UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 RENAISSANCE BLVD., SUITE 100
KING OF PRUSSIA, PA 19406-2713

April 7, 2015

Mr. Bryan Hanson
Senior Vice President, Exelon Generation
President and Chief Nuclear Officer, Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 – NRC COMPONENT DESIGN BASIS INSPECTION REPORT 05000289/2015007

Dear Mr. Hanson:

On February 27, 2015, 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 February 27, 2015, with Mr. Rick Libra, Site Vice President, 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 and operator actions 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 two NRC-identified findings which were of very low safety significance (Green). Both of these findings were determined to involve violations of NRC requirements. However, because of the very low safety significance of the violations and because they were entered into your corrective action program, the NRC is treating these violations as non-cited violations (NCV) consistent with Section 2.3.2.a of the NRC Enforcement Policy. If you contest any of the NCVs 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, D.C. 20555-0001, with copies to the Regional Administrator, Region I; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001; and the NRC Resident Inspector at Three Mile Island. 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 Resident Inspector at Three Mile Island.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for the public inspection in the NRC Public Docket Room or from the Publicly Available Records component of NRC's document 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/

Paul G. Krohn, Chief
Engineering Branch 2
Division of Reactor Safety

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

Enclosure:
Inspection Report 05000289/2015007
w/Attachment: Supplemental Information

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

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U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket No.:	50-289
License No.:	DPR-50
Report No.:	05000289/2015007
Licensee:	Exelon Generation Company, LLC
Facility:	Three Mile Island Station, Unit 1
Location:	Middletown, PA 17057
Dates:	January 26 to February 27, 2015
Team Leader:	D. Kern, Senior Reactor Inspector, Division of Reactor Safety (DRS)
Team:	W. Cook, Senior Reactor Analyst, DRS K. Mangan, Senior Reactor Inspector, DRS E. Andrews, Project Engineer, Division of Reactor Projects (DRP) J. Ayala, Reactor Inspector, DRS J. Brand, Reactor Inspector, DRS S. Horvitz, Nuclear Safety Professional Development Program, DRP O. Mazzoni, NRC Electrical Contractor W. Sherbin, NRC Mechanical Contractor
Approved by:	Paul G. Krohn, Chief Engineering Branch 2 Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000289/2015007; 1/26/2015 – 2/27/2015; Exelon Generation Company, LLC; Three Mile Island, Unit 1; Component Design Basis Inspection.

The report covers the Component Design Basis Inspection conducted by a team of seven NRC region based inspectors and two NRC contractors. The team identified two findings of very low safety significance (Green) and classified each as a non-cited violation (NCV). The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process (SDP)," dated June 2, 2011. Cross-cutting aspects are determined using IMC 0310, "Aspects Within Cross-Cutting Areas," dated December 4, 2014. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy dated July 9, 2013. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 5.

Cornerstone: Mitigating Systems

- Green. The NRC identified an NCV of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix B, Criterion XVI, "Corrective Action," for failure to promptly identify and correct degraded borated water storage tank (BWST) level transmitter instrument line cold weather protection equipment. Specifically, station personnel performed periodic maintenance and testing activities to verify the adequacy of cold weather protection for the BWST level transmitters prior to the onset of cold weather, but did not identify existing uninsulated sections of the instrument lines or degraded heat trace circuit continuity. Consequently, on February 15, 2015, the sensing line for BWST level transmitter DH-LT-808 froze which challenged the operators' capability to successfully perform a critical design basis manual action. Namely, swapover from the injection to recirculation phase of ECCS operation following a LOCA. Immediate actions included entering the applicable technical specification (TS) limiting condition of operation (LCO), thawing the frozen instrument line, restoring DH-LT-808 to service, and exiting the TS LCO. Exelon entered the cold weather protection issue into their corrective action program as issue reports (IR) 2445164, 2451342, 02452858, and 02454925.

  This finding was more than minor because it was associated with the equipment and human performance 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 determined that the finding was of very low safety significance because it did not affect design or qualification, did not represent a loss of system, did not cause at least one train of BWST level instrumentation to be inoperable for greater than its TS LCO allowed outage time, and did not involve external event mitigation systems. The team assigned a cross-cutting aspect in the area of Human Performance, Procedure Adherence (aspect H.8), because station personnel did not follow processes, procedures, and work instructions when performing maintenance and operational activities that should have identified degraded BWST level instrument cold weather protection equipment associated with missing insulation and loss of heat trace circuit continuity. (Section 1R21.2.1.2)

Cornerstone: Barrier Integrity

- Green. The NRC identified an NCV of Title 10 of the CFR, Part 50, Appendix B, Criterion III, "Design Control," for failure to establish and implement adequate design control measures to assure that the reactor building (RB) fan assemblies were capable of performing their design function to mitigate a design basis loss of coolant accident (LOCA) event. Specifically, testing and design calculations used a non-conservative RB ventilation system alignment to determine the brake horsepower of the RB fan motors during a LOCA. As a result, engineers had not evaluated the capability of the RB fan motors to operate above their nameplate full load rating to perform their intended safety function. Additionally, RB fan motor electrical overload protection analyses were incorrect. Immediate corrective actions included interim calculations which demonstrated that the RB fan assemblies would remain capable of performing their safety functions and that the emergency diesel generators were capable of supplying the additional electrical load requirements. Exelon entered the issues into their corrective action program as IRs 2458932, 2458929, and 2451855.

  This finding was more than minor because it was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective of ensuring the operational capability of the containment barrier to protect the public from radionuclide releases caused by accidents or events. Additionally, the finding was similar to example 3.j in Appendix E of IMC 0612, in that the engineering calculation error resulted in a condition where there was reasonable doubt of the operability of the RB fan assemblies to perform their safety function during a design basis LOCA. The team determined the finding was of very low safety significance because it: did not affect the reactor coolant system (RCS) boundary; did not affect the radiological barrier function of the control room, auxiliary building, or spent fuel pool systems or boundaries; and did not represent an actual open pathway in containment or involve a reduction in the function of hydrogen igniters. This finding was not assigned a cross-cutting aspect because the underlying cause was not indicative of current performance in that the non-conservative calculation error occurred in 1993. (Section 1R21.2.1.1)

REPORT DETAILS

1. REACTOR SAFETY

Cornerstone: Initiating Events, Mitigating Systems, Barrier Integrity

1R21 Component Design Basis 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, Unit 1 (TMI) Probabilistic Risk Assessment (PRA) and the U.S. Nuclear Regulatory Commission's (NRC) Standardized Plant Analysis Risk (SPAR) model. Additionally, the TMI Significance Determination Process (SDP) analysis was referenced 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 team also selected components based on previously identified industry operating experience issues and the component contribution to the large early release frequency (LERF) was also considered. The components selected were located within both safety-related and non-safety related systems, and included a variety of components such as pumps, breakers, heat exchangers, electrical buses, transformers, valves, and storage tanks.

The team initially compiled a list of components based on the risk factors previously mentioned. Additionally, the team reviewed the previous component design basis inspection reports (05000289/2007006, 2009006, and 2012007) to minimize the selection of those components previously inspected. The team then performed a margin assessment to narrow the focus of the inspection to 22 components and three industry operating experience (OE) samples. One component was selected because it was a containment-related component considered for LERF implications. The team's evaluation of possible low design margin included consideration of original design issues, margin reductions due to modifications, and 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 operating experience. Finally, consideration was given to the uniqueness and complexity of the design and the available defense-in-depth margins.

The inspection performed by the team was conducted in accordance with NRC Inspection Procedure 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 and licensing basis requirements. A summary of the reviews performed for each component, operating experience sample, and the specific inspection findings identified 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 (22 samples)

.2.1.1 'B' Reactor Building Fan Assembly (AH-E-1B)

a. Inspection Scope

Three reactor building (RB) fan assemblies transfer heat from the containment atmosphere to the river water systems during normal and accident conditions. Each RB fan assembly consists of a fan, motor, normal cooling coils, separate emergency cooling coils, air manifolds, pressure relief valves, and a reinforced structural housing. The Technical Specifications (TS), operating procedures, and Updated Final Safety Analysis Report (UFSAR) were reviewed to determine the licensing and operating basis for the fan assembly. The team reviewed performance requirements during accident conditions, including fan motor horsepower requirements, motor cooling requirements, and heat transfer capabilities. The team reviewed air flow and water flow testing to ensure adequate heat transfer would be available during operation under containment accident conditions, including design basis loss of coolant accident (LOCA) and main steam line break conditions. The team interviewed the system engineer and reviewed the system health report to assess the material condition of the fan assembly. Maintenance histories and preventive maintenance (PM) histories were reviewed to ensure the fan, heat exchangers, and motor were properly maintained. The team reviewed selected calculations to verify the adequacy of voltage to the RB fan motor under design basis and degraded grid voltage (DGV) conditions. Additionally, the team reviewed motor breaker protection analysis to verify the RB fan motors would remain available to perform their design basis function during a sustained DGV event. Corrective Action documents were reviewed to ensure problems were identified and corrected. Seismic evaluation documents were reviewed to verify the fan assembly was seismically qualified.

b. Findings

Introduction. The NRC identified a Green NCV of Title 10 of the *Code of Federal Regulations* (CFR), Part 50, Appendix B, Criterion III, "Design Control," for failure to establish and implement adequate design control measures to assure that the RB fan assemblies were capable of performing their design function to mitigate a design basis LOCA event. Specifically, testing and design calculations used a non-conservative RB ventilation system alignment to determine the brake horsepower (BHP) of the RB fan motors during a LOCA. As a result, engineers had not evaluated the capability of the RB fan motors to operate above their nameplate full load rating to perform their intended safety function. Additionally, RB fan motor electrical overload protection analyses were incorrect. Consequently, Exelon did not assure that the Class 1E RB fan motors would not be damaged or become unavailable during a design basis LOCA and sustained DGV event.

Description. The RB fans have two operational modes, normal and slow speed. During a LOCA, the fans operate on slow speed. The fan motor nameplate rating for fan horsepower (HP) operating at slow speed is 75 HP with a service factor of 1.0. Exelon calculation, "RB Vent Fan Brake HP during LOCA/LOOP Event," Revision 1, dated March 20, 1993, determined that the maximum RB fan BHP during a LOCA was 61 HP. Exelon performed additional fan motor testing in 2010 as a result of previous issues identified with achieving consistent and repeatable flow rates due to a lack of backdraft damper maintenance. The team noted fan motor current was significantly higher during the 2010 tests than during original plant construction testing. The team questioned the reason for the higher motor current and questioned whether the RB fan motors may have degraded. Additionally, the team questioned whether the increased current measured during normal plant conditions indicated that the RB fan motor current would exceed thermal overload (TOL) protection settings and trip the electrical supply breaker during a sustained DGV condition (IR 2451855).

Exelon reviewed the team's concerns and determined that calculation C-1101-823-5310-004 was based on a non-conservative RB fan configuration. Specifically, Exelon determined that the calculation used test data measured with all three RB fans operating at the same time. Single fan operation is more limiting condition, since one fan drawing on the common RB fan air inlet plenum would encounter greater flow resistance than when three fans were running. Therefore a single failure LOCA scenario, during which only one RB fan would operate, would require the RB fan to do more work (i.e., produce more HP) than previously evaluated. Exelon used the 2010 test data to reevaluate the maximum RB fan motor BHP requirement during a design basis LOCA. Their preliminary calculation determined the RB fan motor requirement was 85 HP. Additionally, during design DGV conditions the associated motor current would peak at 144 amps, which was above the motor breaker TOL setpoint of 141 amps.

The team questioned whether the RB fan motor was capable of performing its intended safety function which required operation above its nameplate full load rating and whether the increased load would damage the motor (IR 2458932). Exelon evaluated the motor torque capability and thermal effects on the motor and determined the motor was capable of performing its safety function without damage. Additionally, Exelon determined that although RB fan motor current would exceed the breaker TOL setpoint, the TOL inverse time characteristic would permit continued RB fan operation at this reduced voltage for the full period of the DGV relay time delay (12 seconds) without tripping the breaker. The team noted the most recent revision of calculation 1101-733-E420-022, "TOL/Amptector and Motor Operated Valve Confirmation for DGV," Revision 4, was deficient in that it misinterpreted the RB fan motor TOL protection curves and overestimated the TOL actuation time for the RB fan motor breakers (IR 2458929). Exelon also confirmed that the existing emergency diesel generator (EDG) loading had sufficient margin to accept the additional loading associated with the increased RB fan motor HP.

The team discussed the preliminary evaluations with Exelon, reviewed additional related engineering documents, and determined Exelon's preliminary conclusions were technically sound. The team concluded the RB fan motors remained capable of performing their safety function. Exelon entered this issue into its corrective action program as IRs 2458932, 2458929, and 2451855 to document the results of their preliminary evaluations, evaluate the extent-of-condition, and update affected design documents.

Analysis. The team determined that the failure to verify the adequacy of design of the RB fan assemblies to perform their intended safety function under design basis LOCA conditions as required by 10 CFR, Part 50, Appendix B, “Criterion III,” was a performance deficiency. The performance deficiency was more than minor because the finding was associated with the design control attribute of the Barrier Integrity cornerstone and adversely affected the cornerstone objective of ensuring the operational capability of the containment barrier to protect the public from radionuclide releases caused by accidents or events. Additionally, the finding was similar to example 3.j in Appendix E of Inspection Manual Chapter (IMC) 0612, in that the engineering calculation error resulted in a condition where there was reasonable doubt of the operability of the RB fan assemblies to perform their safety function during a design basis LOCA.

The team evaluated the finding in accordance with IMC 0609, “Significance Determination Process,” Attachment 0609.04, “Initial Screening and Characterization of Findings,” dated June 19, 2012, and IMC 0609, Appendix A, “The SDP for Findings At-Power,” Exhibit 3, “Barrier Integrity Screening Questions,” dated June 19, 2012. The team determined the finding was of very low safety significance because it: did not affect the reactor coolant system (RCS) boundary; did not affect the radiological barrier function of the control room, auxiliary building, or spent fuel pool systems or boundaries; and did not represent an actual open pathway in containment or involve a reduction in the function of hydrogen igniters. Exelon’s interim calculations and operability determinations demonstrated adequate motor capability and thermal overload protection during a design basis LOCA, such that RB fan assemblies would perform their safety functions. This finding was not assigned a cross-cutting aspect because the underlying cause was not indicative of current performance in that the non-conservative RB calculation error occurred in 1993. .

Enforcement. Title 10 of the CFR, Part 50, Appendix B, Criterion III, “Design Control,” requires, in part, that measures be established to assure that applicable design bases are correctly translated into specifications. Additionally, design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program.

Contrary to the above, since March 20, 1993, Exelon did not establish and implement adequate design control measures to assure that the most limiting RB fan assembly alignment (single fan assembly operation) was translated into calculations. Additionally engineers did not accurately verify or check the adequacy of the RB fan assembly calculations to ensure they were capable of performing their intended safety function during a design basis LOCA with sustained DGV. Consequently, Exelon did not recognize that the RB fan motors may be relied upon to operate above their full load nameplate ratings to perform their safety function. Furthermore, Exelon did not recognize or evaluate the associated increased EDG loading requirements. Immediate corrective actions included interim calculations which demonstrated the RB fan assemblies were capable of performing their safety functions and the EDGs were capable of supplying the additional electrical load requirements. This violation is being treated as an NCV, consistent with Section 2.3.2 of the NRC Enforcement Policy. Exelon entered the issues into their corrective action program as IRs 2458932, 2458929, and 2451855. **(NCV 05000289/2015007-01, Deficient Design Control for Verifying Reactor Building Fan Assembly Capability to Perform Design Basis Function)**

.2.1.2 Borated Water Storage Tank (DH-T-1)

a. Inspection Scope

The borated water storage tank (BWST) provides a supply of borated water for core cooling and inventory makeup during the injection phase of the mitigating systems response to a design basis LOCA. Emergency core cooling system (ECCS) pumps (building spray, high pressure injection, and low pressure injection) initially take suction from the BWST. Approximately a half hour into a LOCA, operators manually shift ECCS suction from the BWST to the containment sump to establish the long term recirculation phase of core cooling. The team reviewed TSs, operating procedures, and the UFSAR to determine the licensing and operating basis for the tank. The team reviewed tank usable volume calculations to ensure the required water volume was available. The team interviewed the system engineer, reviewed the system health report, and performed a walkdown of the tank, connected piping, and instruments to assess the material condition of the tank. Maintenance records were reviewed to ensure the tank structure was properly maintained. Corrective action documents were reviewed to ensure problems were identified and corrected. Seismic evaluation documents were reviewed to ensure the tank was seismically qualified. The team also reviewed the design, installation, operation, and maintenance of the BWST level instrument line heat trace circuits to provide reasonable assurance that both BWST level instruments would function reliably during periods of cold weather.

b. Findings

Introduction. The NRC identified a Green NCV of Title 10 of the CFR, Part 50, Appendix B, Criterion XVI, “Corrective Action,” for failure to promptly identify and correct degraded BWST level transmitter instrument line cold weather protection equipment. Specifically, station personnel performed periodic maintenance and testing activities to verify the adequacy of cold weather protection for the BWST level transmitters prior to the onset of cold weather, but did not identify existing uninsulated sections of the instrument lines or degraded heat trace circuit continuity. Consequently, on February 15, 2015, the sensing line for BWST level transmitter DH-LT-808 froze which challenged the operators’ capability to successfully perform a critical design basis manual action. Namely, swapover from the injection to recirculation phase of ECCS operation following a LOCA.

Description. Manual pump suction swapover from the BWST to the containment sump for the recirculation phase of LOCA response is a time critical design basis manual operator action. Prior to swapping pump suction to the containment sump, operators must ensure enough BWST volume has been injected to support accident analysis assumptions (including sufficient containment sump level to meet ECCS pump net positive suction head (NPSH) requirements during recirculation mode). Operators must also ensure swapover is complete prior to BWST level lowering below the level needed to maintain ECCS pump NPSH requirements during the injection phase. Operators rely on BWST level instruments DH-LT-808 and DH-LT-809 to provide accurate level indication to support performance of the ECCS swapover to the recirculation phase. Technical specifications require both level transmitter indications to be operable. Heat trace circuits and insulation are installed on the BWST level transmitter instrument lines to ensure the lines do not freeze and adversely affect BWST level indication during periods of extreme cold weather.

On January 29, 2015, the team identified an 18-inch section of missing insulation and an improperly installed heat trace circuit on DH-LT-809. The affected section of the instrument line was located within an unheated concrete structure known as the BWST tunnel. Station personnel initiated prompt action to verify the instrument line was not frozen and properly reinstalled the heat trace line and missing insulation (IR 2445164). The team interviewed station personnel and reviewed records to determine how long this degraded condition existed and assessed the adequacy of station procedures and processes to maintain BWST level instrument operability during extreme cold weather.

Procedure E-70, “Heat Trace Inspection,” Revision 14, required technicians to visually inspect heat traced piping to ensure insulation is intact and properly installed. Procedure WC-AA-107, “Seasonal Readiness,” Revision 14, required system engineers to ensure system readiness by verifying piping and instrument-tube sensing line insulation was properly installed where the line was susceptible to freezing. The team determined heat trace installation procedures and processes to verify cold weather readiness were adequate. Notwithstanding, during the prior 9 months station personnel missed several opportunities (annual heat trace inspection PM, annual cold weather preparation activity, and operation of a manual valve located on the uninsulated instrument line) to identify and correct the degraded condition. The team identified that the annual PM performed a functional check of the heat trace circuit, but not a calibration. Additionally, the PM activity did not test the heat trace circuit at the as-left setting or verify that the circuit would energize at the as-left setting. The team discussed these deficiencies with station personnel who entered them into the corrective action program (IR 2451342).

On February 15, 2015, the sensing line for DH-LT-808 froze during an extended period of record low temperature and wind chill. Control room operators declared the BWST level instrument inoperable, appropriately entered a 72-hour TS limiting condition of operation (LCO), and initiated actions to restore the level instrument to service (IR 02452858). Technicians identified that a short section of the instrument sensing line (less than 6 inches) was uninsulated and was exposed to the cold winds. Additionally, the heat trace circuit did not energize as designed, despite the cold sensing line temperature. Initial troubleshooting identified the temperature controller had a dead spot at the location of the as-left temperature setting. DH-LT-808 was returned to service and operators exited the TS LCO on February 16, 2015.

Station personnel performed extent-of-condition walkdowns on all piping and instruments for the BWST and the ‘A’ and ‘B’ condensate storage tanks which were exposed to the outdoor climate. Several additional insulation and heat trace circuit deficiencies were identified and promptly corrected. The team determined the cause of DH-LT-808 freezing was the same as the performance deficiencies the team had previously identified for DH-LT-809. Additionally, because the PM activity did not verify heat trace circuit performance at the as-left setting, the team questioned the reliability of the eight BWST heat trace circuits to perform their design function during the continued extended period of extreme cold weather. Station management reviewed the issue and established an interim compensatory measure to monitor BWST level instrument line temperature each shift. This interim measure revealed additional instrument line temperature and heat trace circuit deficiencies which were promptly addressed. This team determined this compensatory measure was appropriate.

Analysis. Portions of the BWST level instrument lines were not insulated and heat trace equipment did not properly operate to support reliable operation of DH-LT-808 and DH-LT-809 during cold weather. The team determined failure to promptly identify and correct BSWT level instrument line cold weather protection deficiencies during the conduct of heat trace and seasonal readiness inspections, as required by the TMI corrective action program, was a performance deficiency. This performance deficiency was more than minor because it was associated with the equipment and human performance 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. Additionally, the finding was similar to example 2.f in Appendix E of IMC 0612, in that failure to properly maintain cold weather protection equipment for the BWST level transmitters resulted in DH-LT-808 becoming inoperable. This adversely impacted availability of a BWST level indication necessary for operators to reliably perform a critical design basis manual action.

The team evaluated the finding in accordance with IMC 0609, “Significance Determination Process,” Attachment 0609.04, “Initial Screening and Characterization of Findings,” dated June 19, 2012, and IMC 0609, Appendix A, “The Significance Determination Process for Findings At-Power,” Exhibit 2, “Mitigating Systems Screening Questions,” dated June 19, 2012. The team determined that the finding was of very low safety significance (Green) because it did not affect design or qualification, did not represent a loss of system, did not cause at least one train of BWST level instrumentation to be inoperable for greater than its TS LCO allowed outage time, and did not involve external event mitigation systems. The team determined that the issue had a cross-cutting aspect in the area of Human Performance, Procedure Adherence, because station personnel did not follow processes, procedures, and work instructions when performing maintenance and operational activities associated with BWST level instrument cold weather protection equipment (IMC 0310, Aspect H.8).

Enforcement. Title 10 of the CFR, Part 50, Appendix B, Criterion XVI, “Corrective Action,” requires, in part, that measures be established to assure that conditions adverse to quality such as defective material and equipment and non-conformances are promptly identified and corrected. Exelon procedure PI-AA-120, “Issue Identification and

Screening Process," Revision 0, requires station employees to identify conditions that could have an undesirable effect on equipment performance, ensure immediate actions as appropriate, and ensure the issue is properly documented (e.g., deficiency tag, issue report) for resolution. Contrary to this requirement, during four separate activities since August 14, 2014, operators and technicians did not promptly identify and correct BWST level transmitters (DH-LT-808 and 809) instrument line cold weather protection deficiencies. Specific deficiencies included portions of outdoor-exposed instrument lines that were not properly insulated, heat trace circuit for DH-LT-809 that was not properly installed, and the heat trace controller for DH-TL-808 that did not energize at its as-left temperature setting. Consequently, on February 15, 2015, the BWST level transmitter (DH-LT-808) instrument line froze and DH-LT-808 became inoperable. The inoperable transmitter adversely impacted indication necessary for operators to perform a critical manual action credited to mitigate a design basis LOCA. Operators entered a 72 hour TS LCO. Corrective actions restored the transmitter to operation on February 16, 2015, and operators exited the TS LCO. This violation is being treated as an NCV, consistent with Section 2.3.2 of the NRC Enforcement Policy. The violation was entered into the Exelon corrective action program as IRs 2445164, 2451342, 02452858, and 02454925. **(NCV 05000289/2015007-02, Untimely Identification and Correction of Degraded BWST Level Transmitter Cold Weather Protection Equipment)**

.2.1.3 <u>'B' Intermediate Cooling Pump (IC-P-1B)</u>

a. <u>Inspection Scope</u>

The primary requirement for this pump is to provide cooling water to the control rod drive cooling system. The pump is not safety-related, and is not in the in-service testing (IST) program. The team reviewed the performance monitoring program, which included vibration testing to ensure pump degradation is monitored. The team reviewed pump NPSH requirements to ensure adequate NPSH was available during operation. The team interviewed the system engineer, performed a walkdown and reviewed system health report to assess the material condition of the pump. Maintenance history and PM history were reviewed to ensure the pump and motor were properly maintained. Corrective action documents were reviewed to ensure problems were identified and corrected. Seismic evaluation documents were reviewed to ensure the pump was seismically qualified. The team reviewed Exelon commercial grade dedication (CGD) procedures and a sample of two CGD plan evaluations for commercially procured motor bearings which were dedicated and installed in pump IC-P-1B. Five critical characteristics were identified and properly verified though testing. The team reviewed the associated purchase orders, receipt inspections, technical evaluation forms, completed third-party CGD test reports, and maintenance work orders to verify critical component characteristics were properly identified and that the design basis, licensing basis, and performance capability of pump had not been degraded.

b. <u>Findings</u>

No findings were identified.

.2.1.4 Makeup Pump Suction Valve from the Borated Water Storage Tank (MU-V-14A)

a. Inspection Scope

This motor-operated check valve is required to open on an engineered safeguards actuation system (ESAS) actuation signal to provide a suction path from the BWST to the makeup (MU) pumps for high pressure injection (HPI) initiation. This valve is required to close following the post-LOCA injection phase to isolate the BWST during the recirculation phase. The TS, operating procedures, and UFSAR were reviewed to determine the licensing and operating basis for the valve. The team reviewed motor operated valve (MOV) calculations and analysis to ensure the valve was capable of functioning under design basis conditions. These included calculations for required thrust, maximum differential pressure, and valve weak link analysis. Diagnostic testing and IST surveillance test (ST) results, including exercise test, position indication, available thrust, and leak rate testing were reviewed to verify acceptance criteria were met and performance degradation could be identified. The team interviewed the system engineer, performed a system walkdown, and reviewed the system health report to assess the material condition of the valve. Maintenance history and PM history were reviewed to ensure the valve and motor operator were being properly maintained. Corrective action documents were reviewed to ensure problems were identified and corrected. Seismic evaluation documents were reviewed to ensure the valve is seismically qualified.

b. Findings

No findings were identified.

.2.1.5 RCP Recirculation Valve (MU-V-37)

a. Inspection Scope

This normally open MOV receives an ESAS signal to close to assure full MU pump discharge flow is directed to the reactor coolant system (RCS) for accident mitigation. In the open position, this valve allows recirculation of flow from the discharge of the operating MU pump during low system flow conditions. The TS, operating procedures, and UFSAR were reviewed to determine the licensing and operating basis for the valve. The team reviewed MOV calculations and analysis to ensure the valve was capable of functioning under design basis conditions. These included calculations for required thrust, maximum differential pressure, and valve weak link analysis. Diagnostic testing and IST ST results, including exercise test, position indication, available thrust, and leak rate testing were reviewed to verify acceptance criteria were met and performance degradation could be identified. The team interviewed the system engineer, performed a system walkdown, and reviewed the system health report to assess the material condition of the valve. Maintenance history and PM history were reviewed to ensure the valve and motor operator were being properly maintained. Corrective action documents were reviewed to ensure problems were identified and corrected. Seismic evaluation documents were reviewed to ensure the valve is seismically qualified.

b. Findings

No findings were identified.

.2.1.6 ‘B’ Decay Heat Removal Cooler (DH-C-1B)

a. Inspection Scope

The team inspected the ‘B’ decay heat removal cooler heat exchanger (DH-C-1B) to determine if it was capable of meeting its design basis function. Specifically, the team evaluated the ability of the heat exchanger to adequately remove decay heat during normal operations and following a postulated accident. The team reviewed applicable portions of the UFSAR, design basis documents (DBD), and drawings to identify the design basis requirements for the heat exchanger. The team also reviewed design calculations to evaluate whether the heat exchanger had adequate capacity to transfer the required heat load during normal operations and postulated accident conditions. The team also interviewed system and design engineers and performed a walkdown of the heat exchanger to assess the material condition of the equipment. Finally, the team reviewed corrective action documents and system health reports to evaluate whether there were any adverse operating trends and to assess Exelon’s ability to identify and correct problems.

b. Findings

No findings were identified.

.2.1.7 ‘B’ Decay Heat Service Cooler (DC-C-2B)

a. Inspection Scope

The team inspected the ‘B’ decay heat service cooler (DC-C-2B) to determine if it was capable of meeting its design basis function. Specifically, the team evaluated the ability of the heat exchanger to adequately remove decay heat during normal operations and following a postulated accident. The team reviewed applicable portions of the vendor manual, UFSAR, and DBDs to identify the design basis requirements for the heat exchanger. The team then reviewed design calculations to evaluate the capability of the heat exchanger to transfer the required heat load during normal operations and postulated accident conditions. Additionally, the team reviewed the tube plugging limit and current tube plugging status, cleaning and inspection results, and thermal performance results to determine if the physical condition of the heat exchanger was within the design calculation assumptions used to assess the adequacy of the cooler to respond to design basis events. The team interviewed system and design engineers, reviewed maintenance history, and performed a walkdown of the heat exchanger to assess the current material condition of the equipment. Finally, the team reviewed corrective action documents and system health reports to evaluate whether there were any adverse operating trends and to assess Exelon’s ability to identify and correct problems.

b. Findings

No findings were identified.

.2.1.8 Nuclear River Water Isolation Valve (NR-V-4A)

a. Inspection Scope

The team inspected nuclear river water (NR) motor-operated valve 1NR-V-4A to determine if it was capable of meeting its design function. The team reviewed the UFSAR, DBDs, vendor manual, and procedures to identify the design basis requirements for the valve. The team performed a review of system operating procedures to assess whether component operation and alignments were consistent with design and licensing basis assumptions. Valve testing procedures and valve specifications were also reviewed to verify that design basis requirements, including worst case system and environmental conditions, were incorporated into the test acceptance criteria. The team reviewed periodic verification diagnostic test results and stroke test documentation to verify acceptance criteria were met, and that the valve's safety function, torque switch settings, and performance capability were adequately monitored and maintained. Finally, corrective action documents and system health reports were reviewed to verify deficiencies were appropriately identified and resolved.

b. Findings

No findings were identified.

.2.1.9 'A' Nuclear River Water Pump (NR-P-1A)

a. Inspection Scope

The team inspected the 'A' NR pump to determine if the pump was capable of performing its design basis function. The team reviewed the system hydraulic calculations under normal, transient, and accident conditions to evaluate whether the pump would provide adequate cooling to safety-related components. Additionally, the team verified that system design requirements for flow and pressure were properly assessed when determining IST acceptance criteria. The team also evaluated IST results to determine if the pump performance had degraded from initial installation. The team reviewed the NR pump submergence requirements and minimum river water levels to evaluate whether the pump was capable of fulfilling its safety function at the maximum expected flow rate. Additionally, the team reviewed operating procedures to determine if the pump and NR system were operated in accordance with the design assumptions and pump and motor operating limits. Specifically the team reviewed the NR pump performance curve and design basis flow requirements to determine if the brake HP of the motor was adequate to ensure pump operation during design basis conditions. The team also performed a walkdown of the equipment and interviewed system engineers to assess the material conditions of the pump and motor. Finally, corrective action documents were reviewed by the team to verify deficiencies were appropriately identified and resolved.

b. Findings

No findings were identified.

.2.1.10 Closed Cooling Water Inlet Valve to 'B' Decay Heat Removal Cooler (DC-V-2B)

a. Inspection Scope

The team inspected the closed cooling water inlet valve to the 'B' decay heat removal cooler (DC-V-2B), to determine if it was capable of supporting the design basis requirements of the system. The UFSAR, TSs, and DBDs were reviewed to determine the design and licensing basis for the valve. The team reviewed valve lineup and operating procedures to determine if the valve was being operated in accordance with accident analysis assumptions. The team also reviewed the valve actuator and its associated air system supply to ensure that the valve would be in the required accident position in the event of a loss-of-air event. Additionally, the team reviewed the valve and actuator specification/design sheets to ensure the valve installation was consistent with the design. The team conducted several walkdowns of the valve and interviewed system and design engineers to assess the overall material condition of the valve. Finally, corrective action documents and system health reports were reviewed to verify deficiencies were appropriately identified and resolved.

b. Findings

No findings were identified.

.2.1.11 'A' Control Building Chiller (AH-C-4A)

a. Inspection Scope

The team inspected control building chiller AH-C-4A, to verify that it was capable of performing its design function. The team reviewed the UFSAR, calculations, and procedures to identify the design basis requirements of the chiller and supporting equipment. The team also reviewed accident system alignments to determine if component operation would be consistent with the design and licensing basis assumptions. Applicable testing procedures and specifications were also reviewed to ensure consistency with design basis requirements. The team reviewed periodic verification diagnostic test results to verify acceptance criteria were met and consistent with the design basis.

The team interviewed the system and design engineers to gain an understanding of maintenance issues and overall reliability of the chiller. The team conducted several walkdowns to assess both the 'A' and 'B' chillers' material condition, and to verify the installed configuration was consistent with design basis assumptions and plant drawings. Corrective action documents were reviewed to verify that deficiencies were appropriately identified and resolved and that the chiller was properly maintained.

b. Findings

No findings were identified.

.2.1.12 'B' Decay River Water Pump Discharge Motor-Operated Valve (DR-V-1B)

a. Inspection Scope

The team inspected the 'B' decay river water pump discharge MOV (DR-V-1B), to verify that it was capable of meeting its design basis requirements. The team reviewed the UFSAR, drawings, and procedures to identify the design basis requirements of the valve. The team also reviewed accident system alignments to determine if component operation would be consistent with the design and licensing basis assumptions. Applicable testing procedures and specifications were also reviewed to ensure consistency with design basis requirements. The team reviewed periodic verification diagnostic test results to verify acceptance criteria were met and consistent with the design basis.

The team interviewed the system and design engineers to gain an understanding of maintenance issues and overall reliability of the valve. The team conducted a walkdown to assess the material condition of the valve and associated components, and to verify the installed configuration was consistent with design basis assumptions and plant drawings. Corrective action documents were reviewed to verify that deficiencies were appropriately identified and resolved and that the valve was properly maintained. The team reviewed the corrective and preventive maintenance activities associated with the valve to gain an understanding of the performance history and overall component health.

b. Findings

No findings were identified.

.2.1.13 'B' Decay Heat Removal Pump Discharge Check Valve (DH-V-16B)

a. Inspection Scope

The team inspected the 'B' decay heat removal pump discharge check valve (DH-V-16B), to verify that it was capable of meeting its design basis requirements. The team reviewed the UFSAR, drawings, and procedures to identify the design basis requirements of the check valve. The check valve testing procedures and decay heat system hydraulic analyses were reviewed to verify the design basis requirements were appropriately incorporated into the test acceptance criteria. The team reviewed a sample of test results to verify the acceptance criteria were met. The team reviewed the corrective and preventive maintenance activities associated with the check valve to gain an understanding of the performance history and overall component health.

The team interviewed the system and design engineers to gain an understanding of maintenance issues and overall reliability of the check valve. The team conducted a walkdown to assess the material condition of the check valve and associated components including the 'B' decay heat removal pump, and to verify the installed configuration was consistent with design basis assumptions and plant drawings. Corrective action documents were reviewed to verify that deficiencies were appropriately identified and resolved and that the check valve was properly maintained and inspected.

b. Findings

No findings were identified.

.2.1.14 Manual Operator Action to Open Drop-Line Valves DH-V-1, 2, and 3 to Establish Decay Heat Removal

a. Inspection Scope

The team evaluated the manual operator actions to open the decay heat drop-line valves DH-V-1, 2, and 3 to circulate water through the core following a cold-leg LOCA or a steam generator tube rupture in order to prevent the concentration of boron from exceeding its solubility limits. Precipitation of boron could result in clogged flow channels and limit the ability to remove heat. In addition, these valves perform a containment isolation function and are also opened to use the decay heat system as the normal and preferred method of placing and maintaining the reactor in the cold shutdown condition. Operator critical tasks included:

- Verify a RCS leak exists and incore shutdown margin is <25 F
- Verify indicated RCS pressure <5 psid (RCS is in pressure equilibrium with the reactor building)
- Verify DH-P-1B is operating
- Verify DH-V-6B is open
- Verify the breakers for DH-V-1, 2, and 3 are closed at the 1C ES Valves Motor Control Center (MCC)
- Reset bistables for DH-V-1 and 2
- Jog open DH-V-3. Time open travel and release open pushbutton at 5.5 seconds
- Open DH-V-2
- Open DH-V-1
- Monitor DH-P-1B motor current and discharge pressure.

The team interviewed licensed operators and control room simulator instructors and reviewed associated operating procedures and operator training documents to evaluate the operators' ability to perform the required actions. The team walked down applicable control and indicating panels in the simulator and observed operations personnel perform the required actions satisfactorily and within the required time to assess the likelihood of cognitive or execution errors. The team also walked down applicable controls and indicating panels in the main control room and evaluated the available time margins to perform the actions to verify the reasonableness of Exelon's operating procedures and risk assumptions. The team also reviewed equipment deficiency reports to access the material condition of the valves and performed independent field observations of valve DH-V-3 which was the only valve of the three drop-line valves accessible outside of primary containment.

The team reviewed the UFSAR, drawings, and procedures to identify the design basis requirements of the valves. The team also reviewed accident system alignments to determine if component operation would be consistent with the design and licensing basis assumptions. Applicable testing procedures and specifications were also reviewed to ensure consistency with design basis requirements. The team reviewed periodic verification diagnostic test results to verify acceptance criteria were met and consistent with the design basis. The team interviewed the system and design engineers to gain an understanding of maintenance issues and overall reliability of the valves. Corrective action documents were reviewed to verify that deficiencies were appropriately identified and resolved and that the valves were properly maintained. The team reviewed the corrective and preventive maintenance activities associated with the valves to gain an understanding of the performance history and overall component health.

b. Findings

No findings were identified.

2.1.15 1S 480V Engineered Safeguards Safety Bus (including 1S 4kV/480V Transformer, S1-02 and 1S-02 Breakers

a. Inspection Scope

The team inspected the 1S 480V Engineered Safeguards Safety Bus (including 1S 4kV/480V transformer, S1-02 and 1S-02 Breakers) to verify its ability to meet the design basis requirements in response to steady-state, transient, and accident events and conditions. Bus 1S-ESSB is fed from safety-related bus 4.16 kV bus 1E, through breaker S1-02 and the 1S 4kV/480V transformer. The bus incoming feeder breaker is 1S-02 on the low voltage side of the transformer. The team reviewed the electrical DBD to determine the required operational parameters. The team reviewed the vendor documentation to determine if the equipment was properly rated and to verify that it met the plant requirements. The team reviewed the maintenance and functional history of the switchgear by sampling corrective action reports, the system health report, operating procedures, and ST procedures and results. The team evaluated short circuit, voltage drop, and protective relaying calculations to ensure that adequate voltage and current would be available to meet design basis conditions. The team verified that protective relay and breaker setpoints were properly translated into system procedures and tests, and reviewed completed tests intended to demonstrate component operability. The team reviewed drawings, component calculations, and system calculations to verify that calculation inputs and assumptions were accurate and justified. The team reviewed the interlocking scheme to ensure that there was no single point vulnerability. The team also conducted several walkdowns to visually inspect the physical condition of the switchgear and transformer to ensure adequate configuration control.

b. Findings

No findings were identified.

2.1.16 1C 480V Engineered Safeguard Valve Motor Control Center (EE-MCC-ESV-1C)

a. Inspection Scope

The team inspected the 1C ESV 480V MCC to verify its ability to meet the design basis requirements in response to transient and accident events. The MCC 1C ESV is safety related and feeds motors and valves, including the Reactor Building Air Handling units. The team reviewed the electrical DBD to determine the required operational parameters. The team reviewed the vendor documentation to determine if the equipment was properly rated and to verify that it met the specification requirements. The team reviewed the maintenance and functional history of the MCC by sampling corrective action reports, the system health report, operating procedures, and ST procedures and results. The team evaluated short circuit, voltage drop, and protective device calculations to ensure that adequate voltage and current would be available to meet design basis conditions, and that protective devices would not spuriously trip under worst case voltage conditions. The team verified that protective overload elements and breaker setpoints were properly selected to preclude spurious tripping and adequately entered into system procedures and tests, and reviewed completed tests intended to demonstrate component operability. The team reviewed drawings, component calculations, and system calculations to verify that calculation inputs and assumptions were accurate and justified. The team reviewed the interlocking scheme to ensure that there was no single point vulnerability. The team also conducted several walkdowns to visually inspect the physical condition of the switchgear to ensure adequate configuration control.

b. Findings

No findings were identified.

2.1.17 1E/1F Station Battery Chargers (EED-BC-1E, EED-BC-1F)

a. Inspection Scope

The team inspected the 1E and 1F Station Battery Chargers to verify their ability to meet design basis requirements in response to transient and accident events. The chargers use silicon controlled rectifiers (SCR) and supply all steady state normal direct current (DC) power while maintaining the associated safety-related station batteries fully charged. Battery charger 1E is safety-related and it is connected to safety-related Bus 1A, located in Inverter Room 1A. Battery charger 1F is also safety-related and feeds safety-related Panel 1B, located in Inverter Room 1B. The team reviewed the electrical DBD to determine the required operational parameters. The team reviewed the vendor documentation to determine if the equipment was properly rated and to verify that it met the specification requirements. The team reviewed the maintenance and functional history of the Battery Chargers by sampling corrective action reports, the system health report, operating procedures, and ST procedures and results. The team evaluated short circuit, voltage drop, and protective device calculations to ensure that adequate voltage and current would be available to meet design basis conditions. The team verified that protective overload elements and breaker setpoints for the battery charger and panels 1A and 1B were properly translated into system procedures and tests, and reviewed completed tests intended to demonstrate component operability. The team reviewed drawings, component calculations, and system calculations to verify that calculation inputs and assumptions were accurate and justified.

The team reviewed the interlocking scheme to ensure that there was no single point vulnerability. The team also conducted several walkdowns to visually inspect the physical condition of the battery charger and panels 1A and 1B to ensure adequate configuration control. The team reviewed Exelon CGD procedures and a sample of two CGD plan evaluations for commercially procured capacitors which were dedicated and installed in safety-related battery charger EED-BC-1E to ensure that four critical characteristics were identified and properly verified through testing. The team reviewed the associated purchase orders, receipt inspections, technical evaluation forms, completed third-party CGD test reports, and maintenance work orders to verify critical component characteristics were properly identified and that the design basis, licensing basis, and performance capability of battery charger had not been degraded.

b. Findings

No findings were identified.

2.1.18 'B' Emergency Diesel Generator (EG-Y-1B)

a. Inspection Scope

The team inspected the 'B' EDG (EG-Y-1B) to verify its ability to meet the design basis requirements in response to transient and accident events. The design function of the 'B' EDG is to provide standby power to the 1E safety-related emergency 4160V bus, when the preferred power supply is not available. The team reviewed the electrical DBD to determine the required operational parameters. The team reviewed the vendor documentation to determine if the equipment was properly rated and to verify that it met the specification requirements. The team reviewed the maintenance and functional history of the EDG by sampling corrective action reports, the system health report, operating procedures, and ST procedures and results. The team evaluated short circuit, EDG loading, and protective device calculations to ensure that sufficient capability would be available to meet maximum loading under design basis conditions. The team verified that protective overload elements and breaker setpoints were properly translated into system procedures and tests, and reviewed completed tests intended to demonstrate component operability.

The team reviewed electrical schematics to confirm that the diesel generator would start automatically during a loss of offsite power or degraded voltage condition and that the bus loading would occur in accordance with the design requirements and licensing basis. The team reviewed drawings, component calculations, and system calculations to verify that calculation inputs and assumptions were accurate and justified. The team reviewed the interlocking scheme to ensure that there was no single point vulnerability. The team also reviewed EDG loading logic and the transient frequency and voltage excursions, to ensure that the EDG could respond to simultaneous loss of offsite power and LOCA events. The team also conducted several walkdowns to visually inspect the physical condition of the switchgear to ensure adequate configuration control.

b. Findings

No findings were identified.

.2.1.19 1N 480 Volt Bus (EE-SWG-480V-1N)

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 safety-related 1N 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 PM inspection and testing procedures to ensure that breakers were maintained in accordance with industry and vendor recommendations. The team performed a thermography and 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 1N bus to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.20 1T 480V Screen House Engineered Safeguards Bus Transformer (including Breakers 1T-02 and T1-02)

a. Inspection Scope

The team inspected the 1T 480V screen house engineered safeguards bus transformer to verify it was capable of performing its design basis function. The team reviewed load flow and short circuit current calculations to determine if the maximum load, interrupting duty, and bus bracing requirements were within the load center equipment vendor ratings and were in conformance with design basis requirements. The team also reviewed the coordination/protection calculation for the incoming line, bus tie, and feeder breaker trip settings to ensure the protection scheme was evaluated for design basis load flow conditions. Walkdowns at the 480V load center were performed to assess the material condition of the transformer and associated components. Also, the team reviewed transformer cooling fan operation to determine if it would satisfy design basis load requirements. The IRs and corrective maintenance history for issues affecting reliability were reviewed to ensure deficiencies were properly evaluated and corrected.

b. Findings

No findings were identified.

.2.1.21 1A 480 Volt Engineered Safeguards Bus (EE-MCC-ES-1A)

a. Inspection Scope

The team reviewed calculations and drawings to determine if the loading of the 1A 480V safety-related bus was within equipment ratings. The team reviewed the adequacy and appropriateness of design assumptions and calculations related to the battery charger, motor starting, and loading voltages to determine if the voltages, under worst case motor starting and loading conditions, would remain above the minimum acceptable values. On a sample basis, the team reviewed maintenance and test procedures and acceptance criteria to verify that the 1A 480V vital bus and the 1P feeder bus were capable of supplying the minimum voltage necessary to ensure proper operation of connected equipment during normal and accident conditions. The team reviewed the adequacy of the short circuit ratings of the switchgear and circuit breakers, and the adequacy of protective device coordination provided for a selected sample of equipment. The team reviewed the PM inspection and testing procedures to ensure that the 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 1A 480V bus to ensure that Exelon appropriately identified, characterized, and corrected problems.

b. Findings

No findings were identified.

.2.1.22 IA-P-4 Instrument Air Compressor (including IA-F2A/2B pre-filters and pressure switch IA-PS-1404)

a. Inspection Scope

The team reviewed design and performance of non-safety related air compressor, IA-P-4. The main instrument air system is designed to provide continuous clean, dry, pressurized air. IA-P-4 is the preferred air compressor and provides both instrument and station air. It also serves to reduce the duty cycle on the separate plant instrument air (IA-P-1A/B) and station air compressors (SA-P-1A/B). The team reviewed the adequacy of design flow rates and pressures, and the automatic transfer of IA-P-4 to the separate instrument and station air compressors. The team verified that on a loss of IA-P-4 that the backup air compressors would be capable of picking up and maintaining system loads.

The team reviewed the PM inspection and testing procedures to ensure that the instrument air compressor was maintained in accordance with industry and vendor recommendations. The team performed a thermography and visual non-intrusive inspection of observable portions of the air compressor 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 IA-P-4 to ensure that Exelon appropriately identified, characterized, and corrected problems.

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 TMI Unit 1. The team performed a detailed review of the OE issues listed below to evaluate whether Exelon had appropriately assessed potential applicability to site equipment and initiated corrective actions when necessary.

.2.2.1 NRC Information Notice 2000-20, Potential Loss of Redundant Safety-Related Equipment because of the Lack of High-Energy Line Break Barriers

a. Inspection Scope

The team reviewed a sample of actions taken by the licensee as a result of their evaluation of NRC Information Notice (IN) 2000-20. A walkdown was performed to ensure there were no penetrations in the walls of the turbine building that could allow high energy steam to enter safety-related equipment rooms in the event of a potential steam line break. Also, the team observed high energy line break barriers that were installed over some equipment that were deemed to be potential targets of high energy line breaks. Additionally, non-destructive examinations of piping deemed to be potential line break areas were reviewed to ensure piping wall thicknesses were maintained within allowable values.

b. Findings

No findings were identified.

.2.2.2 NRC Information Notice 2011-14, Component Cooling Water System Gas Accumulation and Other Performance Issues

a. Inspection Scope

The team assessed Exelon's applicability review and disposition of NRC IN 2011-14. This IN discussed industry operating experience regarding air intrusion into component cooling water (CCW) systems, as well as other CCW system performance issues including protection from high wind missiles, high energy line breaks, and seismic events. The team reviewed TMI's decay closed cooling water (DCCW) system operating, fill and vent, and maintenance procedures to verify that procedures adequately addressed the concerns identified in the IN. In addition, the team performed several walkdowns of accessible DCCW piping, reviewed DCCW system corrective action condition reports, reviewed the DCCW system design basis and modification history, and interviewed design engineers to assess whether Exelon had adequately addressed the vulnerability described in the IN.

b. Findings

No findings were identified.

2.2.3 NRC Bulletin 2012-01, Byron Event: Single Phase Failure at Switchyard Caused Plant Trip

The team reviewed the plant approach to the issue described in NRC Bulletin 2012-01, Byron Event: Single phase failure at switchyard caused plant trip. The team reviewed the modification implemented to ensure that a single failure in the switchyard would not have undue consequences on the plant operation. The modification installed a new programmable relay, which was purported to be able to discriminate between normal plant events, such as transformer paralleling and fast bus transfers, and an event that involved an open phase. At the time of this inspection, the new protective scheme was set to alarm only, and it was closely monitored. The trip function of the scheme was scheduled to be implemented by the end of 2017. A similar scheme had been operating at Byron without any reported issues. The modification appeared to have considered all major issues involved.

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

b. Findings and Observations

No findings were identified.

4OA6 Meetings, including Exit

On February 27, 2015, the team presented the inspection results to Mr. Rick Libra, Site Vice President, and other members of the Exelon staff. The team verified that none of the information in this report is proprietary.

Attachment: Supplementary Information

ATTACHMENT

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel
R. Libra, Site Vice President
T. Haaf, Plant Manager
D. Atherholt, Manager, Regulatory Assurance
K. Baldwin, System Engineer
P. Bennett, Manager, Mechanical Design Engineering
A. Crawford, Design Engineer
S. Diven, System Engineer
R. Ezzo, Electrical Design Engineer
M. Fitzwater, Senior Regulatory Assurance Engineer
K. Heisey, MOV Program Engineer
E. Hickman, System Engineer
K. Hirstik, Mechanical Design Engineer
B. Hreha, TMI Site Risk Management Engineer
A. McDowell, System Engineer
J. Piazza, Senior Manager, Design Engineering
F. Reeser, System Engineer
J. Sherk, Electrical Design Engineer
T. Stertzel, System Engineer
G. Yockey, Manager, Operations Services
D. Williams, Supervisor, Work Control Operations
V. Zeppos, Mechanical Design Engineer

NRC Personnel
D. Werkheiser, Senior Resident Inspector, TMI
J. Heinly, Resident Inspector, TMI

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Closed

05000289/2015007-01	NCV	Deficient Design Control for Verifying Reactor Building Fan Assembly Capability to Perform Design Basis Function (Section 1R21.2.1.1)
05000289/2015007-02	NCV	Untimely Identification and Correction of Degraded BWST Level Transmitter Cold Weather Protection Equipment (Section 1R21.2.1.2)

LIST OF DOCUMENTS REVIEWED

Audits and Self-Assessments
NOSMDA-TM-14-05, TMI1 Winter Readiness Assessment dated November 15, 2014
PI-AA-126-1001, TMI Readiness Review for 2015 NRC Component Design Basis Inspection, Revision 0

Calculations
268-TMI-027, Weak Link Analysis for Group No. 27, Walworth 12 inch , 1500 # Gate Valve, dated 10/3/2000
42047-C-002, TMI-U1, Chiller Anchorage Evaluation, Revision 2, dated 2/22/90
C-1101-168-E410-003, River Water Level Indicator, Revision 0
C-1101-210-E510-074, Low Pressure Injection (LPI)/Decay Heat (DH) Removal Flow Calibration and Instrument Loop Error-CMT 606659, Revision A
C-1101-212-E410-081, TMI-1: 1R14 DH-C-1A Performance Evaluation, Revision 0
C-1101-212-E410-084, TMI-1: DH-C-1A/B Design Analysis, Revision 0C-1101-212-E504-067, TMI-1: DHR Heat Exchanger Performance Evaluation, Revision 1
C-1101-212-E510-074, low Pressure Injection (LPI)/Decay Heat (DH) Removal Flow Calibration and Instrument Loop Error, Revision 1
C-1101-531-5310-010, TMI-1 Nuclear River Water System Performance, Revision 2
C-1101-531-E410-019, TMI-1 Nuclear River Water System Pipe-Flo Model, Revision 1
C-1101-542-E540-014, TMI-1: Decay Heat Service Closed Cooling Water Hydraulic Analysis, Revision 0A
C-1101-700-5350-006, Short Circuit Study, Revision 4
C-1101-700-E420-018, TMI1 Open Phase Study, Revision 0
C-1101-700-E510-010, Load Analysis, Revision 5
C-1101-700-E510-010, AC Voltage Regulation Study, Revision 6
C-1101-731-E420-006 Emergency Diesel Generators EG-Y-1A/B Protective Relay Settings, Revision 1
C-1101-731-E420-007 Emergency Diesel Generator Voltage and Frequency Response – CMT 608163, Revision 1
C-1101-732-5350-003, TMI Class 1E 480V Unit Substation Setting for Conversion to Solid State Trip Units, Revision 3
C-1101-732-5350-005 TMI-1 Protective Relays 4.16KV Class 1E Switchgear, Revision 8
C-1101-733-E420-022, TOL/Amptector Confirmation for TDR-995 Conversion, Revision 3
C-1101-733-E420-022, TOL/Amptector Confirmation for Degraded Grid Voltage, Revision 4
C-1101-733-E510-024, 480V Under/Overvoltage (Alarm) Relay Settings, Revision 1
C1101-741-E510-005 Loading Summary of Emergency Diesel Generators and Engineered Safeguard Buses, Revision 5
C-1101-823-5310-004, RB Vent Fan Brake Horsepower during a RB LOCA/LOOP Event, Revision 0
C-1101-823-5310-004, RB Vent Fan Brake Horsepower during a RB LOCA/LOOP Event, Revision 1
C-1101-823-5450-001, TMI-1 LBLOCA EQ Temperature Profile Using the GOTHIC Computer Code, Revision 9
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01004908	01252775	01607694	02448096*
01011715	01262899	01636787	02448152*
01012195	01269258	01643041	02448638*
01017471	01269435	01657138	02448646*
01021772	01272192	01665021	02450373*
01023997	01274162	01689184	02451342*
01049556	01274395	02175352	02451855*
01055676	01280171	02414913	02452249*
01061194	01281446	02414920	02452333*
01066123	01286623	02434610	02452858
01066638	01287008	02435043	02453521
01071239	01289205	02439088*	02453528
01084788	01305721	02441183	02453540
01094461	01314551	02442676*	02454780*
01102739	01317830	02443083*	02454925*
01112241	01322450	02443205	02455207
01136439	01363932	02443687*	02455828
01143407	01392609	02444388*	02456909
01161423	01409750	02445115*	02458489*
01161995	01460209	02445164*	02458491*
01175143	01470986	02445250*	02458929*
01183728	01471730	02446076*	02458932*
01186666	01578516	02446393	02458980*
01186845	01583237	02446655*	02459579*
01203459	01583250	02446714*	02461773*
01211027	01583267	02446903*	02465143*
01212455	01584924	02446923*	
01217470	01584961	02447581*	
01240338	01585974	02447817*	

* NRC identified during this inspection.

Design and Licensing Basis
TMI Unit 1 Final Safety Analysis Report, Revision 20
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SDBD-T1-700, Onsite electrical Distribution System, Revision 0
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Drawings

1E-710-11-001, Electrical Schematic One Line Diagram 230kV, 6.9kV, 4.16 &480 SA &SB, Revision 9
1E-710-11-002, Electrical Schematic One Line Diagram 416V & 480V, Revision 1
201-044, 480V. Control Center 1B Engineered Safeguards, Revision 38
201-057, 480V Control Center 1B Turbine Plant, Sheet 2, Revision 26
201-173, 120/280V AC Distribution Panel (CC/CT-3, 1A Reactor Plant Cont. CTR), Revision 19
208-162, 4160V Switchgear (ES) (1E12) T1-02 Transformer 1T Feeder Breaker, Revision 4
208-163, 480V Control Center 1B Engineered Safeguards Screen House, Sheet 1, Revision 29
208-163, 480V Control Center 1B Engineered Safeguards Screen House, Sheet 2, Revision 26
208-293, Electrical Elementary Diagram, 480V Switchgear (ES) (1T-1B) 1T-02 1T Screen House ES Bus Feeder Breaker, Revision 5
208-561, Electrical Elementary Diagram 480V. Control Center 1B Engineered Safeguards, Revision 38
229-002, Electrical Substation One Line Diagram, Revision 19
302-202, Nuclear Services River Water System, Revision 81
302-270, Instrument Air Flow Diagram, Revision 5
302-271, Instrument & Station Service Air Flow Diagram, Revision 72
302-640, Decay Heat Removal, Revision 84
302-645, Decay Heat Flow Diagram – Closed Cycle Cooling Water, Revision 39
308-572, Instrument Air Pressure Transmitter and Switches, Revision 6
308-707, Electrical Elementary Diagram Instrument Air Compressor IA-P-4 & Isolation Valves IA-V2104A & 2104B, Revision 1
B-308-810, Intermediate Cooling Surge Tank & BWST Level Transmitters, Revision 10
D-46290, 8” and 10” N-2376-SP, 300 Lb, Swing Check Assembly, Revision 2
E-206-011, Electrical Main One Line & Relay Diagram, Revision 54
E-206-021, One Line & Relay Diagram – 6900 V. & 4160 V. Switchgear, Revision 16
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E-206-031, One Line & Relay Diagram – Turbine & Serv. H.&V., Turb., Reactor, Aux. & F.B. H.&V. 480V. Swgr., Revision 27
E-206-032, One Line & Relay Diagram – Engineered Safeguards Screen House, Reactor Building H&V, 480V Switchgear, Revision 18
E-206-051, Electrical One Line Diagram – 250/125V D.C. Sys. & 120V A.C. Vital Instrumentation, Revision 36
E-206-164, Electrical 4160V. Switchgear (1E3) G11-02 Diesel Generator 1B Breaker, Revision 27
E-208-161, Electrical 4160V. Switchgear (1E6) S1-02 Transformer 1S Feeder Breaker, Revision 5
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SS-208-292, Electrical Elementary Diagrams 480V. Switchgear (E.S.) (1S-4A), Revision 2
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OP-TM-212-212, LPI Test of DH Train B, Revision 9, performed 11/11/13
OP-TM-212-244, Shutdown IST of DH Pump Check Valves, Revision 1, performed 11/10/13
1302-5.18, HPI/LPI Flow Channel Calibration, Revision 38
1303-13.4, Remote Shutdown System Functional Testing, Revision 9, performed 11/8/13
1303-13.4, Remote Shutdown System Functional Test, performed 11/11/13
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A2372886	R2112737	R2191421	R2228925
A2372930	R2140795	R2191422	R2229607
C2010971	R2151809	R2191561	R2231491
C2023915	R2153032	R2196576	R2239474
C2033926	R2154464	R2207879	R2239621
M2308868	R2160549	R2212237	R2246389
M2373871	R2160565	R2214290	R2246506
R1825355	R2168133	R2219432	R2246588
R1828686	R2170879	R2222110	R2248187
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ECR-11-00511, T1R19 DC-C-2B Performance Evaluation, Revision 0
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Sulzer Product Manual Curve No. SJT-861.000-63-11-00, dated 07/31/07
TDR 1183, Single Failure Analysis of Nuclear services Closed cooling Water and Nuclear Services River Water (NR) Systems, Revision 0
TDR-1212, TMI Response to Generic Letter 96-06, Revision 2
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PM 204555, 480V Distribution System Thermography Survey
PM 004288, EE-MCC-ESV-1C Cleaning and Inspection, performed 9/21/2013
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1056, Protective Relay Settings, Revision 8
1104-19, Control Building Ventilation System Operating Procedure, Revision 81
1104-45R, Fire Protection System Operations Surveillance, Revision 59
1104-46, Electric Heat Tracing, Revision 60
1107-3, TMI – Diesel Generator Unit 1 Operating Procedure, Revision 142
1107-4.1, 480V Breakers Overcurrent Tripping Device Setpoints, Revision 19
1303-13.4, Remote Shutdown System Functional Test, Revision 9
1420-HT-1.3, Heat Trace Replacement, Revision 5
1450-026, 480V Under/Overvoltage (Alarm) Relay Maintenance, Revision 11
E-2, Dielectric Check of Insulation, Motors and Cables, Revision 15
E-21, Thermal Overload Devices Inspection and Testing, Revision 40
E-67, Air Blast Fans Checks and Lubrication, Revision 8
ER-AA-200-101, Equipment Classification, Revision 0
ER-TM-390-1001, Control Room Habitability Program Implementation, Revision 4
ER-TM-700-402, External Surfaces Monitoring Program, Revision 3
ES-024T, Overload Heater Selection for Electric Motors, Revision 4
ES-025T, Selection and Setting of Protective Devices, Revision 5
MA-TM-125-014, Inspection and Cleaning of 480 Volt Switchgear, Revision 1
MA-TM-125-029, 1E Station Battery Charger Cleaning and Inspection, Revision 2
MA-TM-135-650, Inspection Rubber Expansion Joints, Revision 4
OP-TM-211-901, Emergency Injection HPI/LPI, Revision 7
OP-TM-212-000, Decay Heat Removal System, Revision 19
OP-TM-212-911, Post LOCA Reactor Vessel Boron Concentration Control, Revision 2
OP-TM-340-1002, Guidance for Heat Exchanger Inspections and Cleaning at TMI, Revision 3
OP-TM-533-252, DR Train B Leakage Exam, Revision 8
OP-TM-533-272, DC-C-2B Heat Transfer Test, Revision 8
OP-TM-541-000, Primary Component Cooling, Revision 21
OP-TM-541-231, IST of NR-P-1A and Valves – Multiple Pump Operations, Revision 9

OP-TM-541-461, IC & NS Temperature Controls, Revision 8
OP-TM-543-000, Decay Heat Closed System, Revision 8
OP-TM-543-202, IST of DC-P-1B, Revision 3
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OP-TM-731-904, Energize 1L 480V Bus Using 1N Bus Cross Tie, Revision 3
OP-TM-861-902, Diesel Generator EG-Y-1B Emergency Operations, Revision 16
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OP-TM-AOP-020, Loss of Station Power, Revision 20
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OP-TM-AOP-0141, Loss of 1E 4160V Basis Document, Revision 6
OP-TM-AOP-0201, Loss of Station Power Basis Document, Revision 2
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OP-TM-RCE-0205, Low Temperature Trace Heated Lines, Revision 0
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PI-AA-125, Corrective Action Program, Revision 0
SM-AA-300, Procurement Engineering Support Activities, Revision 6
SM-AA-300-1001, Procurement Engineering Process and Responsibilities, Revision 17
WC-TM-430, Surveillance Test Procedure, Revision 0

Risk and Margin Management
TMI Unit 1 List of Low Design Margin Issues dated12/10/2014

System Health, System Walkdowns, and Trending
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480 V Power, Standard Quarterly System Health Challenge and Reporting, 04/01/2014-06/30/2014
250/125 Volt DC System, Standard Quarterly System Health Challenge and Reporting, 04/01/2014-06/30/2014

Vendor Technical Manuals
VM-TM-0029, Valve Operators, Revision 49
VM-TM-0041, Yuba Heat Transfer Corporation Shell and Tube Heat Exchanger, Revision 13
VM-TM-0160, TMI-1 Vendor Manual C&D Autoreg Battery Charger, Revision 13
VM-TM-0191, EG-Y-1B Vendor Manual, Revision 64
VM-TM-0283, 480V Switchgear Vendor Manual, Revision 0
VM-TM-0293, Butterfly Valves, Associated Control Equipment, Revision 8
VM-TM-0691, Remotely Operated Cast Steel Gate Valves for Auxiliary Services System, Revision 11
VM-TM-0822, Intermediate Close Cooling Water System, Revision 4
VM-TM-2911, Johnston Pump Company, Revision 4
Woodward Product Specification 03029, Revision K

LIST OF ACRONYMS

ADAMS	NRC's Document System
BHP	Brake Horsepower
BWST	Borated Water Storage Tank
CCW	Component Cooling Water
CDBI	Component Design Basis Inspection
CFR	Code of Federal Regulations
CGD	Commercial Grade Dedication
DBA	Design Basis Accident
DBD	Design Basis Document
DCCW	Decay Closed Cooling Water
DGV	Degraded Grid Voltage
DRS	Division of Reactor Safety
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EOP	Emergency Operating Procedure
ESAS	Engineered Safeguards Actuation System
HPI	High Pressure Injection
HP	Horsepower
HX	Heat Exchanger
IMC	Inspection Manual Chapter
IN	[NRC] Information Notice
IP	Inspection Procedure
IR	Issue Report
IST	In-Service Testing
kV	Kilovolt
LERF	Large Early Release Frequency
LCO	Limiting Condition of Operation
LOCA	Loss of Coolant Accident
LPI	Low Pressure Injection
MCC	Motor Control Center
MOV	Motor Operated Valve
MU	Makeup
NCV	Non-Cited Violation
NPSH	Net Positive Suction Head
NR	Nuclear River Water
NRC	Nuclear Regulatory Commission
OE	Operating Experience
P&ID	Piping and Instrument Diagram
PM	Preventive Maintenance
PRA	Probabilistic Risk Assessment
RAW	Risk Achievement Worth
RB	Reactor Building
RCS	Reactor Coolant System
RRW	Risk Reduction Worth
SCR	Silicon Controlled Rectifier
SDP	Significance Determination Process

SPAR	Standardized Plant Analysis Risk
SSC	Structures, Systems, and Components
ST	Surveillance Test
TMI	Three Mile Island, Unit 1
TOL	Thermal Overload
TS	Technical Specification
UFSAR	Updated Final Safety Analysis Report
V	Volt