U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-320/88-10

Docket No. 50-320

License No. DPR-73 Priority -- Category C

Licensee: GPU Nuclear Corporation
P. O. Box 480
Middletown, Pennsylvania 17057

Facility Name: Three Mile Island Nuclear Station, Unit 2

Inspection At: Middletown, Pennsylvania

Inspection Conducted: June 5, 1988 - July 7, 1988

Inspectors: R. Conte, Senior Resident Inspector
D. Johnson, Resident Inspector
T. Moslak, Resident Inspector (Reporting Inspector)
A. Sidpara, Resident Inspector

Approved by: C. Cowgill III
C. Cowgill, Chief, Reactor Projects Section 1A — 7/29/88 Date

Inspection Summary:

Areas Inspected: Routine safety inspection by site inspectors of defueling and decontamination activities, including the proper implementation of housekeeping and fire protection measures and the review of selected events. There was also a management meeting to discuss recent human performance events of concern to NRC staff. Other areas reviewed included licensee event reports and proper implementation of selected sections of the radiological controls program.

Results: In general, licensee personnel properly implemented procedures, except as noted for certain events listed within this report. The inspector identified no adverse conditions with respect to the licensee's radiological controls and fire protection programs. Minor implementation problems continued to be noted.

For the events reviewed in this report and at the management meeting of July 1, 1988, the NRC staff determined that the licensee is to take appropriate actions to enhance performance and this area is to be closely monitored by both the licensee and NRC staff.

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DETAILS

1.0 Introduction and Overview

1.1 Licensee Activities

Progress continued to be made in cutting and removing sections of the Lower Core Support Assembly (LCSA) to provide access for defueling the lower head of the reactor vessel. Decontamination of external surfaces and plant systems continued. One plant area was isolated and placed in an interim Post-Defueling Monitored Storage (PDMS) status. Five other plant areas were in the process of being verified to meet the interim PDMS criteria.

Using the plasma arc torch, defueling crews completed cutting the upper flow distributor into four sections. Preparations were being made to remove these sections and place them in storage in a modified core flood tank. The flow distributor was the second of five plates that would be removed from the LCSA. In preparation for cutting the flow distributor, workers cleared this plate of core debris and completed trimming the periphery of the lower grid rib section to remove potential interferences. The next section to be cut into sections and removed will be the grid forging. Failures of electrical components in the plasma arc cutting equipment slowed the overall progress of cutting the LCSA. The licensee established a task force to examine the nature of these failures and to provide recommendations to improve the reliability of the cutting equipment.

The licensee reported that defueling operations were completed in the pressurizer using a robotic mini-submarine. The submarine picked up rock-like material and placed it into buckets that were eventually loaded into defueling canisters. Four and one-half gallon buckets of debris were removed from the pressurizer.

No shipments of casks containing core debris were made during this reporting period.

Scabbling, steam vacuuming, and hands-on decontamination continued in the auxiliary and fuel handling buildings. To date, 119 of 143 cubicles were decontaminated to end point criteria. The remaining cubicles contained highly contaminated plant systems that first must be cleaned before the cubicle is decontaminated. Flushes of these systems were being performed to lower dose rates in the cubicles.

Attempts to transfer highly contaminated resins from the "A" make-up demineralizer were unsuccessful. To better access this problem, a video camera was inserted into the tank to evaluate the resin consistency and quantities.

A series of holes were drilled in the concrete block wall in the RB basement. The wall was filled and drained with water in an attempt to flush contamination from the wall. The contaminated water was subsequently processed through the submerged demineralizer system to remove the contaminants.

The licensee implemented the initial phase of assessing specific plant areas for eventual placement of these areas into a PDMS condition. Following the assessment, the seal return cooler/filter room was isolated from plant activities to assure that it would not become re-contaminated nor be impacted by other plant operations. Five other areas were to be verified that they meet the criteria and would also be isolated from the balance of the plant.

1.2 NRC Staff Activities

The purpose of this inspection was to assess licensee activities during defueling and decontamination activities. The inspectors made this assessment through actual observations of licensee activities, interviews with licensee personnel, measurement of radiation levels, or review of listed applicable documents. NRC staff inspections use the acceptance criteria and guidance of NRC Inspection Procedures (NIP's). These NIP's are annotated in the Table of Contents to this report.

The inspector also reviewed the implementation of the licensee's site security program related to TMI-2 as documented in NRC Inspection Report No. 50-289/88-13 for TMI-1.

1.3 Persons Contacted

During this inspection, the following key licensee personnel provided substantial information in the development of the inspectors' findings.

-- *J. Byrne, Manager, TMI-2 Licensing
-- S. Levin, Defueling Director
-- *W. Marshall, Operations Engineer
-- W. Potts, Director, Plant Operations
-- *R. Rogan, Director, Licensing and Nuclear Safety
-- *E. Schrull, TMI-2 Licensing Engineer
-- J. Tarpinian, Manager, Radiological Engineering
-- *D. Turner, Director, Radiological Controls
-- D. Tuttle, Manager, Radiological Field Operations
-- *M. Williams, Manager, Plant Maintenance

2.0 Defueling/Decontamination Activities

2.1 Scope of Review

The inspector observed and/or reviewed licensee defueling decontamination activities to: (1) ascertain factual status of such activities; (2) assure proper adherence to applicable procedures; and, (3) select and re-

view significant events warranting further inspection follow-up. The inspector also made observations in facility spaces with respect to proper housekeeping, fire protection, and radiological controls. The general acceptance criteria for this review was Section 6 of the TMI-2 Technical Specifications.

In response to recent events at TMI-2 and based on other relevant information, the TMI Resident Office provided augmented coverage for activities at TMI-2 between June 17 and July 1, 1988. This included additional back shift inspections and increased daily coverage for the unit.

In performing the above inspections, the inspectors focused on the following areas of licensee performance:

-- control of operations in progress by supervisory personnel;

-- knowledge of the task by technicians and support persons;

-- appropriateness of governing documents, including procedures and Radiation Work Permits (RWP's);

-- alertness of various controlling station personnel;

-- assess the quality of implementation of selected evolutions witnessed; and,

-- assess the material condition of the plant.

The inspections were made at random intervals and frequently between the hours of 10:00 p.m. and 6:00 a.m.

Date/Day	Time Periods
6/12 Sunday	10:30 a.m. - 11:30 a.m.
6/17 Friday	4:45 p.m. - 5:45 p.m.
	6:00 p.m. - 7:00 p.m.
6/18 Saturday	9:00 a.m. - 10:00 a.m.
	5:30 p.m. - 9:00 p.m.
6/19 Sunday	11:00 a.m. - 12:30 p.m.
6/22 Wednesday	4:00 a.m. - 6:00 a.m.
6/24 Friday	4:00 a.m. - 7:00 a.m.
6/25 Saturday	11:30 p.m. - 2:30 a.m.
6/28 Tuesday	8:45 p.m. - 10:15 p.m.
6/29 Wednesday	9:00 p.m. - 11:30 p.m.
6/30 Thursday	9:00 p.m. - 11:30 p.m.
7/1 Friday	5:00 a.m. - 7:00 a.m.

2.2 General Findings

As a result of the routine and augmented review noted above, the inspectors identified no major discrepancies. In general, licensee representatives properly implemented procedures, except as noted for certain events listed within this report. Addressed below were specific observations in the area of housekeeping, fire protection, and event review. Of particular note was the licensee's low threshold for documenting and reporting off-normal events that were below reporting requirement thresholds.

2.3 Housekeeping/Fire Protection

On June 8, 1988, two resident inspectors accompanied a licensee's fire protection engineer on an inspection of reactor building (RB) spaces. The inspectors noted overall improvement of the implementation of housekeeping and fire protection measures. Along with the fire protection engineer, the inspectors noted certain discrepancies, however.

The fire protection engineer recorded these discrepancies for follow-up. Generally, these discrepancies were: motor or lubricating oil in unapproved containers; loose (unused) or empty spray paint containers not properly stored or discarded; machinery oil leaks; plastic bags with apparent contaminated material and untagged; and/or radioactive material tags loose (not attached to bags).

Throughout the rest of the period, the inspectors made observations in other facility spaces. Again, the inspector noted licensee attention to these areas to maintain existing standards for housekeeping and fire protection. The discrepancies noted were similar to those found in the RB. The inspectors discussed these items with licensee management for follow-up.

This area will continue to be routinely reviewed by the NRC resident inspectors.

2.4 Event Review

A number of events were identified by the licensee in their internal reporting system and they were reported to the resident inspectors.

-- On June 9, 1988, six pages of word puzzles were found in the procedures book (operations procedures manual) at the defueling platform in the RB.

-- On June 9, 1988, the defueling platform was being rotated and a jib crane hit and severed a 480-volt electrical line causing arcing and sparking. No personnel injuries resulted.

-- On June 9 and 23, 1988, the containment ventilation (purge) system was not operating during plasma arc operation as required.

-- On June 17, 1988, there was an inadvertent start of fire protection deluge pumps at the waste handling and packaging facility during instrument and control technician work on the deluge system.

-- On June 17, 1988, the fire service supply valve (FS-V-639) for the RB was not shut during a heavy load transfer of the Power Cutting Incorporated (PCI) "x-y" bridge and this was contrary to facility procedures.

The licensee reported other events to the inspector that appeared to be due to equipment malfunctions or failures. The events listed above were of interest to the NRC staff because the root causes appeared to be poor human performance deficiencies.

These events were added to the list of other events reported in 1988 concerning root causes involving the human element. The NRC staff discussed this concern with licensee management in a meeting in the Region I office on July 1, 1988 (see Section 5).

The inspector also reviewed licensee internal report Serial No. 4420-88-0050, 1988, by the Safety Review Group (SRG), dated June 2, 1988, on the recent (March 23 to May 23, 1988) radiological occurrence/incident events. The report compared the recent event data to periods in 1986 and 1987. It presented information on the status of the events and percentage of events due to various causes, including personnel error and underlying causes for the personnel errors; e.g., communications, procedure inadequacy, human error, training, etc. The report concluded that there was an increase in the rate of such occurrences previously due to human causes, after a period of relatively successful "error free" operations, and that this trend needed to be halted before it affected more critical aspects of the recovery effort.

Additional information on licensee management perspective on these events is discussed in Section 5, along with corrective actions.

With respect to the SRG report, the inspector concluded that it was thorough and it provided useful information to licensee management on which they could focus appropriate corrective actions. The inspector also concurred with the trend noted in the licensee's report (see also NRC Inspection Report No. 50-320/88-08).

2.5 Defueling/Decontamination Summary

The defueling/decontamination activities were proceeding as planned. The above-noted events did not result in significant radiological consequences. The licensee's reporting system was noteworthy. However, additional NRC staff review was needed to further assess underlying causes.

Overall, housekeeping in several areas has significantly improved; however, substantial licensee attention was necessary to maintain facility cleanliness and fire protection standards.

3.0 Radiological Controls Program Implementation

3.1 Scope of Review

The inspector conducted a review of the implementation of the licensee's radiological controls program. The inspector performed this review during routine and back shift plant tours by observation of on-going defueling and decontamination activities; review of Radiation Work Permits (RWP's); and, supporting documentation and review of general radiological conditions, including verification of the status of locked high radiation areas and review of the ALARA (as low as reasonably achievable) program.

3.2 Radiation Work Permits

The inspector reviewed RWP Nos. 17386 and 17398 for performing defueling operations and for conducting resin transfers from the make-up demineralizers, respectively. Through this review, the inspector determined that the RWP's contained the following information.

-- Radiation/contamination levels
-- Concentrations of airborne radioactivity
-- Respiratory/protective clothing equipment requirements
-- Dosimetry
-- Special precautions
-- Expiration dates
-- Radiological controls coverage
-- Job descriptions

For work in the RB (RWP 17386), the inspector attended the pre-job briefing conducted in support of defueling operations, observed actual work performed, and determined the following. The licensee adequately informed the defueling crew of radiological conditions, precautions to be taken while performing tasks, and dosimetry, respiratory/protective clothing requirements. Workers encountered no radiological problems that were not previously addressed by the RWP or its supporting documentation, including radiological surveys, ALARA Reviews, or within the limits/precautions or prerequisites of the applicable operating procedures. There was an adequate understanding of the RWP requirements by personnel. The inspector noted no problems with the implementation of this particular RWP.

In reviewing the implementation of the radiological controls for performing resin transfers from the make-up demineralizers (RWP 17398), the inspector examined the ALARA Review (ARN 880042) that the licensee prepared. Through this examination, the inspector determined that the ALARA Review consisted of the following information:

-- task time study;

-- dose rates based on real measurements or anticipated worst case estimates;

-- emergency actions for specific aspects of the task being performed; e.g., operation of the plunger pump, air sparging, and for use of a hydrolance;

-- pre-job briefing and post-job debriefing requirements;

-- reference to specific prerequisites and limiting conditions for continued operations contained in the operating procedures (4215-OPS-3233.27); i.e., Stop Job Points;

-- dosimetry and radiological monitoring requirements;

-- exposure tracking action levels; and,

-- mock-up testing and training.

The above review indicated that the Radiological Engineering Department addressed the appropriate aspects of an ALARA program to support the transfer of resin from the make-up demineralizers.

3.3 Control of Locked High Radiation Areas

Licensee technical specifications required that any area accessible to personnel with dose rates greater than 1 R/hr be locked to prevent unauthorized entry and be conspicuously posted.

On June 25, 1988, between the hours of midnight and 2:30 a.m., the inspector checked a representative sample (approximately forty locks) of locked high radiation areas to verify compliance with the requirement stated above, by challenging the latching mechanism and by observing the postings. The inspector did not identify any examples of non-adherence to existing administrative controls.

Through discussions with radiological controls technicians and supervisors and through examinations of logs, records, and the applicable procedure (9200-ADM-4110.06), the inspector determined that the licensee verified the status of these locked high radiation areas at least once each shift.

The inspector had no further questions on this aspect of the licensee's radiological controls program.

3.4 ALARA

The inspector discussed implementation of the licensee's ALARA program with a cross section of managers, supervisors, engineers, and technicians responsible for performing various functions within the Radiological Controls organization. From these discussions, the inspector determined that the staffing of radiological engineers and of radiological controls technicians was appropriate for the defueling/decontamination activities being performed. An adequate number of technicians and supervisors from the Radiological Engineering Department were available or all shifts.

The overall pace of these activities appeared to be controlled to permit adequate coverage to assure implementation of the requisite radiation protection measures.

The inspector determined that mock-up training was extensively used on such tasks as pressurizer and decay heat drop leg defueling to anticipate and resolve exposure control problems.

The inspector reviewed the licensee's procedures that implement the ALARA program, specifically 4000-PLN-4010.01, "TMI-2 ALARA Program Plan," 9200-ADM-4010.01, "TMI-2 Radiological Controls ALARA Program," and 9200-ADM-4010.02, "ALARA Review Procedures," and examined selected ALARA Reviews. The inspector determined that the licensee effectively coordinated the various aspects of the ALARA program.

4.0 Licensee Event Report Follow-Up

The following Licensee Event Reports (LER's) were reviewed. The inspector verified that the reporting requirements were met, causes were identified, corrective actions were appropriate, generic applicability was considered, and the LER forms were complete.

-- LER 88-005, dated May 20, 1988, addressed radiological occurrences on April 21 and 23, 1988. The two events involved removal of trash containing solid contaminated debris in excess of established limits from a radiologically-controlled area (RCA) without proper release surveys. The primary cause for both events was a lack of awareness of survey requirements for material removed from an RCA and/or inattention to requirements posted at all exits to RCA's requiring frisking/survey of such material. The measured contamination levels did not constitute a significant personnel exposure hazard.

-- LER 88-006, dated June 2, 1988, concerned the exposure of a minor. As a result of falsification of his date of birth, the individual received exposure in excess of the limits of regulatory requirements. As corrective action, the individual was removed from Three Mile Island (TMI) and has been denied future access to the site.

-- LER 88-007, dated May 27, 1988, addressed the discovery of a containment personnel airlock being maintained open on April 28, 1988. The root cause of this event was personnel error by the airlock attendants and the RB entry supervisors, based on a lack of understanding of the above technical specifications (TS) requirement. Contributing causes included a failure of the operating procedure for the airlock doors to specify the referenced TS requirement and a misunderstanding on the part of some licensed operators concerning the requirement of this TS as it related to frequent containment access.

-- LER 88-008, dated June 3, 1988, addressed radiological occurrences on May 4 and 8, 1988, which involved removal of trash containing solid contaminated debris in excess of established limits. These events were similar in nature to LER 88-05.

-- LER 88-009, dated June 10, 1988, addressed the operation of the "x-y" bridge flush wand on May 13, 1988, with an inappropriate water source. The applicable procedure required that the flush wand be connected to the water jet supply pump, VAC-P1, which is submerged in the reactor vessel (RV). However, at the time of the event, VAC-P1 was inoperable; thus, the task supervisor and lead engineer decided to perform the flushing operation using the borated water storage tank/fuel transfer canal fill (BWST/FTC) system as the source of flush water, which was contrary to facility procedures.

The inspector noted the repetitive nature of some of these events and the fact that root causes related to poor human performance. The LER's addressed appropriate specific corrective actions (planned or taken). The NRC staff generally discussed the human performance aspects of these events with the licensee in a management meeting (see Section 5).

5.0 Management Meeting - Defueling/Decontamination Events

5.1 Introduction

At 1:00 p.m. on July 1, 1988, the below-listed licensee and NRC staff personnel participated in a management meeting to discuss recent events (1988) at TMI-2 that were of concern to the NRC staff.

GPU Nuclear Corporation (GPUNC)

-- C. Clawson, Vice President and Director, Communications
-- E. Kintner, Executive Vice President
-- R. Rogan, Director, Licensing and Nuclear Safety
-- F. Standerfer, Vice President and Director, TMI-2

NRC Staff

-- L. Bettenhausen, Chief, Reactor Projects Branch No. 1, Division of Reactor Projects (DRP), Region I (RI)
-- R. Conte, Senior Resident Inspector (TMI), RI
-- C. Cowgill, Chief, Reactor Projects Section No. 1A, DRP, RI
-- W. Johnston, Acting Director, Division of Reactor Safety, RI
-- W. Kane, Director, DRP, RI
-- M. Masnik, Project Manager (TMI-2), Office of Nuclear Reactor Regulation (NRR)

Also, a representative of the Commonwealth of Pennsylvania, Ajit Bhattachayyra attended the meeting. No written material was exchanged at the meeting. A summary of the discussion follows.

5.2 Overview

The NRC's Director of DRP, RI, summarized the purpose of the meeting. The purpose was for licensee representatives to provide their perspective on the recent events (listed in Attachment 1 and Section 2.4 of this report). The NRC staff's concern focused on the causes of the events apparently attributable to poor human performance. Underlying causes were to be discussed, such as complacency, with respect to the changing plant status leading to post-defueling monitored storage and/or the influence of poor procedures or work instructions, for example.

The GPUN Executive Vice President led off the licensee's discussion by assuring the NRC staff that these events do not indicate a breakdown in the quality assurance program at TMI-2. Their performance indicators revealed a leveling off of performance in distinction to improved or degradation of performance and the licensee planned corrective actions oriented toward enhancing performance.

The licensee representative acknowledged the potential for apathy in light of the end of the cleanup project. He indicated that licensee management was sensitive to other possible personnel attitudes and they were taking measures to mitigate such behavior on the part of its personnel (details discussed later).

5.3 Special Task Force

Licensee representatives then discussed the results of a special task force designed to review the subject events and related aspects on how site personnel process the documentation and review (critiques) of such events. The licensee initiated this task force review when the NRC staff requested this meeting. The task force had recommendations and forwarded the report to the Director of TMI-2 for review and response.

The task force noted positive aspects on the performance of TMI-2 Division. Corrective actions for major problems of the past year or so were effective. Examples noted were: hot particles contamination, fires, unlocked high radiation doors and improper lifting of heavy loads. Although the number of events per month increased somewhat in the March - April 1988 time period, the yearly number to date was about par with previously years (average of about ten events/month). The task force also recognized the ambitious program for review of such events and the relatively low threshold for reporting in light of TMI-2 unique conditions compared to operating reactors.

However, the task force noted a leveling off of performance (with respect to the licensee performance indicator curves) and it recommended that the TMI-2 Division needed to provide action in certain areas oriented toward improved performance. The areas included: root cause analysis, specialized review of the human performance element, and procedure adequacy and adherence.

The conclusions of the task force were:

-- the events had no significant impact on nuclear safety;

-- there was a leveling off or flattening of performance indicator curves; i.e., measure of performance; and,

-- low threshold for reporting was better than industry-wide performance.

5.4 Corrective Actions

As a result of the above, the licensee representatives provided the following planned (or taken) corrective actions.

-- Meetings between the TMI-2 Director and division supervisors (190 -- 82 done with 108 due) and the major contractor management to re-emphasize: (1) quality of operations; (2) review all thirty-four events for 1988 attributable to personnel errors or procedure inadequacies; and, (3) review the latest performance indicators (expected to be completed by July 8, 1988).

-- A policy memorandum was issued June 27, 1988, banning all non-company reading material within the protected area.

-- Decide by July 14, 1988, what type of re-review was needed to resolve the issue of making procedures better or "user-friendly."

-- Enhance the adequacy of critiques by improving root cause analysis and by having personnel trained in human performance analysis present at critiques.

-- GPUN Office of the President reissue of policy to all GPUN divisions on the use of procedures; namely, to follow the procedure or fix it if it cannot be followed.

In response to the licensee's request for feedback on these actions, the NRC staff suggested enhanced use of the licensee's management off shift tours to focus on the management of idle time during back shift hours and at remote locations in the plant, such as at the defueling water cleanup station on the operating floor of the fuel handling building. Licensee representatives acknowledged the staff's comments.

The NRC staff tentatively agreed with the licensee's proposed or taken actions. The staff indicated that they would continue to closely monitor licensee performance; and, if the performance did not improve, another meeting at the end of this year may be warranted.

Accordingly, this area is unresolved pending completion of licensee action as stated above and further review by NRC Region I (320/88-10-01).

5.5 Special Measures

The licensee representatives also summarized GPUN's plan for managing the "end of project" employee relations. To be done right, the plan included factoring in the career needs of personnel at TMI-2, use of contractors at TMI-2 integrated into the organization, application of existing resources at TMI-1, and providing for a means for departing personnel to air any safety concerns. The licensee representatives indicated that the reduction of 130 licensee (not contractor) personnel occurred to date by attrition (transfer or early retirement), not by termination.

The major reduction in force in the TMI-2 organization will come as contractors phase out their work.

Further, any personnel terminating employment at TMI have the opportunity to air safety concerns on a form developed by the Division of Human Resources.

The GPUN Executive Vice President summarized that it was the company's desire to be able to place all employees prior to position termination, preferably within the company or by attrition, and that existing measures for employees to air safety concerns were adequate.

5.6 Meeting Conclusion/Summary

The NRC staff summarized the licensee's perspective on the subject events. Licensee management was not content with the leveling off of performance indicators. The licensee oriented corrective actions toward the human performance element. There was no adverse impact on nuclear safety.

The NRC staff considered licensee proposed or taken action tentatively acceptable pending further Region I review. The collective affect of these actions were to be reviewed in a future inspection or management meeting.

6.0 Exit Meeting

The inspectors discussed the inspection scope and findings with licensee management at a final exit interview conducted July 7, 1988. Senior licensee personnel attending the final exit meeting were noted in Section 1.3.

The inspection results, as discussed at the meeting, are summarized in the cover page of the inspection report. Licensee representatives indicated that none of the subjects discussed contained proprietary or safeguards information.

ATTACHMENT 1

TMI-2 HUMAN PERFORMANCE EVENTS
JANUARY TO MAY 1988

Date	Inspection	Description
1/88	88-01	Inattentive worker to duties in RWP area
1/88	88-01	Worker enters locked high radiation area without proper dosimetry
2/22/88	88-05	Fire at decontamination facility in RB
2/27/88	88-05	Fire at decontamination facility in RB
4/1/88	88-08	Hose rupture during "A" spent resin tank decanting apparently due to banging clogged line (clogged line repetitive event - same line previously ruptured due to improper crimping to fitting)
4/4/88	88-06	High airborne in RB due to hole drilling in stairwell block wall with wrong type of tool - RB evacuated
4/12/88	88-06	Turbine building work - electric hoist hook snapped free knocking a worker unconscious
4/28/88	88-08	Containment outer door left open without people transiting contrary to TS
5/5/88	88-06	CA-V-238 and DH-V-163 found open after inadvertent transfer of BWST water to bleed tank
5/2/88 & 5/31/88	88-09	Locked high radiation doors found open
5/13/88	88-08	"x-y" bridge for plasma arc equipment flushed with BWST water contrary to procedures
5/23/88	88-08/09	Worker falls into reactor vessel