UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
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KING OF PRUSSIA, PA 19406-1415

May 8, 2012

Mr. Michael J. Pacilio
Senior Vice President, Exelon Generation Company, LLC
President and Chief Nuclear Officer, Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND STATION, UNIT 1 - NRC COMPONENT DESIGN BASES INSPECTION REPORT 05000289/2012007

Dear Mr. Pacilio:

On March 30, 2012, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Three Mile Island, Unit 1 (TMI) facility. The enclosed inspection report documents the inspection results, which were discussed on March 30, 2012, with Mr. W. Carsky, Director of Engineering, and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. In conducting the inspection, the team examined the adequacy of selected components to mitigate postulated transients, initiating events, and design basis accidents. The inspection involved field walkdowns, examination of selected procedures, calculations and records, and interviews with station personnel.

This report documents four NRC-identified findings of very low safety significance (Green). These findings were determined to be violations of NRC requirements. However, because of the very low safety significance and because they have been entered into your corrective action program, the NRC is treating these findings as non-cited violations (NCVs) consistent with Section 2.3.2.a of the NRC's Enforcement Policy. Additionally, a licensee-identified violation, which was determined to be of very low safety significance, is listed in this report. If you contest any NCV in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region I; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Senior Resident Inspector at Three Mile Island Station. In addition, if you disagree with the cross-cutting aspect assigned to any finding in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region I, and the NRC Senior Resident Inspector at Three Mile Island Station.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Docket Room or from the Publicly Available Records component of NRC's document system, Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

Lawrence T. Doerflein

Lawrence T. Doerflein, Chief
Engineering Branch 2
Division of Reactor Safety

Docket No.: 50-289
License No.: DPR-50

Enclosure:
Inspection Report 05000289/2012007
w/Attachment: Supplemental Information

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In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Docket Room or from the Publicly Available Records component of NRC's document system, Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

***/RA/***

Lawrence T. Doerflein, Chief
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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket No: 50-289

License No: DPR-50

Report No: 05000289/2012007

Licensee: Exelon Generation Company

Facility: Three Mile Island Station, Unit 1

Location: Middletown, PA 17057

Inspection Period: February 27 through March 30, 2012

Inspectors: F. Arner, Senior Reactor Inspector, Division of Reactor Safety (DRS), Team Leader
J. Schoppy, Senior Reactor Inspector, DRS
J. Lilliendahl, Reactor Inspector, DRS
J. Brand, Reactor Inspector, DRS
C. Edwards, NRC Mechanical Contractor
J. Nicely, NRC Electrical Contractor

Approved By: Lawrence T. Doerflein, Chief
Engineering Branch 2
Division of Reactor Safety

## SUMMARY OF FINDINGS

IR 05000289/2012007; 02/27 - 03/30/2012; Three Mile Island, Unit 1; Component Design Bases Inspection.

The report covers the Component Design Bases Inspection conducted by a team of four U.S. Nuclear Regulatory Commission (NRC) inspectors and two NRC contractors. Four findings of very low safety significance (Green) were identified, all of which were considered to be non-cited violations (NCV). The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process." Cross-cutting aspects associated with findings are determined using IMC 0310, "Components Within the Cross-Cutting Areas." The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

NRC-Identified Findings

**Cornerstone: Mitigating Systems**

- Green: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon had not verified the adequacy of their design with respect to ensuring the capability of the emergency core cooling system piggyback mode of operation during sump recirculation in response to postulated small break loss-of-coolant accident (SBLOCA) conditions. Specifically, the decay heat system low pressure injection (LPI) piggyback motor operated valves (DH-V-7A/B) and containment isolation sump valves (DH-V-6A/B) had not been evaluated to ensure they would open against the maximum expected differential pressures assuming the maximum allowable technical specification (TS) backleakage of system pressure isolation valves (PIVs). Exelon entered the issue into their corrective action program to evaluate the current design and ensure the valves required for piggyback operation could be opened in response to SBLOCA scenarios which may require the transfer to the sump recirculation mode of operation.

  The performance deficiency was determined to be more than minor because it was associated with the design control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The team evaluated the finding in accordance with IMC 0609, Significance Determination Process, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings." The finding was determined to be of very low safety significance because it was a design deficiency confirmed not to result in a loss of operability. This finding was not assigned a cross-cutting aspect because it was a historical design issue not indicative of current performance. (Section 1R21.2.1.1)

- Green: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon had not verified the adequacy of the design regarding motor operated valve (MOV) thermal overload relay (TOL) sizing. Specifically, Exelon had not verified that TOL relays on safety-related low pressure injection (LPI) MOV circuits for the LPI injection valves, DH-V-4A(B), were properly sized to support the design function of repetitive jogging and throttling of the MOVs in response to design basis accidents. Exelon entered the issue into their corrective action program to evaluate the condition that the existing design analysis did not address TOL sizing for jogging MOVs. Exelon performed an initial review for operability of the LPI injection valves and included an extent-of-condition review for other engineered safeguards (ES) MOVs that are operated in a jogging mode to ensure the MOVs would not inadvertently trip under reasonable assumptions.

  The performance deficiency was determined to be more than minor because it was associated with the design control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The team evaluated the finding in accordance with IMC 0609, Significance Determination Process, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings." The finding was determined to be of very low safety significance because it was a design deficiency confirmed not to result in a loss of operability. This finding was not assigned a cross-cutting aspect because it was a historical design issue not indicative of current performance. (Section 1R21.2.1.2)

- Green: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon did not verify the adequacy of design with respect to the Battery 1A sizing calculation. Specifically, non-conservative design inputs and incorrect methodologies were used for the safety related Battery 1A sizing calculation which reduced the battery capacity margin. Exelon entered this issue into the corrective action program and concluded that the issues identified did not render any of the batteries inoperable, based on the magnitude of the errors and currently available aging margin.

  The performance deficiency was determined to be more than minor because it was associated with the design control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The team evaluated the finding in accordance with IMC 0609, Significance Determination Process, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings." The finding was determined to be of very low safety significance because it was a design deficiency confirmed not to result in a loss of operability. The finding had a cross-cutting aspect in the area of Human Performance, Resources Component, because Exelon did not ensure that accurate design documentation was available. Specifically, Exelon inadequately revised the battery sizing calculation in 2009. (IMC 0310, Aspect H.2(c)) (Section 1R21.2.1.3)

- Green: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR 50.63, "Loss of all Alternating Current Power," because Exelon did not ensure that necessary support systems had sufficient capability to mitigate a station blackout (SBO). Specifically, Exelon did not ensure that the design and maintenance of the SBO diesel generator starting battery was adequate to ensure that the SBO diesel generator would be able to start and load within the required time following an SBO. Exelon entered this issue into the corrective action program and concluded that the issues identified did not render the SBO emergency diesel generaor (EDG) inoperable, based on testing performed during the inspection to validate the operability of the SBO EDG output breaker, the adequate performance of the battery during SBO diesel generator surveillances, the adequate acceptance test results, and adequate monthly monitoring.

  The performance deficiency was determined to be more than minor because it was associated with the design control and procedure quality attributes of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The team evaluated the finding in accordance with IMC 0609, Significance Determination Process, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings." The finding was determined to be of very low safety significance (Green) because it did not represent a loss of system safety function, and did not screen as potentially risk significant due to a seismic, flooding, or severe weather initiating event. This finding was not assigned a cross-cutting aspect because the most significant causal factor of the finding was the inadequate design verification for adequate voltage to the battery loads, which was not reflective of current performance. The design calculation was last revised in March 2008. (Section 1R21.2.1.4)

**Other Findings**

One violation of very low safety significance, which was identified by Exelon, was reviewed by the team. Corrective actions taken or planned by Exelon have been entered into Exelon's corrective action program (CAP). This violation and its corrective action tracking numbers are listed in Section 4OA7 of this report.

REPORT DETAILS

# 1. REACTOR SAFETY

**Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity**

1R21 Component Design Bases Inspection (IP 71111.21)

.1 Inspection Sample Selection Process

The team selected risk significant components for review using information contained in the Three Mile Island (TMI) Probabilistic Risk Assessment (PRA) and the U.S. Nuclear Regulatory Commission's (NRC) Standardized Plant Analysis Risk (SPAR) model for the TMI Station. Additionally, the team referenced the Risk-Informed Inspection Notebook for the TMI Station (Revision 2.1a) in the selection of potential components for review. In general, the selection process focused on components that had a Risk Achievement Worth (RAW) factor greater than 1.3 or a Risk Reduction Worth (RRW) factor greater than 1.005. The components selected were associated with both safety-related and non-safety related systems, and included a variety of components such as pumps, transformers, diesel engines, batteries, and valves.

The team initially compiled a list of components based on the risk factors previously mentioned. Additionally, the team reviewed the previous component design bases inspection (CDBI) reports (05000289/2009006 and 05000289/2007006) and excluded the majority of those components previously inspected. The team then performed a margin assessment to narrow the focus of the inspection to 20 components and three operating experience (OE) items. The team selected low pressure injection (LPI) pressure isolation valves (PIVs) to review for large early release frequency (LERF) implications. The team's evaluation of possible low design margin included consideration of original design issues, margin reductions due to modifications, or margin reductions identified as a result of material condition/equipment reliability issues. The assessment also included items such as failed performance test results, corrective action history, repeated maintenance, Maintenance Rule (a)(1) status, operability reviews for degraded conditions, NRC resident inspector insights, system health reports, and industry OE. Finally, consideration was also given to the uniqueness and complexity of the design and the available defense-in-depth margins.

The inspection performed by the team was conducted as outlined in NRC Inspection Procedure (IP) 71111.21. This inspection effort included walkdowns of selected components; interviews with operators, system engineers, and design engineers; and reviews of associated design documents and calculations to assess the adequacy of the components to meet design basis, licensing basis, and risk-informed beyond design basis requirements. Summaries of the reviews performed for each component and OE sample are discussed in the subsequent sections of this report. Documents reviewed for this inspection are listed in the Attachment.

.2 Results of Detailed Reviews

.2.1 Results of Detailed Component Reviews (20 samples)

.2.1.1 'B' Decay Heat Removal Pump, DH-P-1B

a. Inspection Scope

The team inspected the 'B' Decay Heat Removal (DHR) pump, DH-P-1B, to verify the pump was capable of performing its design basis function. This included a review of the net positive suction head (NPSH) analysis for both the borated water storage tank (BWST) and reactor building (RB) sump suction flow paths. The team verified that design inputs were properly translated into system procedures and tests, and reviewed completed surveillance tests to ensure pump operability was demonstrated. The team reviewed emergency operating procedures to verify consistency between system flow paths and assumptions used in the applicable design analyses for the pump and associated valves. The team reviewed system flow calculations, the updated final safety analysis report (UFSAR) and the Technical Specifications (TS) to ensure consistency between pump design parameters and pump test acceptance criteria. The team reviewed equipment service conditions and qualification documentation to determine whether the associated motor would operate under postulated abnormal and accident environmental conditions. The team interviewed engineers, operators, and maintenance personnel to discuss historical pump performance, pump modifications, and associated corrective actions. The team walked down the 'A' and 'B' DHR pumps and motors, and accessible portions of the DHR system to independently assess Exelon's configuration control, the operating environment of the pump and associated components, and the DHR system material condition.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon had not verified the adequacy of their design with respect to ensuring the capability of the emergency core cooling system (ECCS) piggyback mode of operation during sump recirculation in response to postulated small break loss-of-coolant accident (SBLOCA) conditions. Specifically, the decay heat system low pressure injection (LPI) to high pressure injection (HPI) (piggyback) motor operated valves (DH-V-7A/B) and containment isolation sump valves (DH-V-6A/B) had not been evaluated to ensure they could open against the maximum expected differential pressures given the TS allowable back-leakage of system pressure isolation valves (PIVs).

Description: Calculation C-1101-900-E410-039, Motor Operated Valve (MOV) Delta P and Basis, Rev. 9, and the MOV 89-10 Program Scope Evaluation, referenced 218 pounds per square inch differential (psid) and 39 psid as bounding maximum expected differential pressures (MEDP) for valves DH-V-7A/B and DH-V-6A/B, respectively. These maximum values were identified to verify that thrust design margins existed to ensure the capability of the LPI piggyback motor operated valves (DH-V-7A/B) and the reactor building sump isolation motor operated valves (DH-V-6 A/B) to open during the transfer to RB sump recirculation operation. The team reviewed the LPI design in response to a SBLOCA scenario and identified that the established MEDP design inputs had not been verified to be conservative values. Specifically, the team noted that MEDP would be higher for postulated reactor coolant system (RCS) break sizes where the RCS pressure is elevated above the existing MEDP for valves DH-V-7A/B during the transfer of LPI suction to the sump.

The team noted that the DHR system injection lines connecting to the reactor vessel included two PIV check valves in series. PIVs are defined for each interface as any two valves in series within the reactor coolant pressure boundary which separates the high pressure RCS from a low pressure system. These valves are normally closed during power operation and form part of the RCS pressure boundary (RCPB). The team noted the associated PIV TS (Section 3.1.6) allows up to a maximum of 5 gallons per minute (gpm) backleakage through the PIVs. Additionally, the normally closed LPI MOV injection valves in each line downstream of these check valves, which may prevent leakage during normal plant operation, are designed to automatically open when the reactor pressure drops below 1600 pounds per square inch guage (psig) during an accident condition.

The team determined that during a postulated SBLOCA, there was a potential for the design allowable backleakage from the RCS through the two series check valves (CF-V-5 A/B and DH-V-22 A/B) to pressurize the closed system DHR/LPI piping up to the DHR pump discharge and suction relief valves (set to relieve at a nominal 520 and 495 psig respectively). The team noted that this pressure would exceed the currently established maximum expected differential pressure for both the LPI piggyback (218 psid) and the RB sump isolation motor operated valves (39 psid) depending on what the RCS pressure was prior to the transfer to sump recirculation. The team also questioned the impact of the design on the DHR system pressure relief valves (DH-V-18A/B and DH-V-13A/B) due to the potential for repetitive cycling.

Exelon entered the issue into their corrective action program (IR 1337871) to evaluate the current design and ensure the valves required for piggyback operation could be opened during postulated SBLOCA scenarios requiring transfer to the sump recirculation mode of operation. Exelon reviewed historical leak test results for the PIVs performed under OP-TM-213-211/212 and verified the last test performed showed that the PIVs were not leaking. The team reviewed the data and agreed with Exelon's conclusion that based on the latest test results the system pressure would not be challenged and the piggyback valves would remain operable. Additionally, Exelon engineers performed an evaluation of SBLOCA scenarios requiring piggyback sump recirculation. This analysis determined that if PIV backleakage existed, the piggyback valves had sufficient thrust capability to open against the maximum DP which would exist due to the system relief valve settings. This evaluation also determined that when valve DH-V-7A or DH-V-7B is opened, the pressure in the decay heat system would be relieved to the makeup pump suction line due to the resultant flowpath resulting in MEDP for the RB sump valves (DH-V-6A/B) to be within the previously analyzed values. Additionally, as part of their design review, Exelon plans to evaluate the expected duty cycle on the system relief valves to ensure they were designed for the number of cycles that could occur given the postulated SBLOCA scenario and allowable PIV TS backleakage.

Analysis: The team determined that the failure to verify the adequacy of the design with respect to ensuring the capability of the piggyback valves and RB sump isolation valves to operate for all postulated accident conditions, assuming maximum allowable TS backleakage through the pressure isolation check valves, was a performance deficiency. The performance deficiency was more than minor because it was similar to IMC 0612, Appendix E, Examples of Minor Issues, Example 3.j, in that the design analysis deficiency resulted in a condition where the team had reasonable doubt regarding the operability of the LPI to HPI (piggyback) and containment isolation sump valves. In addition, the performance deficiency was associated with the design control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. In accordance with IMC 0609, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings," the team conducted a Phase 1 Significance Determination Process (SDP) screening and determined the finding was of very low safety significance (Green) because it was a design deficiency confirmed not to result in a loss of operability. The finding was not assigned a cross-cutting aspect because it was a historical design issue not indicative of current performance.

Enforcement: 10 CFR Part 50 Appendix B, Criterion III, Design Control, requires, in part, that design control measures provide for verifying or checking the adequacy of design. Contrary to the above, as of March 7, 2012, measures had not been established to ensure that the maximum design basis differential pressure established in the MOV program design analysis for the DHR/LPI piggyback valves was a conservative bounding value for all postulated accident conditions. Because this violation is of very low safety significance and has been entered into Exelon's corrective action program (IR 1337871), this violation is being treated as a non-cited violation consistent with Section 2.3.2 of the NRC Enforcement Policy. **(NCV 05000289/2012007-01, Nonconservative Differential Pressure Value used in DHR/LPI Motor Operated Valves Design Analysis)**

.2.1.2 'A' Decay Heat Removal Low Pressure Injection Valve (DH-V-4A)

a. Inspection Scope

The team inspected MOV, DH-V-4A, to verify that it was capable of performing its specified design functions. The valve opens on an LPI actuation signal to provide LPI flow to the RCS in the event of loss-of-coolant accidents (LOCAs). The valve is also required to close by remote manual operation to provide long-term containment isolation. The team reviewed the UFSAR, design basis documents, calculations, vendor drawings, and procedures to identify the design basis requirements for the valve. The team also reviewed expected system alignments to assess whether component operation in these permitted alignments was consistent with the design and licensing basis assumptions. The team reviewed valve testing procedures and valve specifications to verify that the design bases requirements, including assessment of worst case system and environmental conditions, were incorporated into test acceptance criteria and component design. The team also interviewed operators and reviewed emergency operating procedures (EOP), vendor guidance, motor heating calculations, and simulator data to evaluate valve jogging operations and controls under design basis accident (DBA) conditions to ensure that the valve would continue to function as designed when throttled repeatedly, over short intervals, to control LPI flow.

The team reviewed periodic verification diagnostic test results and stroke test documentation to verify acceptance criteria were met. Additionally, the team verified that the valve's safety function, torque switch settings, performance capability, and design margins were adequately monitored and maintained in accordance with Generic Letter (GL) 89-10 guidance. The team reviewed test frequencies to verify they were correctly determined, based on test results, as described in GL 96-05. The team reviewed the calculations for the degraded voltage at the MOV terminals to ensure that the proper voltage was utilized in MOV torque calculations. The team reviewed the calculations that established control circuit voltage drop, short circuit, and protection/coordination including thermal overload sizing and application. Additionally, the team reviewed Exelon's motor control center (MCC) thermal overload testing programs. The team interviewed the MOV program and LPI system engineers to evaluate maintenance issues and overall reliability of the valve. The team also conducted walkdowns to assess the material condition of the valve, and to verify that the installed valve configuration was consistent with design bases assumptions and plant drawings. Finally, the team reviewed a sample of corrective action issue reports (IR) and the LPI system health report to verify that deficiencies were appropriately identified and resolved, and that the valve was properly maintained.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon had not verified the adequacy of the design regarding MOV thermal overload (TOL) relay sizing. Specifically, Exelon had not verified that TOLs on safety-related LPI MOV circuits for the LPI injection valves, DH-V-4A(B), were properly sized to support the design function of repetitive jogging and throttling of the MOVs in response to DBAs.

Description: The team noted that the safety function of the LPI Injection valve, DH-V-4A(B), was to fully open upon an engineered safeguards (ES) actuation signal and then be capable of being jogged to a throttled position, as directed by EOPs. Procedure OP-TM-EOP-010, HPI Rule 2 LPI Throttling, provides direction to throttle the 4A valve while taking suction from the BWST to control LPI flowrate less than or equal to 3300 gpm per pump in response to a DBA. This criterion was provided, in part, for motor overload protection, but also to provide more time before reactor building (RB) sump recirculation was required. The team noted that OP-TM-EOP-010, Rule 2, also provided additional guidance later on in the event when operating from the RB sump. The procedural direction is that when both LPI pumps are available and the debris accumulating on the RB sump ECCS strainer is not acceptable, operators are required to throttle the LPI flowrate to less than 1500 gpm. Procedure OP-TM-EOP-101, Rev. 5, Section 2.2, Rule 2 HPI/LPI Throttling, states that this limitation serves to prevent damaging the ECCS strainer when the strainer DP increases to levels approaching 7.5 feet. The team noted that the LPI injection valves are gate valves and the team performed independent calculations of the potential position of the valves when throttling down to flowrates below 1500 gpm in each train. The team determined that the design of the valve along with the required position of the valve at these flowrates may result in additional jogs to be able to properly control flow.

The team noted that the TOLs for various safety related valve motors are not bypassed during accident conditions. Calculation C-1101-730-5350-002, GL 89-10 MOV TOL Determination, sized the TOL for the DH-V-4A(B) LPI valve motors based on one duty cycle, which is an opening of the valve followed by a close stroke. The team determined that consideration of the design function of jogging or throttling of MOV DH-V-4A had not been factored into the sizing criteria. The team observed that the TOL for DH-V-4A had not been evaluated to ensure that it would not inadvertently trip during operation of the MOV in response to EOP guidance following DBA conditions. The team noted that Exelon had established very conservative protection criteria within TMI Engineering Procedure ES-024T, Overload Heater Selection for Electric Motors. Section 5.3(7) allowed acceptance criteria for locked-rotor or stall conditions of 3 seconds. However, the team noted that Exelon corporate standard, NES-EIC-10.02, Standard for TOL Selection for MOVs, Section 6.0 stated that the procedure does not cover throttling valves, which have unique TOL performance requirements. The team noted as a minimum, throttling valves must be able to perform the required number of jogging operations without tripping the TOL.

Exelon entered this issue into their corrective action program (IR 1337871) to evaluate the adequacy of existing design analysis regarding TOL sizing for jogging MOVs. Exelon performed an initial review for operability of the LPI injection valves and included an extent-of-condition review for other ES MOVs that are operated in a jogging mode to ensure the MOVs would not inadvertently trip during jogging operations in response to a DBA. Based on a best-estimate calculation and a review of internal operating experience, Exelon concluded there was a reasonable expectation that the ES throttling MOVs, including DH-V-4A/B, the makeup injection valves MU-V-16A/B/C/D, and the pressurizer power operated relief valve (PORV) block valve, RC-V-2, would be able to perform their function under ES conditions. The team reviewed internal operating experience where the DH-V-4A/B valves had been jogged during outage testing without inadvertent tripping of the TOLs and based on this data and the initial engineering review concluded there was a reasonable basis of operability. However, the team noted that the design verification required bounding assumptions to be determined to ensure under all conditions the TOLs would not trip inadvertently during response to DBA events.

<u>Analysis</u>: The performance deficiency associated with this finding was that Exelon had not verified the adequacy of their design with respect to ensuring that TOL's on safety-related LPI MOV circuits were sized properly to support their design function of jogging/throttling during DBAs. This performance deficiency was more than minor because it was similar to IMC 0612, Appendix E, Examples of Minor Issues, Example 3.j,

in that, the design analysis deficiency resulted in a condition where the team had reasonable doubt regarding the operability of the MOV jogging valves. In addition, the finding was associated with the design control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. In accordance with IMC 0609, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings," the team conducted a Phase 1 SDP screening and determined the finding was of very low safety significance (Green) because it was a design deficiency confirmed not to result in a loss of operability. The finding was not assigned a cross-cutting aspect because it was a historical design issue not indicative of current performance.

Enforcement: 10 CFR Part 50 Appendix B, Criterion III, Design Control, requires, in part, that design control measures provide for verifying or checking the adequacy of design. Contrary to the above, as of March 12, 2012, measures had not been established to verify and ensure that TOLs for safety-related MOVs that have a jogging/throttling design function would not inadvertently trip and adversely affect MOV operation and EOP implementation. Because this violation is of very low safety significance and has been entered into Exelon's corrective action program (IR 1347306), this violation is being treated as a non-cited violation consistent with Section 2.3.2 of the NRC Enforcement Policy. **(NCV 05000289/2012007-02, Inadequate TOL Sizing Evaluation for Jogging/Throttling Valves)**

.2.1.3 1A Station Battery

a. Inspection Scope

The team reviewed the design, testing, and operation of the 1A station battery to verify that it could perform its design function of providing a reliable source of direct current power to connected loads under operating, transient, and accident conditions. The team reviewed design calculations to assess the adequacy of the battery's sizing to ensure it could power the required equipment for a sufficient duration, and at a voltage above the minimum required for equipment operation. The team reviewed the battery room hydrogen dilution calculation to verify that the hydrogen concentration would stay below flammable limits during normal and postulated accident conditions. The team reviewed battery test results, including discharge tests, to ensure the testing was in accordance with design calculations, plant technical specifications, vendor recommendations, and industry standards; and that the results confirmed acceptable performance of the battery. Design and system engineers were interviewed regarding the design, operation, testing, and maintenance of the battery. The team performed a walkdown of the 1A station battery and associated distribution panels to assess the material condition of the equipment. Finally, a sample of issue reports was reviewed to ensure Exelon was identifying and properly correcting issues associated with the 1A station battery.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, Design Control, because Exelon did not verify the adequacy of the design with respect to the Battery 1A sizing calculation. Specifically, non-conservative design inputs and incorrect methodologies were used for the safety-related Battery 1A sizing calculation which reduced the battery capacity margin.

Description: The team reviewed calculation, C-1101-734-5350-003, Battery Capacity Sizing and Voltage Drop for DC System, which established the adequacy of the 1A battery to supply the DC loads. The team identified that several non-conservative design inputs and incorrect methodologies in the 1A battery sizing calculation resulted in significant reduction in the battery capacity margin. The design input errors were: 1) raising the minimum battery capacity from 80 percent to 90 percent which conflicted with technical specifications, 2) using a minimum voltage for the safety related inverter of 100VDC instead of the correct value of 102VDC, and 3) using an incorrect current value for 480VAC breaker closing coils. The methodology errors were: 1) using an average voltage instead of worst case voltage to calculate inverter current requirements, 2) neglecting inrush currents for spring charging motors, and 3) neglecting control power wiring when calculating voltage drop to certain loads.

The result of these errors was that there was reasonable doubt that the battery capacity would have been adequate under all design conditions; and since the battery sizing calculation was the basis for the acceptance criteria of the battery service and performance tests, there would not have been indications of inadequate capacity during testing. Preliminary evaluations performed by Exelon during the inspection revealed that although the errors resulted in the battery sizing margin being reduced, there was currently adequate capacity. Exelon entered this issue into the corrective action program (IR 1340254). Based on the extent of the errors, Exelon plans to perform an apparent cause evaluation to understand the full extent of the issues. Exelon performed an initial sample and extent-of-condition for all of the station batteries and determined there were no operability issues. The team reviewed Exelon's basis for operability and independently evaluated battery operability. The team similarly concluded that the issues identified did not render any of the batteries inoperable, based on the magnitude of the errors and currently available aging margin.

Analysis: The performance deficiency associated with this finding was that Exelon had not ensured that adequate design control measures existed to verify the adequacy of the design capacity for the 1A station battery. The performance deficiency was determined to be more than minor because it was similar to example 3.j of IMC 0612, Appendix E, Examples of Minor Issues, in that, based on the quantity and magnitude of the errors there was reasonable doubt that the 1A battery would have adequate capacity under all design conditions. In addition, the performance deficiency was associated with the design control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. In accordance with

IMC 0609, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings," a Phase 1 SDP screening was performed and determined the finding was of very low safety significance (Green) because it was a design deficiency confirmed not to result in a loss of operability. The finding had a cross-cutting aspect in the area of Human Performance, Resources Component, because Exelon did not ensure that accurate design documentation was available. Specifically, Exelon inadequately revised the battery sizing calculation in 2009. (IMC 0310, Aspect H.2(c))

Enforcement: 10 CFR Part 50, Appendix B, Criterion III, Design Control, requires, in part, that design control measures shall provide for verifying or checking the adequacy of design. Contrary to the above, as of March 30, 2012, Exelon's design control measures had not verified the adequacy of the design regarding the 1A battery sizing calculation. Specifically, non-conservative design inputs and incorrect methodologies were used for the safety related 1A Battery sizing calculation. Because this violation was of very low safety significance (Green) and has been entered into Exelon's corrective action program (IR 1340254), this violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the NRC Enforcement Policy. **(NCV 05000289/2012007-03, Inadequate Design Control for Battery Sizing Calculation)**

.2.1.4 Station Blackout Diesel Generator (Electrical)

a. Inspection Scope

The team inspected the station blackout diesel generator to verify that it was capable of meeting its design basis requirements. The review included starting components such as starting air solenoids, generator field flash, and the generator breaker close coil. The team reviewed electrical one-line diagrams for the diesel generator, vendor documentation, and diesel generator operating procedures to ensure that the diesel generator was operated consistent with its rating and was capable of operating under all conditions. The team reviewed the adequacy of voltage available for the starting components and ensured that surveillance testing adequately verified that components would be functional. Design and system engineers were interviewed regarding the design, operation, testing, and maintenance of the diesel generator. The team performed a walkdown of the diesel generator and support systems to assess the material condition of the equipment. Finally, a sample of issue reports was reviewed to ensure Exelon was identifying and properly correcting issues associated with the station blackout diesel generator.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving a non-cited violation of 10 CFR 50.63, "Loss of all Alternating Current Power," because Exelon did not ensure that necessary support systems had sufficient capability to mitigate a station blackout (SBO). Specifically, Exelon did not ensure that the design and maintenance of the SBO diesel generator starting battery was adequate to ensure that the SBO diesel generator would be able to start and load within the required time following an SBO.

Description: The team reviewed calculation, C-1101-864-E420-001, SBO Battery and Charger Sizing and Hydrogen Calculation, which sized the SBO diesel generator starting battery. The team noted that C-1101-864-E420-001 assumed that a battery terminal voltage of 105VDC would be adequate. However, the team noted that the calculation did not include a voltage drop analysis to verify that adequate voltage was available to the loads. The team questioned the adequacy of voltage to the loads, with a focus on the SBO diesel output breaker. In response to this concern, during the inspection Exelon performed a bounding calculation for the voltage drop to the SBO diesel output breaker and determined that the voltage drop could be as high as 30VDC which would leave 75VDC for the output breaker. The team noted that the SBO diesel output breaker manufacturer's minimum required voltage for the breaker was 90VDC. The team determined that based on the voltage being below the manufacturer's rating, there was reasonable doubt of operability for the breaker.

Exelon entered this issue into the corrective action program (IR 1342814) and promptly tested a spare equivalent breaker to verify that it would operate at 70VDC. Based on the ability of the breaker to operate at 70VDC, Exelon determined it was operable. The team determined Exelon's basis for operability was reasonable. Exelon issued a work order to perform a test on the installed SBO diesel output breaker to validate their conclusion. Exelon plans to address the longer term solution to this design issue within their corrective action program to ensure the breaker has adequate voltage under all conditions.

The team noted that the SBO diesel generator battery was installed in 2008, and an acceptance test was appropriately performed at that time. However, the team determined that a performance test had not been completed after 2008 in accordance with the Institute of Electrical and Electronics Engineers (IEEE) standard 450-1995, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications. This requires a performance test two years after an acceptance test. This test is important for detecting cell failures and trending battery degradation. Exelon entered this issue into the corrective action program (IR 1346099) with actions to verify the adequacy of the schedule to perform the performance test, which is currently scheduled for late 2012. Based on the adequate performance of the battery during SBO diesel generator surveillances, the adequate acceptance test results, and adequate monthly monitoring, Exelon determined that there were no current operability issues. The team determined Exelon's basis for continued operability was reasonable.

Finally, the team reviewed the inter-cell and inter-tier resistance testing for the SBO diesel generator battery and determined that the acceptance criteria contained in E-135, SBO Diesel Batteries Inspection, was not conservative and was outside of the guidance provided in IEEE 450. These criteria contributed to the inability of maintenance activities to adequately identify high resistance connections. Additionally, the team determined that inadequate corrective actions were taken when a high resistance connection was identified. The team noted that in accordance with the vendor manual and IEEE 450-1995, the acceptance criteria for inter-cell and inter-tier connections is 20 percent above the installed baseline value. However, Exelon used acceptance criteria of

20 percent above the highest connection in the battery for all connections. Based on applying the correct acceptance criteria, the team noted that four connections were slightly above the limit. Because of the non-conservative acceptance criteria, these connections were not previously identified as high resistance connections. Also, because inter-tier connection 38-39 included cable resistance, the original acceptance criteria masked a high resistance problem. The team noted that Exelon had identified in April 2011 high resistance on connection 38-39 even with the higher allowable resistance due to factoring in cable resistance. Although the connection was appropriately re-torqued, the vendor manual and IEEE 450-1995 require that connections that continue to exceed the acceptance criteria after re-torquing must be disconnected, cleaned, and reconnected. At the time of the inspection the 38-39 connection had not been cleaned and the resistance had increased to 179 percent of the acceptance criteria. Exelon entered this issue into the corrective action program (IR 1341523) with actions to promptly clean the connection and revise the acceptance criteria. Based on the sum of the battery connection resistances, Exelon calculated the total voltage drop from all of the inter-cell and inter-tier resistances to be 0.35VDC. Based on this small voltage drop, Exelon determined that there were no operability issues. The team determined Exelon's basis for operability was reasonable.

Analysis: The team determined that the failure to ensure that the SBO diesel battery was designed and maintained to be capable of supporting the SBO diesel in the event of a station blackout was a performance deficiency that was reasonably within Exelon's ability to foresee and prevent. The performance deficiency was determined to be more than minor because it was similar to example 3.j of IMC 0612, Appendix E, Examples of Minor Issues, in that, based on the excessive voltage drop to the SBO diesel output breaker and inadequate maintenance there was reasonable doubt that the battery would have adequate capacity under all conditions. In addition, the performance deficiency was associated with the design control and procedure quality attributes of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective of ensuring the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. In accordance with IMC 0609, Attachment 4, "Phase 1 - Initial Screening and Characterization of Findings," a Phase 1 SDP screening was performed and determined the finding was of very low safety significance (Green) because it did not represent a loss of system safety function, and did not screen as potentially risk significant due to a seismic, flooding, or severe weather initiating event. This finding was not assigned a cross-cutting aspect because the most significant causal factor of the finding was the inadequate design verification for adequate voltage to the battery loads, which was not reflective of current performance. The design calculation was last revised in March 2008.

Enforcement: 10 CFR Part 50.63, requires, in part, that necessary support systems must provide sufficient capacity and capability to ensure that the core is cooled and appropriate containment integrity is maintained in the event of a SBO. Contrary to the above, as of March 18, 2012, Exelon did not adequately ensure that the SBO diesel starting battery was sufficiently capable of starting and loading the SBO diesel in the event of a SBO. Specifically, the SBO diesel generator battery design had not been verified to provide the manufacturer's required voltage to the SBO diesel generator output breaker, a battery capacity test was not performed, and battery connection resistances were not maintained within conservative acceptance criteria. Because this violation was of very low safety significance (Green) and has been entered into Exelon's corrective action program (IR 1342814, 1346099, and 1341523), this violation is being treated as a non-cited violation, consistent with Section 2.3.2 of the NRC Enforcement Policy. **(NCV 05000289/2012007-04, Inadequate Design and Maintenance of SBO Diesel Generator Battery)**

.2.1.5 'B' Decay Heat River Water Pump (DR-P-1B)

a. Inspection Scope

The team inspected the 'B' decay heat (DH) river water (RW) pump to verify that it was capable of performing its design function. The pump supports ECCS operation by providing sufficient flow from the Susquehanna River (the ultimate heat sink) to DH service cooler DC-C-2B to remove 100 percent of the DBA heat load from the 'B' loop of the DH closed cooling water (DHCCW) system. The team reviewed drawings, calculations, hydraulic analyses, procedures, system health reports, and design basis documents to evaluate whether the maintenance, testing, and operation of the pump was adequate to ensure that the pump would deliver the design basis flow at the required pressure during transient and accident conditions. The team reviewed surveillance test results to determine if the pump was operating within established acceptance criteria, and that the criteria ensured that the pump could meet its design requirements. The team also reviewed calculations that establish voltage drop, ampacity, protection and coordination, and motor brake horsepower (BHP) requirements for the motor power supply and feeder cable to verify that Exelon appropriately translated the design bases and assumptions into design calculations.

The team reviewed vendor requirements for the suction bell submergence at minimum river level to ensure conditions that would cause vortexing were not present and NPSH requirements were met. Additionally, the team reviewed procedures for external flood control at the intake structure to ensure that the pump would perform during a design basis flooding event. The team discussed system design, testing, operation, and performance with operators and engineers to ensure that the system performed as designed. The team performed several walkdowns of the DHRW pumps, traveling water screens, suction and discharge piping at the intake structure, and associated control room instrument panels to assess the material condition and configuration control of these risk significant structures, systems and components (SSC). The team also reviewed a sample of corrective action IRs related to the 'B' DHRW pump to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

### .2.1.6 Emergency Diesel Generator 1A (Mechanical Review)

a. Inspection Scope

The team inspected the 'A' emergency diesel generator (EDG) fuel oil, lube oil, cooling water, starting air, and EDG room ventilation systems to ensure they could respond to design basis events. The team reviewed the UFSAR, design basis calculations, vendor documents, and procedures to identify the design basis requirements for the EDG and its support systems. The team reviewed EDG surveillance test (ST) results and observed portions of the 'B' EDG ST on March 14, 2012, to ensure that the mechanical support systems operated as designed. The team also reviewed EDG related maintenance history, vendor documents, and maintenance procedures to verify that Exelon performed appropriate preventive maintenance on the EDG and its support systems.

The team reviewed fuel oil consumption, EDG electrical loading, and vortexing calculations to verify that the fuel oil supply and operating procedures ensured that the EDG met its design basis and TS requirements. The team compared fuel oil analysis results to fuel oil quality monitoring limits to ensure that there was no adverse trend or impact on EDG reliability. The team also reviewed seismic qualification documents related to the fuel oil transfer pumps to verify that the pumps would continue to function as designed following a seismic event. Additionally, the team reviewed external flood protection design features, related modifications, operating experience, and procedures to ensure that the EDG, and associated support equipment, would operate as designed during design flood conditions.

The team discussed system design, testing, operation, and performance with operators and engineers to ensure that the systems performed as designed. The team performed several walkdowns of the EDGs, fuel oil day tanks, support systems, and associated control room instrument panels to assess the material condition and configuration control of these SSCs. The team also reviewed a sample of corrective action IRs related to the EDGs to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

### .2.1.7 Diesel Driven Fire Pump (FS-P-1) and Motor Driven Fire Pump (FS-P-2)

a. Inspection Scope

The team inspected the No. 1 diesel-driven fire pump (DDFP) and the motor-driven fire pump (MDFP) to verify that they were capable of meeting their design basis requirements. The primary purpose of the fire water system is to provide a sufficient and reliable water source for fire fighting. Its secondary functions are to provide station blackout diesel generator (SBODG) cooling, backup cooling supply for the DHCCW system, and a backup cooling supply to the instrument air compressors. The team reviewed applicable portions of the UFSAR, vendor documents, the system notebook, and drawings to identify the design basis requirements for the fire pumps. The team reviewed fire pump test procedures to verify that the pumps were capable of achieving design basis head/flow requirements during limiting design basis conditions and that test acceptance criteria were consistent with these requirements. The team reviewed system health reports, preventive and corrective maintenance work orders, test results, and corrective action IRs to identify failures or nonconforming issues, and to determine if Exelon appropriately identified, evaluated, and corrected deficiencies. On March 14, 2012, the team observed portions of the monthly DDFP functional test and weekly battery surveillance to independently verify that the DDFP operated as designed and that operators appropriately identified any abnormal conditions. Finally, the team conducted several walkdowns of the DDFP, MDFP, and associated support systems to assess Exelon's configuration control, the material condition, the operating environment, and potential vulnerability of the fire pumps to external hazards.

b. Findings

No findings were identified.

.2.1.8 4160 Volt Bus 1E

a. Inspection Scope

The team reviewed selected calculations for the electrical distribution system load flow/voltage drop, degraded voltage protection, short-circuit, and electrical protection and coordination for the 1E 4kV bus. The team reviewed the adequacy of calculations and the appropriateness of design assumptions to verify that bus capacity was not exceeded and bus voltages remained above minimum acceptable values under design basis conditions. The team reviewed the switchgear's protective device settings and breaker ratings to ensure that selective coordination was adequate for protection of connected equipment during the most challenging postulated short-circuit conditions. The team reviewed automatic and manual transfer schemes between alternate offsite sources and the EDG and the voltage protection schemes for degraded and loss-of-voltage relaying. The team verified that degraded and loss-of-voltage relays were set in accordance with calculations, and that associated calibration procedures and latest surveillance test results were consistent with calculation assumptions.

The team reviewed TMI's interface and coordination procedures with the transmission system operator for plant voltage requirements. The team reviewed the preventive maintenance inspection and testing procedures to ensure that breakers were maintained in accordance with industry and vendor recommendations. The team reviewed selected operating procedures for normal, abnormal, and emergency conditions to ensure consistency with the licensing bases. The team performed a visual non-intrusive inspection of observable portions of the safety-related 4160V switchgear to assess the installation configuration, material condition, and potential vulnerability to hazards. The team also reviewed a sample of corrective action IRs related to the 4kV 1E Bus to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.9 480 Volt Bus 1R

a. Inspection Scope

The team reviewed selected calculations for the electrical distribution system load flow/voltage drop, degraded voltage protection, short-circuit, and electrical protection and coordination for the 1R 480V bus. The team reviewed the adequacy of calculations and the appropriateness of design assumptions to verify that bus capacity was not exceeded and bus voltages remained above minimum acceptable values under design basis conditions. The team reviewed the switchgear's protective device settings and breaker ratings to ensure that selective coordination was adequate for protection of connected equipment during the most challenging postulated short-circuit conditions. The team reviewed the preventive maintenance inspection and testing procedures to ensure that breakers were maintained in accordance with industry and vendor recommendations. The team performed a visual non-intrusive inspection of observable portions of the safety-related 480V switchgear to assess the installation configuration, material condition, and potential vulnerability to hazards. The team also reviewed a sample of corrective action IRs related to the 480V 1R Bus to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.10 Emergency Diesel Generator 1A, Electrical Review

a. Inspection Scope

The team reviewed the EDG 1A loading and voltage regulation calculations, including the bases for brake horsepower (BHP) values, to verify that design bases and design input assumptions had been appropriately translated into design calculations and procedures. The team reviewed protection/coordination and short-circuit calculations to verify that the EDG was adequately protected with properly set protective devices during test conditions and emergency operation, including short-circuit capability of the output breaker under the most challenging fault conditions. The team reviewed analyses and surveillance testing to assess EDG operation under required operating conditions. The team reviewed calculations and technical evaluations to verify that steady-state and transient loading were within design capabilities, adequate voltage would be present to start and operate connected loads, and operation at maximum allowed frequency would be within design capabilities.

The 125VDC voltage calculations were reviewed to ensure adequate voltage would be available for the breaker closure and opening control circuit components and the breaker spring charging motors. The team reviewed the basis for the EDG load sequence time delay setpoints, calibration intervals, and results of the most recent calibration testing to ensure they were in accordance with design assumptions. The team reviewed the interfaces and interlocks associated with the 1D 4160V safeguards bus, including voltage protection schemes that initiate connection to the EDG, to verify adequacy. The team reviewed the setpoint calculations, calibration procedures, and latest surveillance results for the voltage detection relays, including the applicable time delays. The team performed a visual non-intrusive inspection of the EDG to assess the installation configuration, material condition, and potential vulnerability to hazards. The team also reviewed a sample of corrective action IRs related to the 1A EDG to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.11 Auxiliary Transformer 1A

a. Inspection Scope

The team inspected the 230kV-4160V auxiliary transformer, 1A, to verify that it was capable of meeting its design basis requirements. Transformer 1A is designed to provide the preferred offsite power source to the associated 4160V buses. The team reviewed the system one-line diagrams, automatic load tap changer (LTC) vendor specifications, automatic voltage load tap changer setpoints and control circuit calculations, nameplate data, protective relay setting calculations, and loading requirements to ensure capability of the transformer to meet its design basis requirements. The team reviewed the load flow calculations and protective/coordination calculations to verify that station offsite power would be available during accident conditions. The team reviewed offsite power connections and the transmission operator notification protocols for the 230kV switchyard. The team reviewed periodic maintenance and testing practices to ensure the equipment was maintained in accordance with industry standards. The team performed a visual inspection of the observable portions of the 1A auxiliary transformer to assess the installation configuration, material condition, and potential vulnerability to hazards. The team also reviewed a sample of corrective action IRs related to the 1A transformer to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.12 High Pressure Injection Pump (MU-P-1C)

a. Inspection Scope

The team inspected the 1C High Pressure Injection/Make-Up Pump, MU-P-1C, to verify that it was capable of meeting its design basis requirements in response to transient and accident events, including supply of makeup water to the reactor pressure vessel for all credible RCS break scenarios. The team reviewed the make-up (MU) system hydraulic model and the design basis hydraulic analysis/calculations to verify that required total dynamic head (TDH), required NPSH and potential for vortex formation had been properly considered under all DBA conditions. The team reviewed system operating procedures to ensure they were consistent with the design function of the pump and with relevant calculations for maintaining adequate NPSH, control of vortexing and prevention of pump runout.

The team also reviewed pump in-service test (IST) procedures, recent test results, and trends in test data to verify that pump performance was consistent with design basis requirements. The IST acceptance criteria were reviewed to verify appropriate correlation to accident analyses conditions, taking into account set point tolerances and instrument inaccuracies. Seismic design documentation was reviewed to verify pump design was consistent with limiting seismic conditions. The team reviewed design documentation to verify the pump motor design was consistent with the environmental qualification (EQ) basis for limiting temperature/radiation conditions. The team also conducted a detailed walkdown to visually inspect the physical/material condition of the pump and its support systems and to ensure adequate configuration control. The team reviewed a sample of corrective action IRs related to the 1C MU pump to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.13 Motor Driven Emergency Feedwater Pump (EF-P-2A)

a. Inspection Scope

The team inspected the 2A motor driven emergency feedwater (EFW) pump (EF-P-2A) to verify that it was capable of meeting its design basis requirements. The EFW pump provides emergency feedwater to the once through steam generators in response to transient and accident events for all credible feedwater line break, main steam line break, and steam generator tube rupture scenarios. The team reviewed the EFW system hydraulic model and the design basis hydraulic analysis/calculations to verify that required TDH, required NPSH and potential for vortex formation had been properly considered under all DBA/event conditions. The team reviewed system operating procedures to ensure they were consistent with the design function of the pump and with relevant calculations for maintaining adequate NPSH, control of vortexing and prevention of pump runout.

The team also reviewed pump IST procedures, recent test results, and trends in test data to verify that pump performance was consistent with design basis requirements. The IST acceptance criteria were reviewed to verify appropriate correlation to accident analyses conditions, taking into account set-point tolerances and instrument inaccuracies. Seismic design documentation was reviewed to verify pump design was consistent with limiting seismic conditions. The team reviewed design documentation to verify the pump motor design was consistent with the EQ basis for limiting temperature/radiation conditions. The team also conducted a detailed walkdown to visually inspect the physical/material condition of the pump and its support systems and to ensure adequate configuration control. The team reviewed a sample of corrective action IRs related to the 2A EFW pump to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.14 Reactor Building Sump Suction Valve ( DH-V-6A)

a. Inspection Scope

The team inspected the reactor building sump suction valve, DH-V-6A, to verify that it was capable of meeting its design basis requirements, including isolation of the RB sump until needed for supply of water to the 'A' LPI pump during sump recirculation following a LOCA. The team reviewed the calculations for maximum differential pressure and the inputs/outputs of the analyses used to determine required thrust and the valve weak link. The team reviewed the diagnostic testing and IST surveillance results, including stroke time and available thrust, to verify acceptance criteria were met and performance degradation could be identified. The team reviewed design documentation to verify valve motor design was consistent with EQ basis for limiting temperature/radiation conditions. The team also conducted a detailed walkdown to visually inspect the physical/material condition of the valve and its support systems and to ensure adequate configuration control. The team reviewed the maintenance and functional history of the sump isolation valve by sampling corrective action issue reports, the system health report, and preventive maintenance/corrective maintenance records to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.15 Reactor Pressure Vessel Drop-Line Inboard Containment Isolation Valve (DH-V-2)

a. Inspection Scope

The team inspected the reactor pressure vessel drop-line inboard containment isolation valve, DH-V-2, to verify that it was capable of meeting its design basis requirements, including isolation of the reactor pressure vessel drop-line until needed for supply of water to the DHR system for long-term cooling following a LOCA. The team reviewed the calculations for maximum differential pressure and the inputs/outputs of the analyses used to determine required thrust and the valve weak link. The team reviewed diagnostic testing and IST surveillance results, including stroke time and available thrust, to verify acceptance criteria were met and performance degradation could be identified. The team reviewed design documentation to verify valve motor design was consistent with EQ basis for limiting temperature/radiation conditions. A review was conducted of the modification to add an anti-pressure locking line to the valve bonnet to ensure that it was installed properly without adversely affecting the intended design function of the valve. The team reviewed the maintenance and functional history of the drop-line isolation valve by sampling corrective action reports, the system health report, and preventive maintenance/corrective maintenance records to ensure Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.16 'B' Decay Heat Closed Cooling Water Pump, (DC-P1B)

a. Inspection Scope

The team inspected the 'B' decay heat closed cooling water pump, DC-P1B, to verify that it was capable of meeting its design basis function. The team reviewed drawings, calculations, hydraulic analyses, procedures, system health reports, and the system design basis document (DBD) to ensure consistency with design and licensing bases requirements. The team reviewed completed pump surveillance tests to ensure pump performance, and procedure acceptance criteria were consistent with system flow calculations, the UFSAR and TSs. The team walked down the 'A' and 'B' DHCCW pumps and motors, and accessible portions of the system, to independently assess Exelon's configuration control, the operating environment of the pumps, and the overall system material condition. The team reviewed the maintenance and functional history of the pump by sampling corrective action reports, the system health report, and preventive maintenance/corrective maintenance records to ensure Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.17 'B' Nuclear Service River Water Pump, (NR-P1B)

a. Inspection Scope

The team inspected the 'B' nuclear service RW pump, NR-P1B, to verify that it was capable of meeting its design basis function. The team reviewed drawings, calculations, hydraulic analyses, procedures, system health reports, and the system DBD to ensure consistency with design and licensing bases requirements. The team reviewed completed pump surveillance tests to ensure pump performance, and procedure acceptance criteria were consistent with system flow calculations, the UFSAR and TSs. The team performed a walkdown of the pump to independently assess Exelon's configuration control, the pump operating environment, and the overall system material condition. The team reviewed the maintenance and functional history of the pump by sampling corrective action issue reports, the system health report, and preventive maintenance/corrective maintenance records to ensure Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.18 Main Steam Atmospheric Dump Valve, (MS-V-4A)

a. Inspection Scope

The team inspected the main steam atmospheric dump valve (ADV), MS-V-4A, to verify the valve was capable of performing its design basis function. The air operated main steam atmospheric dump valves function to perform steam generator pressure control and decay heat removal during a loss-of-power event or when the main condenser is not available. MS-V-4A is a normally closed valve designed to fail closed on loss of instrument air or loss-of-power. The team reviewed the UFSAR, the TSs, design basis documents, drawings, and procedures to identify the design basis requirements of the valve. The team reviewed the valve inspection and periodic diagnostic test results and stroke-timing test data to verify acceptance criteria were met. The team verified the ADV safety functions and performance capability were adequately monitored and maintained. The team discussed the design, operation, and maintenance of the ADV with engineering staff to evaluate the performance history, maintenance, and overall component health. The team also conducted walkdowns of both ADVs (MS-V-4 A/B), to assess their material condition and to verify the installed configuration was consistent with the plant drawings, and the design and licensing bases. Finally, the team reviewed corrective action documents to determine if there were any adverse trends associated with the ADVs and to asses Exelon's capability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.19 1B and 1D Battery Chargers

a. Inspection Scope

The team reviewed the design, testing, and operation of the 1B and 1D battery chargers to verify that they could perform their design function of providing a reliable source of DC power to the associated batteries and connected loads under operating, transient, and accident conditions. The team reviewed design calculations to assess the adequacy of the chargers' sizing to ensure they could recharge their associated batteries within the required time. The team reviewed battery charger test results and maintenance records to ensure the testing and maintenance were in accordance with design calculations and vendor recommendations, and that the results confirmed acceptable performance of the battery chargers. Design and system engineers were interviewed regarding the design, operation, testing, and maintenance of the battery chargers. The team performed a walkdown of the battery chargers to assess the material condition of the equipment. Finally, a sample of issue reports was reviewed to ensure Exelon was identifying and properly correcting issues associated with the 1B and 1D battery chargers.

b. Findings

No findings were identified.

.2.1.20 Reactor Trip Breakers, CRD-CB-1B and CRD-CB-1D

a. Inspection Scope

The team reviewed the design, testing and operation of the reactor trip breakers, CRD-CB-1B and CRD-CB-1D, to verify that they could perform their design function of opening upon a valid reactor trip signal. The reactor trip breakers were replaced in 2011 as part of an upgrade to the Control Rod Drive Control System. The team reviewed the associated modification package to verify that the new breakers provided rapid response and diverse means of tripping. The team reviewed drawings for the new system to ensure the design was adequate and consistent with design requirements. The team reviewed the post maintenance testing to ensure the testing was in accordance with design calculations, testing procedures, and vendor recommendations; and that the results confirmed acceptable performance of the breakers. Finally, a sample of issue reports was reviewed to ensure Entergy was identifying and properly correcting issues associated with the reactor trip breakers.

b. Findings

No findings were identified.

.2.2 Review of Industry Operating Experience and Generic Issues (3 samples)

The team reviewed selected OE issues for applicability at the TMI Station. The team performed a detailed review of the OE issues listed below to verify that Exelon had appropriately assessed potential applicability to site equipment and initiated corrective actions when necessary.

.2.2.1 NRC Information Notice 2011-04: Contaminants and Stagnant Conditions Affecting Stress Corrosion Cracking in Stainless Steel Piping in Pressurized Water Reactors

a. Inspection Scope

The NRC issued Information Notice (IN) 2011-04 to inform licensees of the effects of contaminants and stagnant conditions on the potential for stress corrosion cracking (SCC) in stainless steel piping in pressurized water reactors (PWR). NRC IN 2011-04 also stressed the importance of periodic inspections of the susceptible piping systems as part of the licensee's existing boric acid corrosion control (BACC) program or as part of routine walkdowns in detecting SCC in stainless steel piping. The team reviewed Exelon's evaluation of IN 2011-04 and their associated follow-up response. The team independently walked down accessible susceptible piping associated with the team's selected SSCs to assess the material condition and Exelon's stainless steel piping cleanliness controls.

b. Findings

No findings were identified.

.2.2.2 NRC Information Notice 2011-12, Reactor Trips Resulting from Water Intrusion into Electrical Equipment

a. Inspection Scope

The NRC issued IN 2011-12 to inform licensees of several events where uncorrected water leaks have resulted in electrical faults and grounds that have resulted in reactor trips. The IN also describes the trip of an EDG due to an agastat relay which was significantly beyond the vendor recommended replacement interval, timing out prematurely. The team reviewed Exelon's actions relative to the conditions described within the IN to ensure Exelon had performed appropriate evaluations for the TMI site.

b. Findings

No findings were identified.

.2.2.3 NRC Generic Letter 87-06, Periodic Verification of Leak Tight Integrity of Pressure Isolation Valves

The team performed a detailed review of Exelon's evaluation of NRC GL 87-06. This GL requested information to verify how each operating reactor licensee assures the leak-tight integrity of all PIVs as independent barriers against abnormal leakage, rapidly propagating failure, and gross rupture of the reactor coolant pressure boundary. The PIVs are defined for each interface as any two valves in series within the reactor coolant pressure boundary which separates the high pressure RCS from an attached low pressure system. These valves are normally closed during power operation and form part of the RCPB. Periodic tests or verification of the leak tight integrity of all PIVs are necessary to ensure integrity of the RCPB in accordance with 10 CFR Part 50, Appendix A and B. The team reviewed the UFSAR, the TSs (TS Section 3.1.6.10), design basis documents, and TMI's response dated June 12, 1987 (GPUN Response to Generic Letter (GL) 87-06), to assess the completed evaluation and applicable corrective actions to ensure the operability of TMI's PIVs.

b. Findings

No findings were identified.

## 4. OTHER ACTIVITIES

### 4OA2 Identification and Resolution of Problems (IP 71152)

a. Inspection Scope

The team reviewed a sample of problems that Exelon had previously identified and entered into the corrective action program. The team reviewed these issues to verify an appropriate threshold for identifying issues and to evaluate the effectiveness of corrective actions. In addition, corrective action IRs written on issues identified during the inspection, were reviewed to verify adequate problem identification and incorporation of the problem into the corrective action system. The specific corrective action documents that were sampled and reviewed by the team are listed in the Attachment.

b. Findings

No findings were identified.

### 4OA6 Meetings, including Exit

On March 30, 2012, the team presented the inspection results to Mr. W. Carsky, Director of Engineering, and other members of the TMI Station management. The team verified that no proprietary information was documented in the report.

### 4OA7 Licensee-Identified Violation

The following violation of NRC requirements was identified by Exelon. The issue was determined to have very low safety significance (Green) and met the criteria of Section 2.3.2 of the NRC Enforcement Policy, NUREG-1600, for being dispositioned as an NCV.

- 10 CFR Part 50, Appendix B, Criterion III, Design Control, requires in part, that design control measures provide for verifying or checking the adequacy of design. Contrary to this, design control measures had not ensured and verified that connected Class 1E loads are not damaged or become unavailable for a design basis event concurrent with a degraded voltage condition between the 4kV degraded voltage dropout setting and the loss-of-voltage setting, prior to and following transfer to the EDG onsite source. Exelon had previously identified in early 2009, within AR 838100, that actions were required to review their design at TMI with respect to the selection and sizing of TOLs which were not bypassed on an accident signal. This included proposed actions to review the long time trip of protective relays and the impact of extended duration of locked rotor current on potential motor damage from additional heating. Additionally, Exelon identified in

December 2011 within AR 1276061, the need to review the design to verify the allowable degraded voltage relay (DVR) time duration would not result in failure of safety-related systems or components. The finding was of very low safety significance (Green) because the finding did not represent the loss of a system safety function, an actual loss of safety function of a single train for greater than the TS allowed outage time, or screen as potentially risk significant due to a seismic, flooding, or severe weather initiating event. Exelon initiated AR 1347885 to ensure all aspects of the design issue will be resolved based on additional comments from the inspection team.

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACT

Exelon Personnel
D. Atherholt, Manager, Regulatory Assurance
P. Bennett, Manager, Design Engineering-Mechanical
J. Cavanaugh, System Engineer
M. Fitzwater, Senior Regulatory Assurance Engineer
M. Harty, Design Engineer
W. McSorley, Design Engineer
J. Piazza, Senior Manager, Design Engineering
M. Reed, System Engineer

NRC Personnel
W. Cook, Senior Risk Analyst
D. Werkheiser, DRP, Senior Resident Inspector
J. Heinly, DRP, Resident Inspector

### LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Open and Closed

| | |
|---|---|
| NCV 05000289/2012007-01 | Nonconservative Differential Pressure Value used in DHR/LPI Motor Operated Valves Design Analysis (Section 1R21.2.1.1) |
| NCV 05000289/2012007-02 | Inadequate TOL Sizing Evaluation for Jogging/Throttling Valves (Section 1R21.2.1.2) |
| NCV 05000289/2012007-03 | Inadequate Design Control for Battery Sizing Calculation (Section 1R21.2.1.3) |
| NCV 05000289/2012007-04 | Inadequate Design and Maintenance of SBO Diesel Generator Battery (Section 1R21.2.1.4) |

### LIST OF DOCUMENTS REVIEWED

Audits and Self-Assessments
648601-03, EDG Leakage Benchmarking Report, dated 10/15/07

Calculations & Engineering Evaluations

C-1101-210-E610-011, LPI and BS Pump NPSH Margin Available Following a LBLOCA, Rev. 9A
C-1101-211-E540-091, TMI-1 IST Acceptance Criteria for HPI Pumps, Rev. 1
C-1101-211-E410-100, TMI-1 MU and HPI Flow, Rev. 5
C-1101-212-E410-070, DH-P-1A and DH-P-1B NPSH at Minimum BWST Water Level, Rev. 0, dated 10/8/98
C-1101-212-5310-050, TMI-1 BWST Vortex Determination, Rev. 2
C-1101-424-E410-075, TMI-1 EFW NPSH Analysis & Suction Design Basis Lineups, Rev. 0
C-1101-424-E410-069, TMI-1 EFW Multi-use Flow Model (Pipe-Flo computer platform), Rev. 0
C-1101-424-E610-062, EFW Flow Requirements for DBAs, Rev. 1
C-1101-424-E540-065, TMI-1 IST Acceptance Criteria for EFW Pumps, Rev. 2
C-1101-424-E410-075, TMI-1 EFW NPSH Analysis and Suction Design Basis Lineups, Rev. 0
C-1101-424-E610-062, EFW Flow Requirements for Design Basis Accidents, Rev. 1
C-1101-533-E410-013, TMI-1 DR Hydraulic Performance Using Field Test Data, Rev. 4
C-1101-533-E510-008, TMI-1 Decay Heat River Water System Pump IST – Pressure and Flow Instrument Error, Rev. 2
C-1101-533-E540-004, Decay Heat River Water Pipe Flow Model, Rev. 6
C-1101-542-E540-014, TMI-1 Decay Heat Service Closed Cooling Water Hydraulic Analysis, Rev. 0
C-1101-642-E420-007, ESAS Block Loading Timers Uncertainty Calculation, Rev. 0
C-1101-700-5350-006, Short Circuit Study, Rev. 4
C-1101-700-E510-008, Electrical Impedance Model, Rev. 4
C-1101-700-E510-010, AC Voltage Regulation Study, Rev. 6
C-1101-730-5350-001, GL89-10 MOV Heating Effects Due to Jogging or Frequent Cycling, Rev. 11
C-1101-730-5350-002, GL89-10 MOV Thermal Overload Heater Determination, Rev. 4
C-1101-732-5350-005, Protective Relays Class 1E SWGR, Rev. 1
C-1101-733-E420-022, TOL/Amptector Confirmation for TDR-995 Conversion, Rev. 0
C-1101-733-E510-021, 480VAC MCC 120C Control Circuit Voltage Drop, Rev. 3
C-1101-734-5350-003, Battery Capacity Sizing and Voltage Drop for DC System, Rev. 11
C-1101-734-5520-001, Station Battery Hydrogen Generation, Rev. 0
C-1101-734-E420-008, 250/125V DC Power System Fuse Coordination, Rev. 0
C-1101-735-5350-003, Vital AC Panel VBA Voltage Drops, Rev. 3
C-1101-740-5430-002, Station Blackout Coping Duration Category, Rev. 2
C-1101-741-E420-006, EDG Protective Relay Settings, Rev. 1
C-1101-741-E420-007, EDG Voltage and Frequency Response, Rev. 1
C-1101-741-E510-005, Loading Summary of EDG and Engineered Safeguards Buses, Rev. 5
C-1101-823-5450-001, TMI-1 LBLOCA EQ Temperature Profile using the GOTHIC Computer Code, Rev. 9C
C-1101-862-E410-004, TMI-1 DF-T-1 Tank Level Requirements, Rev. 1
C-1101-862-5360-002, TMI-1 EDG Fuel Requirement, Rev. 5
C-1101-864-E420-001, SBO Battery and Charger Sizing and Hydrogen Calculation, Rev. 0
C-1101-900-E410-039, MOV Delta P and Basis, Rev. 9
C-1101-900-E410-049, Weak Link Calculation for TMI GL89-10 Valves, Rev. 7
C-1101X-5350-053, DC Power System Short Circuit Calculations, Rev. 3
CC-AA-309-1001, Emergency Feedwater NPSHa Evaluation for TMI, Rev. 0
DC-5390-207.1-SE, Electrical Equipment Anchorage, Rev. 1

DH-V-0004A MIDAS Datasheets, dated 4/10/11
ECR TM 02-106, Basis for IST Reference Values for EF-P-2A, Rev. 0
ECR TM-02-72, Reference Value Update for DH-V-6A, Rev. 0
ECR TM-02-1278, EF-P-2A PMT Reference Value Evaluation, Rev. 0
ECR TM-02-1075, MU-P-1C Reference Value Update Post PMT, Rev. 0
ECR TM 07-01037, CRDCS Controls Upgrade, Rev. 3
ECR TM 07-01039, Digital Upgrade of CRD Control System (Installation), Rev. 4
ECR TM 08-00145-001, Replacement of Atmospheric Dump Valves MS-V-4A/B, Rev. 0
ECR 07-0792, Thermal Binding Analysis for 14" Aloyco Solid Wedge Gate Valves, Rev. 0
ECR 09-0391, Engine Cylinder Liner Equivalency Evaluation, Rev. 0
ECR 10-0271, EG-Y-1A/B & EG-Y-4 Replacement Gaskets Item Equivalency Evaluation, Rev. 0
ER-AA-231, IST Evaluation 113 for MU-P-1C, Rev. 2
ER-AA-302-1004 Attachment 2, MOV Post-Test Engineering Review Trend Evaluation Summary Report (DH-V-4A), dated 2/15/12
PA-MSC-0474, Outside Diameter Initiated Stress Corrosion Cracking White Paper, dated 3/19/10
SQ-T1-Battery Charger 1A, Battery Charger 1A Seismic Qualification, Rev. 0
TE 844506-26, Technical Evaluation for Station Battery Connection Resistance, Rev. 0
TM-02-00657-001, Install Replacement Breakers, dated 3/02/04
TM-07-00496-000, Modification of Station Battery Spacers, dated 6/21/07
TR 104, Review of the Potential for Pressure Locking and Thermal Binding of Safety Related Power Operated Gate Valves at TMI-1, Rev. 2
893289-02, Evaluation of Boric Acid Leakage (DH-V-38A), dated 4/6/09
984710-02, Evaluation of Boric Acid Leakage (DH-V-2), dated 11/22/09
1017122-02, Evaluation of Boric Acid Leakage (DH-P-1A), dated 2/2/10
1064102-05, EG-Y-1A Fuel Oil Leak #2 & #3 Cylinder Control Side Equipment Apparent Cause Report, dated 10/29/10
1064102-30, EG-Y-1A Emergency Diesel Generator Fuel Injection Pump Leaks Equipment Apparent Cause Report, dated 4/10/11
1101-212-5360-008, Decay Heat Removal System Resistance, Rev. 0, dated 7/16/05
1126350-02, Emergency Diesel Generator Oil Leaks Common Cause Analysis, dated 11/8/10
1250258-02, FS-P-2 Sole Plate Studs/Nuts Corrosion Damage Evaluation, dated 8/16/11
1286932-02, Evaluation of Boric Acid Leakage (MU-V-159A), dated 11/22/10
1291236-02, Technical Evaluation on Higher than Expected Unwedging Thrust during As-Left Testing of DH-V-4A and DH-V-4B in 1R19, dated 11/18/11
1312566-02, Configuration Control Trend Common Cause Analysis, dated 2/7/12
1314953, Leakage from Altitude Tank FS-T-1 Adverse Condition Monitoring and Contingency Plan, dated 1/24/12

<u>Corrective Action Issue Reports</u>

| | | | | |
|---|---|---|---|---|
| 0238195 | 0391844 | 0538069 | 0694932 | 0893289 |
| 0255716 | 0393855 | 0553192 | 0694953 | 0904946 |
| 0284592 | 0440322 | 0574605 | 0712559 | 0922120 |
| 0307483 | 0440325 | 0619111 | 0720507 | 0927513 |
| 0353687 | 0440328 | 0661725 | 0866360 | 0927536 |
| 0356966 | 0461115 | 0668157 | 0885699 | 0932956 |
| 0390796 | 0535841 | 0675412 | 0868606 | 0981377 |

| | | | | |
|---|---|---|---|---|
| 0984240 | 1291236 | 1335397* | 1340907* | 1344312 |
| 0984710 | 1292747 | 1335471* | 1341048* | 1344561 |
| 0999346 | 1297163 | 1335506* | 1341079* | 1345123 |
| 1008399 | 1310997 | 1336546* | 1341244* | 1345204 |
| 1008437 | 1314056 | 1337057 | 1341338* | 1345396 |
| 1017122 | 1314953 | 1337067 | 1341523* | 1345863* |
| 1024587 | 1318727 | 1337071 | 1341592* | 1345926* |
| 1029252 | 1327788* | 1337086 | 1341597* | 1346099* |
| 1055647 | 1329593 | 1337119 | 1341786* | 1346384* |
| 1060628 | 1332947* | 1337146 | 1341795* | 1346659* |
| 1061411 | 1333263 | 1337154 | 1341844* | 1347012* |
| 1183948 | 1333938* | 1337163 | 1341856* | 1347306* |
| 1190117 | 1333976 | 1337543* | 1341881* | 1347322* |
| 1190664 | 1334007 | 1337827* | 1342659* | 1347391* |
| 1200173 | 1334848* | 1337871* | 1342814* | 1347565* |
| 1215455 | 1334869* | 1338338* | 1342842* | 1347885* |
| 1239787 | 1334928* | 1338992 | 1342903* | 1349428* |
| 1245990 | 1334950 | 1339856* | 1343588* | |
| 1250258 | 1334958 | 1340095* | 1343709* | |
| 1284722 | 1334964 | 1340254* | 1343831* | |
| 1286657 | 1335332* | 1340764 | 1343852* | |

* IR written as a result of this inspection

<u>Design and Licensing Basis Documents</u>

IST-DH-BDOC-V-12, Containment Isolation - DH-P1A Discharge ISOL VLV In-service Testing Bases Document, dated 9/28/11

IST-DR-BDOC-V-13, Decay Heat River Water Pump B In-service Testing Bases Document, dated 9/28/11

SDBD-T1-211, System Design Basis Document for Makeup and Purification System, Rev. 6

SDBD-TI-212, System Design Basis Document for Decay Heat System, Rev. 6

SDBD-TI-533/543, System Design Basis Document for Decay Heat River Water and Decay Heat Closed Cooling Systems, Rev. 6

TMI-IST-PLAN-INT4, Inservice Testing Program Fourth Ten-Year Interval, Rev. 3

<u>Drawings</u>

201-052, 480V MCC 1A, Rev. 44

201-069, 480V MCC 1C, Rev. 33

208-222, Electrical Elementary Diagram, 4160V Station Blackout Diesel, Rev. 1

209-481, Elementary ES Actuation A Injection & Loading Sequence, Rev. 13

302-202, Nuclear Services River Water System Flow Diagram, Rev. 77

302-283, Diesel Fire Pump Fuel Oil Tank Level Indication Mod (ECR 09-00467), Rev. 22

302-353, Emergency Diesel Generator Services Flow Diagram - Lube Oil, Fuel Oil, Air Start, Rev. 12

302-354, Diesel Generator Jacket & Air Cooler Coolant System, Gear Box Lube Oil System Flow Diagram, Rev. 16

302-357, Station Blackout Diesel Generator Cooling Water for EG-Y-4 Flow Diagram, Rev. 5
302-640, Decay Heat Removal Flow Diagram, Rev. 83
302-660, Make-up & Purification Flow Diagram, Rev. 45
302-661, Make-up & Purification Flow Diagram, Rev. 60
302-662, MU Pump Auxiliary Systems Flow Diagram, Rev. 0
302-713, Decay Heat and Core Flood Check Valve Test System, Rev. 5
616-006, Sh. 1, Schematic Station Blackout, Diesel Generator, Rev. 3
616-006, Sh. 2, Schematic Station Blackout, Diesel Generator, Rev. 1
616-006, Sh. 3, Schematic Station Blackout, Diesel Generator, Rev. 1
71505-D, Cross Sectional 24 EC 1 Stage DR-P-1A/B, Rev. 3
A-9559-M-73C, 12" Cast Steel Pressure Seal & Wedge Gate Valve Assembly, Rev. F
E-209299, Worthington Corp Pump Data Test Curve (EF-P-2A/B), 12/9/69
D-304-281, Emergency Diesel Generator (Misc. Piping), Rev. 5
E-206-011, Main One Line and Relay Diagram, Rev. 52
E-206-022, 4160V Engineered Safeguards Switchgear, Rev. 21
E-206-051, 250/125V DC System and 120VAC Vital Instrumentation, Rev. 35
E-303-131, Intake Pump House Plans and Sections, Rev. 15
E-303-132, Intake Pump House Plans and Sections, Rev. 16
E-304-641, Decay Heat Removal Plans, Rev. 21
E-311-823, Roof, Floor, and Equipment Drains Diesel Generator Building, Rev. 2
E-421-401, Structural - Concrete Diesel Generator Building, Rev. 7
1D-ISI-CF-001, Core Flood System from Tank CF-T1A, Rev. 2
1D-ISI-DH-002, DH System-10" Line from Core Flood 14" Pipe, Rev. 1
1D-ISI-CF-002, Core Flood System from Tank CF-T1B, Rev. 2
1D-ISI-DH-003, DH System-Reactor Building from 14" Core Flood Pipe, Rev. 1
IE-153-02-001, General Arrangement Reactor Building, Rev. 8
1E-710-11-01, Electric Schematic 230kV, 6.9kV, 4.16kV, and 480V SA and SB, Rev. 9

Functional, Surveillance and Modification Acceptance Testing

E-135, SBO Diesel Batteries Inspection, performed 4/19/10, 4/29/11, 1/23/12, 2/22/12, and 3/20/12
E-136, SBO Diesel Battery Charger Inspection, performed 1/30/08 and 5/29/10
1107-3 Section 3.9, Fuel Pump and Air Start System Surveillance/PMT, performed 1/31/12, 2/7/12, 2/14/12, 2/21/12, and 2/28/12
1107-9, SBO Diesel Generator Two Hour Run, performed 11/12/11 and 1/25/12
1301-4.6.1, Station Battery 1A Weekly, performed 8/5/10, 1/5/12, 2/2/12, 2/9/12, and 2/16/12
1301-8.2B, EG-Y-1A/ EG-Y-1B Instrumentation (Low Lube Oil Pressure Trip), performed 4/26/10
1303-11.11, Station Battery Load Test, performed 10/29/07, 10/31/09, 12/15/09, and 10/27/11
1301-Q2.1, Fire System Diesel FS-P-1 Specific Gravity Check, performed 12/21/11
1301-W2.1, Fire System Diesel FS-P-1 Battery Check, performed 2/15/12
1303-A3, Fire Pump Capacity Testing (FS-P-1), performed 7/16/11
1303-A3, Fire Pump Capacity Testing (FS-P-2), performed 9/22/11
1303-M1, Fire Pump Periodic Operation (FS-P-1), performed 7/16/10 and 2/14/12
1303-M1, Fire Pump Periodic Operation (FS-P-2), performed 2/12/12
1303-R1, Fire Pump Start Circuit, performed 3/6/11
1303-5.2A, "A" Emergency Loading Sequence and HPI Logic Channel/Component Test, performed 12/21/11

1304-4.16, Emergency Power System, performed 2/8/12
1420-EL-1, Station Battery Charger Maintenance, performed 12/12/08
FTP 622.01, DCRDCS Power Up and Component Test, performed 11/15/11
FTP 622.01, DCRDCS Power Up and Component Test, performed 11/6/11
FTP 622.02, DCRDCS Integrated Test – No Rod Movement, performed 11/14/11
FTP 622.02, DCRDCS Integrated Test – No Rod Movement, performed 11/6/11
FTP 622.03, DCRDCS Integrated Test with Rod Movement, performed 11/6/11
OP-TM-211-211, HPI Test, performed 11/03/11
OP-TM-211-208, IST of MU-P-1C, performed 2/15/12
OP-TM-212-202, IST of DH-P-1B and Valves from ES Standby Mode, performed 1/19/12
OP-TM-212-212, LPI Test of DH Train B, performed 11/11/11
OP-TM-212-214, DH-P-1B Refueling IST, performed 11/11/11
OP-TM-212-240, Data for IST of DH-V-1 & DH-V-2 during Cooldown, performed 10/25/11
OP-TM-212-242, Shutdown IST of DH-V-4A and DH-V-4B, performed 11/13/11
OP-TM-411-204, Stroke Test of MS-V-4A and MS-V-4B, Rev. 9, performed 1/2/12
OP-TM-411-204, Stroke Test of MS-V-4A and MS-V-4B, Rev. 7, performed 03/30/11
OP-TM-411-204, Stroke Test of MS-V-4A and MS-V-4B, Rev. 6, performed 1/8/10
OP-TM-411-204, Stroke Test of MS-V-4A and MS-V-4B, Rev. 4, performed 3/23/09
OP-TM-424-201, IST of EF-P-2A, performed 12/09/11
OP-TM-424-231, Capacity Test of EFW System, performed 11/23/11

Miscellaneous

1410-P-1, Pump Packing Maintenance, performed 12/21/09
3301-R1, Fire Service Diesel Engine Inspection - Mechanical, performed 9/8/08 and 7/14/10
3301-R1.E, Fire Service Diesel Engine Inspection - Electrical, performed 7/13/10
AOP Box 1 Inventory, performed 7/22/11
Auxiliary Operator Rounds (ISPH and EDG Building), dated 2/12/12 - 2/18/12
Control Room Narrative Log, dated 2/20/12 - 2/25/12
E-2, Dielectric Check of Insulation, Motors and Cables, performed 1/11/11
EDG Load Control Spreadsheet, Rev. 12
EQ-T1-103, Environmental Qualification Limitorque Valve Actuators Model SMB Series, Rev. 6
ES-010T, TMI-1 Environmental Parameters, Rev. 8
Fairbanks Morse Opposed Piston Engine (EDG) PCM Template, dated 8/5/11
High Priority Open Margin Issues for Three Mile Island, dated 1/27/12
Hyd-337, Study of Gate Valves as Flow Regulators for Systems Under Heads to 125 feet of Water (US Dept of Interior Report)
IST-DH-BDOC-V-12, Containment Isolation - DH-P1A Discharge ISOL VLV Inservice Testing Bases Document, dated 9/28/11
IST-DR-BDOC-V-13, Decay Heat River Water Pump B Inservice Testing Bases Document, dated 9/28/11
Maintenance Strategy TM-1-533-M-PP-DR-P-1B, dated 12/15/11
MA-AA-723-300, Diagnostic Testing of Motor Operated Valves, Rev. 5
MD-G973-001, DH-V-1 and DH-V-2 Pressure Locking Modification, Rev. 0
5211-97-2115, GPUN Response To Generic Letter (GL) 87-06, dated June 12, 1987
5211-81-3100, Order For Modification Of License Concerning Primary Coolant System Pressure Isolation Valves, dated April 20, 1981
SDBD-TI-212, System Design Basis Document for Decay Heat System, Rev. 6

SDBD-TI-533/543, System Design Basis Document for Decay Heat River Water and Decay Heat Closed Cooling Systems, Rev. 6
Small Diesel Engine (FS-P-1 Fire Pump) PCM Template, dated 8/5/11
SP-1101-38-016, Specification for Diesel Fuel Oil No. 2, Rev. 9
SQ-T1-MU-P-1C, Seismic Qualification for MU-P-1C, Rev. 1
SQ-T1-EF-P-2A, Seismic Qualification for EF-P-2A, Rev. 1
SQ-T1-DH-V6A, Seismic Qualification for DH-V6A, Rev. 0
TMI-IST-PLAN-INT4, In-service Testing Program Fourth Ten-Year Interval, Rev. 3
TMI-PRA-005.005, Decay Heat River Water/Closed Cooling Water System Notebook, Rev. 0
TMI-PRA-005.014, Low Pressure Injection/Decay Heat Removal System Notebook, Rev. 0
TMI-PRA-005.020, Fire Service Water System Notebook, Rev. 0
Vertical Pumps PCM Template, dated 7/26/04

Non-Destructive Examinations
C2019632-16, DR-P-1B VT-2 Visual Examination NDE Report, performed 12/23/09
OP-TM-212-215, DHR Train A/B VT-2 Exam, performed 11/21/11
OP-TM-212-251, DH Leakage Exam for ISI, performed 10/14/10, 2/12/11 and 3/1/12
OP-TM-212-253, BS Leakage Exam Train A, performed 8/11/11
OP-TM-212-254, BS Leakage Exam Train B, performed 8/5/11
OP-TM-212-261, DH Drop Line VT-2 Exam, performed 1/20/10
OP-TM-533-251, DR Train A Leakage Exam, performed 1/4/12
PIR No. 9300234, Weld Quality of Battery Charger Anchorage, performed 6/22/93

Operating Experience
EPRI Technical Report 1000975, Boric Acid Corrosion Guidebook, Rev. 1
GPU Response to NRC Information Notice 97-21, dated 11/17/97
IR 661725-19, Exelon Response to NRC Information Notice 2007-27, dated 10/17/07
IR 1031112-10, Exelon Response to NRC Information Notice 2010-03, dated 2/8/10
IR 1206377-03, Exelon Response to NRC Information Notice 2011-04, dated 5/26/11
NRC Generic Letter 95-07, Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves, dated 8/17/95
NRC Information Notice 97-21, Availability of Alternate AC Power Source Designed for Station Blackout Event, dated 4/18/97
NRC Information Notice 2004-21: Additional Adverse Effect of Boric Acid Leakage: Potential Impact on Post-Accident Coolant pH, dated 11/24/04
NRC Information Notice 2010-03: Failures of Motor-Operated Valves Due to Degraded Stem Lubricant, dated 2/3/10
NRC Information Notice 2011-04: Contaminants and Stagnant Conditions Affecting Stress Corrosion Cracking in Stainless Steel Piping in Pressurized Water Reactors, dated 2/23/11
Topical Report No. 104, Review of the Potential for Pressure Locking and Thermal Binding of Safety Related Power-Operated Gate Valves at TMI-1, dated 8/1/08

Operating Procedures
1104-45b, Fire Service Water System, Rev. 101
1107-2a, Emergency Electrical - 4KV and 480 Volt, Rev. 21
1107-3, Diesel Generator, Rev. 131

1107-9, SBO Diesel Generator, Rev. 66
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1303-A3, Fire Pump Capacity Testing, Rev. 17
1303-M1, Fire Pump Periodic Operation, Rev. 43
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OP-TM-212-212, LPI Test of DH Train B, Rev. 9
OP-TM-212-217, DH-V-6A and Associated Tests, Rev. 8
OP-TM-212-230, Leakage Test of DH-V-1 and DH-V-2, Rev. 0
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OP-TM-212-901, Emergency DHR Operations, Rev. 4
OP-TM-424-000, Emergency Feedwater System, Rev. 11
OP-TM-424-901, Emergency Feedwater, Rev. 1
OP-TM-424-902, EFW Alternate Inventory, Rev. 4
OP-TM-533-204, Comprehensive Pump Test of DR Train B Pump and Valves, Rev. 6
OP-TM-533-402, Operating DR-P-1B for Other Then Decay Heat Removal Operations, Rev. 4
OP-TM-541-227, IST of NR-V-4 A/B, Rev. 4
OP-TM-861-901, Diesel Generator EG-Y-1A Emergency Operations, Rev. 12
OP-TM-861-910, Emergency Ventilation of EG-Y-1A Room, Rev. 1
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1107-11, TMI Grid Operations, Rev. 26
1302-5.31A, 4160V D&E Degraded Grid Undervoltage Relay Calibration, Rev. 22
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E-4, Switchgear, Bus Duct, and MCC Transformer Inspection and Cleaning, Rev. 41
E-5.1, Westinghouse 480V DB-25 Circuit Breaker Maintenance and Testing, Rev. 6
E-5.2, Westinghouse 480V DB-50 Circuit Breaker Maintenance and Testing, Rev. 7
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ER-AA-302-1003, MOV Margin Analysis and Periodic Verification Test Intervals, Rev. 7
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NES-EIC-10.02, Standard for TOL Selection for MOVs, Rev. 0
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<u>Vendor Technical Manuals</u>
Decay Heat River Water Pump Curve, dated 11/5/00
Diesel Driven Horizontal Fire Pump Curve, Rev. 6
Motor Driven Fire Pump Curve, Rev. 1
VM-TM-0001, Vertical Open Lineshaft Pumps Vendor Manual, Rev. 8
VM-TM-0019, Willamette Co. Nine stage Centrifugal Makeup Pumps, Rev. 25
VM-TM-0021, C&D Power Systems Station Batteries, Rev. 0
VM-TM-0029, Limitorque Valve Operator, Rev. 43
VM-TM-0063, Worthington Emergency Feed Pumps/Turbine, Rev. 21
VM-TM-0160, C&D Battery Charger Vendor Manual, Rev. 0
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VM-TM-2812, DR-P-1A/B Vendor Manual, Rev. 5
VM-TM-2999, Ametek Solidstate Controls 15KVA Inverters, Rev. A

<u>Work Orders</u>

| | | | |
|---|---|---|---|
| C1104322 | C2025393 | R2045685 | R2156978 |
| C2015937 | C2025553 | R2093058 | R2157816 |
| C2019632 | R1822963 | R2093552 | R2162875 |
| C2020072 | R1829345 | R2129938 | R2186642 |
| C2020073 | R2045680 | R2136349 | R2192319 |

## LIST OF ACRONYMS

| | |
|---|---|
| ADAMS | Agencywide Documents Access and Management System |
| ADV | Atmospheric Dump Valve |
| BACC | Boric Acid Corrosion Control |
| BHP | Brake Horsepower |
| BWST | Borated Water Storage Tank |
| CAP | Corrective Action Program |
| CDBI | Component Design Bases Inspection |
| DBA | Design Basis Accident |
| DBD | Design Basis Document |
| DDFP | Diesel Driven Fire Pump |
| DH | Decay Heat |
| DHR | Decay Heat Removal |
| DHCCW | Decay Heat Closed Cooling Water |
| DHRW | Decay Heat River Water |
| DRS | Division of Reactor Safety |
| ECCS | Emergency Core Cooling System |
| EDG | Emergency Diesel Generator |
| EFW | Emergency Feedwater |
| EOP | Emergency Operating Procedure |
| EQ | Environmental Qualification |
| ES | Engineered Safeguards |
| Exelon | Exelon Nuclear Northeast |
| GL | Generic Letter |
| GPM | Gallons per Minute |
| HPI | High Pressure Injection |
| IEEE | Institute of Electrical and Electronics Engineers |
| IMC | Inspection Manual ChapterIN Information Notice |
| IP | Inspection Procedure |
| IPE | Individual Plant Examination |
| IR | Issue Report |
| IST | In-Service Test |
| LERF | Large Early Release Frequency |
| LOCA | Loss-of-Coolant Accident |
| LPI | Low Pressure Injection |
| LTC | Load Tap Changer |
| MU | Make-Up |
| MCC | Motor Control Center |
| MDFP | Motor Driven Fire Pump |
| MEDP | Maximum Expected Differential Pressure |
| MOV | Motor Operated Valve |
| NCV | Non-cited Violation |
| NPSH | Net Positive Suction Head |
| NRC | U.S. Nuclear Regulatory Commission |
| OE | Operating Experience |
| PIV | Pressure Isolation Valve |

| | |
|---|---|
| PORV | Power Operated Relief Valve |
| PRA | Probabilistic Risk Assessment |
| PSID | Pounds per Square Inch Differential |
| PWR | Pressurized Water Reactor |
| RAW | Risk Achievement Worth |
| RB | Reactor Building |
| RCPB | Reactor Coolant Pressure Boundary |
| RCS | Reactor Coolant System |
| RPV | Reactor Pressure Vessel |
| RRW | Risk Reduction Worth |
| RW | River Water |
| SBLOCA | Small Break Loss-of-Coolant Accident |
| SBO | Station Blackout |
| SBODG | Station Blackout Diesel Generator |
| SCC | Stress Corrosion Cracking |
| SPAR | Standardized Plant Analysis Report |
| SSC | Structure, System and Component |
| ST | Surveillance Test |
| TDH | Total Dynamic Head |
| TMI | Three Mile Island |
| TOL | Thermal Overload |
| TS | Technical Specification |
| UFSAR | Updated Final Safety Analysis Report |
| VAC | Volts, Alternating Current |
| VDC | Volts, Direct Current |