

RS-12-162

November 27, 2012

U.S. Nuclear Regulatory Commission
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Byron Station, Units 1 and 2
Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: Exelon Generation Company, LLC's 180-day Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendation 2.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident

References:

1. NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, dated March 12, 2012
2. NRC Letter, Endorsement of Nuclear Energy Institute (NEI) 12-07, "Guidelines For Performing Verification Walkdowns of Plant Flood Protection Features," dated May 31, 2012
3. Exelon Generation Company, LLC's 90-day Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendations 2.1 and 2.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Flooding), dated June 11, 2012

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to all power reactor licensees. Enclosure 4 of Reference 1 contains specific Requested Actions, Requested Information, and Required Responses associated with Recommendation 2.3 for Flooding. On June 11, 2012, Exelon Generation Company, LLC (EGC) submitted the 90-day response requested in Enclosure 4 of Reference 1, confirming that EGC would use the NRC-endorsed flooding walkdown procedure (Reference 3).

For flooding Recommendation 2.3 (walkdowns), Enclosure 4 of Reference 1 states that within 180 days of the NRC's endorsement of the walkdown process (Reference 2), each addressee will submit a final response, including a list of any areas that are unable to be inspected due to inaccessibility and a schedule for when the walkdown will be completed. This letter provides the Byron Station, Units 1 and 2 180-day response to Reference 1 for Flooding Recommendation 2.3.

Conditions identified during the walkdowns were documented and entered into the corrective action program. Performance of the walkdowns provided confirmation, with two exceptions, that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis. The two deficiencies will be restored to their original design for resolution of the issues.

Enclosure 1 to this letter provides the requested information for Byron Station Units 1 and 2.

This letter contains no new regulatory commitments.

Should you have any questions concerning the content of this letter, please contact Ron Gaston at (630) 657-3359.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 27th day of November 2012.

Respectfully,



Glen T. Kaegi
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosures:

1. Flooding Walkdown Report In Response To The 50.54(f) Information Request Regarding Near-Term Task Force Recommendation 2.3: Flooding for the Byron Station, Units 1 and 2

cc: Director, Office of Nuclear Reactor Regulation
Regional Administrator - NRC Region III
NRC Senior Resident Inspector – Byron Units 1 and 2
NRC Project Manager, NRR – Byron Units 1 and 2
Illinois Emergency Management Agency - Division of Nuclear Safety

Enclosure 1

**Flooding Walkdown Report In Response To The 50.54(f) Information
Request Regarding Near-Term Task Force
Recommendation 2.3: Flooding for the
Byron Station, Units 1 and 2**

(22 pages)

FLOODING WALKDOWN REPORT

IN RESPONSE TO THE 50.54(f) INFORMATION REQUEST REGARDING
NEAR-TERM TASK FORCE RECOMMENDATION 2.3: FLOODING

for the

BYRON NUCLEAR POWER STATION

4450 N. GERMAN CHURCH ROAD BYRON IL, 61010

Facility Operating License No. NPF-37 / NPF-66

NRC Docket No. 50-454/50-455



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100% Report, Rev. 1, 11/02/12

(Supersedes Rev. 0 in its entirety)

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1. EXECUTIVE SUMMARY

In response to the Nuclear Regulatory Commission (NRC) Request for Information regarding Near-Term Task Force (NTTF) Recommendation 2.3, a flooding walkdown was conducted at Byron Nuclear Power Station to verify that plant features credited in the current licensing bases (CLB) for protection and mitigation from external flood events are available, functional, and properly maintained. The flooding walkdown was conducted between July 31 and August 2, 2012. An additional walkdown at Byron for two features identified during the Braidwood walkdowns was performed on August 23, 2012.

The scope of the flooding walkdown was developed following a detailed review of all relevant licensing documents. Since Byron is situated above the probable maximum flood (PMF) level, the station relies entirely on passive features incorporated in the design to keep water out of the plant, specifically site runoff from a local intense precipitation (LIP) event and groundwater. The flooding walkdown scope consisted of four main parts.

- The walls, floors and penetrations through the walls and floors in the River Screen House Essential Service Water (SX) Make-up Pump Diesel Drive cubicles were inspected.
- The Main Steam Isolation Valve (MSIV) Rooms, Radwaste Truck Bay, Fuel Handling Building and the Refueling Water Storage Tank (RWST) tunnel exterior hatches were inspected to ensure runoff from LIP is kept out of the safety related buildings.
- An outdoor walkdown was conducted to verify that plant modifications implemented since original construction, such as security barrier installation and changes to topography, do not adversely affect plant flooding protection.
- The below-grade structures (i.e., basement walls and basement slabs and penetrations through these walls and floors) in the main power block were inspected. These areas are credited in the CLB to keep groundwater and runoff from LIP out of the safety related buildings.

The methodology and acceptance criteria for the evaluation of flood protection features was developed based on Nuclear Energy Institute (NEI) report 12-07 [Rev 0-A](Reference 2), Guidelines for Performing Verification Walkdowns of Plant Protection Features.

Visual inspections of walls, floors and penetrations through the walls and floors were conducted to verify there are no observable structural deficiencies that may impact the structure's ability to perform its intended flood protection function.

With two exceptions, inspections of walls, floors and penetrations confirmed that credited flood barriers are in place and are capable of performing their intended function. A small slab that serves as an LIP curb between the Radwaste Truck Bay and the Auxiliary Building was observed as "not per design". The slab is actually installed 12" below the designed elevation (0.82' below the LIP flood level). Caulking around the LIP curb located in the 1A/1D Main Steam Isolation Valve (MSIV) room was identified as degraded. These observations, and any other that could not be immediately judged as acceptable, were entered into the Corrective Action Program (CAP) for disposition resulting in these two deficiencies.

Whether conduits from manholes or cable vaults could provide a path for ground water or rain water to safety related buildings was considered relevant to the walkdown scope. Conduits from manholes/cable

vaults generally are not routed to safety related buildings at Byron. In a few cases, there are conduits that turn up and terminate above grade level such that no path for water is provided. Groundwater/rainwater leakage through conduits into safety related buildings at Byron was not identified. Conduits at Byron do not provide a path for ground water or rain water to enter safety related buildings (Reference 21).

A small portion of the total floor and wall areas within the walkdown scope were deemed inaccessible and were not inspected. Reasonable assurance that these portions of the walls and floors are acceptable is based on the fact that visual inspection of the walls and floors in these buildings and throughout the plant revealed no deficiencies or degradation that would prevent performance of flood protection functions.

There are no deferred components/areas requiring future review.

Performance of the walkdowns provided confirmation, with two exceptions, that flood protection features are in place, are in good condition and will perform as credited in the current licensing basis. The two deficiencies will be restored to their original design for resolution of the issues. Observations not immediately judged as acceptable were addressed and dispositioned under the Corrective Action Program resulting in these two deficiencies.

A total of 14 Issue Reports (IRs) were entered in the CAP as a result of this effort. These IRs are described in Table 2 in the Conclusion section of this report.

The outcome of the CAP disposition included two deficiency findings. There are no observations awaiting final disposition in CAP.

2. PURPOSE

a. Background

In response to the nuclear fuel damage at the Fukushima-Dai-ichi power plant due to the March 11, 2011 earthquake and subsequent tsunami, the United States Nuclear Regulatory Commission (NRC) established the Near Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations, and to make recommendations to the Commission for its policy direction. The NTTF reported a set of recommendations that were intended to clarify and strengthen the regulatory framework for protection against natural phenomena.

On March 12, 2012, the NRC issued an information request pursuant to Title 10 of the Code of Federal Regulations, Section 50.54 (f) (10 CFR 50.54(f) or 50.54(f)) (Reference 3) which included six (6) enclosures:

- [NTTF] Recommendation 2.1: Seismic
- [NTTF] Recommendation 2.1: Flooding
- [NTTF] Recommendation 2.3: Seismic
- [NTTF] Recommendation 2.3: Flooding
- [NTTF] Recommendation 9.3: EP
- Licensees and Holders of Construction Permits

In Enclosure 4 of Reference 3, the NRC requested that licensees 'perform flood protection walkdowns to identify and address plant-specific degraded, nonconforming, or unanalyzed conditions and cliff-edge

effects (through the corrective action program) and verify the adequacy of monitoring and maintenance procedures'. (See note below regarding 'cliff-edge effects'.)

Structures, systems, and components (SSCs) important to safety are designed either in accordance with, or meet the intent of, Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 2. GDC 2 states that SSCs important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena, including floods, without loss of capability to perform their intended safety functions. For flooding walkdowns, identifying/addressing plant-specific degraded, nonconforming, or unanalyzed conditions (through the corrective action program) and verifying the adequacy of monitoring and maintenance procedures is associated with flood protection and mitigation features credited in the current design/licensing basis. New flood hazard information will be considered in response to Enclosure 2 of Reference 3.

On behalf of Exelon Generation Company, LLC (Exelon), this report provides the information requested in the March 12, 50.54(f) letter; specifically, the information listed under the 'Requested Information' section of Enclosure 4, paragraph 2 ('a' through 'h'). The 'Requested Information' section of Enclosure 4, paragraph 1 ('a' through 'j'), regarding flooding walkdown procedures, was addressed via Exelon's June 11, 2012, acceptance (Reference 1) of the industry walkdown guidance (Reference 2).

Note Regarding Cliff-Edge Effects

Cliff-edge effects were defined by the NTTF Report (Reference 5), which noted that 'the safety consequences of a flooding event may increase sharply with a small increase in the flooding level'. While the NRC used the same term as the NTTF Report in the March 12 50.54(f) information request (Reference 3), the information the NRC expects utilities to obtain during the Recommendation 2.3: Flooding Walkdowns is different. To clarify, the NRC is now differentiating between cliff-edge effects (which are dealt with under Enclosure 2 of Reference 3) and a new term, Available Physical Margin (APM). APM information will be collected during the walkdowns, but will not be reported in the response to Enclosure 4 of Reference 3. The collected APM information will be available for use in developing the response to Enclosure 2 of Reference 3.

b. Site Description

Byron Station is located 3 miles southwest of Byron in Ogle County, in north central Illinois, and 2 miles east of the Rock River, at about river mile 115 from the confluence with the Mississippi River. The plant site occupies about 1300 acres and includes a portion of Woodland Creek, which is an intermittent stream and a 3-mile long tributary to the Rock River. The elevations of the Rock River at the site corresponding to the mean annual flow and the probable maximum flood (PMF) are 672.0 feet and 708.3 feet, respectively. (All elevations herein refer to USGS 1929 datum). The plant grade and floor elevation is 869.0 feet and 870 feet USGS-29, respectively. The PMF level is below the level of the plant grade floor; therefore, it will have no damaging effect on any safety-related structure, except the river screen house at the Byron Station which is discussed below (Reference 13, Section 2.4.1.1).

The Byron River Screen House is the only structure which could be affected by floods on the Rock River. This structure is designed for the combined event flood and waves produced by a 40 mph wind. The makeup water system for the ultimate heat sink consists of a combination of the River Screen House SX make-up pumps and deep wells. The deep wells, located at the plant site, are above the PMF water levels and used for makeup whenever the river screen house is unavailable. The River Screen House is designed

for the combined event flood. The combined event flood stage for the Rock River at the river screen house is 698.68 feet. The maximum wave run-up plus setup is 4.71 feet. To prevent damage due to flood, the floor elevation is established at 702 feet and a 4-foot-high fire wall encloses the area where safety-related equipment is located (Reference 13, Section 3.4.1.1).

The local intense precipitation (LIP) event causes only minor local flooding. Grading and drainage at the Byron Site are designed to ensure that no flooding of safety-related facilities will occur for events as severe as the LIP. It also has no appreciable effect on the maximum perched groundwater elevation of 824 feet (Reference 13, Sections 2.4.2.3 and 3.4.1.1, and Reference 14, DC-ST-03-BY/BR).

The structures that house safety-related equipment are the Containment, Auxiliary and Fuel Handling buildings. These structures all have reinforced concrete walls below grade level. The only exterior, personnel, or equipment access to these buildings is at grade level or above. All pipes penetrating the exterior walls are provided with water penetration sleeves. Water stops are provided in all horizontal and vertical construction joints in all exterior walls, as required (Reference 13, Section 3.4.1.3).

Access to the plant site would be maintained during any flood conditions. The site is bounded by County Highway 2 (German Church Road), Deerpath Road, and Razorville Road. The road elevations vary from 769 feet to 883 feet. None of the above roads would be affected by the PMF from the Rock River. Other principal roads in the area are Illinois State Highway 72, about 3 miles northeast and Illinois Highway 64, about 4 miles south. The plant site is also accessible from the Chicago and North Western Railroad which is about 3 miles northeast of the site. Ground topography along the railroad tracks is high and the tracks are well above the PMF level of the Rock River (Reference 13, Section 2.4.1.1).

c. Requested Actions

Per Enclosure 4 of Reference 3, the NRC requests that each licensee confirm use of the industry-developed, NRC-endorsed, flood walkdown procedures or provide a description of plant-specific walkdown procedures. In a letter dated June 11, 2012 (Reference 1), Exelon confirmed that the flooding walkdown procedure (Reference 2), endorsed by the NRC on May 31, 2012, will be used as the basis for the flooding walkdowns.

Other NRC's requested actions include:

- (1) Perform flood protection walkdowns using an NRC-endorsed walkdown methodology;
- (2) Identify and address plant-specific degraded, nonconforming, or unanalyzed conditions, as well as, cliff-edge effects through the corrective action program, and consider these findings in the Recommendation 2.1 hazard evaluations, as appropriate;
- (3) Identify any other actions taken or planned to further enhance the site flood protection;
- (4) Verify the adequacy of programs, monitoring and maintenance for protection features; and
- (5) Report to the NRC the results of the walkdowns and corrective actions taken or planned.

Per Enclosure 4 of Reference 3 also states, 'If any condition identified during the walkdown activities represents a degraded, nonconforming, or unanalyzed condition (i.e. noncompliance with the current licensing basis) for an SSC, describe actions that were taken or are planned to address the condition using the guidance in Reference 6, including entering the condition in the corrective action program. Reporting requirements pursuant to 10 CFR 50.72 should also be considered.

d. Requested Information

Per Enclosure 4 of Reference 3,

1. The NRC requests that each licensee confirm that it will use the industry-developed, NRC endorsed, flooding walkdown procedures or provide a description of plant-specific walkdown procedures. As indicated previously, Exelon's letter dated June 11, 2012 (Reference 1), confirmed that the flooding walkdown procedure (Reference 2), endorsed by the NRC on May 31, 2012, will be used as the basis for the flooding walkdowns.
2. The NRC requests that each licensee conduct the walkdown and submit a final report which includes the following:
 - a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
 - b. Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.
 - c. Describe any warning systems to detect the presence of water in rooms important to safety.
 - d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information item 1.h.
 - e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures,) using the documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review.
 - f. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Revision 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.
 - g. Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects. See note in Section 1a regarding the NRC's change in position on cliff-edge effects.
 - h. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

3. METHODOLOGY

a. Overview of NEI 12-07 (Walkdown Guidance)

In a collaborative effort with NRC staff, NEI developed and issued report 12-07 [Rev 0-A], *Guidelines for Performing Verification Walkdowns of Plant Protection Features*, dated May 2012 (Reference 2). The NRC endorsed NEI 12-07 on May 31, 2012 with amendments. NEI 12-07 was updated to incorporate the amendments and re-issued on June 18, 2012. On June 11, 2012, Exelon issued a letter to the NRC (Reference 1) stating that the endorsed flooding walkdown procedure (Reference 2) will be used as the basis for the flooding walkdowns. NEI 12-07 provides guidance on the following items:

- Definitions
 - Incorporated Barrier/Feature
 - Temporary Barrier/Feature
 - Exterior Barrier/Feature
 - Current Licensing Basis (CLB)
 - Design Bases
 - Inaccessible
 - Restricted Access
 - Deficiency
 - Flood Protection Features
 - Reasonable Simulation
 - Visual Inspection
 - Cliff-Edge Effects
 - Available Physical Margin
 - Variety Of Site Conditions
 - Flood Duration
- Scope
 - Basis for Establishing Walkdown Scope
 - Identify Flood Protection Features (Walkdown List)
- Methodology
 - Develop Walkdown Scope
 - Prepare Walkdown Packages
 - Walkdown Team Selection and Training
 - Perform Pre-Job Briefs
 - Inspection of Flood Protection And Mitigation Features
 - General
 - Incorporated or Exterior Passive Flood Protection Features
 - Incorporated or Exterior Active Flood Protection Features
 - Temporary Passive Flood Protection Features
 - Temporary Active Flood Protection Features
 - Procedure Walk-through and Reasonable Simulation
 - Review of The Maintenance and Monitoring of Flood Protection Features
 - Review of Operating Procedures
 - Documentation of Available Physical Margins
 - Documenting Possible Deficiencies

- Restricted Access, or Inaccessible
- Acceptance Criteria
- Evaluation and Reporting Results of The Walkdown
- Related Information Sources
- Examples
- Walkdown Record Form
- Sample Training Content
- Walkdown Report

b. Application of NEI 12-07

At Byron, the approach to the flooding walkdowns included three phases:

Phase 1 – Preparation, Training, Data Gathering, and Scoping

Exelon developed a fleet-wide program and training course for walkdown team members to provide complete and consistent implementation of NEI 12-07 guidelines. In addition, all walkdown team members completed the applicable NANTeL training and testing. Data gathering began with identification of station-specific licensing commitments and station design basis relative to external flooding events. This included review of the Byron Updated Final Safety Analysis Report (UFSAR) (Reference 13), identification of drawings showing flood protection features and review of station procedures and calculations relative external flooding events. A walkdown scope was developed to capture features credited as performing a flood protection function in the current licensing basis. A walkdown list was prepared identifying the specific features to be inspected. For each feature on the walkdown list, a walkdown package was prepared for use by the walkdown team in performing and documenting the walkdown.

The scope developed for the walkdowns at Byron included the following:

- The floors and walls enclosing the service water (SX) makeup pump rooms in the river screen house. Scope included inspection of all penetrations.
- The floors and exterior watertight walls (up to max groundwater water level) of the Auxiliary building. The Containment building was not included in the inspection scope because the exterior walls and the floor are credited with leak tightness based on periodic ILRT testing, and the lowest elevation of the building is above the maximum groundwater elevation.
- Whether conduits from manholes or cable vaults could provide a path for ground water or rain water to enter safety related buildings was considered relevant to the walkdown scope. Conduits from manholes/cable vaults generally are not routed to safety related buildings at Byron. In a few cases there are conduits that turn up and terminate above grade level such that no path for water is provided. Conduits at Byron do not provide a path for ground water or rain water to enter safety related buildings.
- The Main Steam Isolation Valve (MSIV) Rooms, Radwaste Truck Bay, Fuel Handling Building and the Refueling Water Storage Tank (RWST) tunnel exterior hatches were inspected to ensure runoff from LIP is kept out of the safety related buildings.

- An outdoor walkdown was conducted to verify that plant modifications implemented since original construction, such as security barrier installation and changes to topography, do not adversely affect plant flooding protection.

Phase 2 – Inspections and Reasonable Simulations

Visual inspection of each feature was performed on the walkdown and the results were documented on the applicable Walkdown Record Forms. The condition of each feature as observed on the walkdowns was compared to the acceptance criteria defined in the Supplemental Walkdown/Inspection Guidance (Reference 17). No reasonable simulations were conducted at Byron since all features are incorporated passive.

Phase 3 – Final Reporting

The Walkdown Record Forms were completed and assembled into a package that included a summary and a cover page to document a management review of the entire package. Completion of the Walkdown Record Forms was performed in accordance with the guidance provided in Section 7 of NEI 12-07. A Flooding Walkdown Report (this report) was prepared to address the items outlined in the “Requested Information” section of the “Recommendation 2.3: Flooding” enclosure from the 10CFR50.54 (f) letter.

c. Reasonable Simulations

Per NEI 12-07 (Reference 2), reasonable simulation includes the following:

- Verify that any credited time dependent activities can be completed in the time required. Time-dependent activities include detection (some signal that the event will occur, has occurred, or is occurring), recognition (by someone who will notify the plant), communication (to the control room), and action (by plant staff).
- Verify that specified equipment/tools are properly staged and in good working condition.
- Verify that connection/installation points are accessible.
- Verify that the execution of the activity will not be impeded by the event it is intended to mitigate or prevent. For example, movement of equipment across unpaved areas on the site could be impeded by soft soil conditions created by excessive water.
- Review the reliance on the station staff to execute required flood protection features. If during the review several activities are identified to rely on station staff, then perform and document an evaluation of the aggregate effect on the station staff to demonstrate all actions can be completed as required.
- Verify that all resources needed to complete the actions will be available. (Note that staffing assumptions must be consistent with site access assumptions in emergency planning procedures.)

- Show that the execution of the activity will not be impeded by other adverse conditions that could reasonably be expected to simultaneously occur (for example, winds, lightning, and extreme air temperatures).
- Personnel/departments that have responsibility for supporting or implementing the procedure should participate in the simulation effort.
- The simulation should demonstrate that the personnel assigned to the procedure do not have other duties that could keep them from completing their flood protection activities during an actual event. Actions that would be performed in parallel during an event should be simulated in parallel; not checked individually and the results combined.
- Reasonable simulation need not require the actual performance of the necessary activities if they have been previously performed and documented or it is periodically demonstrated and documented that the activities can be completed in the credited time.

The purpose of reasonable simulations is to verify required flood protection procedures or activities can be executed as specified/written. Byron flood protection features do not include any temporary or active features that require implementation of a procedure for performance of manual/operator actions in order for the feature to perform its intended flood protection function. Therefore, no procedure walk-through, or 'Reasonable Simulation', was conducted at Byron Station.

d. Walkdown Inspection Guidance

A 'Walkdown Inspection Guidance' was developed by Exelon to supplement NEI 12-07 (Reference 2), based largely on Appendix A of NEI 12-07 (Examples). The guidance was intended to supplement, not supersede, NEI 12-07 and provide inspection guidance for specific features, listed below.

- Incorporated or Exterior Passive Features:
 - Site Elevations and Topography
 - Earthen Features (i.e., Flood Protection Berm, Dike, Levee)
 - Concrete and Steel Structures
 - Wall, Ceiling, and Floor Seals (e.g. Penetration Seals, Cork Seals)
 - Passive Flood Barriers or Water Diversion Structures
 - Drains and Catch Basins
 - Plugs and Manhole Covers
 - Drainage Pathways (Swales, Subsurface Drainage System, etc.)
 - Piping and Cable Vaults and Tunnels, Electrical Cable Conduit
 - Floor Hatches
 - Flap Gate/Backwater Valve/Duckbill Valve
 - Flood Wall
- Incorporated or Exterior Active Features:
 - Credited Water Tight Doors
 - Credited Non-Watertight Doors
 - Pumps
 - Water Level Indication
 - Gate Valves

- Temporary Passive Features:
 - Portable Flood Barriers and Inflatable Rubber Seals
 - Flood Gate
- Temporary Active Feature
 - Pumps

4. RESULTS

The information requested in Reference 3, Enclosure 4, under paragraph 2 of the 'Requested Information' section, is provided below. The contents of each item were developed in accordance with Reference 2, Appendix D.

a. Requested Information Item 2(a) – Design Basis Flood Hazards

Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.

The Byron Station design basis for external flooding is described in Byron UFSAR Sections 2.4 and 3.4 (Reference 13) and DC-ST-03-BY/BR (Reference 14). Byron is designed to be protected from the effects of river flooding (based on the probable maximum flood (PMF)) and local intense precipitation (LIP). In addition Byron is designed to be protected against groundwater ingress.

With the exception of the safety-related Essential Service Water (SX) makeup pumps in the river screen house, all safety-related equipment is protected from a river flood by virtue of its location above the PMF elevation and by being housed within flood-protected structures. The PMF level has been determined to be at elevation 708.3 ft. The SX makeup pumps, which provide Ultimate Heat Sink (UHS) makeup during long-term reactor cool down, are mounted at an elevation of 702 ft and enclosed by a 4-ft high concrete fire wall. The PMF level would, therefore, be 2.3 ft over the fire wall and the SX makeup pumps would be flooded. As backup to the SX makeup pumps, nonsafety-related wells are provided. The wells and well pumps are above the PMF level, are powered from essential (Class 1E) power sources, and thus are capable of supplying makeup to the UHS in the event of a loss of the SX makeup pumps coincident with a loss of offsite power as a result of the PMF. This design has been deemed acceptable (Reference 13, SER 3 Design Criteria for SSC). The river screen house is the only structure that could be affected by flooding on the Rock River and is designed for the combined event flood, described further below. The design bases for the river screen house, under both high and low water conditions, are discussed in Reference 13, Subsections 2.4.3 and 2.4.11, respectively. All other structures are 161 feet or more above the PMF level of the Rock River.

The design basis combined event flood (CEF) still-water elevation is 698.68 ft. The significant and maximum wave effects of a coincident 40-mph overland wind were superimposed on the combined event water level at the river screen house. The wave runups were calculated to be 2.77 ft and 4.71 ft for the significant and maximum waves, respectively. Therefore, the design-basis CEF is 703.39 ft with maximum waves (Reference 13, Section 2.4.3.9), and is the elevation used during the walkdowns.

Upstream dam/landslide blockage failures and downstream landslide blockage can cause or increase floods by creating: (1) a flood-wave surcharge through the release of a significant water volume over a short period of time and (2) backwater through the blockage of flow and/or conveyance reduction, respectively. An upstream failure flood-wave dissipates rapidly in a downstream direction. Since the

site area is remote from upstream gorge-type topography and the nearest dam is 22 miles upstream, an increase in elevation of the Rock River near the site from an upstream failure flood-wave was considered negligible in the current licensing basis. Since there is no gorge downstream, backwater from a downstream landslide blockage was also considered negligible. All the safety-related structures are protected against this event. (Reference 13, Section 2.4.2.2)

Byron main power block buildings are situated at grade elevation 869 feet, well above the PMF level. The portions of the building substructures located below the maximum groundwater level are designed to prevent groundwater ingress. The design basis groundwater elevation is 824 feet. All substructures below grade elevation 869 ft at the Byron site are designed to withstand full hydrostatic head of groundwater. (Reference 14, DC-ST-03-BY/BR)

The design basis LIP results in a maximum water surface elevation of 870.82 ft in the immediate station area where safety-related facilities are located (western half of the main power block structure). The analysis assumes that local surface drainage systems do not function during the LIP event. The areas surrounding the plant are graded to direct surface runoff away from the plant. The station floor elevation is at elevation 870 ft, 0.82 foot below the maximum LIP flood elevation. By its very nature, the LIP event and associated runoff occurs over a short period of time (Reference 13, Section 2.4.2.3).

Byron UFSAR Section 2.4 addresses additional flooding mechanisms that are either not critical or not bounding for Byron. Probable maximum surge and seiche flooding is not bounding for Byron because there is no large body of water near the site where significant storm surges and seiche formations can occur. The station will not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area.

b. Requested Information Item 2(b) – CLB Protection and Mitigation Features

Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.

The only safety related equipment at Byron Station that could be impacted by flooding is the SX makeup pumps. These pumps are installed in the river screen house at elevation 702 ft and are housed within a 4 foot high fire wall. The walls of these rooms are designed to be flood protected to elevation 706 ft. The CEF still-water level is 698.68 ft. Superimposing the wind wave effect will result in a maximum wave runup elevation of 703.39 ft. (Reference 13, Sections 2.4.3.9). The engine for the SX makeup pumps is mounted on its sub-base at elevation 703.71 feet. The engine shaft centerline is at elevation 705.33 feet and the lower battery post elevation is approximately 703.67 feet. It is anticipated that this elevation would be limiting under flood conditions. This is above the CEF plus wave runup elevation and is anticipated to be the elevation at which the engine would stop. In the unlikely event that the engines are rendered inoperable by a flood level in excess of 703.67 feet, the plant site deep wells will be powered from their respective Unit 1 Engineered Safety Features (ESF) buses. These deep wells will then provide makeup for the SX cooling towers (Reference 13, Section 2.4.10).

Safety-related equipment is located below grade in the Auxiliary and Containment buildings. No safety-related equipment is located in the Turbine or Radwaste buildings. All of the buildings with exterior walls below grade, including the Turbine and Radwaste buildings, are designed to be water tight up to plant floor elevation 870 feet, which is above the grade elevation 869 feet. Potential sources of external flooding of the main power block buildings are LIP and groundwater ingress. The design basis

groundwater elevation is 824 ft. All substructures below elevation 869 feet at the Byron site are designed to withstand full hydrostatic head of groundwater (Reference 14, Section 12.1.4). LIP has been determined to result in a maximum water surface elevation of 870.82 ft in the immediate station area where safety-related facilities are located (Auxiliary, Containment and Fuel Handling buildings). Local surface drainage systems are assumed not to function during the LIP event. The areas surrounding the plant are graded to direct surface runoff away from the plant (UFSAR Section 2.4.2.3, Reference 13). To prevent water from entering areas containing essential equipment/systems, incorporated reinforced concrete curbs or steel barriers are provided above elevation 870.82 ft (Reference 19 and 20).

In general, all flood protection features designed to protect safety-related equipment are passive incorporated features, and as such does not involve invoking any procedures. The only active features are the sump pumps in the SX rooms. These are credited in the current licensing basis as protecting against internal flooding (not part of the NTTF Recommendation 2.3 flooding walkdowns) but are providing an additional function of removing water leaks from external sources in the SX rooms. Therefore, the pumps were not included in the flooding walkdown scope.

The licensing basis does not explicitly address flood duration or adverse weather conditions concurrent with flooding, presumably because the protection features are all incorporated passive. In addition, Byron flood protection features are designed to function during any plant mode of operation.

c. Requested Information Item 2(c) – Flood Warning Systems

Describe any warning systems to detect the presence of water in rooms important to safety.

Per UFSAR Section 9.2.1.2.4 (Reference 13), leak detection is provided by means of system flow and pressure drop instrumentation and leak detection sumps in the Auxiliary building basement where the essential service water pumps are installed. The 1A and 2A essential service water pumps are located in one compartment and the 1B and 2B pumps are located in a separate adjacent compartment. Each compartment contains an essential service water sump. Each sump has two sump pumps. Although designed to detect internal flooding, the leak detection sumps will also detect significant groundwater ingress into these rooms (Reference 16). These alarms are not credited in the CLB for detecting external groundwater leakage, and were not required to be inspected.

d. Requested Information Item 2(d) – Flood Protection System/Barrier Effectiveness

Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information Item 1.h [in Enclosure 4 of the March 12, 2012, 50.54(f) letter]

Section 6 of NEI 12-07 defines 'acceptance' as:

"Flood protection features are considered acceptable if no conditions adverse to quality were identified during walkdowns, verification activities, or program reviews as determined by the licensee's Corrective Action Program. Conditions adverse to quality are those that prevent the flood protection feature from performing its credited function during a design basis external flooding event and are 'deficiencies'. Deficiencies must be reported to the NRC in the response to the 50.54(f) letter."

NTTF Recommendation 2.3 (Walkdowns): Flooding

Exelon Corporation

11/02/12

Revision 1

As indicated in Section 3d, inspection guidance was developed, supplementing NEI 12-07, to provide more specific criteria for judging acceptance. All observations that cannot be immediately judged as acceptable were entered into the site's Corrective Action Program (CAP) where an evaluation of the observation can be made.

Walkdowns were conducted to verify the exterior walls, floors and seals, credited with keeping water out of safety-related areas containing safety related equipment, are capable of performing their intended function based on visual observations. Flood protection features inspected at Byron also included the external hatches that provide access to the refueling water storage tank piping tunnels, and the interface between the Radwaste building and the Auxiliary building radwaste tunnel. The purpose of the walkdowns is to verify conformance with the Byron current licensing basis. The adequacy of the current licensing basis will be addressed in response to NTTF Recommendation 2.1. An outdoor walkdown was conducted to verify that plant modifications implemented since original construction, such as security barrier installation and changes to topography, do not adversely affect plant flooding protection.

Acceptance criteria for visual inspections performed during the walkdowns were developed to identify conditions adverse to quality and included the following considerations:

- Flood protection configuration is in accordance with design drawings and the station's current licensing basis.
- Visual inspection did not identify material degradation per established acceptance criteria (discussed previously).
- When applicable, PMs or periodic inspections are in place, within their required periodicity, and of adequate scope.
- No topography changes, including security barrier installations, compared to conditions assumed in the current design basis site drainage evaluation.

Whether conduits from manholes or cable vaults could provide a path for ground water or rain water to enter safety related buildings was considered relevant to the walkdown scope. Conduits from manholes/cable vaults generally are not routed to safety related buildings at Byron. In a few cases there are conduits that turn up and terminate above grade level such that no path for water is provided. Conduits at Byron do not provide a path for ground water or rain water to enter safety related buildings (Reference 21).

With two exceptions, inspections of walls, floors and penetrations confirmed that credited flood barriers are in place and are capable of performing their intended function. A small slab that serves as an LIP curb between the Radwaste Truck Bay and the Auxiliary Building was observed as "not per design" (Reference IR 01404340). The slab is actually installed 12" below the designed elevation (0.82' below the LIP flood level). Caulking around the LIP curb located in the 1A/1D Main Steam Isolation Valve (MSIV) room was identified as degraded (Reference IR 01414231). These observations, and any other that could not be immediately judged as acceptable, were entered into the Corrective Action Program (CAP) for disposition resulting in these two deficiencies.

A review of the external hatches providing access to the refueling water storage tank piping tunnels, confirmed the hatches are located at an elevation above the maximum LIP.

It was identified that the current calculation does not address the addition of the New Service Building or the installation of the Containment Access Facilities and has been entered into CAP for disposition (Reference IR 01396000).

The flood protection features incorporated in the Byron design provide effective barriers for keeping external flooding from reaching safety-related systems and equipment. Water entering these areas would be accommodated by the floor drain system. However, the walkdowns and document reviews resulted in observations that could not immediately be judged as acceptable. These were entered into the corrective action program for disposition. The SX makeup pump rooms in the river screen house are designed to provide flood protection from CEF level flooding of the river. The exterior walls of the main power block buildings are designed to prevent ingress of groundwater.

In addition to these walkdowns, the station structural monitoring program (Reference 15) provides for ongoing verification of flood barrier effectiveness by identifying/trending areas affected by groundwater ingress.

e. Requested Information Item 2(e) – Implementation of Walkdown Process

Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures) using the documentation template discussed in Requested Information Item 1.j [in Enclosure 4 of the March 12, 2012, 50.54(f) letter], including actions taken in response to the peer review.

Station walkdowns were implemented in accordance with the guidelines provided in NEI 12-07 (Reference 2). The Byron walkdown team included three Sargent & Lundy employees as well as the Byron Lead Responsible Engineer for flooding issues. All team members are familiar with the station licensing basis relative to external flooding, were badged at Byron and completed both NANTeL based training and Exelon specific training on implementation of the NEI 12-07 guidelines. The Sargent & Lundy team consisted of two mechanical engineers familiar with Byron Station and one civil engineer. There were no cases requiring a team member with a specific knowledge. At least two team members performed all visual inspections. Walkdown results were documented using the NEI 12-07 recommended form. Walkdown packages, one for each feature, were prepared in advance and included the NEI 12-07 walkdown form with Parts A and B already completed as well as reference drawings and documentation. The remaining parts of the walkdown forms, including documenting available physical margin (APM), were finalized after the feature walkdown was completed, and the identification of observations entered into CAP. Walkdowns were conducted following the guidance of NEI 12-07 and no exceptions were taken to the guidance.

f. Requested Information Item 2(f) – Findings and Corrective Actions Taken/Planned

Results of the walkdown including key findings and identified degraded, non-conforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Rev 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

The walkdown scope was developed to confirm that flood protection features credited in the current licensing basis are acceptable and capable of performing their credited flood protection functions. For Byron Power Station, the scope primarily consisted of visual inspections of floors and exterior watertight walls both in the River Screen House SX Makeup Pump rooms and in the main power block. The scope included visual inspection of all applicable penetrations and associated seals. In addition, an outdoor walkdown was conducted to confirm credited surface drainage provisions have not been impacted by changes to topography, such as installation of new security barriers. Inspections of credited walkdown features were performed by the walkdown team following the guidance provided in NEI 12-07 and were documented in walkdown packages using the NEI 12-07 walkdown forms. Walkdown record forms are not submitted to the NRC, but as discussed in Section 7 of Reference 2, are retained onsite for NRC inspection. Observations of degraded, non-conforming or unanalyzed conditions were documented and entered into the station corrective action program (CAP).

Observations Not Immediately Judged as Acceptable

With two exceptions, the inspections of walls, floors and penetrations confirmed that credited flood barriers are in place and are capable of performing their intended function. A small slab that serves as an LIP curb between the Radwaste Truck Bay and the Auxiliary Building was observed as “not per design” (Reference IR 01404340). The slab is actually installed 12” below the designed elevation (0.82’ below the LIP flood level). Caulking around the LIP curb located in the 1A/1D Main Steam Isolation Valve (MSIV) room was identified as degraded (Reference IR 01414231). These observations, and any other that could not be immediately judged as acceptable, were entered into the Corrective Action Program (CAP) for disposition resulting in these two deficiencies.

A total of 14 IRs were generated in the process of performing the walkdowns. These, along with the resolution status, are described below and listed in Table 2 with resolutions, in the Conclusions section of this report.

- *IRs 01395377 and 01395379 identify minor corrosion on watertight hatches that provide access to the Auxiliary building via the Refueling Water Storage Tank (RWST) tunnels.*
- *IR 01395487 identified abandoned drain lines located on these RWST hatches that should be sealed. Note, these drains are above the maximum PMP water level so flooding of the Auxiliary building is not a concern.*
- *IR 01395406 identified a floor sleeve in the river screen house SX makeup pump room as not requiring a flood seal. Further investigation revealed this not to be an issue and the issue was closed.*
- *IR 01396000 identified the PMP flooding calculation did not appear to address the addition of the New Service Building and the Containment Access Facilities.*
- *IRs 01395996, 01395999, 01396507 and 01396509 document the evidence of past groundwater intrusion.*
- *IRs 01396742 and 01396746 identify the need to replace installed vent seals in spare conduits with an approved flood seal.*
- *IRs 01407641 and 01414231 identify a loose bolt and degrading caulking on PMP curbs located within the Main Steam Isolation Valve (MSIV) rooms.*

- *IR 01404340 identified the slab functioning as a PMP curb between the radwaste building truck bay and the Auxiliary building is not installed per the design drawings.*

Observations Designated through CAP as Deficient

- IR 01404340 identified the slab functioning as an LIP curb between the radwaste building truck bay and the Auxiliary building is not installed per the design drawings.
- IR 01414231 identified degraded caulking on the LIP curb located within the 1A/1D Main Steam Isolation Valve (MSIV) room.

Observations Awaiting Final Disposition in CAP

None.

Restricted Access Areas

None.

Inaccessible Areas

A portion of the exterior wall located directly behind the Recycle Holdup Tanks (0AB01TA/TB) and the Regeneration Waste Drain Tank (0WX25T) was deemed inaccessible due to the close proximity of the tanks to the wall. Reasonable assurance that these portions of the walls are acceptable is based on the fact that visual inspection of the walls and floors adjacent to these tanks and throughout the plant revealed no deficiencies or degradation that would prevent performance of flood protection functions. There is no conduit or piping penetrations located within these areas, and water stops are provided in all horizontal and vertical construction joints in all exterior walls (Reference 13, Section 3.4.1.3).

g. Requested Information Item 2(g) – Cliff –Edge Effects and Available Physical Margin

Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.

Cliff-edge effects were defined in the NTTF Report (Reference 5) as “the safety consequences of a flooding event may increase sharply with a small increase in the flooding level”. As indicated in Sections 3.12 of NEI 12-07 (Reference 2), the NRC is no longer expecting the Recommendation 2.3: Flooding Walkdowns to include an evaluation of cliff-edge effects. The NRC is now differentiating between cliff-edge effects, which are addressed in Enclosure 2 of Reference 3, and Available Physical Margin (APM).

As indicated in Sections 3.13 of NEI 12-07 (Reference 2), APM describes the flood margin available for applicable flood protection features at a site (not all flood protection features have APMs). The APM for each applicable flood protection feature is the difference between licensing basis flood height and the flood height at which water could affect an SSC important to safety.

APM information was collected during the walkdowns in accordance with guidance provided in NEI 12-07 and the final resolution to FAQ-006 (Reference 22). APM was collected to primarily support the response to Enclosure 2 of Reference 3 and, as such, is not included in this report. APM determinations did not involve calculating cliff-edge effects (i.e. the safety consequences). During the Integrated Assessment (see Enclosure 2 of Reference 3), the cliff-edge effects and the associated safety risks will be evaluated using the APMs and other information, such as the specific SSCs that are subjected to flooding and the potential availability of other systems to mitigate the risk.

Since the walkdowns were completed prior to the final resolution of FAQ-006 (Reference 22), APM information was collected and documented on the Walkdown Record Form using the “old approach”; that is, a simple measurement of the difference between the licensing basis flood height and the flood height at which water could affect an SSC important to safety.

h. Requested Information Item 2(h) – Planned/Newly-Installed Flood Protection Enhancements

Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

- Modification of the LIP curb between the radwaste building truck bay and the Auxiliary building to reflect existing design drawings is required (Reference IR 01404340).
- Replacement of caulking on the 1A/1D MSIV room LIP curb is required (Reference IR 01414231).
- No additional enhancements are planned.
- The PEER review did not result in any changes to the walkdown process or methodology.

5. CONCLUSIONS

With two exceptions, inspections of walls, floors and penetrations confirmed that credited flood barriers are in place and are capable of performing their intended function. All IRs entered into the CAP have been addressed with 2 IRs being deficiencies.

A small portion of the total floor and wall areas within the walkdown scope were deemed inaccessible and were not inspected. Reasonable assurance that these portions of the walls and floors are acceptable is based on the fact that visual inspection of the walls, floors and penetrations in these buildings and throughout the plant revealed no deficiencies or degradation that would prevent performance of flood protection functions.

IR 01404340 identified the slab functioning as an LIP curb between the radwaste building truck bay and the Auxiliary building is not installed per the design drawings. IR 01414231 identified degraded caulking on the LIP curb located within the 1A/1D Main Steam Isolation Valve (MSIV) room. These deficiencies will be restored to original design.

There are no additional enhancements planned.

Table 1 provides a summary of the number and type of features included in the walkdown scope.

Table 2 provides the list of the IRs generated and entered into the station corrective action program (CAP) as a result of the walkdown. The status of each IR at the time of this report is indicated. None of these IRs resulted in an operability concern.

Table 1: Features Included in the Walkdown Scope

Type	# of Visual Inspections	# of Simple Simulations	# of Complex Simulations	# of Drills or Exercises
Incorporated/Exterior Passive	39	0	0	0
Incorporated/Exterior Active	0	0	0	0
Temporary Passive	0	0	0	0
Temporary Active	0	0	0	0
Totals	39	0	0	0

Table 2: IRs Generated in CAP

IR Number	Description	Proposed Resolution	Status
01395377	Identification of minor surface corrosion on Unit 1 RWST tunnel hatch	Close to work request.	Actioned to work order 01563689
01395379	Identification of minor surface corrosion on Unit 2 RWST tunnel hatch	Close to work request.	Actioned to work order 01563690
01395406	One of four floor penetrations in slab does not call out flood seal.	None. Previous IR 1139072 accepted gap in an adjacent penetration due to elevation of electrical components in room.	Closed-no further actions required
01395487	Identification of RWST tunnel hatch abandoned drains. Drain is located above PMP height, but provides a vent path into Aux. Bldg.	Install seal in drains.	AT 1395487-04 is tracking resolution.
01395996	Evidence of past water intrusion on 1A/2A SX PP room.	Closed to CAP trending.	Closed-no further actions required
01395999	Evidence of past water intrusion on 1B/2B SX PP room.	Closed to CAP trending.	Closed-no further actions required

IR Number	Description	Proposed Resolution	Status
01396000	LIP flooding calc does not address the addition of New Service Bldg or Containment Access Facilities.	Reconstitution of calc during the 2.1 Flood Hazard Assessment.	AT 1396000-02 is tracking resolution
01396507	Evidence of past water intrusion on Unit 1 Auxiliary Bldg. El. 346' walls.	Closed to CAP trending.	Closed-no further actions required
01396509	Evidence of past water intrusion on Unit 2 Auxiliary Bldg. El. 346' walls.	Closed to CAP trending.	Closed-no further actions required
01396742	Spare conduit requires flood seal installed	Replace seal.	Actioned to work order 01563694
01396746	Spare conduit requires flood seal installed	Replace seal.	Actioned to work order 01563695
01404340	Concrete slab performing a PMP curb installed 12" lower than design drawing.	Correct deficient condition. Install concrete to height required on drawings.	Actioned to work order 01574214
01407641	Loose bolt on 2A/2D MSIV room PMP curb	Tighten loose bolt.	Actioned to work request 410721
01414231	Identification of degraded caulking on 1A/1D MSIV room PMP curb	Remove and re-install per S-993.	Actioned to work request 415856

6. REFERENCES

1. Exelon Letter to U.S. Nuclear Regulatory Commission. *Exelon Generation Company, LLC's 90-Day Response to March 12, 2012 Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1 and 2.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident (Flooding)*. June 11, 2012.
2. Nuclear Energy Institute (NEI), Report 12-07 [Rev 0-A]. *Guidelines for Performing Verification Walkdowns of Plant Protection Features*. May 2012 [NRC endorsed May 31, 2012; updated and re-issued June 18, 2012].
3. U.S. Nuclear Regulatory Commission. Letter to Licensees. *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*. March 12, 2012.
4. U.S. Nuclear Regulatory Commission. *Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire*. NUREG-1852. October 2007.
5. U.S. Nuclear Regulatory Commission. *Recommendations for Enhancing Reactor Safety in the 21st Century, The Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*. July 12, 2011.
6. U.S. Nuclear Regulatory Commission. *Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety*. NRC Inspection Manual. Part 9900: Technical Guidance. Regulatory Issues Summary 2005-20, Revisions 1. September 26, 2005.

7. Institute of Nuclear Power Operations. *Fukushima Dai-ichi Nuclear Station Fuel Damage Caused by Earthquake and Tsunami*. INPO Event Report 11-1. March 15, 2011.
8. U.S. Nuclear Regulatory Commission. *Follow-up to the Fukushima Dai-ichi Nuclear Station Fuel Damage Event*. Inspection Manual. Temporary Instruction 2515/183. ML113220407. November 2011.
9. U.S. Nuclear Regulatory Commission. *Inspection of Structures, Passive Components, and Civil Engineering Features at Nuclear Power Plants*. Inspection Manual. Inspection Procedure 62002. Section 03.01(h), Dams, Embankments and Canals.
10. U.S. Nuclear Regulatory Commission. *Evaluate Readiness to Cope with External Flooding*. Inspection Procedures. Attachment 71111.01. *Adverse Weather Protection*. Section 02.04.
11. U.S. Nuclear Regulatory Commission. *NRC Inspector Field Observation Best Practices*. NUREG/BR-0326, Rev. 1. August 2009.
12. U.S. Nuclear Regulatory Commission. *Flood Protection for Nuclear Power Plants*. Regulatory Guide 1.102.
13. Byron UFSAR, Rev. 13
14. Byron/Braidwood Structural Project Design Criteria, DC-ST-03-BY/BR, Rev. 23
15. Exelon Procedure ER-AA-450, Rev. 1, Structures Monitoring
16. Drawing M-48, Sheet 19, Rev. AE
17. Supplemental Walkdown/Inspection Guidance, Rev. 1, August 17, 2012
18. Calculation WR-BY-PF-10, Rev. 4D, Effect of Local Probable Maximum Precipitation (PMP) at Plant Site
19. Drawings S-899, Rev. Z, S-900, Rev. AB, S-973, Rev. X and S-974, Rev. Z
20. Drawing A-47, Rev. AK
21. Drawings 6E-0-3680, Rev. AF and 6E-0-3681, rev. AL
22. FAQ-006, Rev. 4, 9/13/12