**UNITED STATES**
**NUCLEAR REGULATORY COMMISSION**
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

October 6, 2009

Mr. Charles G. Pardee
Senior Vice President, Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO), Exelon Nuclear
4300 Winfield Road
Warrenville IL 60555

SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2
TRIENNIAL FIRE PROTECTION INSPECTION REPORT 05000254/2009-006; 05000265/2009-006

Dear Mr. Pardee:

On September 10, 2009, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your Quad Cities Nuclear Power Station, Units 1 and 2. The enclosed inspection report documents the inspection results, which were discussed on September 10, 2009, with Mr. R. Gideon 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. The inspectors reviewed selected procedures and records, observed activities, and interviewed personnel.

The report documents two NRC-identified findings of very low safety-significance (Green). Two of these findings were determined to involve violations of NRC requirements. However, because of the very low safety-significance and because they were entered into your corrective action program, the NRC is treating these finding as Non-Cited Violations (NCV) consistent with Section VI.A.1 of the NRC Enforcement Policy. If you contest any NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington DC 20555-0001; with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at Quad Cities Nuclear Power Station, Units 1 and 2. In addition, if you disagree with the characterization of 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 III, and the NRC Resident Inspector at Quad Cities Nuclear Power Station, Units 1 and 2. The information you provide will be considered in accordance with Inspection Manual Chapter 0305.

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 Document Room or from the Publicly Available Records System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Robert C. Daley, Chief
Engineering Branch 3
Division of Reactor Safety

Docket Nos. 50-254; 50-265
License Nos. DPR-29; DPR-30

Enclosure: Inspection Report 05000254/2009-006; 05000265/2009-006
w/Attachment: Supplemental Information

cc w/encl: Distribution via Listserv

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

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| Docket Nos: | 50-254; 50-265 |
| License Nos: | DPR-29, DPR-30 |
| Report No: | 05000254/2009-006 and 05000265/2009-006 |
| Licensee: | Exelon Nuclear |
| Facility: | Quad Cities Nuclear Power Station, Units 1 and 2 |
| Location: | Cordova, IL |
| Dates: | July 20 through September 10, 2009 |
| Inspectors: | R. Langstaff, Senior Reactor Inspector, Lead<br>A. Dahbur, Senior Reactor Inspector<br>D. Szwarc, Reactor Inspector |
| Observer: | K. Levy, Department of Energy<br>G. Taylor, Fire Protection Engineer, Office of Research |
| Approved by: | Robert C. Daley, Chief<br>Engineering Branch 3<br>Division of Reactor Safety |

Enclosure

## SUMMARY OF FINDINGS

IR 05000254/2009-006, 05000265/2009-006; 07/20/2009 – 09/10/2009; Quad Cities Nuclear Power Station, Units 1 and 2

This report covers an announced triennial fire protection baseline inspection. The inspection was conducted by Region III inspectors. Two Green findings were identified by the inspectors. The findings were considered Non-Cited Violations (NCV) of NRC regulations. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. 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-Revealed Findings

**Cornerstone: Mitigating Systems**

- Green. A finding of very low safety-significance and associated non-cited violation (NCV) of license condition 3.F for Units 1 and 2 was identified by the inspectors for the licensee's failure to evaluate the lack of supports for a water spray system. Specifically, the licensee failed to evaluate a deviation from fire protection standards for the lack of supports on two sections of water spray system piping. Upon discovery of the unsupported piping, the licensee entered the issues into their corrective action program and performed an evaluation of the piping which subsequently demonstrated acceptability.

  The finding was determined to be more than minor because there was reasonable doubt on the acceptability of the unsupported piping. The issue was of very low safety-significance because the piping was subsequently determined to be acceptable. No cross-cutting aspects were associated with this finding because the finding was not representative of current performance. (Section 1R05.4.b(1))

- Green. A finding of very low safety-significance and NCV of 10 CFR Part 50, Appendix R, Section III.L.3 was identified by the inspectors for the licensee's failure to ensure that the alternate shutdown capability was independent from the fire area of concern. Specifically, the licensee failed to provide adequate electrical coordination of protective devices to ensure that postulated fire-induced electrical faults would have not resulted in the loss of post-fire alternative safe shutdown equipment, i.e., safe shutdown makeup pump. The licensee subsequently entered the issue into their corrective action program, revised the affected safe shutdown procedure, and replaced the affected circuit breakers to improve electrical coordination.

  The finding was determined to be more than minor because the failure to ensure adequate electrical coordination between the fuses and the upstream breaker for the safe shutdown makeup pump control circuit could have impacted the capability of achieving and maintaining safe shutdown condition following a postulated fire in the cable spreading room or auxiliary electric equipment room. The issue was of very low safety-significance because there was a high degree of confidence that a fire would be controlled prior to cable damage resulting from credible fire scenarios. No cross-cutting

aspects were associated with this finding because the finding was not representative of current performance. (Section 1R05.7.b(1))

## B. Licensee-Identified Violations

No violations of significance were identified.

## REPORT DETAILS

## 1. REACTOR SAFETY

### Cornerstone: Initiating Events and Mitigating Systems

1R05 Fire Protection (71111.05T)

The purpose of the fire protection triennial baseline inspection was to conduct a design-based, plant specific, risk-informed, onsite inspection of the licensee's fire protection program's defense-in-depth elements used to mitigate the consequences of a fire. The fire protection program shall extend the concept of defense-in-depth to fire protection in plant areas important to safety by:

- preventing fires from starting;
- rapidly detecting, controlling and extinguishing fires that do occur; and
- providing protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent the safe shutdown of the reactor plant.

The inspectors' evaluation focused on the design, operational status, and material condition of the reactor plant's fire protection program and post-fire safe shutdown systems. The objectives of the inspection were to assess whether the licensee had implemented a fire protection program that: (1) provided adequate controls for combustibles and ignition sources inside the plant; (2) provided adequate fire detection and suppression capability; (3) maintained passive fire protection features in good material condition; (4) established adequate compensatory measures for out-of-service, degraded or inoperable fire protection equipment, systems or features; (5) ensured that procedures, equipment, fire barriers and systems exist so that the post-fire capability to safely shut down the plant was ensured; (6) included feasible and reliable operator manual actions when appropriate to achieve safe shutdown; and (7) identified fire protection issues at an appropriate threshold and ensured these issues were entered into the licensee's problem identification and resolution program.

In addition, the inspectors' review and assessment focused on the licensee's post-fire safe shutdown systems for selected risk-significant fire areas. Inspector emphasis was placed on determining that the post-fire safe shutdown capability and the fire protection features were maintained free of fire damage to ensure that at least one post-fire safe shutdown success path was available. The inspection was performed in accordance with U. S. Nuclear Regulatory Commission (NRC) Inspection Procedure (IP) 71111.05T, "Fire Protection (Triennial)," dated April 21, 2006. The NRC regulatory oversight process IP used a risk-informed approach for selecting the fire areas and/or fire zones and attributes to be inspected. The inspectors with assistance from a senior reactor analyst used the licensee's Individual Plant Examination for External Events (IPEEE) to select several risk-significant areas for detailed inspection and review. Documents reviewed are listed in the Attachment to this report.

The fire areas and fire zones selected for review during this inspection are listed below and constituted five inspection samples as defined in IP 71111.05T.

| Fire Area | Fire Zone | Description |
|---|---|---|
| 24-1 | 8.2.8.C | Unit 2 Switchgear Area |
| CT-2 | 8.2.5 | Unit 2 Cable Tunnel |
| RB-1N | 1.1.1.1N | Unit 1 Reactor Building Basement Floor |
| | 11.1.3 | Unit 1 HPCI Room |
| | 11.2.3 | Unit 1 Northwest Corner Room |
| SB-1 | 2.0 | Control Room |
| | 3.0 | Cable Spreading Room |
| | 6.3 | Auxiliary Electrical Equipment Room |
| TB-II | 5.0 | Safe Shutdown Pump Room |
| | 8.1 | Clean and Dirty Oil Tank Room |
| | 8.2.6.C | Unit 1/2 Ground Floor |
| | 8.2.7.C | Unit 1/2 Mezzanine Floor |

.1 Shutdown from Outside Main Control Room

a. Inspection Scope

The inspectors reviewed the functional requirements identified by the licensee as necessary for achieving and maintaining hot shutdown conditions to ensure that at least one post-fire safe shutdown success path was available in the event of fire in each of the selected fire areas and for alternative shutdown in the case of control room evacuation. The inspectors reviewed the plant systems required to achieve and maintain post-fire safe shutdown to determine if the licensee had properly identified the components and systems necessary to achieve and maintain safe shutdown conditions for each fire area selected for review. Specifically, the review was performed to determine the adequacy of the systems selected for reactivity control, reactor coolant inventory makeup, reactor heat removal, process monitoring, and support system functions. The review also included the fire safe shutdown analysis to ensure that all required components in the selected systems were included in the licensee's safe shutdown analysis.

The inspectors reviewed the licensee's post-fire safe shutdown analysis, normal and abnormal operating procedures, piping and instrumentation drawings, electrical drawings, their updated final safety analysis report, and other supporting documents to verify that hot and cold shutdown could be achieved and maintained from outside the control room for fires that rely on shutdown from outside the control room. This review included verification that shutdown from outside the control room could be performed both with and without the availability of offsite power.

The inspectors also examined the operators' ability to perform the necessary manual actions for achieving safe shutdown by reviewing post-fire shutdown procedures, the accessibility of safe shutdown equipment, and the available time for performing the actions.

The inspectors reviewed the updated final safety analysis report and the licensee's engineering and/or licensing justifications (e.g., NRC guidance documents, license amendments, technical specifications, safety evaluation reports, exemptions, and deviations) to determine the licensing basis.

b. Findings

No findings of significance were identified.

.2 Protection of Safe Shutdown Capabilities

a. Inspection Scope

For each of the selected fire areas, the inspectors reviewed the fire hazards analysis, safe shutdown analysis, and supporting drawings and documentation to verify that safe shutdown capabilities were properly protected.

The inspectors reviewed the licensee procedures and programs for the control of ignition sources and transient combustibles to assess their effectiveness in preventing fires and in controlling combustible loading within limits established in the fire hazards analysis. The inspectors performed plant walkdowns to verify that protective features were being properly maintained and administrative controls were being implemented.

b. Findings

No findings of significance were identified.

.3 Passive Fire Protection

a. Inspection Scope

For the selected fire areas, the inspectors evaluated the adequacy of fire area barriers, penetration seals, fire doors, electrical raceway fire barriers, and fire rated electrical cables. The inspectors observed the material condition and configuration of the installed barriers, seals, doors, and cables. The inspectors reviewed approved construction details and supporting fire tests. In addition, the inspectors reviewed license documentation, such as NRC safety evaluation reports, and deviations from NRC regulations and the National Fire Protection Association (NFPA) codes to verify that fire protection features met license commitments.

The inspectors walked down accessible portions of the selected fire areas to observe material condition and the adequacy of design of fire area boundaries (including walls, fire doors, and fire dampers) to ensure they were appropriate for the fire hazards in the area.

The inspectors reviewed the installation, repair, and qualification records for a sample of penetration seals to ensure the fill material was of the appropriate fire rating and that the installation met the engineering design.

b. Findings

No findings of significance were identified.

.4 Active Fire Protection

a. Inspection Scope

For the selected fire areas, the inspectors evaluated the adequacy of fire suppression and detection systems. The inspectors observed the material condition and configuration of the installed fire detection and suppression systems. The inspectors reviewed design documents and supporting calculations. In addition, the inspectors reviewed license basis documentation, such as, NRC safety evaluation reports, deviations from NRC regulations, and the National Fire Protection Association codes to verify that fire suppression and detection systems met license commitments.

b. Findings

(1) Failure to Evaluate Lack of Supports for Water Spray System Piping

Introduction: A finding of very low safety-significance and associated non-cited violation of license condition 3.F for Units 1 and 2 was identified by the inspectors for the licensee's failure to evaluate the lack of supports for a water spray system. Specifically, the licensee failed to evaluate a deviation from standards NFPA 15-1973, "Standard for Water Spray Fixed Systems for Fire Protection," and NFPA 13-1973, "Standard for the Installation of Sprinkler Systems" for the lack of supports for two sections of water spray system piping.

Description: As part of walkdowns conducted during the information gathering visit, a section of spray piping was noted as being unsupported for substantial length. Specifically, the one inch (nominal) spray piping was unsupported for approximately five feet past a support. The spray piping was part of a combined sprinkler system and closed head spray system for the cable spreading room (CSR), Fire Zone 3.0. During the inspection, the inspectors identified a second section of spray piping within the CSR which was also unsupported for a substantial length. Specifically, the second section was comprised of two one inch (nominal) pipes connected by a 90 degree elbow joint. These two pipes were each over 2.5 feet long with the total unsupported length of approximately 5.5 feet.

During the inspection, the codes of record and approved deviations were reviewed for required maximum unsupported lengths of sprinkler pipe. The Fire Hazards Analysis (FHA) required that spray systems be installed in accordance with the NFPA 15-1973. Section 4082(a) of NFPA 15-1973 specified that the installation standards for water spray system piping shall be applicable sections of NFPA 13-1973. Section 3-14.6.3 NFPA 13-1973 specified that the unsupported length between the end sprinkler and the last hanger shall be not more than 36 inches for one-inch pipe. The licensee had not evaluated and documented deviations for these two non-compliances.

Section 3-14 of NFPA 13-1973 further stated that sprinkler piping shall be substantially supported from the building structure which must support the added load of the water filled pipe plus a minimum of 250 pounds applied at the point of hanging.

Section 3-14.1.2 required that the types of hangers and installation methods shall be in accordance with the requirements of Section 3-14, unless they are certified by a registered professional engineer as being designed to support five times the weight of the water-filled pipe plus 250 pounds at each point of piping support.

Based on the substantial dimensional departure from restrictions on unsupported pipe lengths, the inspectors questioned the acceptability of the system. The licensee performed an engineering evaluation, Engineering Change (EC) 376446, "Evaluation of NFPA 13 Deviation on Cantilever Lengths for Cable Spreading Room," on July 23, 2009, using United States of America Standard (USAS) B31.1-1967, "Power Piping," for guidance. The licensee determined that one section of unsupported piping (the more extreme of the two sections) could experience stresses of 6,394 psi which was equivalent to a safety factor of 6.7 (based on ultimate strength). This safety factor was within the NFPA specified value of five times the weight of water filled pipe. From review of Underwriters Laboratory (UL) 203 - 2005, "Pipe Hanger Equipment for Fire Protection Service," the inspectors determined that the safety factor was based on ultimate strength (versus yield strength) and was applicable. The inspectors noted that USAS B31.1-1967, "Power Piping," is generally not used for fire protection piping as stated in Section 100.1.3.D of that code. However, the inspectors concluded that the evaluation documented in EC 376446 was acceptable based on the calculated safety factor.

The licensee entered the issues related to the unsupported spray nozzle piping into their corrective action system as Action Request (AR) 00942195, "2009 Triennial Walkdown 6 Improper Length on Branch Line," dated July 15, 2009 and AR 00945219, "FPI – 2009 Triennial – Improper Length on Branch Line (CSR)," dated July 23, 2009. The licensee initially incorrectly identified the pipes as being 1-1/4 inch in AR 00942195. Subsequently, in their evaluation of the issue (EC 376446), the correct nominal diameter of one-inch was specified.

Analysis: The inspectors determined that the failure to evaluate the lack of piping supports for two sections of water spray system piping was contrary to the requirements of NFPA-15 and NFPA 13-1973 and was a performance deficiency.

The finding was determined to be more than minor because the finding was similar to Inspection Manual Chapter (IMC) 0612, Appendix E, Examples 3.j and 3.k. Specifically, the significant dimensional deviations from NFPA 13-1973 resulted in a reasonable doubt with respect to the acceptability of water spray system piping. Although, by the end of the inspection, the licensee was able to demonstrate acceptability; at the time of discovery, there was reasonable doubt on the acceptability of the water spray system piping. Therefore this performance deficiency also impacted the Mitigating Systems Cornerstone objective of ensuring the capability of systems to respond to initiating events such as fire.

In accordance with IMC 0609, "Significance Determination Process," Attachment 0609.04, "Phase 1 - Initial Screening and Characterization of Findings," Table 3b the inspectors determined the finding degraded the fire protection defense-in-depth strategies. Therefore, screening under IMC 0609, Appendix F, "Fire Protection Significance Determination Process," was required. The inspectors screened the issue under Phase 1 of IMC 0609, Appendix F and assigned a low degradation rating in Step 1.2 because the water spray system piping was determined to be acceptable. The

inspectors determined that the finding screened as a very low safety-significance (i.e., Green) issue in Task 1.3.1 because it was assigned a Low degradation rating.

The inspectors did not identify a cross-cutting aspect associated with this finding because the installation was not representative of current performance.

Enforcement: License condition 3.F for Units 1 and 2 required the licensee to implement and maintain in effect all provisions of the approved fire protection program as described in the Updated Final Safety Analysis Report (UFSAR) and as approved through Safety Evaluation Reports. Section 9.5.1 of the UFSAR stated that the design of the fire protection system was contained in the FHA. Section 5.5 E.3(c) of the FHA stated that, "fixed water extinguishing systems are installed in accordance with the appropriate NFPA standards. NFPA 13 and 15 have been reviewed and deviations justified." The FHA further stated that NFPA 15-1973 was the code of record for fixed water spray systems.

Section 4082(a) of NFPA 15-1973 specified that the installation standards for water spray system piping shall be applicable sections of NFPA 13-1973. Section 3-14.6.3 of NFPA 13-1973 specified that the unsupported length between the end sprinkler and the last hanger shall be not more than 36 inches for one-inch pipe. The licensee did not have a deviation for this non-compliance.

Section 3-14 of NFPA 13-1973 further stated that sprinkler piping shall be substantially supported from the building structure which must support the added load of the water filled pipe plus a minimum of 250 pounds applied at the point of hanging. Section 3-14.1.2 stated that the types of hangers and installation methods shall be in accordance with the requirements of Section 3-14, unless they are certified by a registered professional engineer for the following:

(a) Designed to support five times the weight of the water-filled pipe plus 250 pounds at each point of piping support,

(b) These points of support are enough to support the sprinkler system,

(c) Ferrous materials are used for hanger components.

Contrary to the above, as of July 23, 2009, the licensee failed to provide proper piping supports for two sections of the fixed water spray system in Fire Zone 3.0. Specifically, the licensee failed to provide piping supports for two lengths of water spray system piping that exceeded 36 inches as required by section 3-14.6.3 of NFPA 13-1973. In addition, the licensee had failed to provide an evaluation for the lack of supports as permitted by Section 3-14.1.2 of NFPA 13-1973. Because this violation was of very low safety-significance and it was entered into the licensee's corrective action program as AR 00942195 and AR 00945219, this violation is being treated as a Non-Cited Violation (NCV), consistent with Section VI.A.1 of the NRC Enforcement Policy (NCV 05000254/2009006-01; 05000265/2009006-01).

.5 Protection from Damage from Fire Suppression Activities

a. Inspection Scope

For the selected fire areas, the inspectors verified that redundant trains of systems required for hot shutdown would not be subject to damage from fire suppression activities or from the rupture or inadvertent operation of fire suppression systems including the effects of flooding. The inspectors conducted walkdowns of each of the selected fire areas to assess conditions, such as, the adequacy and condition of floor drains, equipment elevations, and spray protection.

b. Findings

No findings of significance were identified.

.6 Alternative Shutdown Capability

a. Inspection Scope

The inspectors reviewed the licensee's systems required to achieve alternative safe shutdown to determine if the licensee had properly identified the components and systems necessary to achieve and maintain safe shutdown conditions. The inspectors also focused on the adequacy of the systems to perform reactor pressure control, reactivity control, reactor coolant makeup, decay heat removal, process monitoring, and support system functions.

The team conducted selected area walkdowns to determine if operators could reasonably be expected to perform the alternate safe shutdown procedure actions and that equipment labeling was consistent with the alternate safe shutdown procedure. The review also looked at operator training as well as consistency between the operations shutdown procedures and any associated administrative controls.

b. Findings

No findings of significance were identified

.7 Circuit Analyses

a. Inspection Scope

The inspectors reviewed the licensee's post-fire safe shutdown analysis to verify that the licensee had identified both required and associated circuits that may impact safe shutdown. On a sample basis, the inspectors verified that the cables of equipment required achieving and maintaining hot shutdown conditions, in the event of fire in the selected fire zones, had been properly identified. In addition, the inspectors verified that these cables had either been adequately protected from the potentially adverse effects of fire damage, mitigated with approved manual operator actions, or analyzed to show that fire-induced faults (e.g., hot shorts, open circuits, and shorts to ground) would not prevent safe shutdown. In order to accomplish this, the inspectors reviewed electrical schematics and cable routing data for power and control cables associated with each of the selected components.

In addition, on a sample basis, the adequacy of circuit protective coordination for the safe shutdown systems' electrical power and instrumentation busses were evaluated. Also, on a sample basis, a cable tray that contain both safe shutdown and non-safe shutdown cables was evaluated for proper circuit protection to ensure that cables are protected by a proper protective device in order to preclude common enclosure concerns.

b. Findings

(1) Failure to Provide Adequate Electrical Coordination for Control Circuit

Introduction: A finding of very low safety-significance and associated NCV of 10 CFR Part 50, Appendix R, Section III.L.3 was identified by the inspectors for the licensee's failure to ensure that the alternate shutdown capability was independent from the fire area of concern. Specifically, the licensee failed to provide adequate electrical coordination of protective devices to ensure that postulated fire-induced electrical faults, in the event of a fire in the cable spreading room or auxiliary electric equipment room, would not result in the loss of the safe shutdown makeup pump (SSMP).

Description: On July 23, 2009, the inspectors identified a lack of proper electrical coordination between the 125 Volt direct current (Vdc) breaker control power supply protective devices, the 40 Amp breaker (upstream) and the 35 Amp fuses (downstream), for the 4.16 kilovolt (kV) SSMP. The SSMP is part of the post-fire alternative shutdown system that would be used in the event of a severe fire in Fire Area SB-1 and other alternative shutdown fire areas to maintain reactor core cooling and prevent uncovering of the core. The SSMP provides the only source of injection to Unit 1 for a fire in Fire Area SB-1.

Fire Area SB-1 included Fire Zones 2.0, "Control Room;" 3.0 "Cable Spreading Room;" 4.0 "Old Computer Room;" and 6.3, "Auxiliary Electrical Equipment Room." The SSMP could be controlled from the control room or locally. For a fire within Fire Area SB-1, the pump was to be operated locally to shutdown Unit 1. A selector switch was provided in the SSMP room on a local control panel (panel 1/2-2591-104) that isolated the Fire Area SB-1 wiring and provided power, including another set of fuses, to control circuitry at the local control panel.

The control power was supplied via motor control center (MCC) 30 located in the SSMP room from Bus 1B-1 for Unit 1 and Bus 2B-1 for Unit 2. A transfer switch could be used to select the direct current (DC) control power supply source. The DC power from MCC 30 was provided to various control circuits for breakers located in switchgear 31. These breakers switch power to Bus 31, the SSMP, and the 4160/480 V transformer that supplied motive power to various safe shutdown equipment required to achieve reactor vessel injection via the SSMP.

The DC supply to the transfer switch in MCC 30, which ultimately provided control power to the switchgear 31 breakers was normally supplied from a 40 Amp circuit breaker in cubicle 7 of Bus 1B-1. There were two sets of 35 Amp fuses within the switchgear that were included for control room operation and for local operation after the control room complex wiring was isolated. Due to cables associated with Bus 2B-1 being routed in Fire Area SB-1, only power provided by Bus 1B-1 was credited for safe shutdown in the event of a fire in Fire Area SB-1.

The inspectors identified that the 35 Amp fuses and the upstream 40 Amp breaker, located in panel 1B-1, did not have proper electrical coordination. The operation (opening) of the upstream 40 Amp circuit breaker in 1B-1, due to postulated fire-induced failure, would have resulted in control power not being available at the local control panel once the local selector switch is manipulated to isolate the wiring from Fire Area SB-1. Two sets of cables had to be affected by fire coordination to be adversely affected. One set of control cables for the SSMP was routed through the control room, CSR, and auxiliary electric equipment room (AEER). The second set of cables, which provided DC power to Bus 2B-1, were routed in conduit through the CSR and the AEER. As such, the circuit coordination would only be potentially affected for fires in the CSR and the AEER.

On July 23, 2009, the licensee promptly entered this issue into their corrective action program as AR 00945275 "SSMP Breaker Coordination Issue," and revised safe shutdown procedure QCARP 0050-01, "SB-1-1, Injection with SSMP and bring the Unit to Cold Shutdown," to provide additional guidance for closure of the 40 Amp breaker at Bus 1B-1 so that control power to the SSMP components could be restored. On July 31, 2009, the licensee also implemented additional actions and replaced both 40 Amp breakers at panels 1B-1 and 2B-1 with 100 Amp breakers to improve electrical coordination. The licensee also evaluated the extent of this condition and determined that similar coordination issues did not exist for other alternate shutdown fire areas. For other fire areas (e.g., Fire Area CT-2, "Unit 2 Cable Tunnel"), the shutdown procedure included steps to restore 125 VDC power to Bus 2B-1, which would ultimately provide control power to the SSMP components.

Analysis: The inspectors determined that the licensee's failure to ensure that the alternate shutdown capability was independent from Fire Area SB-1 was contrary to the requirements of 10 CFR Part 50, Appendix R, Section III.L.3 and was a performance deficiency. Specifically, the licensee failed to provide adequate electrical coordination of protective devices, between 35 Amp fuses and the upstream 40 Amp circuit breaker, to ensure that postulated fire-induced electrical faults would not have resulted in the loss of the safe shutdown makeup pump in the event of a fire in the Fire Area SB-1.

The finding was determined to be more than minor because the failure to ensure that the alternate shutdown capability was free of fire damage in Fire Area SB-1 was associated with the Mitigating System cornerstone attribute of Protection Against External Factors (Fire) and affected the cornerstone objective of ensuring the availability of systems that respond to initiating events to prevent undesirable consequences (i.e., core damage). Specifically, lack of coordination between the protective devices for the SSMP control circuit could have affected the availability of the safe shutdown makeup pump and could have impacted the capability of achieving and maintaining safe shutdown condition following a postulated fire in Fire Area SB-1.

This finding was screened using the SDP in accordance with IMC 0609, "Significance Determination Process," Attachment 0609.04, "Phase 1 – Initial Screening and Characterization of Findings," Table 3b, "SDP Phase 1 Screening Worksheet for Initiating Events, Mitigation Systems, and Barriers Cornerstones" and IMC 0609, Appendix F, "Fire Protection Significance Determination Process." Using an exposure time of greater than 30 days, the finding was determined to require additional significance review because the finding resulted in a high degradation within the safe shutdown finding category.

The inspectors, in conjunction with a Senior Reactor Analyst (SRA), performed a Phase 3 evaluation using fire modeling Consolidated Fire and Smoke Transport (CFAST) model computational analysis (http://cfast.nist.gov/). The inspectors evaluated several scenarios including cable risers within both the CSR and AEER, and electrical cabinets within the AEER. The electrical cabinets in the AEER did not pose a significant contribution to risk because the cabinets and connecting overhead cables would not provide a sufficiently high heat release rate capable of generating a damaging hot gas layer in a relatively short period of time. The inspectors determined that a fire involving only a small number of cable risers within the CSR was capable of damaging both targets because one of the targets was located less than four feet above the floor. In addition, the CSR had a wet-pipe sprinkler system installed, which would be effective in cooling any hot gas layers generated as a result of a fire. Consequently, CSR fire scenarios did not pose a significant contribution to risk. With respect to the AEER, the inspectors determined that a fire starting within three clusters of four cable risers each (total of twelve) could result in a sufficiently high release rate to generate a hot gas layer above the cable damage threshold (400 degrees Fahrenheit) within a relatively short period of time. This scenario was evaluated in greater detail.

The SRA considered credit for recovery actions which could have been performed to locally initiate and control SSMP injection without control power. No credit for recovery was given because operations personnel would have a limited amount of time to correctly diagnose the problem and perform local actions. In addition, local actions to initiate injection using alternative shutdown strategies (i.e., using the SSMP with an electrical line-up appropriate for fire conditions) would not be undertaken until control from the control room was no longer possible due to widespread fire damage. However, fire damage from a fire in the AEER could cause conditions necessitating SSMP injection before operations personnel decided to implement alternative shutdown strategies. As such, the time available to implement alternative shutdown strategies for injection may not have been sufficient. For room ignition frequencies, the inspectors used the values developed by the licensee in analysis QC-SDP-01, “Significance Determination Process for SSD Control Power Lack of Circuit Coordination,” Revision 1. The inspectors independently developed appropriate area weighting factors for ignition frequencies based on walkdowns and review of electrical cable tray and riser layout drawings. For probabilities of non-suppression, the inspectors used values from the Alexander R. Klein memorandum, “Closure of National Fire Protection Association 805 Frequently Asked Question 08-0050 Manual Nonsuppression Probability (Draft),” dated August 7, 2009, (ADAMS Accession Number ML092320044). Based on evaluation of fire frequencies for the affected cable risers in the AEER, the inspectors determined that a time-to-damage of 25 minutes or less would be required to result in a risk contribution greater than $1 \times 10^{-6}$ per year. Although hot gas layer temperatures of 400 degrees Fahrenheit and higher could be generated within 25 minutes, the inspectors determined that one of the targets, contained within conduit, would not be damaged for a period well in excess of 30 minutes. The conduit would provide sufficient thermal inertia to significantly delay cable damage. In summary, the inspectors determined that the issue was of very low significance, because there was a high degree of confidence that a fire would be controlled prior to cable damage resulting from credible fire scenarios.

The inspectors did not identify a cross-cutting aspect associated with this finding because the finding was not representative of current performance.

Enforcement: Section III.G.3 of 10 CFR Part 50, Appendix R, requires, in part, that the alternative of dedicated shutdown capability and its associated circuits, independent of cables, systems, or components in the area, room, or zone under consideration should be provided where the protection of systems whose function is required for hot shutdown does not satisfy the requirement of Section III.G.2 of 10 CFR Part 50, Appendix R. Section III.L of 10 CFR Part 50, Appendix R, specifies implementation of alternative of dedicated shutdown capability required by Section III.G.3 of 10 CFR Part 50, Appendix R. Section III.L.3 of 10 CFR Part 50, Appendix R, requires, in part, that alternative shutdown capability shall be independent of the specific fire area and that procedures shall be in effect to implement this capability. Fire Area SB-1 was a fire area which required alternative of dedicated shutdown capability.

Contrary to the above, on July 23, 2009, the licensee failed to provide alternative shutdown capability independent of Fire Area SB-1. Specifically, the inspectors identified improper electrical coordination between the protective devices for the SSMP control circuit could have resulted in the loss of the alternative shutdown capability (SSMP) following a postulated fire in Fire Area SB-1. In addition, safe shutdown procedure QCARP 0050-01 did not include steps to restore the alternate shutdown capability by reclosing the affected 40 Amp circuit breaker. Because this violation was of very low safety- significance and because it was entered into the licensee's corrective action program as AR 00945275, this violation is being treated as an NCV, consistent with Section VI.A.1 of the NRC enforcement policy. (NCV 05000254/2009006-02; 05000265/2009006-02)

.8 Communications

a. Inspection Scope

The inspectors reviewed, on a sample basis, the adequacy of the communication system to support plant personnel in the performance of alternative safe shutdown functions and fire brigade duties. The inspectors verified that plant telephones, page systems, sound powered phones, and radios were available for use and maintained in working order. The inspectors reviewed the electrical power supplies and cable routing for these systems to verify that either the telephones or the radios would remain functional following a fire.

b. Findings

No findings of significance were identified.

.9 Emergency Lighting

a. Inspection Scope

The inspectors performed a plant walkdown of selected areas in which a sample of operator actions would be performed in the performance of alternative safe shutdown functions. As part of the walkdowns, the inspectors focused on the existence of sufficient emergency lighting for access and egress to areas and for performing necessary equipment operations. The locations and positioning of the emergency lights were observed during the walkdown and during review of manual actions implemented for the selected fire areas.

b. Findings

No findings of significance were identified.

.10 Cold Shutdown Repairs

a. Inspection Scope

The inspectors reviewed the licensee's procedures to determine whether repairs were required to achieve cold shutdown and to verify that dedicated repair procedures, equipment, and material to accomplish those repairs were available onsite. The inspectors also evaluated whether cold shutdown could be achieved within the required time using the licensee's procedures and repair methods. The inspectors also verified that equipment necessary to perform cold shutdown repairs was available onsite and properly staged.

b. Findings

No findings of significance were identified.

.11 Compensatory Measures

a. Inspection Scope

The inspectors conducted a review to verify that compensatory measures were in place for out-of-service, degraded or inoperable fire protection and post-fire safe shutdown equipment, systems, or features (e.g., detection and suppression systems, and equipment, passive fire barriers, pumps, valves or electrical devices providing safe shutdown functions or capabilities). The inspectors also conducted a review on the adequacy of short term compensatory measures to compensate for a degraded function or feature until appropriate corrective actions were taken.

b. Findings

No findings of significance were identified.

## 4. OTHER ACTIVITIES

4OA6 Management Meetings

.1 Exit Meeting Summary

On September 10, 2009, the inspectors presented the inspection results to Mr. R. Gideon and other members of the licensee staff. The licensee acknowledged the issues presented. The inspectors confirmed that none of the potential report input discussed was considered proprietary.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## SUPPLEMENTAL INFORMATION

## KEY POINTS OF CONTACT

Licensee

R. Gideon, Plant Manager
W. Beck, Director, Regulatory Assurance
D. Collins, Supervisor, Design Engineering
S. Darin, Manager, System Engineering
V. Ezugha, Systems Engineering
S. Fisher, Field Supervisor, Operations
L. Geerts, Fire Marshal, Operations
M. Humphrey, Engineer, Engineering Programs
T. Peterson, Engineer, Regulatory Assurance
C. Pragman, Fire Protection Program Manager, Exelon
S. Reynolds, Engineer, System Engineering
T. Sarver, ERIN Engineering
M. Taylor, Fire Protection Engineer, Exelon
M. Wagner, Engineer, Regulatory Assurance
T. Wojcik, Manager, Engineering Programs

Nuclear Regulatory Commission

R. Daley, Branch Chief, Division of Reactor Safety
B. Cushman, Resident Inspector
J. McGhee, Senior Resident Inspector

## LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

| | | |
|---|---|---|
| 05000254/2009006-01<br>05000265/2009006-01 | NCV | Failure to Evaluate Lack of Water Spray System Piping |
| 05000254/2009006-02<br>05000265/2009006-02 | NCV | Failure to Provide Adequate Electrical Coordination for Control Circuit |

Closed

| | | |
|---|---|---|
| 05000254/2009006-01<br>05000265/2009006-01 | NCV | Failure to Evaluate Lack of Water Spray System Piping |
| 05000254/2009006-02<br>05000265/2009006-02 | NCV | Failure to Provide Adequate Electrical Coordination for Control Circuit |

Discussed

None

## LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather, that selected sections of portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

### ASSESSMENTS

| Number | Description or Title | Date or Revision |
|---|---|---|
| 864682-03 | Pre NRC Triennial Inspection Self Assessment | Revision 0 |

### CALCULATIONS

| Number | Description or Title | Date or Revision |
|---|---|---|
| GE-NE-A22-00103-56-01-Q | Dresden and Quad Cities Extended Power Uprate, Task T0611: Appendix R Fire Protection (Quad Cities Station) [Proprietary] | Revision 0 |
| MPED-920001-04 | Calculation for Required Flow Through the Fire Protection System Service Water Tie-In Orifice | Revision 0 |
| QDC-4100-M-0434 | Hydraulic Water Based Suppression Systems Analysis Simultaneously Operating Suppressions Systems | Revision 1 |
| QDC-4100-M-0537 | Quad Cities Design Basis Hydraulic Calculations | Revision 2 |
| QDC-4100-M-1295 | Unit 1 and 2 Cable Tunnel Fire Protection Sprinkler System Flow Analysis | Revision 0 |
| QDC-4100-M-1524 | Fire Protection Hose Reel Supply Piping Pressure Drop | Revision 0 |

### CORRECTIVE ACTION PROGRAM DOCUMENTS GENERATED DURING INSPECTION

| Number | Description or Title | Date or Revision |
|---|---|---|
| 00942195 | 2009 Triennial Walkdown 6 Improper Length on Branch Line | July 14, 2009 |
| 00943901 | FPI – 2009 Triennial – Pre-Fire Plan Questions | July 20, 2009 |
| 00944114 | FPI – Informal Reference in Safe Shutdown Analysis | July 21, 2009 |
| 00944158 | FPI – QCARP 0060-02 Walkdown | July 21, 2009 |
| 00944167 | FPI – Typographical Error in Safe Shutdown Analysis | July 21, 2009 |
| 00944195 | FPI – QCARP 0060-01 Walkdown | July 21, 2009 |
| 00944269 | FPI – 2009 Triennial – Fire Door with Broken | July 21, 2009 |

**CORRECTIVE ACTION PROGRAM DOCUMENTS GENERATED DURING INSPECTION**

| Number | Description or Title | Date or Revision |
|---|---|---|
| | Latch | |
| 00944317 | FPI – QCARP 0030-01 Procedure Discrepancy | July 21, 2009 |
| 00944322 | FPI – QCARP 0060-02 Procedure Discrepancy | July 21, 2009 |
| 00944325 | FPI – QCARP 0030-04 Procedure Discrepancy | July 21, 2009 |
| 00944328 | FPI – QCARP 0030-02 Procedure Discrepancy | July 21, 2009 |
| 00944331 | FPI – QCARP 0060-01 Procedure Discrepancy | July 21, 2009 |
| 00944334 | FPI – QCARP 0030-03 Procedure Discrepancy | July 21, 2009 |
| 00944335 | FPI – QCARP 0020-01 Procedure Discrepancy | July 21, 2009 |
| 00944336 | FPI – QCARP 0030-04 Procedure discrepancy | July 21, 2009 |
| 00944337 | FPI – QCARP 0050-01 Procedure Discrepancy | July 21, 2009 |
| 00944338 | FPI – QCARP 0050-02 Procedure Discrepancy | July 21, 2009 |
| 00944369 | FPI – QCARP 0050-01 Procedure Discrepancy | July 22, 2009 |
| 00944470 | FPI – Incorrect Line Size on M-27 Sh. 1 for SW Bypasss to FP | July 22, 2009 |
| 00944621 | FPI – QCARP 0060-02 Walkdown with NRC | July 22, 2009 |
| 00944776 | FPI – QCARP 0060-02 Walkdown with NRC | July 22, 2009 |
| 00944784 | FPI – NRC Identified Potential Cable Tunnel Egress | July 22, 2009 |
| 00945219 | FPI – 2009 Triennial – Improper Length on Branch Line (CSR) | July 23, 2009 |
| 00945275 | FPI – SSMP Breaker Coordination Issue | July 23, 2009 |
| 00947201 | FPI – SSMP Breaker and Fuse Coordination for CT-2 | July 29, 2009 |
| 00949230 | FPI – Pressure Stress Not Addressed in EC 376446 | August 4, 2009 |
| 00949859 | FPI – Procedure Typographical Error | August 5, 2009 |

**CORRECTIVE ACTION PROGRAM DOCUMENTS REVIEWED**

| Number | Description or Title | Date or Revision |
|---|---|---|
| Q2000-04344 | Certain Fire Protection commitments in the 1979 FP SER Not Being Maintained | December 8, 2000 |
| 00485702 | Required SSDA Actions Not Contained in | May 2, 2006 |

**CORRECTIVE ACTION PROGRAM DOCUMENTS REVIEWED**

| Number | Description or Title | Date or Revision |
|---|---|---|
| | QCARP 0030-01 | |
| 00489160 | Justification of Fire Hose Pressure and flow Meeting NFPA | May 11, 2006 |
| 00489426 | Class A Fire Extinguisher Placement Improvements | May 12, 2006 |
| 00556335 | MMD did Not Request Operations Open Service Water Crosstie | November 10, 2006 |

**DRAWINGS**

| Number | Description or Title | Date or Revision |
|---|---|---|
| 4E-6701A | Interconnection Block Diagram Fire Protection System Loop 1-1 | Revision J |
| 4E-2484E, sheet 1 | Schematic Diagram – Reactor Core Isolation Cooling System Part 5 | Revision W |
| 4E-1318B | Overall Key Diagram – 125V DC Distribution Centers | Revision J |
| 4E-6624 | Schematic Diagram – 4160 Bus 24-1 Safe Shutdown System | Revision D |
| B-446 | Turbine Building Plumbing Substructure Diagram | Revision G |

**ENGINEERING CHANGES**

| Number | Description or Title | Date or Revision |
|---|---|---|
| 370562 | GL 86-10 Evaluation: Justification for Use of Manual Hose Stations in Lieu of Class A Portable Fire Extinguishers | Revision 0 |
| 376446 | Evaluation of NFPA 13 Deviation on Cantilever Lengths for Cable Spreading Room | July 31, 2009 |

**EVALUATIONS**

| Number | Description or Title | Date or Revision |
|---|---|---|
| | Fire Hazards Analysis | Revision 19 |
| | Safe Shutdown Report | Revision 19 |
| GL 86-10 Evaluation NTSC 98-020.002 | Appendix R Fire Protection Evaluation Justification for Lack of Complete Suppression and Detection in Fire Area TB-II | Revision 3 |
| GL 86-10 Evaluation NTSC 98-020.004 | Appendix R Fire Protection Evaluation Justification for Lack of Complete Suppression and Detection in Fire Areas 13-1 and 24-1 (4-kV Bus Switchgear Areas) | Revision 3 |

**EVALUATIONS**

| Number | Description or Title | Date or Revision |
|---|---|---|
| GL 86-10 Evaluation Q-ECDS-00-167 | Separation of Fire Zone 11.1.3 and 11.2.3 from Cables in Fire Area RB-1N Associated with Valve MO 1-2301-4 and MO 1-1301-16 Respectively | Revision 0 |
| GL 86-10 Evaluation S040-QH-0614 | Appendix R Fire Protection Evaluation Justification for Lack of Complete Fire Detection and Suppression in the Unit 1 Reactor Building | Revision 1 |
| QC-SDP-01 | Significance Determination Process for SD Control Power Lack of Coordination | Revision 1 |

**OTHER**

| Number | Description or Title | Date or Revision |
|---|---|---|
| | Fire Detection and Alarm System Survey (NFPA 72E) in Nuclear Safety-Related Areas | Revision 1 |
| | Quad Cities Aux Electric Cable Spreading Room Sprinkler System Piping Code Deviation White Paper | August 13, 2009 |

**PLANT PROCEDURES**

| Number | Description or Title | Date or Revision |
|---|---|---|
| QCARP 0050-01 | SB-1-1, Injection with SSMP and Bringing the Unit to Cold Shutdown | Revision 15 |
| QCARP 0060-02 | CT-2, Injection with SSMP and Bring the Unit to Cold shutdown | Revision 14 |
| QCOA 0010-12 | Fire/Explosion | Revision 33 |
| QCOP 4100-01 | Firewater System Lineup for Standby Operation | Revision 4 |

**WORK ORDERS**

| Number | Description or Title | Date or Revision |
|---|---|---|
| 00772618 | Fire Door Inspection | August 11, 2006 |
| 00774139 | Replace Group B Fire Hoses | July 1, 2005 |
| 00870385 | Fire System Flow Test | June 13, 2007 |
| 00948945 | Fire Door Inspection | May 2, 2008 |
| 01042941 | Fire Extinguisher Inspection Turbine / Radwaste and LTD Bld | June 27, 2008 |
| 01043344 | Fire Extinguisher Inspection Reactor Bldg | July 2, 2008 |
| 01044796 | Fire Extinguisher Inspection Service Bldg | July 28, 2008 |
| 01046483 | Service Bldg Control Room HVAC Fire | September 8, 2008 |

**WORK ORDERS**

| Number | Description or Title | Date or Revision |
|---|---|---|
| | Protection Func Test | |
| 01065561 | Group A Fire Hose Inspection | October 3, 2008 |
| 01148765 | Fire Extinguisher Inspection Turbine / Radwaste and LTD Bld | June 29, 2009 |
| 01150463 | Fire Extinguisher Inspection Reactor Bldg | July 7, 2009 |
| 01155955 | Fire Extinguisher Inspection Service Bldg | June 6, 2009 |
| 01234609 | Rx Building Fire Inspection | June 8, 2009 |
| 01240127 | Turb/LTD Bldg/Rad Waste Fire Ext. Inspection | June 25, 2009 |
| 01243215 | Rx Building Fire Inspection | July 7, 2009 |
| 01243216 | Service Bldg Fire Inspection | June 26, 2009 |
| 01248645 | Service Bldg Fire Inspection | July 22, 2009 |
| 990054582 | Group B Fire Hose Inspection | July 06, 2000 |

List of Acronyms Used

| | |
|---|---|
| ADAMS | Agencywide Document Access Management System |
| AR | Action Request |
| CFAST | Consolidated Fire and Smoke Transport |
| CFR | Code of Federal Regulations |
| CSR | Cable Spreading Room |
| DC | Direct Current |
| DPR | Demonstration Power Reactor |
| DRS | Division of Reactor Safety |
| EC | Engineering Change |
| FHA | Fire Hazards Analysis |
| IMC | Inspection Manual Chapter |
| IP | Inspection Procedure |
| IPEEE | Individual Plant Examination of External Events |
| IR | Inspection Report |
| kV | Kilovolt |
| MCC | Motor Control Center |
| NCV | Non-Cited Violation |
| NFPA | National Fire Protection Association |
| NRC | U.S. Nuclear Regulatory Commission |
| PARS | Publicly Available Records |
| SDP | Significance Determination Process |
| SRA | Senior Reactor Analyst |
| UFSAR | Updated Final Safety Analysis Report |
| USAS | United States of America Standard |
| Vdc | Volts Direct Current |

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Sincerely,

Robert C. Daley, Chief
Engineering Branch 3
Division of Reactor Safety

Docket Nos. 50-254; 50-265
License Nos. DPR-29; DPR-30

Enclosure: Inspection Report 05000254/2009-006; 05000265/2009-006
w/Attachment: Supplemental Information

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