UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
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:

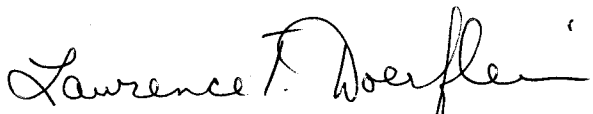
On March 30, 2012, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Three Mile Island, Unit 1 (TMI) facility. The enclosed inspection report documents the inspection results, which were discussed on March 30, 2012, with Mr. W. Carsky, Director of Engineering, and other members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