UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 RENAISSANCE BLVD., SUITE 100
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September 8, 2015

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

SUBJECT: LIMERICK GENERATING STATION - COMPONENT DESIGN BASES INSPECTION REPORT 05000352/2015007 AND 05000353/2015007

Dear Mr. Hanson:

On July 10, 2015, the U.S. Nuclear Regulatory Commission (NRC) completed the onsite portion of an inspection at the Limerick Generating Station (LGS), Units 1 and 2. The enclosed inspection report documents the inspection results, which were preliminarily discussed on July 10, 2015, with Mr. Rick Libra, Limerick Site Vice President, and other members of your staff. Subsequent to the onsite inspection, continued dialogue and evaluation continued for two of the items discussed on July 10, 2015. The NRC's conclusions on these items were discussed via teleconference on July 30, 2015, with Mr. Wayne Lewis, Senior Design Engineering Manager, 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 two NRC-identified findings, both of which were of very low safety significance (Green). Both of the findings were determined to be violations of NRC requirements. However, because of the very low safety significance and because they were both entered into your corrective action program, the NRC is treating these findings as non-cited violations (NCV) consistent with Section 2.3.2.a of the NRC's 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 Senior Resident Inspector at LGS. In addition, if you disagree with the cross-cutting aspect assigned to the findings 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 LGS.

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

Sincerely,

***/RA/***

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

Docket Nos. 50-352 and 50-353
License Nos. NPF-39 and NPF-85

Enclosure:
Inspection Report 05000352/2015007 and
05000353/2015007
w/Attachment: Supplemental Information

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**REGION I**

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| Docket Nos. | 50-352; 50-353 |
| License Nos. | NPF-39, NPF-85 |
| Report Nos. | 05000352/2015007 and 05000353/2015007 |
| Licensee: | Exelon Generation Company, LLC |
| Facility: | Limerick Generating Station, Units 1 and 2 |
| Location: | Sanatoga, PA |
| Inspection Period: | June 8 through July 30, 2015 |
| Inspectors: | S. Pindale, Senior Reactor Inspector, Division of Reactor Safety (DRS), Team Leader<br>K. Mangan, Senior Reactor Inspector, DRS<br>J. Lilliendahl, Reactor Inspector, DRS<br>N. Floyd, Reactor Inspector, DRS<br>N. Della Greca, NRC Electrical Contractor<br>M. Yeminy, NRC Mechanical Contractor |
| Approved By: | Paul G. Krohn, Chief<br>Engineering Branch 2<br>Division of Reactor Safety |

## SUMMARY OF FINDINGS

IR 05000352/2015007 and 05000353/2015007; 6/8/2015 – 7/30/2015; Limerick Generating Station, Units 1 and 2; 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. Two findings of very low safety significance (Green) were identified, 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.

A. NRC-Identified and Self-Revealing Findings

**Cornerstone: Mitigating Systems**

- Green. The team identified a finding of very low safety significance involving a non-cited violation (NCV) of the 10 CFR Part 50, Appendix B, Criterion III, "Design Control," in that Exelon did not verify and assure in design basis calculations, that adequate voltage would be available for starting Class 1E accident mitigating motors when the safeguards buses are powered by the emergency diesel generators (EDG). Specifically, in the calculation performed to evaluate voltage available to individual motors when they are powered by the EDGs, Exelon assumed that the generator output voltage would be 4285 Volts, alternating current (Vac), rather than the minimum voltage allowed by station technical specifications (4160 Vac). Additionally, the electrical ratings of loads powered by the EDG were not adjusted for the maximum frequency allowed by station technical specifications (61.2 hertz (Hz)). As a result, the starting voltage for some of the safety-related motors would not have been acceptable under EDG generator voltage and frequency limiting conditions. In response, Exelon entered the issue into their corrective action program and performed evaluation that determined that EDG actual test results demonstrated the EDGs to be operable. The team review of the evaluation determined it to be reasonable.

  This finding was more than minor because it was similar to Example 3.j of NRC IMC 0612, Appendix E, and 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 determined the finding was of very low safety significance because it was a design deficiency confirmed not to result in a loss of safety-related motor operability or functionality. The team determined this finding had a cross-cutting aspect in the area of Problem Identification and Resolution (Identification, Aspect P.1), because during a calculation revision in 2014, Exelon did not recognize that the limits of voltage and frequency allowed by the station technical specifications affected the calculation results and, therefore, did not completely and accurately identify the issue and revise the calculation in accordance with the station's corrective action program requirements. (Section 1R21.2.1.1)

- Green. The team identified a finding of very low safety significance involving a non-cited violation (NCV) of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," in that Exelon's design control measures did not verify the adequacy of the design regarding adequate direct current voltage (Vdc). Specifically, Exelon did not ensure that adequate voltage existed to emergency diesel generator (EDG) relays and output breaker spring charging motors. Additionally, the team determined that the overall impact to voltage drop calculations was not adequately assessed when the temporary battery cart is used. Following identification of the issue, Exelon entered it into their corrective action program and evaluated the operability of the batteries, concluding that the affected DC components would function at the current battery capacities. The team's review of the evaluation determined it to be reasonable.

  The finding was more than minor because it was similar to Example 3.j of NRC IMC 0612, Appendix E, and was associated with the Design Control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. The team determined the finding was of very low safety significance because it was a design deficiency affecting the safety-related batteries that did not result in the loss of operability or functionality. The team determined this finding had a cross-cutting aspect in the area of Human Performance, (Documentation, Aspect H.7) because the battery sizing calculation was revised on March 15, 2014, which provided an opportunity to identify the inaccuracies of the battery calculations. (Section 1R21.2.1.2)

B. Licensee-Identified Violations

None

# 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 Limerick (LGS) Probabilistic Risk Assessment (PRA) and the U.S. Nuclear Regulatory Commission's (NRC) Standardized Plant Analysis Risk (SPAR) model for LGS. Additionally, the team referenced the Risk-Informed Inspection Notebook for LGS 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, operator actions, electrical busses, 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 (05000352 and 353/2007007, 05000352 and 353/2009006, and 05000352 and 353/2012007) and excluded those components previously inspected. The team then performed a margin assessment to narrow the focus of the inspection to 19 components and three operating experience (OE) items. The team selected two components based on 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 and licensing bases. 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 (21 samples)

.2.1.1 D14 Emergency Diesel Generator

a. Inspection Scope

The team reviewed the electrical and mechanical capabilities of Unit 1 emergency diesel generator (EDG), D14. The design function of EDG D14 is to provide standby power to the 4160 Vac safety-related emergency switchgear bus D14 when the preferred offsite power is not available. The electrical evaluation of the EDG focused on its ability to supply power to the safety-related loads during design basis abnormal and accident events. Specifically, the team reviewed transient and steady state loading analyses and the design capabilities of the EDG to confirm its ability to accept and run the required loads. The team reviewed the brake horsepower basis for selected pump motors to ensure that the loads were adequately considered in the loading study at conservative motor operating conditions. The team also reviewed EDG voltage settings and voltage drop calculations to verify that adequate voltage was provided to the safety-related loads during worst-case loading conditions. Additionally, the team reviewed short circuit calculations and the 4160 Vac coordination analysis to ensure that the switchgear equipment was adequately rated and the protective devices selectively coordinated such that the loads and cables were adequately protected without interruption of service to other components during overload or faulted conditions. The team reviewed bus voltage relay settings and control schematic wiring diagrams to confirm that the EDG would start automatically during a loss-of-offsite power or degraded voltage condition and that the bus loading would occur, in accordance with design requirements and licensing bases. The team reviewed the EDG surveillance test procedures and results to verify that such testing complied with technical specification (TS) requirements and, in particular, that during the sequential starting of loads, the EDG had sufficient capability to accelerate the loads within the time periods specified in the Updated Final Safety Analysis Report (UFSAR). The team reviewed the details associated with an EDG time delay relay testing minor deficiency, wherein the safety function could still be performed but the team evaluated a potential timing and sequencing issue with the alternate source of offsite power and EDG breakers closing on safety-related buses within the same timeframe (Issue Report (IR) 02535151).

The team also inspected the EDG mechanical support systems to ensure they were capable of meeting their design basis functions, including the fuel oil, lubricating oil, starting air, engine cooling, and room cooling systems. The team reviewed the fuel oil consumption calculation to ensure the quantity of fuel on site was consistent with design and licensing requirements. Engine air start system check valve leakage testing and associated calculations were reviewed to ensure engine starting capability from the stored air supply was adequate to start the EDG during worst case delayed starting assumptions. The team reviewed engine heat exchanger design calculations and recent heat exchanger inspection results to ensure adequate cooling water flow rate and heat transfer assumptions were maintained.

The team also witnessed a monthly surveillance test of the diesel engine which was conducted using the “slow start” method to verify the adequacy of the surveillance, to determine whether all elements of the procedure were completed, and to verify that components were operating as designed.

The team reviewed selected maintenance procedures and completed work records to evaluate whether the EDG was being properly maintained. The team reviewed completed surveillances to determine if the EDG was being tested in accordance with the TSs. The team also interviewed the responsible engineers and performed walkdowns of the EDG and related equipment to assess Exelon’s configuration control, the material condition, the operating environment, and potential external hazards. 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 evaluate and correct problems.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving a non-cited violation (NCV) of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix B, Criterion III, "Design Control," in that Exelon did not verify and assure in design basis calculations, that adequate voltage would be available for starting Class 1E accident mitigating motors when the safeguards buses are powered by the EDGs. Specifically, in the calculation performed to evaluate voltage available to individual motors when powered by the EDGs, Exelon assumed that the generator output voltage would be 4285 Vac, rather than the minimum voltage allowed by the station TSs (4160 Vac). Additionally, the kilowatt (kW) and kilovolt amperes (KVA) ratings of the loads powered by the EDG were assumed to be at nominal frequency (60 Hz) rather than at the maximum frequency allowed by the station TSs (61.2 Hz). As a result, the starting voltage for some of the safety-related motors may not have been acceptable under limiting EDG voltage and frequency conditions.

Description: Calculation 6380E-08, “Diesel Generator Voltage Regulation Study,” was prepared “to predict and evaluate the EDG voltage transient during the addition of step load changes to assure that the capability of the on-site power system is not degraded to a point that prevents the starting and running of all engineered safety feature and emergency shutdown loads required for: 1) a loss-of-offsite power (LOOP); and 2) a loss-of-coolant accident (LOCA) coincident with a LOOP.” The team’s review of the design inputs determined that Exelon had assumed a starting EDG voltage of 4285 Vac. Additionally, the team observed that the calculation had assumed a nominal frequency of 60 Hz. Based on the assumed voltage and frequency, the calculation concluded that, when powered from the EDG, all motors received an acceptable starting voltage, albeit the margin for some 460 Vac motors was very limited both under LOOP and LOCA-LOOP conditions.

To confirm the acceptability of the calculation assumptions the team reviewed the UFSAR and the TSs. The team determined that TS Surveillance Requirement (SR) 4.8.1.1.2.a.4 required verification that “the diesel can start and gradually accelerate to synchronous speed with generator voltage and frequency at 4280 ± 120 Vac and 60 ± 1.2 Hz,” and that other SRs have similar requirements. Similarly, the team found that these same voltage and frequency requirements were reflected in the applicable plant surveillance procedures.

The team identified that the surveillance procedures can allow voltages less than the calculated 4285 Vac and higher than the calculated nominal 60 Hz, as permitted by the TSs. However, in light of the very limited margin available on several safety-related motors, the team questioned the acceptability of the assumptions formulated in calculation 6380E-08 compared to the tested acceptance criteria and questioned Exelon as to whether the surveillance acceptance criteria were potentially non-conservative. To address the team’s concern, Exelon conducted preliminary analyses to determine the minimum required EDG voltage to assure that adequate starting voltage at all safety-related motors, assuming EDG operation at a maximum frequency of 61.2 Hz. Exelon staff determined that when the safety-related motors were powered by the EDG, the minimum EDG voltage should be not less than 4235 Vac and that EDG surveillance testing should confirm that the voltage regulator maintained such minimum voltage. Exelon entered the team’s finding in the corrective action program (IR 2525662) and performed an operability evaluation to confirm that, under current governor and voltage regulator settings, all motors remained operable. The team reviewed Exelon’s operability assessment and agreed that, based upon test results demonstrating that the voltage never fell below the calculated value, the EDGs remained operable.

In addition, the team discussed the applicability of NRC Administrative Letter (AL) 98-10, “Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety.” Specifically, in this case, the TSs allowed the EDG minimum voltage (4160 Vac) and maximum frequency to values that are not bounded by the governing design calculation (4285 Vac, 61.2 Hz). Accordingly, and consistent with AL 98-10, Exelon plans to impose administrative controls as a short term compensatory measure (for the TS surveillance test); and will evaluate an amendment to the TS, with appropriate justification and schedule, for submittal to the NRC in a timely fashion.

Analysis: The team determined that the failure to confirm that all safety-related motors had adequate starting voltage when powered by the EDG was a performance deficiency. Specifically, Exelon did not consider the effects of minimum voltage and maximum frequency allowed by TSs on the ability of the engineered safety feature and emergency shutdown loads to start and run, as assumed in the design basis calculation of record, 6380E-08. As a result, at the minimum voltage allowed by the TSs, some of the motors may not have the minimum voltage specified in the applicable industry standards and calculation assumptions. The finding was more than minor because it was similar to Example 3.j of NRC Inspection Manual Chapter (IMC) 0612, Appendix E, “Examples of Minor Issues,” which determined that calculation errors would be more than minor if, as a result of the errors, there was reasonable doubt on the operability of the component.

In addition, the finding was associated with the Design Control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences.

The team performed a risk screening, in accordance with IMC 0609, Appendix A, "Significance Determination Process for Findings At-Power," using Exhibit 2, "Mitigating Systems Screening Questions," and determined the finding was of very low safety significance (Green) because it was a design deficiency affecting motor starting capability that did not result in the loss of operability or functionality of the affected safety-related equipment. Specifically, a preliminary analysis determined that existing settings for the EDG speed governor and voltage regulator were adequate to prevent the voltage at all motors from dropping below the required minimum. Additionally, results of recent surveillance tests indicated that the EDG voltage never fell below the calculated value.

The team determined that this finding had a cross-cutting aspect in the area of Problem Identification and Resolution (Identification), because during a revision of the calculation in 2014, Exelon did not recognize that the limits of voltage and frequency allowed by the TSs affected the calculation results and, therefore, did not completely and accurately identify the issue and revise the calculation in accordance with the station's corrective action program requirements. (IMC 0310, Aspect P.1)

Enforcement: 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures shall provide for verifying the adequacy of design, and for the selection and review for suitability of equipment that is essential to the safety related functions of structures, systems, and components. Contrary to the above, prior to July 10, 2015, Exelon's design control measures had not verified the adequacy of the design basis calculation to assure that adequate voltage would be available for starting Class 1E accident mitigating motors when the safeguards buses are powered by the EDGs. Specifically, in the design basis calculation performed to evaluate voltage drop to individual motors when they are powered by the EDGs (6380E-08), Exelon assumed that the EDG output voltage would be 4280 Vac, rather than the minimum voltage allowed by the TSs (4160 Vac). Additionally, the loads were not adjusted for the maximum frequency allowed by the TSs (61.2 Hz) or the administrative limits imposed on the EDG governor. Because this violation was of very low safety significance (Green) and was entered into Exelon's corrective action program (IR 2525662), this violation is being treated as an NCV, consistent with Section 2.3.2.a of the NRC's Enforcement Policy. **(NCV 05000352; 05000353/2015007-01, Failure to Verify Adequacy of EDG Voltage to Start Safety-Related Motors)**

.2.1.2 Division I 125/250 Vdc Station Battery and Direct Current Bus (2 samples)

a. Inspection Scope

The team inspected the Division I 125/250 voltage direct current (Vdc) station battery and direct current (DC) bus at Unit 1 to evaluate whether the battery and bus could perform the design basis function to provide DC power to the Division I switchgear following postulated design basis accidents.

The team reviewed the UFSAR, TSs, TS Bases, the system design description, drawings, and procedures to identify the performance requirements for the battery and associated DC bus. The team reviewed design calculations to assess the adequacy of the battery's sizing to ensure it could power the required equipment for a sufficient duration, and at a voltage above the minimum required for equipment operation. The team reviewed battery room temperature monitoring to verify that environmental conditions would not adversely affect the life of the battery and that the battery would be capable of performing its intended safety function late in life during normal and postulated accident conditions. The team reviewed battery test results, including discharge tests to ensure the testing was in accordance with design calculations, plant TSs, vendor recommendations, and industry standards; and that the results confirmed acceptable performance of the battery. Design and system engineers were interviewed regarding the design, operation, testing, and maintenance of the battery.

The team reviewed the design and operation of the switchgear bus and associated distribution panels. The review evaluated whether the loading of the DC bus was within equipment ratings and determined whether the bus could perform its design basis function to reliably power the associated loads under worst case conditions. Specifically, the team reviewed calculations and drawings including voltage drop calculations, short circuit analyses, and load study profiles to evaluate the adequacy and appropriateness of design assumptions.

The team walked down the Division I 125 Vdc battery, bus, and distribution panels to independently assess their material condition and to determine if the system alignment and operating environment was consistent with design basis assumptions. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

Introduction: The team identified a finding of very low safety significance (Green) involving an NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," in that Exelon's design control measures did not verify the adequacy of the design regarding adequate DC voltage. Specifically, the team determined that Exelon did not ensure that adequate voltage existed to EDG relays and output breaker safety-related spring charging motors (SCM). Additionally, the team determined that the overall impact to voltage drop calculations was not adequately assessed when the temporary battery cart is used.

Description: The team reviewed three pertinent calculations to assess the capability of the safety-related batteries to provide adequate voltage to the DC loads:

- LE-052, Class 1E Battery Load Duty Cycle Determination
- LE-069, Class 1E 125 Vdc System Voltage Analysis
- LE-053, Determine Acceptable Cable Size for Temporary Cable Jumpers Used During Battery Cell Maintenance/Testing

The team noted that the purpose of LE-052 was to show that battery voltage stays above 105 Vdc when DC loads operate under worst-case conditions. The purpose of the LE-069 calculation was to show that at 105 Vdc, all the DC loads would have sufficient voltage. Finally, calculation LE-053 was developed to demonstrate that even with the increased resistance of the temporary battery cart, there would be sufficient voltage for all of the loads.

The team noted that the calculated worst case component voltage was lower than the manufacturer recommended minimum voltage for EDG relays and several safety-related SCMs. The EDG relay manufacturer required 106 Vdc, however, the calculation showed 94 Vdc available. The SCM manufacturer required 90 Vdc, but the calculation showed 76 Vdc available. A sample of EDG relays and SCMs was tested in the 1994 timeframe to verify that the components would operate at the calculated minimum voltage (i.e., at a value less than the manufacturer recommended voltages); and actions were internally recommended to perform future periodic testing of these devices to provide assurance that they would continue to operate at the reduced voltage. However, the actions to periodically retest the EDG relays and SCMs were not successful in that maintenance procedures were never updated to require periodic retesting at the calculated minimum voltages. The team noted that new relays of the same model as the EDG relays are tested at the calculated minimum voltage prior to installation in the plant; and SCMs are tested, but at the manufacturer's minimum rather than at the lower value in the calculation (76 Vdc).

At Limerick, a temporary battery cart is used to allow online battery maintenance. The cart is designed to jumper out several cells from the battery and jumpers in cells from the cart. The cart is designed to be fully qualified as a replacement for the cells. Calculation LE-053 documents that, although the battery cart causes increased resistance and therefore increases voltage drop, there would be sufficient voltage drop margin so that the battery would remain operable. The LE-053 calculation is dependent on LE-052 and appropriately requires that LE-053 be reviewed whenever LE-052 is revised. The team reviewed the current LE-053 review as documented in the most recent revision to LE-052 and determined that it was inadequate. Specifically, the review included incorrect calculations and erroneous assumptions regarding the worst case increase in voltage drop (~3 Vdc) from the battery cart and the acceptability of being below the required voltage for motor-operated valves and relays to change position, and therefore would invalidate the use of the battery cart regarding Divisions I, II, IIII, and IV.

In response to the team's observations, Exelon entered the DC voltage issues into their corrective action program, evaluated the operability of the affected components, and initiated actions for increased testing and further evaluation. Specifically, Exelon re-calculated the voltage drops using the current battery capacity to demonstrate the ability to perform the intended safety functions, verified the current battery service life calculations, reviewed operating experience to verify no negative trend existed for EDG relay performance, and implemented actions to promptly test spare components, and to periodically test the affected components. In addition, Exelon verified that the temporary battery cart will not be used for the Division III and Division IV batteries until more detailed evaluation can be done to show that the battery cart has sufficient margin for these batteries (their evaluation demonstrated that the cart could be used for Division I and II batteries). The team reviewed the evaluations and agreed that there was reasonable assurance that the batteries will provide adequate voltage to the safety-related components. In the longer term, Exelon planned additional evaluations to ensure operability through the end of expected battery service life.

Analysis: The team determined that the failure to ensure adequate voltage was available to safety-related DC equipment was a performance deficiency. Specifically, Exelon did not ensure that adequate voltage existed to EDG relays and breaker SCMs and did not ensure the overall impact to voltage drop was adequately assessed when the temporary battery cart was used. The finding was more than minor because it was similar to Example 3.j of NRC IMC 0612, Appendix E, "Examples of Minor Issues," which determined that calculation errors would be more than minor if, as a result of the errors, there was reasonable doubt on the operability of the component. In addition, the finding was associated with the Design Control attribute of the Mitigating Systems Cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences.

The team performed a risk screening, in accordance with IMC 0609, Appendix A, "Significance Determination Process for Findings At-Power," using Exhibit 2, "Mitigating Systems Screening Questions," and determined the finding was of very low safety significance (Green) because it was a design deficiency affecting the safety-related batteries that did not result in the loss of operability or functionality. Specifically, a preliminary analysis determined that the affected components would function at the current battery capacities.

The team determined that this finding had a cross-cutting aspect in the area of Human Performance (Documentation), because the battery sizing calculation LE-052 was revised on March 15, 2014, which provided an opportunity to identify the inaccuracies of the battery calculations. (IMC 0310, Aspect H.7)

Enforcement: 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, that measures shall be established to provide for verifying the adequacy of design. Contrary to the above, prior to July 10, 2015, Exelon's design control measures had not verified the adequacy of the design regarding adequate DC voltage. Specifically, Exelon did not perform periodic re-testing of EDG relays or output breaker spring charging motors at reduced voltage, and the DC voltage drop was not adequately assessed when the temporary battery cart was used. Because this finding is of very low safety significance (Green) and was entered into Exelon's corrective action program (IRs 2525692, 2526231, and 2526233), the violation is being treated as an NCV, consistent with Section 2.3.2.a of the NRC's Enforcement Policy. (**NCV 05000352; 05000353/2015007-02, Failure to Verify Adequate Voltage Available for DC Equipment**)

.2.1.3 Reactor Core Isolation Cooling System Logic

a. Inspection Scope

The team inspected the Unit 1 reactor core isolation cooling (RCIC) system logic to evaluate whether it could perform its design basis function to automatically initiate the RCIC system to provide a means for coolant injection to the reactor when the reactor is isolated. The logic also isolates the RCIC system when reactor water level increases to its high setpoint.
The team reviewed the UFSAR, TSs, TS Bases, the system design basis document (DBD), drawings, and procedures to identify the performance requirements for the RCIC system logic. The team reviewed associated surveillance testing of the RCIC system circuitry to verify its performance under design basis conditions. The team reviewed calculations and discussed the design, operation, and maintenance of the system with engineers. The team also conducted a walkdown of related and accessible RCIC system components to assess the material condition of the equipment and to evaluate whether the installed configuration was consistent with the plant drawings, procedures, and the design bases. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.4 Reactor Core Isolation Cooling System Flow Controller

a. Inspection Scope

The team inspected the Unit 1 RCIC system flow controller to evaluate whether it could perform its design basis function to automatically control RCIC system flow to the reactor during transient and postulated accident scenarios. The team reviewed the UFSAR, TSs, TS Bases, the system DBD, drawings, and procedures to identify the performance requirements for the RCIC system flow controller. The team reviewed associated testing and calibration of the flow controller to verify its performance under design basis conditions; and that the controller maintained RCIC pump flowrates and turbine speed within design specifications. The team reviewed calculations and discussed the design, operation, and maintenance of the flow controller with engineers. The team also conducted a walkdown of related and accessible RCIC system components to assess the material condition of the equipment and to evaluate whether the installed configuration was consistent with the plant drawings, procedures, and the design bases. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.5 4160 Vac Bus D14

a. Inspection Scope

The team inspected the Unit 1 4160 Vac switchgear bus D14 to verify that it was capable of meeting its design basis requirements. The team reviewed selected calculations for the electrical distribution system, including load flow/voltage drop, degraded voltage protection, short-circuit, and electrical protection and coordination calculations. The adequacy and appropriateness of design assumptions and calculation results were reviewed to verify that bus capacity was not exceeded and bus voltages remained above minimum acceptable values under design basis conditions. The switchgear's protective device settings and breaker ratings were reviewed to ensure that selective coordination was adequate for protection of connected equipment during worst-case short-circuit conditions. Automatic and manual transfer schemes between alternate offsite sources and the emergency diesel generator were also reviewed to confirm that such transfers were in accordance with DBDs. Voltage protection schemes were reviewed for degraded and loss of voltage relaying. The team reviewed degraded and loss of voltage relays settings to verify that they were set in accordance with design calculations, and that associated calibration procedures were consistent with calculation assumptions, associated time delays, and setpoint accuracy calculations. In addition, the team reviewed selected surveillance test results to determine whether design assumptions and system performance requirements were appropriately verified.

The team reviewed the adequacy of instrumentation/alarms available to operators. To ensure that breakers were maintained in accordance with industry and vendor recommendations, the team reviewed the preventive maintenance templates. Component maintenance history and corrective action program reports were also reviewed to verify that deficiencies and potential degradation mechanisms were appropriately identified and resolved. The team performed a visual non-intrusive inspection of accessible portions of the safety-related 4160 Vac switchgear to assess the installation configuration, material condition, and potential vulnerability to hazards. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.6 4160 Vac - 480 Vac Transformer D144

a. Inspection Scope

The team inspected the 4160 Vac to 480 Vac transformer D144 at Unit 1 to verify that it was capable of performing its design basis function. The team reviewed calculations, drawings, maintenance procedures, and vendor manuals, and assessed the sizing, impedance, loading, protection features, and voltage tap setpoints for the transformer to ensure adequate voltage would be supplied to the vital 480 Vac load center.

The team reviewed the adequacy and appropriateness of design assumptions in calculations related to motor starting and loading voltages to verify that voltage to connected loads would remain above the minimum acceptable values. The team also reviewed the ampacity of associated cables to ensure maximum cable ratings were not exceeded during operation based on lowest allowed voltage supplied from the 4 kV vital bus. Additionally, the team reviewed the protective device settings to ensure that the feeder cables and transformer were protected in accordance with industry standards. A visual walkdown of the equipment was performed and engineers were interviewed to assess the installation configuration, material condition, and potential vulnerability to hazards. Finally, the team reviewed corrective action documents to evaluate whether there were any adverse trends associated with the transformer and to assess Exelon's capability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.7 Residual Heat Removal Service Water Pump Motor 'A'

a. Inspection Scope

The team reviewed the Unit 1 residual heat removal service water (RHRSW) pump motor 'A' to verify that it was capable of performing its design basis function. The team reviewed the UFSAR and the system design basis document to evaluate the design requirements of the 'A' RHRSW pump motor. The team reviewed available short circuit current versus breaker interrupting capability and included an evaluation of the breaker protective relay settings and breaker coordination study to verify adequate protection of the pump motor without interruption of service to other components during circuit overload or faulted conditions.

The team also reviewed the load analysis and voltage drop calculation to confirm that adequate voltage was available at the RHRSW motor terminals under degraded grid voltage conditions. Additionally, the team reviewed control logic and wiring diagrams as well as the available control voltage to verify that the control of the RHRSW motor supply breaker conformed to the design requirements. The team also reviewed test procedures and results of recent tests to evaluate the current health of the pump motor and circuit. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.8 <u>1A Residual Heat Removal System Heat Exchanger</u>

a. <u>Inspection Scope</u>

The team reviewed the Unit 1 residual heat removal (RHR) system heat exchanger 1A to verify that it was capable of performing its design basis function. The RHR heat exchangers are vertical, U-tube heat exchangers that remove heat from the RHR system and provide cooling water to various reactor safety systems and components under all plant conditions. The team verified that these heat exchangers are eddy current tested and visually inspected/cleaned every eight years. The team reviewed the results of these activities to verify that they have been successful in ensuring tube cleanliness and tube structural integrity. The team verified that Exelon conducted periodic performance testing on each RHR heat exchanger to ensure that the design basis heat load is capable of being removed by the heat exchangers. The team reviewed completed performance tests to verify that the 1A RHR heat exchanger was capable of removing the design basis heat loads as required. The team performed a walkdown of the area surrounding the Unit 1 'A' RHR heat exchanger to evaluate the general material condition and the operating environment of the heat exchanger. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. <u>Findings</u>

No findings were identified.

.2.1.9 <u>Safety Relief Valve Automatic Depressurization System Valve 1K</u>

a. <u>Inspection Scope</u>

The team inspected the 1K safety relief valve (SRV) at Unit 1 as a representative sample of the 14 SRVs to verify its ability to meet the design basis requirement to provide overpressure protection for the reactor vessel and associated reactor coolant piping in response to transient and postulated accident events. The 1K valve is also one of five SRVs as part of the automatic depressurization system (ADS), which is designed to reduce the nuclear system pressure so that the low pressure core cooling systems can re-flood the core following certain postulated accidents. The team reviewed applicable portions of the UFSAR, TSs, TS Bases, and system DBD to identify the design basis requirements for the SRV. The team also reviewed surveillance procedures, emergency operating procedures, and SRV test results to evaluate whether the valve's relief capacity was consistent with the design assumptions to depressurize the reactor vessel during design basis accident conditions, and whether test result acceptance criteria enveloped design basis limits. Because the ADS function requires nitrogen to operate the valves, the team reviewed the accumulator and nitrogen bottle back-up sizing calculations as well as periodic surveillance monitoring to verify that the short-term and long-term supply of nitrogen to the SRVs was maintained. The team also reviewed the vendor manual to determine the recommended inspection and maintenance activities and compared those recommendations to Exelon's rebuild and repair procedures and scheduling database.

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 evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.10 Residual Heat Removal Service Water System Piping

a. Inspection Scope

The team inspected the Unit 1 and 2 common RHRSW system piping to evaluate whether it was capable of meeting its design basis requirement to provide cooling water flow for removing heat from the RHR heat exchangers. The inspection included a review of internal piping corrosion that had existed for several years and Exelon's associated monitoring and corrective actions. The team reviewed the TS, UFSAR, the DBD, design bases calculations and modifications to evaluate whether the system's required flows, pressures, and operating conditions for various system configurations were bounded by design assumptions. Additionally, the team evaluated associated non-destructive examination results for RHRSW piping integrity. The team performed a walkdown of the accessible portions of the RHRSW piping and interviewed engineers to assess the material condition of the system. Finally, the team reviewed condition reports and system health reports to determine the overall health of the system, and determine if issues entered into the corrective action program were appropriately addressed.

b. Findings

No findings were identified.

.2.1.12 High Pressure Coolant Injection System Support Components

a. Inspection Scope

The team inspected the Unit 2 high pressure coolant injection (HPCI) system pump and turbine support systems to evaluate whether they were adequate to maintain the HPCI system capabilities per its design basis and operational requirements. The inspection included a review of the lubricating oil/turbine system, cooling system, turbine gland seal system, minimum flow valve, and HPCI discharge check valve. The team performed a walkdown of the HPCI system and interviewed system and design engineers to assess the material condition of the components. The team reviewed the TS, UFSAR, HPCI DBD, and design bases calculations to determine the required flows, pressures, and operating conditions for various system configurations in order to determine the support system operational requirements. Additionally, the team evaluated calculations, technical evaluations, condition reports, and in-service test (IST) data. The review assessed whether TS and design basis requirements could be achieved and IST acceptance criteria were appropriate. The team also reviewed the HPCI lubricating oil cooler heat transfer evaluation, periodic inspection results, tube plugging limits, and current tube plugging to verify that design basis heat removal requirements were satisfied. Finally, the team reviewed condition reports and system health reports to determine the overall health of the system, and determine if issues entered into the corrective action program were appropriately addressed.

b. Findings

No findings were identified.

.2.1.13 Reactor Core Isolation Cooling Turbine

a. Inspection Scope

The team inspected the Unit 1 RCIC system turbine to evaluate whether it was capable of meeting its design basis and operational requirements to support RCIC pump operation to provide cooling water to the reactor vessel under transient and postulated accident conditions. The team reviewed turbine lubricating oil cooler performance and the turbine governor control system including the inner speed loop and outer flow control loop to ensure the capability to meet design conditions. The team performed a walkdown of the turbine and associated equipment and interviewed system and design engineers to assess the material condition of the components. The team reviewed the TSs, UFSAR, and design calculations to determine the capability of the turbine to support the required speed ranges to provide pump flowrates, pressures and operating conditions for both the reactor vessel injection mode and condensate storage tank (CST) recirculation mode of operation. Additionally, the team evaluated whether the turbine control system would operate at worst case atmospheric temperatures. The RCIC turbine lubricating oil cooler inspection results and tube plugging limits were reviewed to verify that design basis heat removal requirements were satisfied. Finally, the team reviewed corrective action documents and system health reports to determine if there were any adverse operating trends and to assess Exelon's ability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.14 Reactor Core Isolation Cooling Pump

a. Inspection Scope

The team inspected the Unit 1 RCIC pump to evaluate whether it was capable of meeting its design basis and operational requirements to provide cooling water to the reactor vessel under transient and postulated accident conditions. The team evaluated the ability of the RCIC pump to deliver the design and licensing bases flow rates at the maximum assumed reactor vessel backpressure. The net positive suction head (NPSH) for the RCIC pump was reviewed for maximum flow rates from the RCIC pump suction sources to verify that adequate NPSH margin was available at minimum water levels.

The team reviewed full flow testing and IST results to verify that the pump performance bounded the flow requirements in the safety analysis and to determine if Exelon had adequately evaluated pump degradation. The team performed a walkdown of the pump and interviewed system and design engineers to assess the material condition of the pump. 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 evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.15 Condensate Storage Tank

a. Inspection Scope

The team reviewed the design, testing, inspection, and operation of the Unit 1 CST and associated tank level instruments to evaluate whether it could perform its design basis function as the preferred water source for the HPCI and RCIC pumps for their use during postulated accident conditions. Specifically, the team reviewed design calculations, drawings, and vendor specifications, including tank sizing, level uncertainty analysis, and pump vortex calculations to evaluate the adequacy and appropriateness of design assumptions and operating limits. The team interviewed engineers; reviewed instrument test records, alarm response procedures, and operating procedures to evaluate whether maintenance and testing were adequate to ensure reliable operation; and evaluated whether these activities were performed in accordance with regulatory requirements, industry standards and vendor recommendations. The team also reviewed the results of recent external visual inspections of the CST, and conducted a walkdown of the tank area to independently assess the material condition of the CST and associated instrumentation. Finally, the team reviewed corrective action documents and system health reports to evaluate whether there were any adverse trends associated with the CST and to assess Exelon’s capability to evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.16 Drywell Vacuum Breaker PSV-057-237A

a. Inspection Scope

The team inspected the Unit 2 drywell-to-suppression chamber vacuum breaker, PSV-057-237A, to evaluate its ability to meet the design basis requirement to prevent suppression pool water from backing up into the drywell during various reactor coolant and suppression system condensation modes, and to limit upward forces on the drywell floor. The team reviewed applicable portions of the UFSAR, TSs, the primary containment DBD, and calculations to identify the design basis functions for the drywell-to-suppression chamber vacuum breakers.

The team verified that Exelon properly translated design inputs into system procedures and surveillance tests and specific acceptance criteria, and reviewed completed tests to verify vacuum breaker operability. The team also reviewed the design changes to the four downcommers on which the four suppression pool-to-drywell vacuum breakers were installed. 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 evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.17 Reactor Core Isolation Cooling System Suction Valve HV-049-1F010

a. Inspection Scope

The team inspected the Unit 1 RCIC system suction valve, HV-049-1F010, to verify its ability to meet the design basis requirements in response to transient and accident events, which includes opening upon an automatic RCIC system initiation. The team reviewed design calculations, including required thrust calculations and actuator capability calculations, to verify design basis assumptions were appropriately translated into these documents, and to verify adequate design margins existed. Additionally, the team reviewed selected design inputs and results of the motor-operated valve (MOV) periodic testing to verify that differences between test conditions and design basis conditions, as well as test uncertainty and control switch repeatability, were accounted for when determining required switch settings. The team reviewed degraded voltage conditions and voltage drop calculations to confirm that the MOV and control components would have sufficient voltage and power available to perform the safety function at worst case degraded voltage conditions. In addition, the team reviewed the valve control wiring diagram to ensure that the valve would function as designed under the most limiting design basis conditions. A detailed walkdown was conducted by the team to visually inspect the physical/material condition of the valve and actuator and to verify the installed configuration was consistent with design inputs.

The team also reviewed the operating conditions of the adjacent check valves, including the function of the RCIC discharge check and condensate storage tank RCIC suction check valves to prevent draining the RCIC discharge piping upon loss of offsite power and their function to prevent contaminated suppression pool water from migrating to the CST. In particular, the team reviewed the details associated with postulated scenarios where multiple check valve back leakage could occur and a potential gas void could be created in RCIC discharge piping (IR 02522625). 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 evaluate and correct problems.

b. Findings

No findings were identified.

.2.1.18 Residual Heat Removal Full Flow Test Return Motor-Operated Valve HV-051-F024A

a. Inspection Scope

The team reviewed the Unit 2 RHR full flow test return MOV, HV-051-F024A, to evaluate whether it was capable of meeting its design basis functions, including providing a flowpath to deliver cooling water to the suppression pool. The team reviewed the UFSAR, TSs, TS Bases, DBD, drawings, procedures, and the IST basis document to identify the performance requirements for the valve. The team reviewed MOV diagnostic test results and stroke-timing test data to verify acceptance criteria were met. The team evaluated whether the MOV safety functions, performance capability, and design margins were adequately monitored and maintained in accordance with Exelon's MOV program requirements. Additionally, the team reviewed the vendor manual and calibration records for the instruments that provide actuation signals to open or close the MOVs to verify the instruments were properly maintained to support valve actuation in accordance with the plant design.

The team verified that the MOV analyses used the maximum differential pressure expected across the valve during worst case operating conditions. The team reviewed supporting electrical calculations that established the degraded and maximum voltages at the MOV terminals to ensure the proper voltages were used in the MOV torque calculations. The design, operation, and maintenance of the valve were discussed with engineers to evaluate the valve's performance history, maintenance, and overall health. The team also conducted a walkdown of the valve and associated equipment to assess the material condition of the equipment and to determine if the installed configuration was consistent with the plant drawings, procedures, and the design bases. 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 evaluate and correct 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 LGS. The team performed a detailed review of the OE issues listed below to verify that Exelon had appropriately assessed potential applicability to site equipment and initiated corrective actions when necessary.

.2.2.1 NRC Information Notice 2011-17, Calculation Methodologies for Operability Determinations of Gas Voids in Nuclear Power Plant Piping

a. Inspection Scope

The team reviewed Exelon's evaluation of NRC Information Notice (IN) 2011-17, "Calculation Methodologies for Operability Determinations of Gas Voids in Nuclear Power Plant Piping," in order to evaluate their response to the operating experience. The NRC issued the IN to alert licensees of recent problems involving analysis performed to determine the size of voids in safety-related piping systems at various nuclear power plants. The team reviewed Exelon's evaluation of the potential impact of the identified issues to determine if the issues in the IN were applicable to Limerick. To further assess Exelon's current analytical methodologies for assessing gas voids in safety-related piping systems, the team reviewed a sample of Exelon's analytical methods for void formations. The team verified that while Limerick does not use the computer programs identified in the IN or any other computer programs, Limerick performed specific analysis for each of the affected systems. The team reviewed a sample of the analyses to verify that they do not contain the type of errors documented in the IN.

b. Findings

No findings were identified.

.2.2.2 NRC Information Notice 2010-04, Diesel Generator Voltage Regulation System Component due to Latent Manufacturing Defect

a. Inspection Scope

The team reviewed Exelon's evaluation of NRC IN 2010-04, "Diesel Generator Voltage Regulation System Component due to Latent Manufacturing Defect," to determine their disposition of the operating experience. The NRC issued the IN to alert licensees to possible latent manufacturing defects in emergency diesel generator voltage regulation components. The team reviewed Exelon's evaluation of the potential impact of the identified issues, including their review as documented in IR 01090746, to determine if the issues in the IN were applicable to Limerick and the resulting actions.

b. Findings

No findings were identified.

.2.2.3 NRC Information Notice 2014-11, Recent Issues Related to the Qualification and Commercial Grade Dedication of Safety-Related Components

a. Inspection Scope

The team inspected Exelon's review of NRC IN 2014-11, "Recent Issues Related to the Qualification and Commercial Grade Dedication of Safety-Related Components." The NRC issued this IN to inform licensees of issues identified during recent NRC vendor inspections regarding the qualification and commercial grade dedication of safety-related replacement components. The team reviewed Exelon's evaluation of the potential impact of the identified issues to determine if the issues in the IN were directly applicable to Limerick and that appropriate corrective actions were taken, if applicable. The team reviewed audits conducted by the Nuclear Procurement Issues Committee, a joint industry group of which Exelon is a member, on selected vendors identified in the NRC IN to verify that any deficiencies were corrected and that vendors were in compliance with their approved quality assurance program. The team also reviewed Exelon's commercial grade dedication procedures and a sample of two recent component evaluations to verify that critical characteristics were identified and properly verified through testing.

b. Findings

No findings were identified.

## 4. OTHER ACTIVITIES

4OA2 Identification and Resolution of Problems (IP 71152)

a. Inspection Scope

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

b. Findings

No findings were identified.

4OA6 Meetings, including Exit

On July 10, 2015, the team presented the preliminary inspection results to Mr. Rick Libra, Limerick Site Vice President, and other members of the LGS staff. Following the completion of additional in-office inspection activities, the final inspection results were discussed via teleconference on July 30, 2015, with Mr. Wayne Lewis, Senior Design Engineering Manager, and other members of your staff. The team reviewed proprietary information, which was returned to Exelon at the end of the inspection. The team verified that no proprietary information was documented in the report.

# ATTACHMENT

# SUPPLEMENTAL INFORMATION

## KEY POINTS OF CONTACT

Exelon Personnel
J. Berg, System Engineer
J. Criczky, Mechanical Design Engineer
D. Cronomiz, Mechanical Design Engineer
R. George, Electrical Design Engineering Manager
G. Hunsberger, Electrical Engineer
T. Kuklensk, Procurement Engineer
M. Lui, Electrical Design Engineer
F. Michaels, Procurement Engineering Supervisor
R. Rowcotsky, Electrical Design Engineer
R. Schwab, Mechanical Design Engineer
G. Weiss, System Engineer

## LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Open and Closed

| | | |
|---|---|---|
| 05000352&353/2015007-01 | NCV | Failure to Verify Adequacy of EDG Voltage to Start Safety-Related Motors (Section 1R21.2.1.1) |
| 05000352&353/2015007-02 | NCV | Failure to Verify Adequate Voltage Available for DC Equipment (Section 1R21.2.1.2) |

## LIST OF DOCUMENTS REVIEWED

Calculations and Engineering Evaluations
6300E.18, Load Study for Station Auxiliary Power System, Revision 21
6300E.19, Short Circuit Calculation with Computer Program TE502 and EA199, Revision 15
6300E.20, Voltage Regulation Study, Revisions 13 & 13A
6300E.23, Millstone Undervoltage Study, Revision 11
6380E.07, Diesel Generator Loading (Steady State), Revision 13
6380E.08, Diesel Generator Voltage Regulation Study, Revision 5
6900E.04, Ground Overcorrect Relays Selection and Coordination, Revision 2
6900E.09, Diesel Generator Protective Relay Settings, Revision 8
6900E.11, Load Center Circuit Breakers - Overcurrent Trip Devices, Revision 11
757303-28, Air Identified In ‘A’ and ‘B’ RHR Discharge Line of HV-051-F016, 10/8/08
757303-31, Acceptance Criteria for Air Voids in ECCS Piping, Revision 2
757303-38, Acceptance Criteria for Air Voids in 6” RCIC Piping, 2/27/09

E51-C001-A-001, RCIC Pump Operation with High Temperature Process Fluid, Revision 0
ECR 01-01233, GE SIL 636 Non-Conservative Decay Heat Calculations, Revision 1
ECR 13-00166, ECR for Changes to RHRSW Min Flows to RHR HXs, Revision 0
ECR 14-00429, Actions to Obtain RHRSW Piping Margin, Revision 1
LE-0052, Class 1E Battery Duty Cycle Determination, Revision 15
LE-0069, Class 1E 125 Vdc System Voltage Analysis, Revision 4
LE-0104, DC MCC Manual Control Circuit Calculation, Revision 1
LE-053, Determine Acceptable Cable Size for Temporary Cable Jumpers Used during Battery Cell Maintenance/Testing, Revision 2
LG 07-00392, RCIC and Blackout Rule Calculations/Documentation, Revision 0
LG 10-00379, RCIC Turbine Governor Speed Limit Increase, Revision 1
LG 94-08553, Revisions of LGS EQ Packages per MOD P-00212, Revision 0
LG 94-08684, Revision of LGS EQ Packages per MOD P-00212, Revision 0
LG-11-00219, 118-00733 EDG Speed Switch X-GA-(1, 2) 0025A, B, C, and D, Revision 3
LG-11-00280, 114-80811 K-1 Contractor ARI for Diesel Generator IEE, Revision 0
LG-11-00336, EDG Speed Switch Replacement Support, Revision 0
LG-11-00479, Vendor Document Submittal for Processing to Record MGMT, Revision 0
LG-11-00526, As-Built/Reformat Calculation 6900E.09 to Current Requirements, Revision 0
LG-12-00013, 11480811 Revision of LG ECR 11-00280 for K-1 Contactor EDG, Revision 0
LG-12-00168, Revision of K-1 Contactor ECR, Revision 1
LM-0060, SBO Analysis for the RCIC and HPCI Pump Rooms, Revision 2
LM-007, Diesel Generator Fuel Oil Consumption, Revision 6
LM-0379, Power Re-rate Evaluation, SBO Analysis, Revision 2
LM-041, Suppression Pool Heat-up during an SBO Event at LGS, Revision 1
LM-0627, ESW Pump Curves, Revision 4
LM-0640, RHR Heat Exchanger Minimum RHRSW Flow/Fouling Factor/Tube Plugging Limits for Shutdown Cooling, Revision 3
LM-0667, Diesel Generator Fuel Oil Tank Volume, Revision 0
LM-0668, Validation and Verification of Spreadsheet to Analyze Shell and Tube HXs, Revision 2
M-0638, RHR Heat Exchanger Minimum RHRSW Flow/Structural Evaluation for Tube Plugging, Revision 4
M20-6, Sizing of Diesel Oil Transfer Pumps, Revision 2
M-41-18, Allowable Leakage for Short-Term ADS Accumulator Tanks, Revision 3
M-49-03, RCIC Pump Discharge Pressure Drop, Revision 6
M-49-04, RCIC Pump Pressure, NPSH, Allowable Degradation and Pipe Volume, Revision 4
M-55-33, HPCI/RCIC Automatic Pump Suction Transfer Delay Timer, Revision 6 and 9
M-59-07, N2 Bottles Required for ADS, Revision 2
M-78-26, Battery Room Hydrogen Concentration, Revision 6
M-81-14, Standby Diesel Generator Building Heating and Cooling Loads, Revision 6
MEL-0116, Minimum ADS Air Supply Bottle Pressure, Revision 1
MEL-0121, WS-5, Determine Heat Capacity Temperature Limit, Revision 8
P1-21-051, Evaluate Piping Stress for RHR Service Water Piping, Revision 12
Procurement Engineering Evaluation for 118-02684 SGTS Heater Control Panel, 3/4/14
Procurement Engineering Evaluation for 118-03494 Circuit Board Assembly, 8/12/14

Corrective Action Issue Reports

| | | | | |
|---|---|---|---|---|
| 00319338 | 01332929 | 01534029 | 02434621 | 02522625* |
| 00394194 | 01339603 | 01534992 | 02441872 | 02523425* |
| 00556902 | 01341449 | 01552435 | 02447086 | 02524185* |
| 01090746 | 01343316 | 01611824 | 02448165 | 02524409* |
| 01224950 | 01354709 | 01629744 | 02478477 | 02525370* |
| 01248979 | 01355481 | 01635066 | 02483175 | 02525630* |
| 01250064 | 01355930 | 01635925 | 02487741 | 02525662* |
| 01250600 | 01365199 | 01647449 | 02487750 | 02526231* |
| 01273125 | 01371381 | 01647464 | 02488128 | 02526233* |
| 01274858 | 01372412 | 01659640 | 02489907 | 02535151* |
| 01276176 | 01380374 | 01661244 | 02490058 | A0664315 |
| 01278797 | 01380701 | 01684077 | 02490063 | A0819255 |
| 01281903 | 01386437 | 01684387 | 02496518 | A1483562 |
| 01297865 | 01388921 | 01691672 | 02496668 | A1766118 |
| 01304086 | 01390033 | 01694076 | 02498978 | A1820071 |
| 01313465 | 01390566 | 01697541 | 02512925 | A1830903 |
| 01313466 | 01395230 | 01699591 | 02515373* | A1867857 |
| 01313469 | 01409406 | 02345075 | 02516273* | A1879692 |
| 01313472 | 01422730 | 02384875 | 02518567* | A1902572 |
| 01324565 | 01426904 | 02390084 | 02518991* | LG-94-00009 |
| 01324728 | 01490105 | 02401081 | 02519480* | LG-94-00011 |
| 01328187 | 01493211 | 02432718 | 02519542* | LG-94-00012 |
| 01332505 | 01496857 | 02434386 | 02520239* | LG-94-00210 |

* IR written as a result of this inspection

Design and Licensing Basis Documents

L-S-01A, Design Basis Document, Class 1E 125/250 Vdc System, Revision 9
L-S-03, Design Basis Document, High Pressure Coolant Injection System, Revision 20
L-S-04, Design Basis Document, Residual Heat Removal Service Water System, Revision 12
L-S-05, Design Basis Document, 4 kV System, Revision 10
L-S-07, Design Basis Document, Diesel Generator and Auxiliary Systems, Revision 15
L-S-09, Design Basis Document, Residual Heat Removal System, Revision 20
L-S-14, Design Basis Document, 480 Vac Load Center System, Revision 8
L-S-31, Design Basis Document, Automatic Depressurization System, Revision 4
L-S-39, Design Basis Document, Reactor Core Isolation Cooling System, Revision 13
L-S-41, Design Basis Document, Condensate Storage and Transfer System, Revision 6
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## LIST OF ACRONYMS

| | |
|---|---|
| AC | Alternating Current |
| ADAMS | Agencywide Documents Access and Management System |
| ADS | Automatic Depressurization System |
| AL | Administrative Letter |
| CDBI | Component Design Bases Inspection |
| CFR | Code of Federal Regulations |
| CST | Condensate Storage Tank |
| DBD | Design Basis Document |
| DC | Direct Current |
| DRS | Division of Reactor Safety |
| EDG | Emergency Diesel Generator |
| HPCI | High Pressure Coolant Injection |
| Hz | Hertz |
| IMC | Inspection Manual Chapter |
| IN | Information Notice |
| IP | Inspection Procedure |
| IR | Issue Report |
| IST | In-Service Test |
| kV | Kilovolt |
| KVA | kilovolt Amperes |
| kW | Kilowatt |
| LERF | Large Early Release Frequency |
| LGS | Limerick Generating Station |
| LOCA | Loss-of-Coolant Accident |
| LOOP | Loss-of-Offsite Power |
| MOV | Motor-Operated Valve |
| NCV | Non-Cited Violation |
| NPSH | Net Positive Suction Head |
| NRC | Nuclear Regulatory Commission |
| OE | Operating Experience |
| PRA | Probabilistic Risk Assessment |
| RAW | Risk Achievement Worth |
| RCIC | Reactor Core Isolation Cooling |
| RHR | Residual Heat Removal |
| RHRSW | Residual Heat Removal Service Water |
| RRW | Risk Reduction Worth |
| SCM | Spring Charging Motors |
| SDP | Significance Determination Process |
| SPAR | Standardized Plant Analysis Report |
| SR | Surveillance Requirement |
| SRV | Safety Relief Valve |
| TS | Technical Specifications |
| UFSAR | Updated Final Safety Analysis Report |
| Vac | Volts, Alternating Current |
| Vdc | Volts, Direct Current |