

IR# 10000819

~~EXEMPT #4~~

2)

Originator: CATHERINE G HARDEE  
Barley

Supv Contacted: Russ Green, C. Wend, R

Condition Description:

Contrary to requirements of ECR TM 06-00816, Rev 1, Containment Structural Opening, RB purge was not maintained to induce air flow into containment after the RB liner plate was removed. The RB liner plate was removed to provide a construction opening to support OTSG replacement during T1R18. Additionally, the alternative measures prescribed for cases when the RB purge was unavailable apparently were not applied.

Immediate actions taken:

Immediate Actions:

- 1.) RB Purge restored.
- 2.) Operations Standing Order issued to ensure appropriate control of RB purge and to ensure airflow into reactor building maintained or alternate control measures in place.

Recommended Actions:

Review issue with regard to failure to implement design requirements and lack of organizational sensitivity to potential release pathway. Identify and implement corrective actions

Why did the condition happen?

A single point of contact for all ventilation related activities was recommended by Ops during the ECR review but does not appear to have been implemented.

Reference IR 994989 alerted station personnel to this problem on 11/18/09.

ALSO NRC ASKED FEW WKS PRIOR ABOUT SIMILAR CONCERN

Operable Basis:

Reportable Basis:

Reviewed by: BRADLEY A PARFITT 12/03/2009 09:44:02 CST

Reviewer Comments:

Reviewed by Operations for operability and reportability. This issue has no impact on the ability to safely operate the plant, to achieve or maintain the plant in a safe shutdown condition, or to mitigate the effect of any accident condition. This is a process issue that does not identify an equipment deficiency that affects operability of any SSC. There are no operability or reportability concerns.

SOC Reviewed by: SUZANNE M SULLIVAN 12/09/2009 09:57:04 CST

SOC Comments:

Followup to Ops to determine action. (SOC 12/04/09)

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Design Engineering agreed to take the lead on the ACE. Close to ACE actions created. (REH 12/8/09) (SOC 12/09/09)

Reviewed by: RANDY E HESS 12/08/2009 10:00:25 CST

Reviewer Comments:

IR-10000819

G/10

Issue discussed with Operations, Engineering, SGRP, and the airborne RCE team lead. Design Engineering agreed to lead the ACE with assistance from Operations and SGRP. ACE actions created. (REH 12/08/09)

Extension 2: From 01/25/10 to 02/03/10 approved by the MRC on 01/20/10. See Attributes for approval document.  
P. Fink 01/20/10.

Reopen and extension approved by Acting Plant Manager 01/11/10.

See Assignment Attributes for approval paperwork and IR submittal for late request (IR 1014623).

ACE reopened extended to 01/25/10  
MRC due dated extended until 02/08/10.

P. Fink 01/11/10.

## Apparent Cause Evaluation

**Title:** Negative Pressure Not Maintained in the Reactor Building during High Contamination Work

**Condition Report #:** T000819-02

**Event Date/Event Time:** 11/7/09 -11/21/09

**Station/Unit(s):** TMI-1

**Sponsoring Manager:** Pat Bennett

**Investigator(s):** Michael Harty

X-8232

NRC ASKED ~ 11/5/09

### Condition Statement:

The reactor building purge exhaust system was not in service between 11/7/09 and 11/21/09 per the requirements of ECR TM 06-00816, "OTSG Replacement - Containment Structural Opening." The intent of running the purge system is to maintain slight negative pressure with respect to the outside environment in the reactor building while high contamination work continued. Without negative pressure, airborne contamination could be free to escape the building through the construction opening or equipment hatch instead of being directed through the purge exhaust system where it would be removed by the reactor building purge filtration system. Additionally, alternative measures prescribed for cases when the reactor building purge was unavailable were not applied.

### Event Description:

#### Background:

The scope of ECR TM 06-00816, was to provide the engineering for creating and restoring a temporary opening in the side of the containment building, above the Equipment Hatch, to facilitate ingress/egress of the steam generators as well as equipment and personnel. The ECR TM 06-00816 details the requirements for the various activities pre-outage while at power, outage activities while in cold shutdown, during refueling shutdown and while defueled. Included in these activities is an extensive list of requirements for containment building liner removal.

From the time that the liner was breached until the time it was restored, the plant was in Mode 6, Defueled. In the de-fueled mode, there are no licensing requirements that require containment integrity or mandate the operation of the purge system. TMI Technical Specifications only require the RB purge to be running when containment integrity is not required during the movement of irradiated fuel. Impact reviews were conducted with extensive documentation and determined that no procedures required revision for this ECR. As determined by impact reviews, the ECR did not take actions to modify any procedures in order to explicitly prevent the planned shutdown of the purge system.

Appendix I of 10 CFR 50.34a sets the limits on the amount of radiological material that can be released to the environment, and mandates the monitoring, calculation, and reporting of results to the NRC. TMI complies with these requirements through the Offsite Dose Calculation Manual (ODCM). In accordance with the ECR, radiation monitors (AMS4) were placed at the construction opening to support data collection for the ODCM.

A slight negative pressure existed within the reactor building with the Auxiliary and Fuel Handling Building Ventilation system on. This system draws air from the Reactor Building through the personnel hatch. So, even with the Reactor Building Purge system off, there was a slight negative pressure in the building with respect to the outside environment.

Prior to approval of ECR 06-00816 the package was sent out for Interfacing Department Impact Reviews in accordance with the requirements of CC-AA-103, Configuration Change Control and CC-

AA-102, Design Input and Configuration Change Impact Screening. The Impact Review phase of a project is used to identify the drawings, design bases, licensing documents, programs, procedures and training that are impacted, evaluate the technical adequacy of the proposed change, and initiate the revisions to the affected documents and programs. This Impact review phase is also used to provide comments on the implementation of the proposed change to address constructability concerns.

A2187706, ECR 06-00816 Remove/Restore Containment Structural Opening Evaluation #04 contains the Interfacing Department Impact Review performed by Operations. Contained in this evaluation is the following question, "There is a significant amount of coordination required with regard to operation of the Reactor Building purge and verification of plant mode prior to initiating various phases of the project. Who is responsible for coordination and what work documents incorporate verification of the plant modes?" Furthermore, the Operations review stated "I have identified no program changes, no changes to plant procedure, and no training."

These comments were addressed in the ECR section 3.19 – System operating requirements changed or added:

"During further interim conditions of the liner plate, to include removal and reinstallation, the Reactor Building Purge and Vent System may be adjusted, for practical reasons, so as to minimize differential pressure across the liner plate. . . . as an aid to maintaining the optimal condition of a slight negative pressure on containment such that all effluent air is passing a monitored release site, a single point of contact with operations will be established to communicate with the Operations department regarding these developments:

- Liner plate is first breached via cutting
- Liner plate is removed
- Liner plate curtains are installed or removed
- Liner plate is placed back into the opening.

Any purge adjustments must be coordinated with the Operations through a single point of contact."

The ALARA Installation Review, page 6 of attachment 7 to the ECR shows the radiation protection department's comments. Control of airborne contamination was deemed necessary.. For the mitigation of airborne release it was recommended that "Negative ventilation should be maintained by RB purge per Exelon procedures" and that "A curtain shall be installed, able to be pulled over the opening to mitigate effects of inclement weather or loss of RB purge."

These comments were addressed in the ECR, section 1.2.1.2- Outage activities while in cold shutdown, refueling shutdown, or defueled:

#### h.) Control and Monitoring of Contamination

"The Reactor Building purge will be maintained as required by Exelon procedures to induce airflow into containment" . . . "if there is a ventilation failure for any reason, RP may direct that any of the following measures be taken until the purge is restored:

- a.) Discontinue work activities with potential airborne contamination levels;
- b.) Close all openings to the outside environment, including the containment access opening (two (2) curtains, an inner and an outer, shall be provided covering the containment opening once the concrete and liner has been removed); and,

- c.) Provide and operate auxiliary purge HEPA units (as needed) to permit appropriate airborne contamination controls for hot particle work.

Outage work was planned for the inspection of purge supply and exhaust valves AH-V-1A and AH-V-1D as well as purge supply isolation valve AH-V-1C. Multi-step clearance #9500697 was written to support this work. Clearance step #2 includes actions by the operations department to shut down the purge system and ensure the purge exhaust (AH-V-1A) and purge supply (AH-V-1D) valves are closed locally, resulting in the inability for air to enter or leave the reactor building through the purge system. The approver of the clearance consulted purge operating procedures and determined it was acceptable to remove the purge from service. He then checked with the Outage Control Center to see if it was an appropriate time to take the purge out so the clearance could go into effect and the scheduled work could be completed. Operations followed procedure OP-TM-823-408, "RB Purge – Doors and/or Equipment Hatch Open" to remove the purge from service on 11/7/2009 and step #2 of the clearance was executed on 11/8/09. It remained active, with the purge system off until it was suspended on 11/19/09 in order to lift all tags to allow the RB purge to be placed back in service.

A timeline of important events has been included as Attachment #1.

Interviews were conducted with the following people to ascertain details of the situation:

- John Blair - Shift Operations Superintendent
- James Rosner – ECR Approver
- Nick Jarecha – ECR Writer
- Bill Price – Clearance Approver
- Don Allison – Operations Services Manager
- Laura Weber – ODCM Coordinator

Causal Factors:

#### Apparent Cause #1

Compensatory measures included in ECR #06-00816 to prevent the release of radiological material in case of a ventilation failure were not installed until long after the liner had been removed. The hanging of the construction opening tarp was included as the second to last step of the SGT work package for the removal of the liner plate. While the final step, notifying TMI SGRP Ops that the containment purge system can be returned to normal service was completed on 11/11, the tarp was not installed until 11/19 (see items 1070 and 1080 in attachment #2).

An error precursor not recognized was unclear goals, roles, and responsibilities. The goal of installing the curtain was to be able to close it while the liner was removed if purge system was lost. A clearer understanding of the curtain's purpose could have forced its installation immediately after the liner was removed, with the knowledge that the reactor building purge system was taken out of service.

A defense that failed to prevent this inappropriate action was planning and OOPS. The work package was written with the assumption that the purge system would be available, temporarily adjusted for the liner removal, and then placed back in service. When step 1080 was performed to notify SGRP Ops that

the Containment Purge System can now be returned to normal service, OOPS would apply in that the service could NOT be returned to normal service due to a clearance.

## Apparent Cause #2

Throughout the development of the ECR, operations, radiation protection, and engineering failed to coordinate the execution of the compensatory measures for any failure of the ventilation system.

While the reactor building purge was addressed several times in the ECR, the directions were to maintain it in accordance with the existing Exelon processes and procedures. While radiation protection may have assumed that this direction would keep the purge running the entire time, Exelon procedures allow the purge to be turned off.

The purge operating procedures were not changed with the assumption that Radiation Protection would execute compensatory measures prior to the planned tag out of the purge system. Per SGT work order, Radiation Protection was informed on 11/6 that the liner would be cut in 48 hours. Per procedure OP-TM-823-408, Radiation Protection was informed on 11/7 that the reactor building-purge-system was taken out of service for maintenance. There were no actions in place to drive radiation protection to take the compensatory measures outlined in the ECR for when the construction opening existed and the purge system was lost.

An error precursor not recognized is assumptions and interpretation requirements. The assumption that Exelon procedures would keep the purge on throughout the work process was incorrect. The statement in the ECR stating "The reactor building purge will be maintained as required by Exelon procedures to induce airflow into containment" was interpreted to mean different things by the Operations and Radiation Protection departments.

A defense that failed to prevent this inappropriate action is an Exelon fundamental, maintaining a questioning attitude. Further questioning the comments included in the impact reviews could have uncovered flaws in the design implementation.

Problem Statement	Cause(s)	Basis for Cause Determination
Compensatory measures included to prevent the release of radiological material in case of a ventilation failure were not installed until 8 days after the liner had been removed.	Apparent Management System SPAC (Standards, Policies, Admin Controls) Not Strict Enough (5NS)	The intent of the ECR was to have the curtain in place as a contingency. The order of the work completion could have been stricter to ensure the curtain was in place immediately following the breach of the liner plate to ensure the opening could be covered.
Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures.	Apparent Inappropriate Action Communications – no communication or not timely (4NC)	Comments provided during the impact review process by the Radiation Protection and Operations departments were not integrated. RP assumed that the operating procedures would keep the purge system on while Operations assumed that RP would take compensatory actions, preventing the need for interim procedural changes. The engineering outlined the compensatory measures to be taken without creating actions to drive their execution.

Cause being addressed	Extent of Condition Review
<p>Compensatory measures included to prevent the release of radiological material in case of a ventilation failure were not installed until 8 days after the liner had been removed.</p>	<p>The extent of condition applies to the possibility of compensatory measures that are unable to be taken if the RB purge is lost for any reason.</p> <p>The liner plate has been restored and the compensatory measures included in the ECR are no longer applicable. No further actions are required.</p>
<p>Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures.</p>	<p>The extent of condition applies to the possibility of compensatory measures not being executed if the RB purge is lost for any reason.</p> <p>The liner plate has been restored and the compensatory measures included in the ECR are no longer applicable. No further actions are required.</p>

Cause being addressed	Extent of Cause Review
<p>Compensatory measures included to prevent the release of radiological material in case of a ventilation failure were not installed until 8 days after the liner had been removed.</p>	<p>The extent of cause applies to ECR's that include compensatory measures in the event that a system that is assumed to be operating is lost or taken out of service. Any work required to enact the contingencies must be completed prior to the time they would be needed.</p> <p>Action # 100819-08 has been created to identify the ECR's that include compensatory measures and interim actions during the construction phase, and ensure that the written steps are explicitly transferred to the planning stage.</p>
<p>Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures.</p>	<p>The extent of cause applies to ECR's that include compensatory measures in the event that a system that is assumed to be operating is lost or taken out of service. The feedback provided by the impact reviews from each department must be integrated and fully understood by all affected parties. The engineering should communicate the exact actions to be taken by the appropriate personnel in the event that compensatory measures need to be taken.</p> <p>Action # 100819-07 has been created to brief design engineering to raise awareness of error likely situations resulting from inadequate communication in incorporating and integrating impact review comments.</p>

**Latent Organizational Weaknesses** - undetected deficiencies in the management control processes (e.g., strategy, policies, work control, training, and resource allocation), or associated *values* (shared beliefs, attitudes, norms, and assumptions), that create workplace conditions that provoke error (precursors) or degrade the integrity of defenses (flawed defenses).

Basic Work Practices  
 Communication  
 Computer Issues  
 Control of Personal Resources  
 Design/Modification  
 Documentation/Procedures/Policies  
 Equipment/Facility  
 Goals/Priorities  
 Housekeeping  
 Industrial Safety  
 Management Effectiveness  
 Material Availability

Oversight/Monitoring  
 Organization Structure  
 Program Controls  
 Roles/Responsibilities  
 Task Structure  
 Tools/Equipment Use  
 Training/Qualifications  
 Values/Norms  
 Work Group Interfaces  
 Work Group Practices/Processes  
 Work Planning/Execution  
 Work Scheduling

**Latent Organizational Weaknesses Questions:**

- A. Were there latent organizational weakness that were identified as contributing to this event? List and justify. (e.g., workarounds became accepted practices, habits allowed to develop over time, Pre-Job Briefs are felt to be unnecessary)

Latent Organizational Weakness that failed	How did it contribute to the event?
Roles / Responsibilities	When considering the impact of the construction opening, Operations considered it the responsibility of RP to monitor potential release path and take the appropriate compensatory actions while RP considered it the responsibility of Operations to maintain the purge system on.

OP&X

**Previous Events:** Describe the review of any relevant previous site and industry events for which there is an indication that the corrective actions to prevent recurrence or industry experience recommendations were ineffective. Identify whether the event is a "Repeat Event."

Previous Events	Previous Event Review
Braidwood Station OE30264	Containment Penetration flow path not isolated as required by the Technical Specification Action Statement at Braidwood Station. No useful learning opportunities or insight for corrective actions. The creation of an undesired release path stemmed from a misunderstanding of the failure position of an isolation valve.
Hope Creek LER 05000354	Potential unmonitored release path has existed since plant startup due to failure of one of the vacuum breakers to close after a loss of power. No useful learning opportunities or insight for corrective actions. A design change removed the potential release path.
McGuire Unit 1 - Failure Number : 217	Work inadvertently opened several Containment Purge Ventilation System (VP) containment isolation valves. The cause was the lack of loop specific information in the generic procedure used for calibrating and testing the VP loop. Categorized as a maintenance preventable functional failure.  Corrective Actions: Preventative maintenance procedures and tasks revised.
Millstone Nuclear Power Station Unit 1 LER 9709080230	Unmonitored Airborne Radioactivity Release Paths.  Several conditions existed on site which could create potential unmonitored airborne radioactivity release paths.  The cause of this event was inadequate program management.  The work control administrative procedure has been revised with appropriate process controls in place to provide a method of monitoring of pathways for potential releases.

There is no operating experience addressing the inability to maintain negative containment pressure or the operation of a purge system during situations where containment integrity is not required.

NO SPECIFIC OP&X

**Corrective Action:** For all causes identified, list the Corrective Actions (CAs) or Action Items (ACITs) implemented or planned to be implemented. Identify the Action, the Owner, and the Due Date.

Cause Being Addressed	Corrective Action (CA) or Action Item (ACIT)	Owner	Due Date
Compensatory measures included to prevent the release of radiological material in case of a ventilation failure were not installed until 8 days after the liner had been removed.	(CA) - Revise RCA related ventilation operating procedures to require a review of RCS work in progress and notify RP prior to operating or manipulating ventilation equipment. Action # 996823-34	Susan Sallade Operations	03/26/2010
Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures	Brief Design engineering on the recent revisions to CC-TM-103-1004 that came out of CCA 693870 under the common cause "Inadequate Design Preparation / Reviews SPAC NI / confusing or incomplete. Action #1000819-06	Mike Harty Engineering	3/17/2010
Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures	Brief design engineering to raise awareness of error likely situations resulting from inadequate communication in incorporating and integrating impact review comments. Action #1000819-07	Mike Harty Engineering	3/17/2010
Adequate measures not taken during the development of the ECR to drive the execution of compensatory measures.	Identify the ECR's that include compensatory measures and interim actions during the construction phase, and ensure that the written steps are explicitly transferred to the planning stage.	Mike Harty Engineering	1/13/2014 <i>WMM</i> <i>SO LATE</i>

## Apparent Cause Evaluation Quality Checklist

Critical Content Attributes (criteria for acceptable product)	YES	NO
1. Is the condition that requires resolution adequately and accurately defined?	X	
2. Are the Causal Factors (problems) that resulted in the condition (i.e., equipment failure or inappropriate actions) clearly defined? <input type="checkbox"/> For issues that involve inappropriate actions are Human Performance issues (i.e., error defenses and error precursors) clearly defined? <input type="checkbox"/> For issues that involve equipment failures are the Equipment Performance issues (i.e., parts, components, systems, programmatic problem areas) clearly defined?	X	
Have the causes been accurately identified and appropriately classified as an Apparent Cause or Contributing Cause? <u>If the cause was indeterminate, has a risk assessment been performed?</u>	X	
4. Are the <u>CAs</u> and <u>ACITs</u> adequate to address the causes identified? <input type="checkbox"/> Do the <del>cor</del> CAs / <u>ACIT</u> rective actions describe the desired end-state and do they clearly identify the action(s) to be taken? <input type="checkbox"/> Corrective Actions / <u>ACITs</u> that are COMPLETE – State: Complete <input type="checkbox"/> Corrective Actions / <u>ACITs</u> that are OPEN – State: Owner, Due Date, and Specific Actions Required <input type="checkbox"/> Have recommended <del>corrective actions</del> CAs / <u>ACITs</u> been concurred with by the assigned organization?	X	
5. Are the extent of condition evaluation results described and appropriate? 3	X	
6. Are all CR Originator, Supervisor, Screener, Manager and MRC questions, comments, or concerns properly addressed?	X	
7. Have previous similar <u>site and industry</u> events been evaluated?	X	

*EXCEPT THE C/A FOR PER APPROVAL*



## Attachment #1 – Timeline of Events

