspection of the water surface.

Radiation readings from the installed probe were taken on November 11, 1979. Gamma radiation levels were in the 3 to 5 rem per hour range, and beta radiation levels were in the range of 400 rems per hour.

At present, Metropolitan Edison Company is documenting the results and conclusions from the review of the tapes. Initial reviews do not show any structural damage. Final evaluation is forthcoming and preparations are being made for initial entry into the containment.

TMI Unit-2 Technical Information & Examination Program

UPDATE

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Coordinator ..... **F. J. Kocsis**

Editor ..... **D. M. Grigg**

Design ..... **L. E. Rockhold**

Secretary ..... **M. R. Rehbogen**

Manager ..... **H. M. Burton**

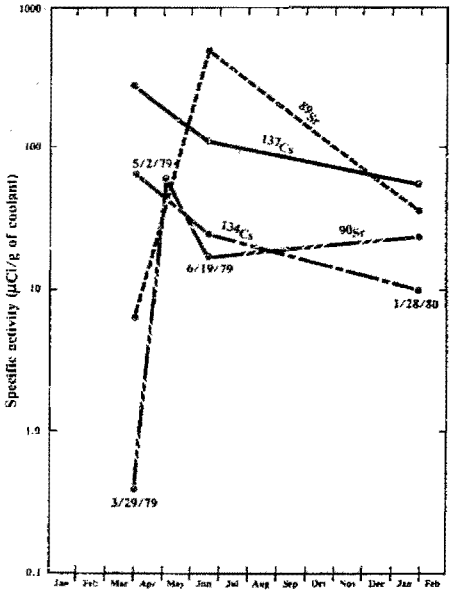
Manager ..... **W. W. Bixby**
DOE-TMI Site Office

B&W Samples Reactor Building

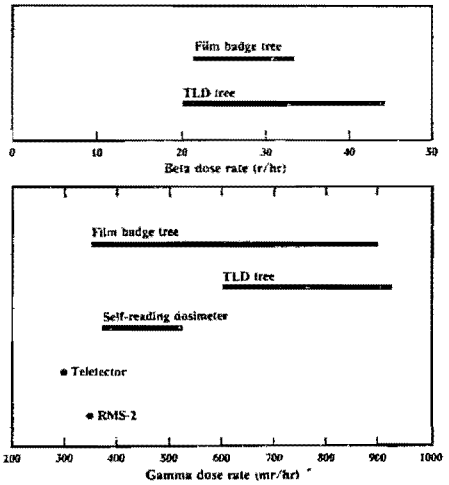
Reactor coolant has been sampled regularly since the TMI Unit-2 accident and then analyzed by Babcock & Wilcox for specific radioisotope activity. Data collected from the samples will be used in the fission product transportation and deposition task, part of the Technical Information and Examination Program. The graph below shows some sample results.

Babcock & Wilcox analyzed other samples in the reactor building such as the sump on October 20, 1979 (see the table to the right), and the air on February 13, 1980. The sample from the reactor building air documented specific radioisotope concentrations (e.g., ^{85}Kr activity of 1 μCi/ml, ^{134}Cs activity of $< 7 \times 10^{-6}$ μCi/ml, ^{137}Cs activity of $< 3.2 \times 10^{-5}$ μCi/ml).

The owner of TMI Unit-2, the General Public Utilities Company, measured the radiation in the reactor building on December 14, 1979, as one of the many preparatory steps for entry into the reactor, and to provide basic planning information for subsequent decontamination efforts. The measurements were performed through a shaft called Penetration R-626, using various instruments (see the chart below). The calculated dose rate to the skin, based on the observed beta dose in the building, lies within a range of 100 to 350 rad/hr.



TMI-2 reactor coolant samples reveal radioisotope concentrations.



Different instruments show dose rates inside the TMI-2 reactor building.

Reactor Building Sump Sample Analysis Results

Analysis		Result
Unfiltered:		
^{137}Cs	(μCi/g solution)	136
^{134}Cs	(μCi/g solution)	27
Filtrate:		
Na (ppm)		1250 ± 100
Cl (ppm)		10 ± 2
B (ppm)		1690 ± 40
pH		8.6 ± 0.2
^{90}Sr	(μCi/g solution)	4.8 ± 1.2
^{137}Cs	(μCi/g solution)	135
^{134}Cs	(μCi/g solution)	26
^{3}H	(μCi/g solution)	0.92
Gross Alpha	(μCi/g solution)	$< 1 \times 10^{-6}$
Gross Beta	(μCi/g solution)	149
Sr-89	(μCi/g solution)	37 ± 4
Filterable Solid (μCi/g solution):		
^{137}Cs		0.2
^{134}Cs		0.03
^{103}Ru		3.0×10^{-3}
^{140}La		8.0×10^{-3}
^{144}Ca		3.0×10^{-3}
^{95}Zr		1.0×10^{-3}
^{95}Nb		4.0×10^{-3}
^{54}Mn		7.0×10^{-5}

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Oak Ridge Analyzes "Cookie" from Containment Building

A disc (cookie) was cut from a shaft called Penetration R-626 in the TMI Unit-2 reactor containment building. Oak Ridge National Laboratory analyzed the 9-in. Type-304 "cookie" made of stainless steel.

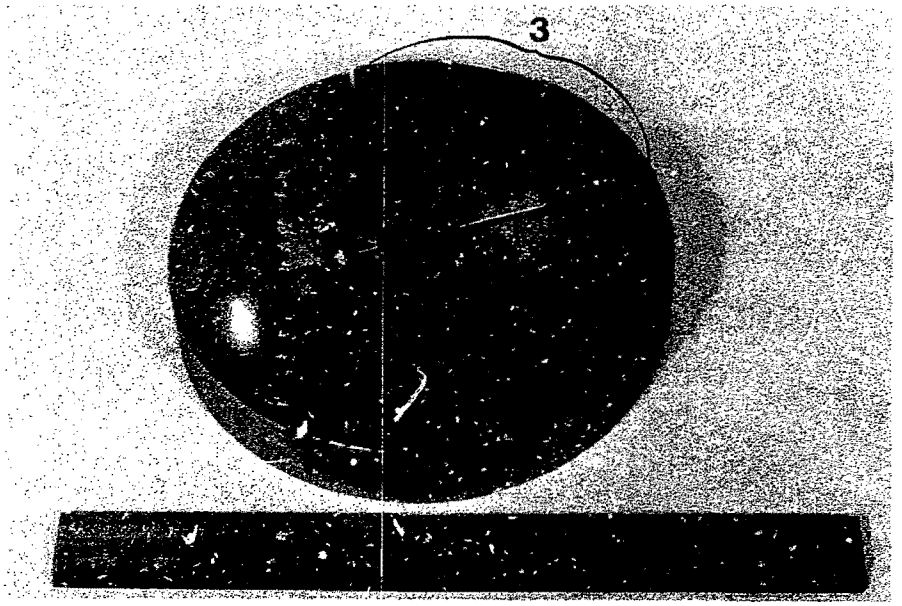
The test results indicated that significant amounts of surface contamination may remain following the decontamination process; however, the decontamination method described below reduced the background radiation levels due to surface contamination to about 1 to 2 mr/hr beta-gamma.

When Oak Ridge received the disc, the initial radiation readings were 80 mr/hr beta-gamma and 6 mr/hr gamma at 2 in. from the disc surface. See the table at the right for the analysis results.

The disc was cut into sections (refer to the photograph) for decontamination tests. The standard Bechtel Corporation Specification CP-952 decontamination series removed approximately 98% of the contamination from piece 3c. Wiping with dry cheesecloth removed approximately 38% of the activity from piece 3a, while wiping with wet cheesecloth removed 17% of the activity from piece 3b. The apparent inconsistency between the wet- and dry-cheesecloth methods may be due to nonuniform contamination levels on the disc surface.

Penetration R-626 Surface Contamination Results

Isotope	Total Activity on Disc (in μCi)	Average Contamination Level on Disc (in $\mu Ci/cm^2$)
^{60}Co	0.019	6.09×10^{-5}
^{134}Cs	2.68	8.4×10^{-3}
^{137}Cs	12.7	4.0×10^{-2}



Penetration R-626 "cookie" is sectioned for decontamination tests.

TMI Unit-2 Technical Information & Examination Program
UPDATE
EG&G Idaho, Inc. • P.O. Box 88
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TMI Unit-2 Technical Information & Examination Program

July 31, 1980

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Containment Airlock Door Freed

A small pin, which acts as a safety device, apparently caused the malfunction of the TMI Unit-2 containment door locking mechanism that prevented entry into the containment. On May 20, a two-man entry team spent 13 minutes trying to turn the containment door locking wheel before halting the effort (see photograph). TMI officials report that the pin has been freed, and the locking mechanism now appears to be operating properly.

Following extensive evaluation, a small hole was drilled into the containment door behind the pin, which freed the pin and allowed it to return to its normal position. TMI officials believe that corrosion may have frozen the locking mechanism.

Proper operation of the locking mechanism has since been verified, and the containment was entered on July 23. Information obtained during the containment purge and early entry will be reported in a future issue of the *TI&EP Update*. TMI officials stress that the airlock door can still be shut and sealed.

TMI Unit-2 containment door-locking mechanism malfunction aborted first entry attempt

The **TI&EP Update** *is specifically designed to highlight data and information obtained as part of the TMI-2 Technical Information and Examination Program (TI&EP). As space permits, the* **TI&EP Update** *may feature certain TMI-related articles which, though not part of the TI&EP, would be of general interest to the scientific community.*

Groups Use TI&EP to Gather Unit-2 Generic Information

Four groups organized the TMI Unit-2 Technical Information and Examination Program (TI&EP) to gather valuable generic information about the Unit-2 accident. The four — the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), the Electric Power Research Institute (EPRI), and General Public Utilities Corporation (GPU) — compose the Coordination Group for the program.

EG&G Idaho, Inc., staffed the Technical Integration Office (TIO) for day-to-day management of the

Continued on following page

TI&EP Establishes Data Bank For Nuclear Community

The Three Mile Island (TMI) Unit-2 Technical Information and Examination Program (TI&EP) is establishing a data bank of material related to the TMI-2 accident. The data bank will include data, analytical reports, and design review documents produced since the accident. The information will be stored on the Zytron computer system at the Electric Power Research Institute Nuclear Safety Analysis Center at Palo Alto, California. The data bank information will be available to program participants and others and will benefit the entire nuclear community by enhancing nuclear plant safety and reliability. Initially, all information retrieval will be through the Technical Integration Office. Information distribution will be done on microfiche. Future issues of the *TI&EP Update* will include instructions for information retrieval and will list both new documents acquired and data developed.

Any information you may have which could be a useful input to the data bank should be sent to the *TI&EP Update*, EG&G Idaho, Inc., PO Box 88, Middletown, PA 17057. Any questions concerning the type of information needed should be directed to Frank Kocsis, Configuration and Document Control Coordinator, phone number (717) 948-8486, FTS number 590-3933.

Unit-2 Generic Information

Continued from page 1

program under contract to DOE. EG&G officials recently signed a contract with GPU to act as the interface between GPU and program agencies for work in the information and examination program. TIO will schedule work to be done and compile necessary documentation.

NRC licensing, inspection, and enforcement activities are unaffected by the contract. GPU and its contractors will perform all work within the Unit-2 facilities.

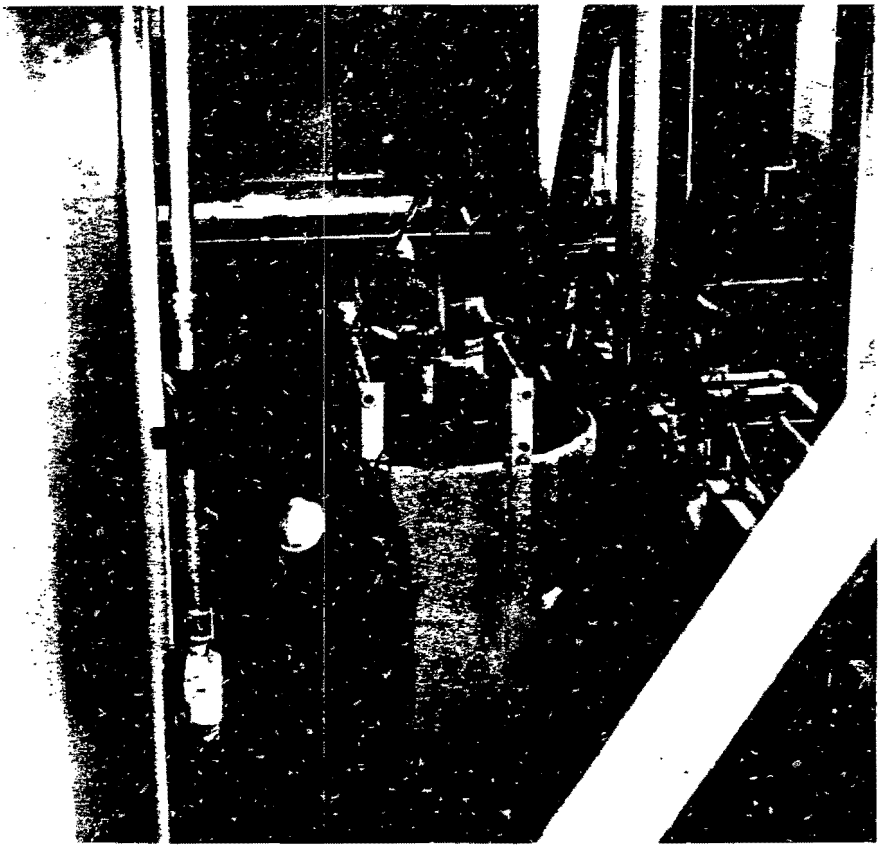
Analyses Completed on Containment Air Sample

EXXON Nuclear, EG&G, and GPU scientists recently completed analyses on air samples drawn from the Unit-2 containment building. The samples were taken in April, 1980, to provide data requested by the TMI Working Group. The samples were taken using a glove box and sampling apparatus installed in containment penetration 626. The analyses were completed on June 27, 1980. The results are presented in the table below.

Air sample analysis results

Isotope	Activity[a] (in microcuries per cubic centimeter)
tritium	$5 \pm 1 \times 10^{-5}$
carbon-14	$4 \pm 1 \times 10^{-7}$
iron-55	less than 6×10^{-11}
cobalt-58	less than 1×10^{-11}
cobalt-60	less than 1×10^{-11}
krypton-85	0.93 ± 0.07
strontium-89	$1.1 \pm 0.5 \times 10^{-10}$
strontium-90	$2.2 \pm 0.2 \times 10^{-10}$
ruthenium-103	less than 2×10^{-9}
ruthenium-106	less than 2×10^{-10}
iodine-129	$6 \pm 2 \times 10^{-11}$
cesium-134	$1.7 \pm 0.1 \times 10^{-10}$
cesium-137	$9.3 \pm 0.3 \times 10^{-10}$
uranium-235	less than 5×10^{-12}
uranium-238	less than 2×10^{-11}
plutonium-238	less than 8×10^{-12}
plutonium-239 and -240	less than 2×10^{-12}

(a) Less than indicates below detectable limits for the analytical techniques available.



Workmen changing EPICOR-II resin cask.

EPICOR-II Cleaning Waste Water

More than 365,000 gallons of contaminated water have passed through the EPICOR-II water treatment system as the first major step in cleaning up the Unit-2 facility at Three Mile Island.

The processing through a system of three large resin casks began last October with water from holding tanks in the auxiliary building. About 125,000 gallons remain to be processed.

The EPICOR-II system uses two filtering and demineralizing casks, each four feet in diameter by four feet high, and a final polishing cask that is six feet in diameter by six feet high. The water is decontaminated by filtration and ion exchange to extract strontium and cesium.

The resin casks are housed in a chemical cleansing building. The water moves into the system via shielded lines from the auxiliary building. If necessary, water can be cycled through the system a second time for additional purification.

A typical processing run handles about 17,000 gallons of water before the resin casks require changing (see photograph). Water samples are taken about every 1500 gallons at points before and after each filter. The processing rate averages 10 gallons a minute.

The water after processing is considered releasable under Environmental Protection Agency regulations, but is being stored in tanks on the island until a programmatic environmental impact statement is prepared. The spent resin casks also are stored in a shielded facility on the island.

TMI Unit-2 Technical Information & Examination Program

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Techniques Being Investigated for Early Core Damage Assessment

Insertion of an underwater television camera through a control rod drive mechanism nozzle may provide the first visual assessment of core damage in the TMI Unit-2 reactor vessel. The camera insertion is part of the potential early core damage assessment before the reactor vessel tophead is removed, according to Dennis E. Owen, Fuels Technical Coordinator of the Technical Integration Office, and George Kulynch of Babcock & Wilcox.

The core damage assessment may use three different approaches:

- Visual inspection of the core
- Temperature and flux mapping of the core
- Damage mapping of the core.

The visual inspection may use control rod drive mechanism (CRDM) and thermocouple penetrations in the reactor vessel head. Following removal of a CRDM, a radiation-hardened, underwater television camera may be inserted through the 2.5-inch-diameter opening in the CRDM nozzles, thus permitting visual inspection of the tops of the fuel elements. Visual examination of the peripheral areas of the core may be accomplished by inserting a borescope through some of the eight thermocouple penetrations. The thermocouple nozzles are on the outer perimeter of the vessel, where it is expected that the fuel may still be intact.

While the CRDM is removed, engineers could insert tooling to try to extract samples of core debris and determine whether any slumping of debris has occurred. Owen said the samples would be taken to a remote-handling hot cell for analysis. Analysis of samples would aid in planning the reactor core removal.

The temperature and flux mapping phase of the assessment could make use of instrument strings that run inside the reactor core. A small-diameter, swaged tube inside the strings, usually used for flux wires, provides a path for thermocouple insertion. The thermocouples would allow temperature measurements and locate physical blockages that might indicate coolant flow blockages within the core. Flux wires also are being considered for use in providing information about fuel distribution in the subcritical areas of the core.

The damage mapping phase of the assessment makes use of the instrument string guide tubes following withdrawl of the instrument string for analysis of the self-powered neutron detectors and other components. Both gamma and neutron detectors are under consideration for use in the instrument guide tubes to provide both radial and axial maps of the extent of reactor core damage, Owen said.

Additional detectors are being considered for insertion in the instrument guide tubes to check fuel redistribution, the extent of oxidation within the core, and mechanical strength of the core materials.

Local Residents Monitor Environmental Radiation

Each day in 12 Pennsylvania communities within a 5-mile radius of TMI Unit-2, specially trained residents take readings from radiation monitoring equipment located in municipal garages, firehouses, and sheds. These readings are part of the Citizens' Radiation Monitoring Program, a joint project of the U.S. Department of Energy (DOE), the Pennsylvania Department of Environmental Resources (DER), the Environmental Protection Agency (EPA), and Pennsylvania State University. Readings taken since May 15 show normal background radiation levels, according to G. R. Eidam, Radiation and Decontamination Project Coordinator for the Technical Integration Office.

Each day after the equipment readings are recorded, a DER employee collects the data for compilation. DER distributes the data each weekday to the General Public Utilities Corporation and local officials of the Nuclear Regulatory Commission, DOE, and EPA. The Pennsylvania governor's office releases the data to the news media.

Circumstances can alter the reading

Continued

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schedules, however. While krypton-85 was being purged from the TMI Unit-2 containment building, some communities chose to monitor the instruments either continuously or on an hourly basis. Residents of the communities can view and read the instruments at any time.

The program began early this year when DOE and DER representatives visited officials of 12 communities and explained the proposed monitoring concept. From a list of 50 people supplied by community officials, course organizers enrolled residents to attend 36 hours of radiation monitoring training presented by Pennsylvania State University faculty members over a 2-1/2-week period.

The course included a day of training at the Breazeale Nuclear Reactor Facility at Pennsylvania State University at State College, where the residents learned to take readings of argon-41 with the same equipment they would later use in their communities. They also participated in the calibration of the monitoring instruments, using a krypton-85 source inside a plastic tent.

The monitoring equipment includes a Ludlum 177 radiation monitor with an Eberline HP-260 two-inch-diameter probe, a Rustrak recorder, and a Lear Siegler Inc. gamma rate recorder. Eidam said the equipment selections were based on sensitivity for detecting beta-emitting radionuclides (i.e., krypton-85) and durability.

TMI Unit-2 Technical Information & Examination Program

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TMI Unit-2 Technical Information & Examination Program

UPDATE

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Third Successful Containment Entry Completed

Five men completed the third successful entry into the Unit-2 containment building on October 16, 1980. They were able to stay longer than planned because radiation levels inside the building were lower than anticipated. The team completed all tasks planned for the entry.

The team members were Sam Griffith, 28, a health physics technician with Nuclear Support Services Inc.; Larry E. Eberly, 44, an instrument and control technician with Metropolitan Edison Company (Met-Ed); Guy E. Wise, 45, a Met-Ed machinist; Richard Croll, 28, a radiation-chemical technician with Met-Ed; and Peter Keegan, 27, a Met-Ed senior health physics technician. Griffith was also a member of the team that performed the second containment entry (see article on inside pages).

During the entry, Wise and Croll repaired the locking mechanism of a personnel airlock that is part of the equipment hatch (refer to location maps on the inside pages). The doors to this airlock have been shut since the incident on March 28, 1979. Other team members completed a radiological survey of core flood tanks, performed maintenance on two monitors that keep operators apprised of certain plant systems, and conducted a visual survey of the polar crane, the device used to lift the reactor head during refueling.

Also completed were five tasks supported by the Technical Integration Office (TIO). These were removal of a source range neutron detector preamplifier; removal of a spare parts monitor preamplifier; photographing areas of interest identified during previous entries; surveying radiation levels in the area around HP-RT-211, the radiation detector removed during the second entry; and removal of a

Continued on page 2

This *TI&EP Update* highlights the venting of the containment and the first three containment entries at TMI Unit-2. This information, although not entirely a part of the technical information and examination program, is considered of general interest to the scientific community.

An entry team member takes beta radiation surveys just south of the enclosed stairway. Behind him are the ventilation ducts. Story on containment entry on inside pages.

Containment Entry Completed

Continued from page 1

ection of cable that was connected to HP-RT-211.

The team recorded radiation eadings of between 200 and 500 nillirem (mrem) per hour on the 305-foot elevation, or entry level, and in average of 150 mrem per hour on he 347-foot elevation, or operating loor.

Wise and Eberly left the building ifter the first hour, staying twice as ong as was planned. Keegan left with hem when a camera malfunctioned. He was scheduled to join Croll and Griffith, who were inside for 90 ninutes (30 minutes longer than cheduled).

Actual radiation doses to the team members were well below the 625 mrem limit set for the entry; they ranged from 200 to just over 450 mrem. By comparison, the company quarterly limit is 1250 mrem and the federal quarterly limit is 3000 mrem.

During the entry, the team wore cotton overalls instead of the heavier fireman's coats worn during the first two entries. They also wore battery-powered air filtration devices with positive-flow air masks, rather than the oxygen tanks worn during the first entry.

The entry preparations and control center activities were videotaped by the TIO. These tapes will be narrated by the entry team manager and will be available for training critiques and management briefing.

TMI Unit-2 Technical Information & Examination Program

TI&EP UPDATE

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Operating Floor Radiation Measurements Taken During Second Entry

he entry team discovered extensive rusting on all of the metal around the power track.

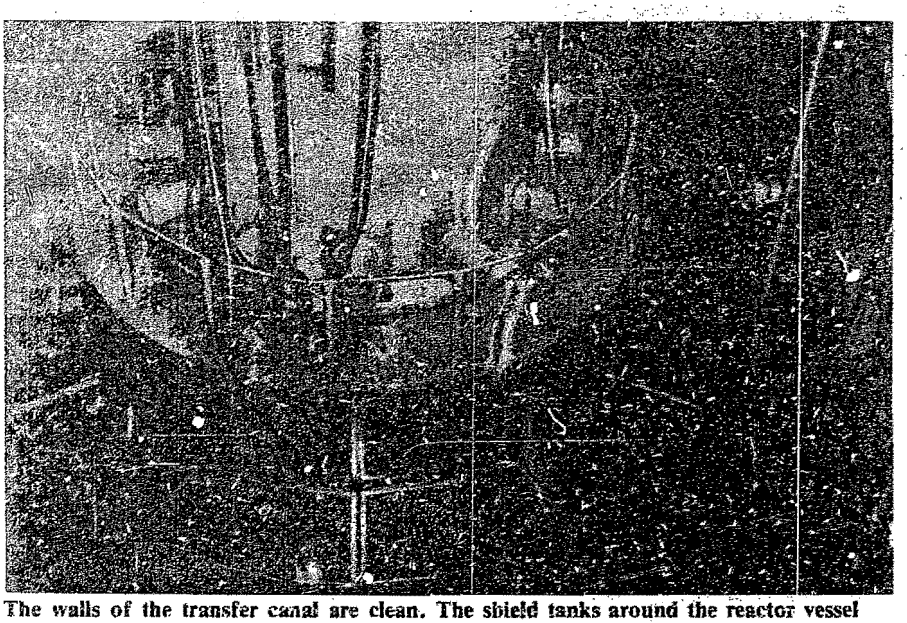
On August 15, 1980, a four-man eam made the second entry into the MI Unit-2 containment and visited he 347-foot level, or operating floor, or the first time since the March 28, 979 incident. While there, they btained radiation readings of 100 to 00 millirem per hour (mrem/hr). (See ccompanying location maps.) The eam members were Martin Cooper, Villiam H. Behrle III, Sam Griffith, nd Michael Benson. Benson and Behrle made the first containment entry on July 23, 1980.

The major priority tasks to be conducted were lighting both the 305-foot and 347-foot levels, surveying for radiation and surface contamination, and photographing the containment interior. Other tasks to be performed included protective covering, directional dose, and surface decontamination experiments and retrieval of selected items from within the containment for subsequent analysis.

After turning on the 305-foot and 347-foot level lights, the team obtained radiation readings and surface contamination samples in areas of the 305-foot level not surveyed during the first entry. Radiation readings on the 305-foot level included: north of the open stairwell, 2 rem/hr (location A); five to seven feet from the sump water (using a teletector), 40 to 45 rem/hr (location B); and at contact with the floor drain near the "A" core flood tank, 10 rad/hr and 3 rem/hr gamma (location C).

Floor swipes taken from the 305-foot level showed cesium-134 and cesium-137 concentrations of 6.6×10^{-2} and 4.07×10^{-1} microcuries per square centimeter ($\mu Ci/cm^2$) respectively under radiation monitor HP-RT-211 (location D) and of 3.8×10^{-4} and 2.3×10^{-3} $\mu Ci/cm^2$ respectively under the air coolers (location E). Scrape samples taken from the 305-foot level showed cesium-134 and cesium-137 sample activities of 8.8×10^{-1} and 5.25 μCi respectively near the open stairwell (location F) and of 2.6 and 16.1 μCi respectively near the air coolers (location G).

Radiation surveys taken as the teams moved up the enclosed stairwell (location H) showed an approximately



The walls of the transfer canal are clean. The shield tanks around the reactor vessel head are dry. On the reactor head, the cooling fans and associated electrical leads appear to be clean.

and water stains on equipment and floors of the 347-foot level, describing the conditions as similar to those found on the 305-foot level during the first entry. Officials said no significant structural damage was seen; however, elevated temperatures had partially melted a telephone housing, plastic rope, and some yellow plastic sheeting. Behrle reported seeing pieces of what appeared to be wood floating in the dark sump water that filled the containment below the ground level. An estimated 700,000 gallons of contaminated water are believed to be in the sump.

Experiments conducted by the teams included placing two trees of thermoluminescent dosimeters in the containment for protective covering and directional dose tests and wiping a portion of the 305-foot level floor

Continued on page 4

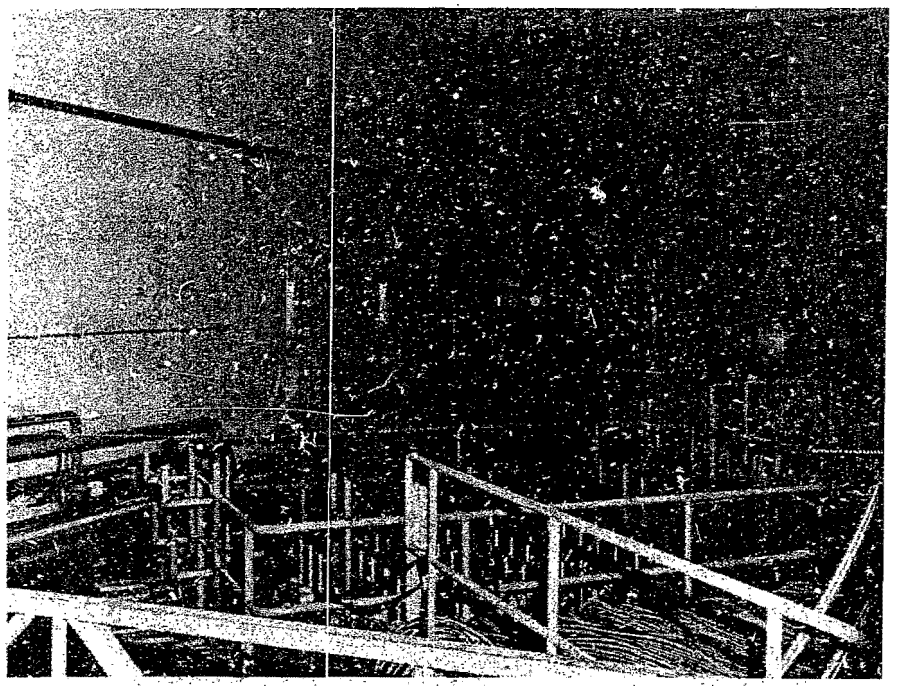
linear decrease from 3 to 5 rem/hr on the 305-foot level to 180 mrem/hr on the 347-foot level.

Radiation surveys on the 347-foot level revealed 600 mrem/hr at the decking outside the enclosed stairwell (location I) and 100 mrem/hr along the south containment wall (location J). Southeast of the head storage stand (location K), the readings increased to 400 mrem/hr. Other radiation levels measured on the 347-foot level included: fuel handling bridge (location L), 100 to 400 mrem/hr; 15 feet from the reactor head and stud bolts (location M), 125 mrem/hr; pressurizer spray line (location N), 2.5 rem/hr; over core flood tanks (locations O and P), 250 to 300 mrem/hr; and behind the enclosed stairwell (location Q), 50 mrem/hr.

Swipes taken on the 347-foot level yielded average cesium-134 and cesium-137 concentrations of 9.0×10^{-3} and 5.6×10^{-2} $\mu Ci/cm^2$ respectively on the floor and of 2.5×10^{-5} and 1.5×10^{-4} $\mu Ci/cm^2$ respectively on the walls. Strontium-90 concentrations were found to be 3.1×10^{-5} $\mu Ci/cm^2$ or less on the floor.

The teams took 67 photographs during the entry. The photographic survey on the 305-foot level showed more details of items identified from the first containment entry on July 23, 1980, and on the 347-foot level, it showed the general areas and structures of the operating deck, fuel handling bridges, D-rings, seal table, and reactor vessel head.

The team members reported rust



A view of the grill plate on top of the control rod drive mechanisms. The entry team reported it was dry and clean with no debris on it.

Gamma Exposures to Second Entry Team

Team member	Whole body dose (mrem)	Maximum extremity dose (mrem)
Cooper	140	210
Behrle	260	320
Beason	300	420
Griffith	165	270

Second Entry

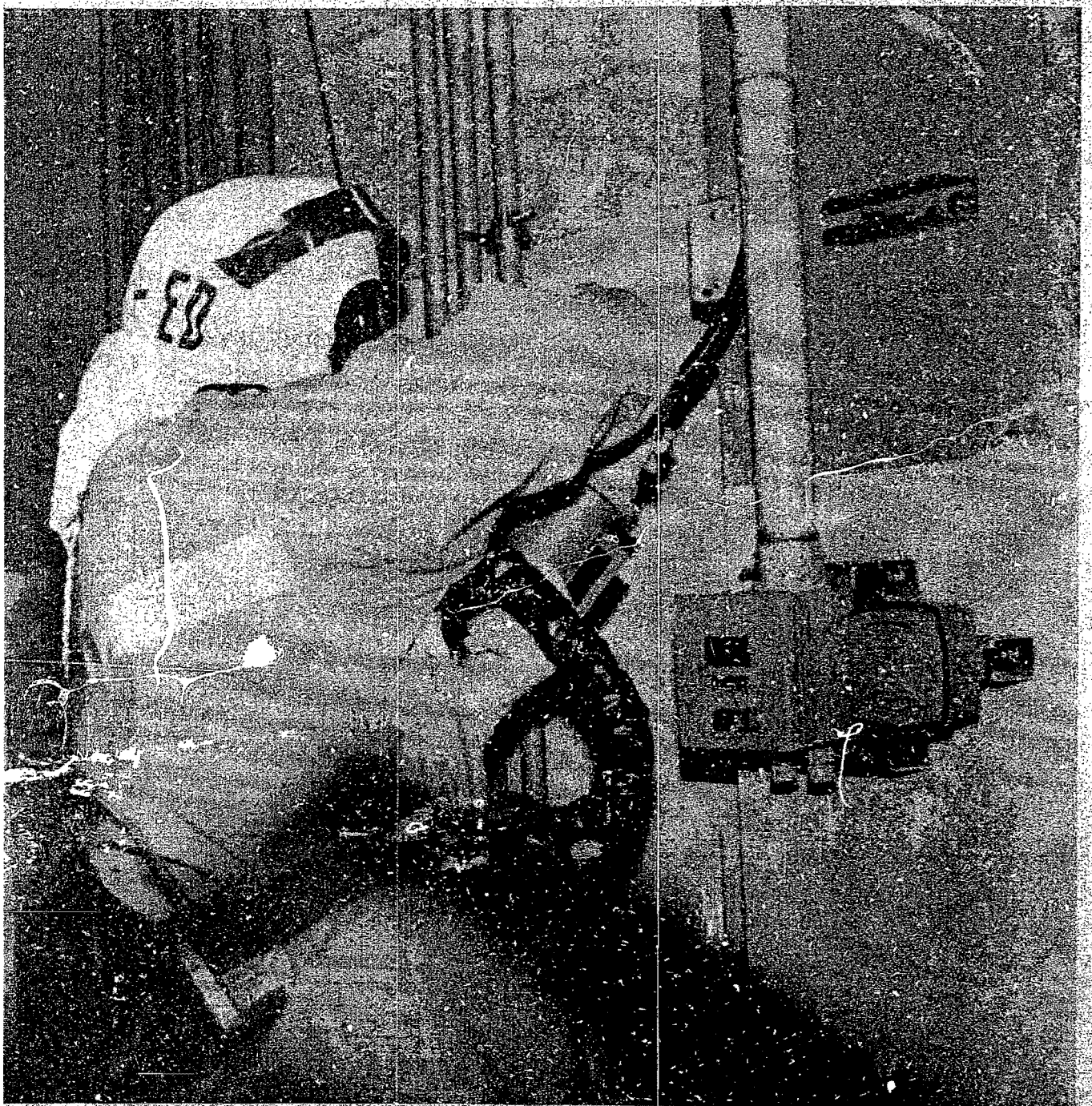
Continued from page 3

with a Masilin wipe for decontamination testing (location R). Swipes taken before and after the decontamination test showed the wipe removed approximately 90 percent of the loose surface contamination.

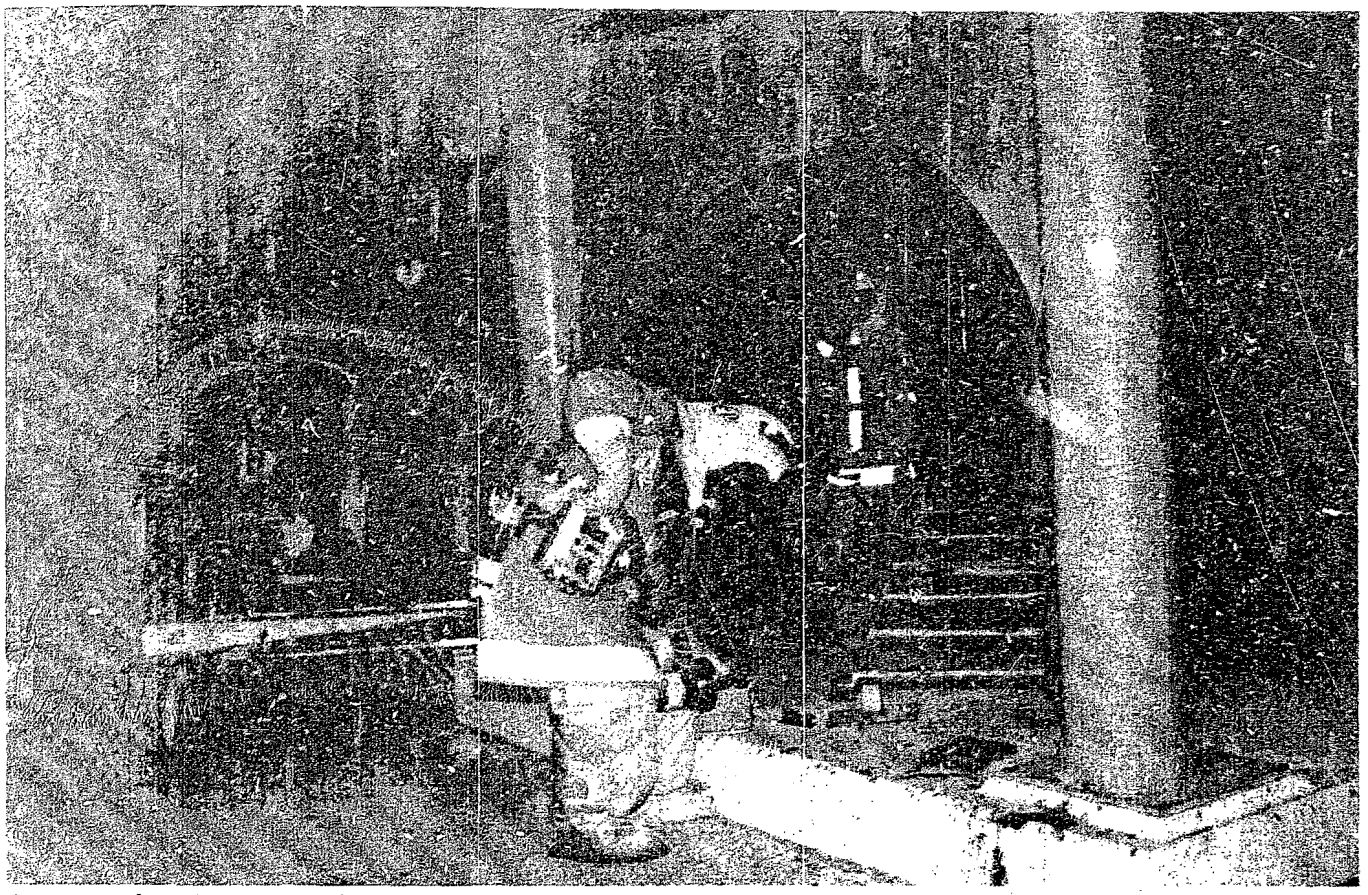
Items retrieved from the containment for subsequent analysis included a radiation detector (location D), a piece of glass (location S), a steel plate (location T), two metal covers, a funnel (location U), and four plastic pipe wrap ties.

Samples gathered during the second entry have been sent to the Department of Energy's Idaho National Engineering Laboratory for comprehensive analysis.

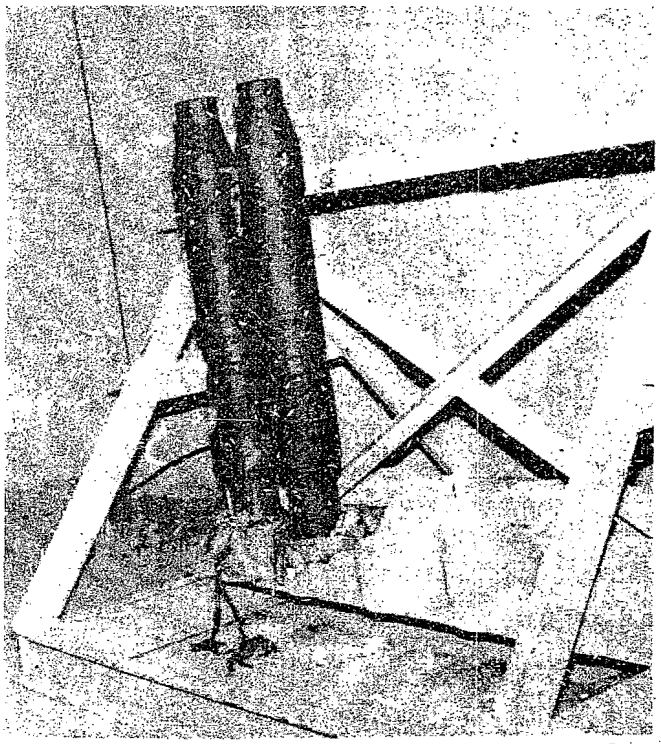
Gamma radiation exposures to the team members varied because of the tasks they performed and the amount of time they were inside the containment. Cooper and Behrle were in the containment just over 20 minutes; Griffith and Benson were in the containment about 40 minutes. The doses measured are presented in the accompanying table.



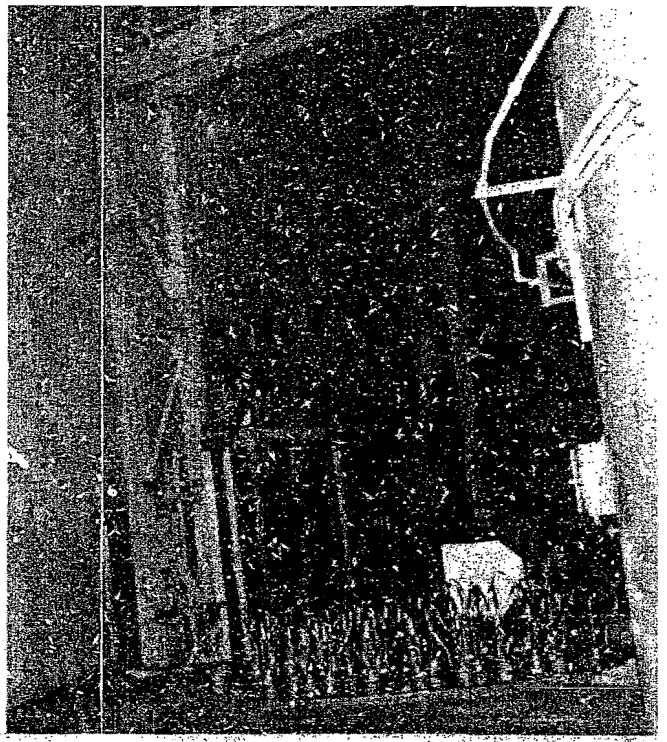
Martin Cooper works on removing radiation monitor HP-RT-211 from the cable. The detector was easily removed from the mounting bracket. The detector has been shipped to Sandia Laboratories for analysis.



A team member takes beta radiation survey at the bottom of the reactor cooler pump stand.



Two guide studs rest on the storage stands for reactor vessel studs. After the initial fueling efforts, the guide studs were wrapped in plastic. Melted plastic is at the bottom of the stand. In addition, a section of magenta and yellow plastic rope has melted to the stand base.



In the foreground, the incore instrumentation electrical connection are visible and appear undamaged. In the background, the steel structure for the fuel handling bridge is visible.

Containment Venting Releases 43,000 Curies of Krypton-85

A two-week project to vent krypton-85 from the Unit-2 containment building released an estimated 43,000 Curies of the isotope to the atmosphere between June 28 and July 11 of 1980. Monitoring by General Public Utilities Corporation (GPU) and federal agencies indicated the maximum offsite radiation doses during the venting were 4.34 millirem (mrem) to the skin and 0.044 mrem to the whole body. The maximum doses allowed by the NRC are 15 mrem to skin and 5 mrem to the whole body.

GPU officials attributed the difference between the actual release and the prerelease estimate of 57,000 Curies to deliberately conservative estimates of the containment volume and the amount of krypton trapped in the building. Original plans called for the venting procedure to take from two to four weeks using the reactor building purge system to effect the operation.

The venting began June 28 after the Nuclear Regulatory Commission (NRC) approved the operation. After four minutes of venting, however, radiation monitors sounded and officials halted the procedure.

Late in the afternoon of June 28, a five-hour test of venting rates began. The test helped engineers conclude that the radiation monitor alarm was erroneous. Venting was resumed at 3 p.m. June 29, using the hydrogen purge system to obtain a smaller air flow rate.

Engineers used the system for the next 10 days, admitting fresh air to the containment as krypton mixed with air was discharged through filtering mechanisms, past radiation monitoring devices, and up a 160-foot exhaust stack. Air flow rates through the hydrogen purge system reached a maximum of 565 cubic feet per minute (cfm).

On July 8, engineers switched the purging process back to the reactor building purge system at a flow rate of 1000 cfm. By this time, the krypton concentration had diminished sufficiently to allow a gradual increase of the purging rate to 18,500 cfm. About 27 Curies were vented in the final four hours of the process before engineers declared the venting completed.

The venting was stopped periodically during the two-week period for routine filter changes. Other stops occurred when weather conditions made venting undesirable.

Since completion of the venting, the utility has vented about 100 curies of krypton a month, which is permissible within NRC guidelines. The releases have usually occurred before teams go into the containment.

Two Engineers First to Enter Containment Since 1979 Incident

On July 23, 1980, William H. Behrle III and Michael Benson became the first persons to enter the Unit-2 containment building since the March 28, 1979 incident. During the entry, they visited the 305-foot elevation, or entry level, to conduct radiological and photographic surveys of conditions within the containment. (See accompanying location map.) While in the containment, they used two-way radios to communicate with the command center. Behrle and Benson are both engineers employed by Metropolitan Edison Company, a subsidiary of General Public Utilities Corporation (GPU).

While in the containment, the men took 29 photographs, made radiation measurements, and gathered six 100-square-centimeter swipe samples for subsequent contamination measurements. In addition, they retrieved a 5-gallon plastic bucket containing debris from the containment for subsequent analysis.

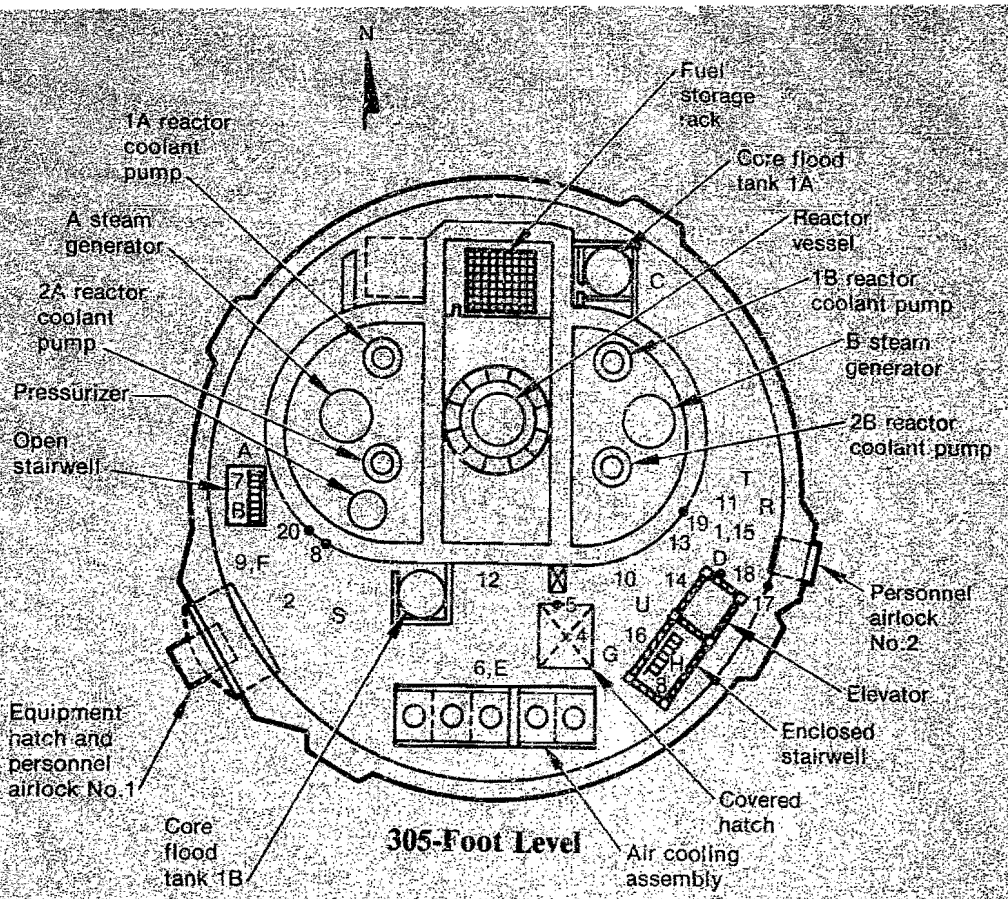
Preliminary information gathered from the radiation measurements showed gamma radiation levels from 500 to 600 millirems per hour (mrem/hr) near the personnel airlock (location 1) and 700 mrem/hr at the equipment airlock (location 2). Other radiation measurements are given in the accompanying table. The general beta radiation levels in the area were 1 to 2 Rad per hour.

Preliminary results from floor swipes (locations 15 and 16) indicated the presence of cesium-134 and cesium-137 in concentrations of about 3×10^{-2} and 1×10^{-1} microcuries per square centimeter ($\mu Ci/cm^2$) respectively. Wall swipes (locations 17 through 20) indicated concentrations of the same cesium isotopes at about 2×10^{-5} and 4×10^{-4} $\mu Ci/cm^2$ respectively. Also detected in the wall swipes were radioactive isotopes of

Continued on page 8

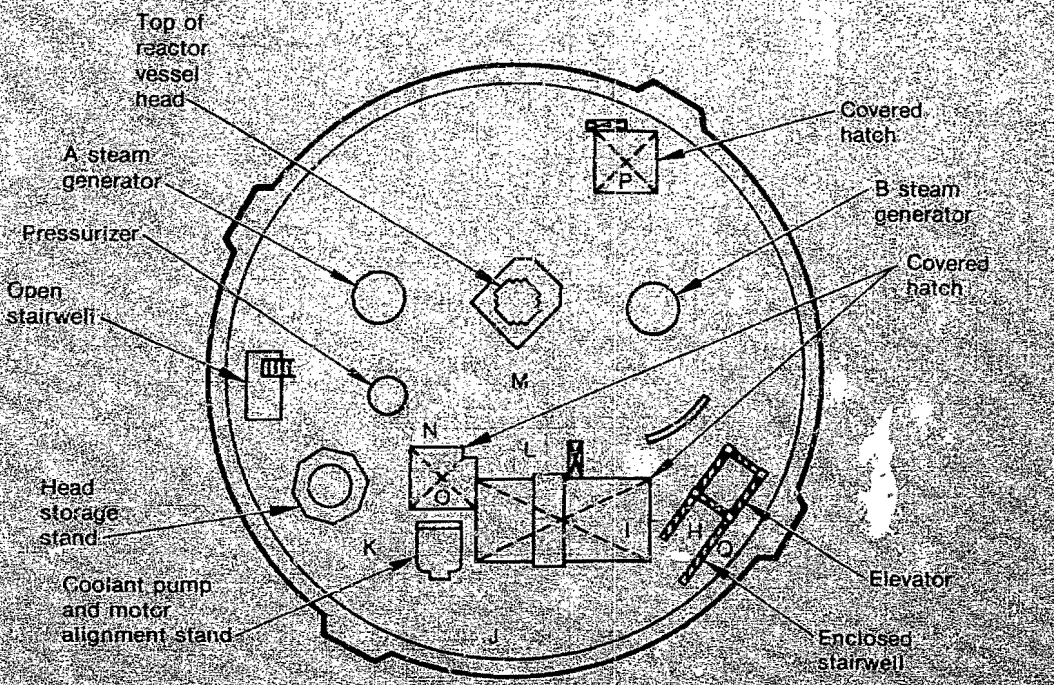
305-Foot Level Gamma Radiation Measurements

Location	Dose Rate (rem/hr)	Map location
Enclosed stairwell	8	3
Metal deck for covered floor hatch	10	4
Edge of metal-covered floor hatch	4	5
Air coolers	1.4	6
Top of open stairwell	18	7
D-ring and liner	0.4	8
Floor drains (range)	2 to 5	9,10,11
Core flood piping	3	12
Seal injection piping	3	13
Elevator door	3	14



305-Foot Level

Numbers indicate first entry locations
Letters indicate second entry locations



347-Foot Level

Continued from page 6

cerium, cobalt, antimony, and niobium in concentrations of 1×10^{-7} to 1×10^{-6} $\mu Ci/cm^2$. Technical personnel indicated that these elements were probably also present in the floor swipes but were undetectable because the high cesium levels masked their activity.

The men reported deposits of rust and dirt, colored orange and purple, on the floor. Some areas had watermarks that indicated apparent operation of the building spray system during or after the incident.

The men received whole body radiation exposures of approximately 190 mrem with a maximum extremity dose of about 220 mrem. No beta-dose measurements were taken. They wore two sets of anticontamination clothing under firefighter-type coats, pants, and boots. Self-contained breathing equipment supplied air for each man.

The first containment entry had been planned for May 20, 1980 but was aborted after the men were unable to turn the airlock door locking wheel. (See TI&EP Update dated July 31, 1980.) GPU officials attributed the failure to a malfunctioning locking mechanism. The door was later opened by drilling through a bulkhead to a locking pin and freeing the pin. The door still can be shut and sealed.

TMI Unit-2 Technical Information & Examination Program

UPDATE

EG&G Idaho, Inc. • P.O. Box 88
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TMI Unit-2 Technical Information & Examination Program

July 31, 1980

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Containment Airlock Door Freed

The **TI&EP Update** *is specifically designed to highlight data and information obtained as part of the TMI-2 Technical Information and Examination Program (TI&EP). As space permits, the* **TI&EP Update** *may feature certain TMI-related articles which, though not part of the TI&EP, would be of general interest to the scientific community.*

Groups Use TI&EP to Gather Unit-2 Generic Information

Four groups organized the TMI Unit-2 Technical Information and Examination Program (TI&EP) to gather valuable generic information about the Unit-2 accident. The four — the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), the Electric Power Research Institute (EPRI), and General Public Utilities Corporation (GPU) — compose the Coordination Group for the program.

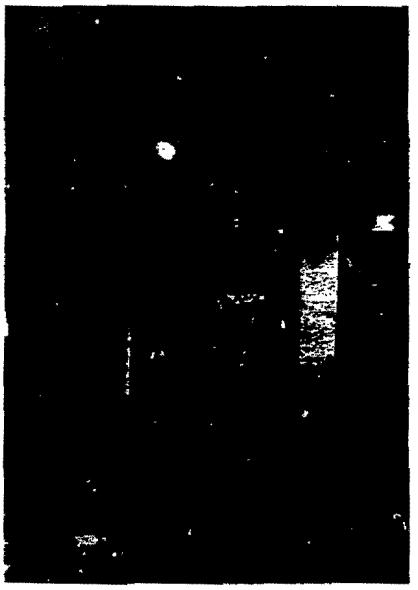
EG&G Idaho, Inc., staffed the Technical Integration Office (TIO) for day-to-day management of the

Continued on following page

A small pin, which acts as a safety device, apparently caused the malfunction of the TMI Unit-2 containment door locking mechanism that prevented entry into the containment. On May 20, a two-man entry team spent 13 minutes trying to turn the containment door locking wheel before halting the effort (see photograph). TMI officials report that the pin has been freed, and the locking mechanism now appears to be operating properly.

Following extensive evaluation, a small hole was drilled into the containment door behind the pin, which freed the pin and allowed it to return to its normal position. TMI officials believe that corrosion may have frozen the locking mechanism.

Proper operation of the locking mechanism has since been verified, and the containment was entered on July 23. Information obtained during the containment purge and early entry will be reported in a future issue of the *TI&EP Update*. TMI officials stress that the airlock door can still be shut and sealed.



TMI Unit-2 containment door-locking mechanism malfunction aborted first entry attempt

TI&EP Establishes Data Bank For Nuclear Community

The Three Mile Island (TMI) Unit-2 Technical Information and Examination Program (TI&EP) is establishing a data bank of material related to the TMI-2 accident. The data bank will include data, analytical reports, and design review documents produced since the accident. The information will be stored on the Zytron computer system at the Electric Power Research Institute Nuclear Safety Analysis Center at Palo Alto, California. The data bank information will be available to program participants and others and will benefit the entire nuclear community by enhancing nuclear plant safety and reliability. Initially, all information retrieval will be through the Technical Integration Office. Information distribution will be done on microfiche. Future issues of the *TI&EP Update* will include instructions for information retrieval and will list both new documents acquired and data developed.

Any information you may have which could be a useful input to the data bank should be sent to the *TI&EP Update*, EG&G Idaho, Inc., PO Box 88, Middletown, PA 17057. Any questions concerning the type of information needed should be directed to Frank Kocsis, Configuration and Document Control Coordinator, phone number (717) 948-8486, FTS number 590-3933.

Unit-2 Generic Information

Continued from page 1

program under contract to DOE. EG&G officials recently signed a contract with GPU to act as the interface between GPU and program agencies for work in the information and examination program. TIO will schedule work to be done and compile necessary documentation.

NRC licensing, inspection, and enforcement activities are unaffected by the contract. GPU and its contractors will perform all work within the Unit-2 facilities.

Analyses Completed on Containment Air Sample

EXXON Nuclear, EG&G, and GPU scientists recently completed analyses on air samples drawn from the Unit-2 containment building. The samples were taken in April, 1980, to provide data requested by the TMI Working Group. The samples were taken using a glove box and sampling apparatus installed in containment penetration 626. The analyses were completed on June 27, 1980. The results are presented in the table below.

Air sample analysis results

Isotope	Activity[a] (in microcuries per cubic centimeter)
tritium	$5 \pm 1 \times 10^{-5}$
carbon-14	$4 \pm 1 \times 10^{-7}$
iron-55	less than 6×10^{-11}
cobalt-58	less than 1×10^{-11}
cobalt-60	less than 1×10^{-11}
krypton-85	0.93 ± 0.07
strontium-89	$1.1 \pm 0.5 \times 10^{-10}$
strontium-90	$2.2 \pm 0.2 \times 10^{-10}$
ruthenium-103	less than 2×10^{-9}
ruthenium-106	less than 2×10^{-10}
iodine-129	$6 \pm 2 \times 10^{-11}$
cesium-134	$1.7 \pm 0.1 \times 10^{-10}$
cesium-137	$9.3 \pm 0.3 \times 10^{-10}$
uranium-235	less than 5×10^{-12}
uranium-238	less than 2×10^{-11}
plutonium-238	less than 8×10^{-12}
plutonium-239 and -240	less than 2×10^{-12}

(a) Less than indicates below detectable limits for the analytical techniques available.

Workmen changing EPICOR-II resin cask.

EPICOR-II Cleaning Waste Water

More than 365,000 gallons of contaminated water have passed through the EPICOR-II water treatment system as the first major step in cleaning up the Unit-2 facility at Three Mile Island.

The processing through a system of three large resin casks began last October with water from holding tanks in the auxiliary building. About 125,000 gallons remain to be processed.

The EPICOR-II system uses two filtering and demineralizing casks, each four feet in diameter by four feet high, and a final polishing cask that is six feet in diameter by six feet high. The water is decontaminated by filtration and ion exchange to extract strontium and cesium.

The resin casks are housed in a chemical cleansing building. The water moves into the system via shielded lines from the auxiliary building. If necessary, water can be cycled through the system a second time for additional purification.

A typical processing run handles about 17,000 gallons of water before the resin casks require changing (see photograph). Water samples are taken about every 1500 gallons at points before and after each filter. The processing rate averages 10 gallons a minute.

The water after processing is considered releasable under Environmental Protection Agency regulations, but is being stored in tanks on the island until a programmatic environmental impact statement is prepared. The spent resin casks also are stored in a shielded facility on the island.

TMI Unit-2 Technical Information & Examination Program

The *TI&EP Update* is issued by the EG&G Idaho, Inc., Technical Integration Office, Configuration Document Control Section, under contract DE-AM07-76ID01570 to the Department of Energy, PO Box 88, Middletown, PA 17057. Telephones (717)948-8586 or FTS 590-3933. W. W. Bixby is manager of the DOE-TMI Site Office. H. M. Burton is manager of the Technical Integration Office. D. M. Grigg is managing editor of the *TI&EP Update*.

Techniques Being Investigated for Early Core Damage Assessment

Insertion of an underwater television camera through a control rod drive mechanism nozzle may provide the first visual assessment of core damage in the TMI Unit-2 reactor vessel. The camera insertion is part of the potential early core damage assessment before the reactor vessel tophead is removed, according to Dennis E. Owen, Fuels Technical Coordinator of the Technical Integration Office, and George Kulynch of Babcock & Wilcox.

The core damage assessment may use three different approaches:

- Visual inspection of the core
- Temperature and flux mapping of the core
- Damage mapping of the core.

The visual inspection may use control rod drive mechanism (CRDM) and thermocouple penetrations in the reactor vessel head. Following removal of a CRDM, a radiation-hardened, underwater television camera may be inserted through the 2.5-inch-diameter opening in the CRDM nozzles, thus permitting visual inspection of the tops of the fuel elements. Visual examination of the peripheral areas of the core may be accomplished by inserting a borescope through some of the eight thermocouple penetrations. The thermocouple nozzles are on the outer perimeter of the vessel, where it is expected that the fuel may still be intact.

While the CRDM is removed, engineers could insert tooling to try to extract samples of core debris and determine whether any slumping of debris has occurred. Owen said the samples would be taken to a remote-handling hot cell for analysis. Analysis of samples would aid in planning the reactor core removal.

The temperature and flux mapping phase of the assessment could make use of instrument strings that run inside the reactor core. A small-diameter, swaged tube inside the strings, usually used for flux wires, provides a path for thermocouple insertion. The thermocouples would allow temperature measurements and locate physical blockages that might indicate coolant flow blockages within the core. Flux wires also are being considered for use in providing information about fuel distribution in the subcritical areas of the core.

The damage mapping phase of the assessment makes use of the instrument string guide tubes following withdrawl of the instrument string for analysis of the self-powered neutron detectors and other components. Both gamma and neutron detectors are under consideration for use in the instrument guide tubes to provide both radial and axial maps of the extent of reactor core damage, Owen said.

Additional detectors are being considered for insertion in the instrument guide tubes to check fuel redistribution, the extent of oxidation within the core, and mechanical strength of the core materials.

Local Residents Monitor Environmental Radiation

Each day in 12 Pennsylvania communities within a 5-mile radius of TMI Unit-2, specially trained residents take readings from radiation monitoring equipment located in municipal garages, firehouses, and sheds. These readings are part of the Citizens' Radiation Monitoring Program, a joint project of the U.S. Department of Energy (DOE), the Pennsylvania Department of Environmental Resources (DER), the Environmental Protection Agency (EPA), and Pennsylvania State University. Readings taken since May 15 show normal background radiation levels, according to G. R. Eidam, Radiation and Decontamination Project Coordinator for the Technical Integration Office.

Each day after the equipment readings are recorded, a DER employee collects the data for compilation. DER distributes the data each weekday to the General Public Utilities Corporation and local officials of the Nuclear Regulatory Commission, DOE, and EPA. The Pennsylvania governor's office releases the data to the news media.

Circumstances can alter the reading

Continued

Continued

schedules, however. While krypton-85 was being purged from the TMI Unit-2 containment building, some communities chose to monitor the instruments either continuously or on an hourly basis. Residents of the communities can view and read the instruments at any time.

The program began early this year when DOE and DER representatives visited officials of 12 communities and explained the proposed monitoring concept. From a list of 50 people supplied by community officials, course organizers enrolled residents to attend 36 hours of radiation monitoring training presented by Pennsylvania State University faculty members over a 2-1/2-week period.

The course included a day of training at the Breazeale Nuclear Reactor Facility at Pennsylvania State University at State College, where the residents learned to take readings of argon-41 with the same equipment they would later use in their communities. They also participated in the calibration of the monitoring instruments, using a krypton-85 source inside a plastic tent.

The monitoring equipment includes a Ludlum 177 radiation monitor with an Eberline HP-260 two-inch-diameter probe, a Rustrak recorder, and a Lear Siegler Inc. gamma rate recorder. Eidam said the equipment selections were based on sensitivity for detecting beta-emitting radionuclides (i.e., krypton-85) and durability.

TMI Unit-2 Technical Information & Examination Program

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