**Exelon Generation**

10 CFR 50.54(f)

RS-12-168

November 27, 2012

U.S. Nuclear Regulatory Commission
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Dresden Nuclear Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

**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 Dresden Station, Units 2 and 3 180-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 Dresden Station Units 2 and 3.

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 Dresden Nuclear Power Station, Units 2 and 3

cc: Director, Office of Nuclear Reactor Regulation
Regional Administrator - NRC Region III
NRC Senior Resident Inspector – Dresden Units 2 and 3
NRC Project Manager, NRR – Dresden Units 2 and 3
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 Dresden Station, Units 2 and 3

**(50 pages)**

# FLOODING WALKDOWN REPORT

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

**for the**

**DRESDEN NUCLEAR POWER STATION (UNIT 2 & UNIT 3)**
**6500 North Dresden Road, Morris, IL 60450**
**Renewed Facility Operating License Nos. DPR-19 & DPR-25**
**NRC Docket Nos. 50-237 & 50-249**

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Exelon

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November 20, 2012

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# 1. EXECUTIVE SUMMARY

Per NRC's request, a flooding protection walkdown was conducted at Dresden Nuclear Power Station (Dresden Station) to identify and address plant-specific degraded, nonconforming, or unanalyzed conditions of plant's flood protection features, including flood mitigation procedures. The flooding walkdown was conducted between August 8 and August 16, 2012 and included visual inspections and reasonable simulations.

The scope of the flooding walkdown was developed following a detailed review of all relevant licensing documents. Since the site is inundated during the design basis PMF event, Dresden Station is licensed to mitigate against the affects of a flood by implementing procedures to prevent damage to the reactor core. The main flood emergency procedure (DOA 0010-04) invokes several standard operating procedures to provide for safe shutdown and cool-down of both reactors. Therefore, the flood emergency procedures along with associated standard operating procedures were the main focus of the walkdown. Dresden Station does not have incorporated/exterior or temporary features that are credited in the current licensing basis (CLB) documents with providing flood protection. However, below-grade structures (i.e., basement walls and basement slabs) of Unit 2 and 3 Reactor and Turbine Buildings were designed to withstand hydrostatic loads associated with extreme groundwater conditions and were visually inspected as part of the flooding walkdown.

The methodology and acceptance criteria for the evaluation of flood protection features was developed based on NEI report 12-07 (Rev 0-A), *Guidelines for Performing Verification Walkdowns of Plant Protection Features.* The verification process for all implementing procedures included a reasonable simulation (i.e., a detailed procedure walk-through with the staff responsible for implementation of the procedure). For procedures or procedural steps that have not been performed in the past, a drill or exercise was performed as part of the reasonable simulation to verify that the procedure can be performed as specified. Since standard operating shutdown procedures are an integral part of the of the flood mitigation strategy at Dresden Station, these procedures were also reviewed to verify that they can be implemented during a flood emergency and will not be challenged by flooding conditions.

Visual inspections of below-grade walls of Unit 2 and 3 Reactor and Turbine Buildings were conducted to verify there are no potential observable structural deficiencies that may impact the structure's ability to withstand hydrostatic loads. In addition, penetration seals were also visually inspected and documented as a component of the wall features. There were fifteen (15) areas with below-grade walls and slabs, which were visually inspected during the walkdown. All of the walls and slabs were accessible; however, three penetrations were considered inaccessible, due to a pipe configuration or a pull box preventing access to the penetration. Since the penetrations are not credited as individual flood protection features in the CLB, review of available drawings and engineering judgment were used to assess whether they could potentially impact the ability of below-grade walls to function as a flood barrier. There was no evidence of leakage below these inaccessible penetrations.

Electrical conduits entering the reactor building were evaluated to determine whether they can provide a pathway for groundwater into safety-related buildings. In general, electrical conduits routed to safety-related buildings are equipped with couplings and plugs on both ends to prevent groundwater intrusion. At one instance, two electrical conduits were routed through a penetration sleeve with an internal seal, which was inaccessible for visual inspection during the walkdown; however, a reasonable assurance that the condition of the conduit is acceptable was provided. None of the electrical conduits entering the safety-related areas of the plant are routed through electrical manholes.

The flood emergency procedure and the associated procedures (including standard shutdown procedures) were reasonably simulated to ensure that they can be performed as specified and protect the reactor from core damage during flooding conditions. Overall, nineteen (19) reasonable simulations related to the implementation of the flood emergency procedure were performed. Based on the results of the evaluation and the review of operator logs, the critical path items of the flood emergency procedure can be implemented as written if sufficient flood warning available. During the evaluation it was determined that resources are not available to accurately predict river levels at the Dresden intake in advance. However, it is reasonable to assume that a limited flood warning would be obtained from Dresden Lock Master or using river forecasting tools for the Illinois River watershed. In addition, the flood emergency procedure is also entered following a notification from Transmission System Operator predicting rainfall of ≥ 2 inches in 6 hours. This allows the site to initiate flood protection measures based on a rainfall forecast and/or limited flood warning. Assuming that only a short flood warning is available, the construction of the Isolation Condenser Makeup Pumphouse sandbag may not be implemented in time using the available resources. However, initiation of sandbagging preparations at an earlier point in the flood emergency procedure due to weather forecast will aid the Station in timely construction of the sandbag berm and provide additional margin of safety.

## 2. PURPOSE

### a. Background

In response to the nuclear fuel damage at the Fukushima Daiichi 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 regarding "cliff-edge effects").

Structures, systems, and components (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, 2012 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

Dresden Station is located approximately 8 miles east of Morris, Illinois. The plant is located at the confluence of the Kankakee, Des Plaines, and Illinois rivers, which are the major flooding sources considered in the CLB. The contributing drainage area to the Kankakee River upstream of the intake is approximately 5,165 square miles, and the contributing drainage area to the Des Plaines River upstream of the confluence is approximately 2,111 square miles.


**Figure 1: Site Location**

The plant is situated directly adjacent to the river, with a design plant grade elevation of 517.0 feet Mean Sea Level (MSL). All of the elevations referenced in the Dresden Licensing documents are based on a MSL Datum. The lowest sub-grade floor containing equipment important to safety are service water pumps motors in the intake structure, which are set on a floor elevation 509.0 ft MSL and are unprotected from flooding above this elevation (Reference 10). Non-watertight openings in walls of safety-related structures are located at elevation 517.5 ft MSL. There are no exterior flood protection barriers (i.e., levees, dikes, gates) that will prevent flooding at the site. The Dresden Station's external flood mitigation strategy is to prevent loss of safe plant control that could be caused by the Probable Maximum Flood (PMF) of the Illinois and Kankakee rivers through the implementation of a flood emergency procedure. The flood emergency procedure entails the safe shutdown of the plant. The PMF is estimated to reach a peak Stillwater Elevation of 524.5 ft MSL. Wind-generated waves on the Kankakee River would be 2.6 feet high and wave run-up would reach 3 feet above stillwater level, increasing the maximum water surface elevation to approximately 528 ft MSL (Reference 10). As a result, predicted maximum water surface elevations are significantly above both the plant grade elevation and the lowest opening leading to safety-related equipment. It is also estimated that the plant would experience flooding (water elevations greater than the design plant grade of 517.0 ft MSL) for 57 hours, and will require the emergency diesel make-up pump to provide make-up water to the isolation condensers for at least 78 hours before the flood water receded to elevation 509 ft MSL and additional 12 hours to allow for service water pump motors to be re-installed. The CLB also considered the affects of a local intense precipitation (LIP) on site drainage.

## 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-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.

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. 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

Exelon's approach to the flooding walkdowns included three phases:

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

Phase 2 – Inspections and Reasonable Simulations

Phase 3 – Final Reporting

The purpose of Phase 1 was to obtain a clear understanding of the site's flood mitigation strategy; develop scope, methodology, and acceptance criteria for the walkdowns; and logistical planning. The following activities were performed during Phase 1:

- Data gathering (CLB documents, procedures, and O&M procedures and documentation);
- Site visit to preview features and plant conditions;
- Desktop review of CLB documents to identify and describe the CLB flood hazard;
- Desktop review of CLB documents to identify and describe flood protection/mitigation strategy;
- Development of Walkdown List;

- Development of Walkdown methodology and acceptance criteria;
- Logistics and strategy planning; and
- Preparation of Walkdown Packages.

The purpose of Phase 2 was to execute the Flooding Walkdown for Dresden, which included:

- Visual Inspection;
- Reasonable Simulation;
- Evaluation of maintenance/monitoring procedures; and
- Documentation of observations and possible deficiencies.

The purpose of Phase 3 is to develop the Walkdown Report to document the methodology and findings of the Flooding Walkdowns and provide a response to "Requested Information" section of the "Recommendation 2.3: Flooding" enclosure from the 10CFR50.54 (f) letter. The Walkdown Report was developed per the template provided in NEI 12-07 [Rev. 0-A], Appendix D.

## c. Reasonable Simulations

A procedure walk-through, or "Reasonable Simulation", was conducted for temporary and/or active features that require manual/operator actions to perform their intended flood protection function. The purpose of the reasonable simulations was to verify the procedure or activity can be executed as specified/written. Per NEI 12-07 (Reference 2), reasonable simulation included 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 has been periodically demonstrated and documented that the activities can be completed in the credited time.

The Flooding Walkdown activities for Dresden predominantly involved reasonable simulations since the flood mitigation strategy is to execute the flood emergency procedure, which prepares the plant for safe shutdown prior to the advent of the CLB flood event. The following categories of reasonable simulations were performed:

- Simple Simulations – simulations/walk-throughs with short performance times that have been previously performed, and for which records are available to document the successful implementation of the procedure in the credited time.
- Complex Simulations - simulations/walk-throughs with long performance times that have been previously performed, and for which records are available to document the successful implementation of the procedure in the credited time.
- Drills or Exercises – activities that have not been performed before require the actual performance of the activity to demonstrate that they can be completed in the credited time.
- Records/Desktop Evaluation - for procedures that are considered standard operating procedures, such as plant shutdown procedures. Only the portions of these procedures that are applicable to the flood response should be validated. The validation/evaluation should include review of past performance records to verify that the procedure can be executed in the credited time. The evaluation should also include the possible effect flooding conditions on execution of the procedure and whether the available warning time is sufficient to execute the procedure.

As part of the reasonable simulations, visual inspections were performed to verify that tools, materials, and components required to execute the procedures were in working order, stored, and accessible per the requirements of the procedures.

The Reasonable Simulation Worksheets and Walkdown Record Forms were used to document the results of the reasonable simulations.

Overall, nineteen (19) reasonable simulations of procedural steps or standard shutdown procedures were performed to demonstrate compliance with the CLB requirements. Table 1 provides a summary of reasonable simulations performed during the walkdown. A detailed description of each reasonable simulation is provided in Section 4.d of this report.

**Table 1: List of Reasonable Simulations**

| Simulation # | Simulation Name |
|---|---|
| 1 | Flood Warning & Flood Watch |
| 2 | Diesel-driven Emergency Make-up Pump (moving and staging) |
| 3 | Construction of Sandbag Berm around the Isolation Condenser Make-up Pumps Building |
| 4 | Deenergize Motor Control Centers (MCCs) |
| 5 | Manual Operation of the Isolation Condensers |
| 6 | Prepare for the Removal of SWP Motors and Secure 2-3 SWPs |
| 7 | Raise Water Storage Tank Level & Check/Fill Below-ground Water Storage Tanks |
| 8 | Restore Reactor Vessel to Normal Water Level |
| 9 | Seal Diesel Oil Storage Tank Vents |
| 10 | Secure Isolation Condenser Pumps |
| 11 | Unit 1 – DFP Control Switch Off Secure Equipment, Secure Power to PC-5 |
| 12 | Unit 1 Post Incident Pump |
| 13 | Close/Open Fire Protection System Valves |
| 14 | Open Plant Doors |
| 15 | Place Local Isolation Condenser Sightglass into Service |
| 16 | Loss of Spent Fuel Pool Cooling |
| 17 | Reactor Scram |
| 18 | Reactor Vessel Slow Fill |
| 19 | Unit Shutdown |

## 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 Watertight 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 design basis flood hazard level for the Dresden site has been evaluated by the NRC as part of the Systematic Evaluation Program (SEP) Topics II-3.A, II-3.B, II-3.B.1 and II-3.C, which was completed in 1982. The results of the SEP study were presented in the Safety Evaluation Report (Enclosure 1) and Technical

Evaluation Report (Enclosure 2). Based on the information provided in the SEP report, the design basis flood hazard level is associated with the PMF, which results in a peak stillwater elevation of 524.5 ft MSL. Coincidental 2-year wind generated waves and wave run-up would increase the maximum water surface elevation to approximately 528 ft MSL. Both flood elevations are significantly above the grade elevation (517.0 ft MSL), the elevation of non-watertight openings in walls of safety-related structures (517.5 ft MSL), and the lowest sub-grade floor containing equipment important to safety (Crib House) (509.0 ft MSL).

The peak flow rate for the PMF was determined by estimating the watershed's response to the Probable Maximum Precipitation (PMP), following the procedure described in EM 1110-02-1411. The PMP used in the analysis was based on a 23.25-inch, 24-hour index storm distributed over 72 hours. Using the USACE HEC-1 software, the peak discharge in the Illinois River was estimated to be 490,000 cfs. The PMF peak discharge for the Illinois River was used in the USACE HEC-2 computer program to compute the corresponding flood stage at the site. The HEC-2 model was calibrated to recorded high water marks from the 1947 and 1957 floods. The PMF hydrograph, presented in Enclosure 2 of the SEP report, indicates that the plant would experience flooding conditions (elevations greater than 517.0 ft MSL) for approximately 57 hours. Flooding of SSCs would begin at river flows between 240,000 cfs and 290,000 cfs (Reference 10). The PMF hydrograph is provided in Figure 2 and is annotated with the corresponding flood elevations and timing.

In addition to estimating flood hazard levels associated with the PMF, the SEP report evaluated the flood hazard for LIP (i.e., site drainage flooding) and determined that the 29-acre study area can produce an estimated peak discharge of 1,230 cfs from the LIP. Two site drainage scenarios were evaluated to estimate the depth of flooding adjacent to the buildings. The first assumed that flooding from a LIP within the three drainage areas occurred simultaneously and was combined and routed through a single drainage channel. An evaluation of the drainage channel determined that the channel could convey the peak flow rate associated with the LIP event. The second analyses evaluated the drainage characteristics of the site and between the buildings. The results of the analysis showed a peak flood depth of 0.45 ft. Since the difference in elevation between the land surface and the finished floor of the buildings 0.5 ft, there is approximately 0.05 ft of freeboard during the LIP event before safety-related equipment is affected. The affects of the LIP event on roof structures was also evaluated. None of the roofs of safety-related structures were designed to sustain LIP loading with the drains clogged. As such, the NRC recommended that structural modifications be completed (Reference 10). Scuppers in the roof parapets of the turbine building, reactor building, and the crib house were installed to comply with the recommendation.

The SEP report indicates that normal groundwater levels at the site are between elevations 505 and 508 ft MSL and the design basis groundwater elevation is 514 ft MSL. However, supporting documentation for the determination of the design basis groundwater elevation was not provided. The NRC acknowledged that the groundwater levels in the plant area are controlled by the water levels in the adjacent water bodies and that the groundwater elevation of 514 ft MSL may be a reasonable estimate. Regardless, the NRC recommended that a design basis of 517 ft MSL be used in combination with seismic events to evaluate structural stability and integrity of the buildings.

According to the UFSAR (Section 3.4.1.1), the structures for Units 2 and 3 were designed to withstand hydrostatic loads, including those associated with extreme groundwater elevations, up to the plant grade elevation. Once flooding reaches above the plant elevation, then flooding of the interior of the structures, which will occur per the CLB, is postulated. This has been previously reviewed and assessed by the NRC (SEP report, Topic III-3.A), which states that floods or high water level will not jeopardize the structural integrity of the plant's seismic Category I structures and that these structures are adequately protected. For the purpose of the flooding walkdowns, groundwater ingress was not identified as a plausible flood-causing event since there are no penetrations or flood protection features credited with providing a barrier to prevent against groundwater ingress were identified in the CLB documents. However, since the CLB did identify the plant basement walls as being designed to withstand hydrostatic loading, the flooding walkdown included visual inspection of the below-grade structures (i.e. basement walls and floor slabs) to verify there are no potential observable physical deficiencies (i.e. cracking, spalling, or degraded concrete) that may impact the structure's ability to withstand hydrostatic loads. The purpose of the visual inspection is solely to verify the structural integrity of the walls and floor slabs, including any associated penetrations and seals. The CLB does not identify the wall as a barrier credited to prevent groundwater ingress and, therefore, potential penetrations through the wall below grade were not included as individual features on the Walkdown List. Penetrations and associated seals were inspected as a component of the wall to identify if there are any observed degraded conditions. Any degraded conditions related to penetrations were recorded on the Field Observation Report and attached to the Walkdown Record Form for the associated wall feature.

Ice-induced flooding was not identified as a concern for safety-related equipment. A log boom is located at the entrance of the intake canals to prevent floating ice chunks from reaching the intake structures. The reach of the Kankakee River upstream from the confluence of the Des Plaines River is kept free from ice to maintain clear shipping lanes. In addition, no flooding problems have been recorded in the past.

No additional flood-causing events, which could result in a flood hazard for the safety-related equipment, were identified in the CLB documents.

Since Dresden Station is not considered a "flood dry" site (i.e., the site will be inundated during the design basis PMF event), the flooding strategy primarily involves implementation of flood emergency procedures to mitigate the effects of the flood and prevent damage to the reactor core. Sufficient flood warning is critical for a successful execution of the flood emergency procedure, including the safe shutdown of both reactors, removal of decay heat, and staging of emergency equipment for alternate reactor cooling. Two types of flood hydrographs are presented in the SEP report, which can be used to estimate the minimum required flood warning: the PMF hydrograph (Figure 2) and the critical-time hydrograph (Figure 3). The PMF hydrograph and stage-discharge curve indicates that the time between the onset of rainfall and the time when the flood levels reach plant grade elevation is 51 hours. The plant would then continue to be inundated for 57 hours and it would take another 23 hours for flood elevation to recede below elevation 509 ft MSL. The critical-time flood hydrograph depicts the relationship of flood elevation to time since the beginning of the limiting rainfall event. The critical-time flood is defined as the flood during which water level rises to elevation 509 ft MSL and subsequently to 517.5 ft MSL. In addition, the report states that the time frame in which safe shutdown must be achieved is determined by the critical flood. Based on the critical-time hydrograph, 33 hours will be available from the onset of the limiting rainfall event until the Illinois River reaches elevation 517.5 ft MSL and begins flooding the safety-related equipment in the main reactor building. For the purpose of the walkdown, the shortest time period, as represented on the critical-time hydrograph, should be used to evaluate whether the procedure can be executed as specified. The duration of the flood was evaluated based on the time period as determined by the PMF hydrograph. However, additional considerations were given to procedural steps completed between water surface elevations 509 ft MSL and 517 ft MSL. The PMF hydrograph shows that only 7 hours will be available to complete the required activities before floodwaters rise from 509 ft MSL to 517 ft MSL. This time frame is shorter than in the critical-time hydrograph, which shows 11 hours for floodwaters to rise from 509 ft MSL to 517.5 ft MSL. Because the critical-time and PMF hydrographs appear to control procedures and resources at different flood elevations, the time period to implement these tasks were evaluated against both hydrographs to establish the shortest time available to achieve safe shutdown of the reactor.

The CLB does not address specific plant configurations during various modes of operation. However, a full power operation mode was considered during the evaluation, as this represents the most critical plant failure mode.

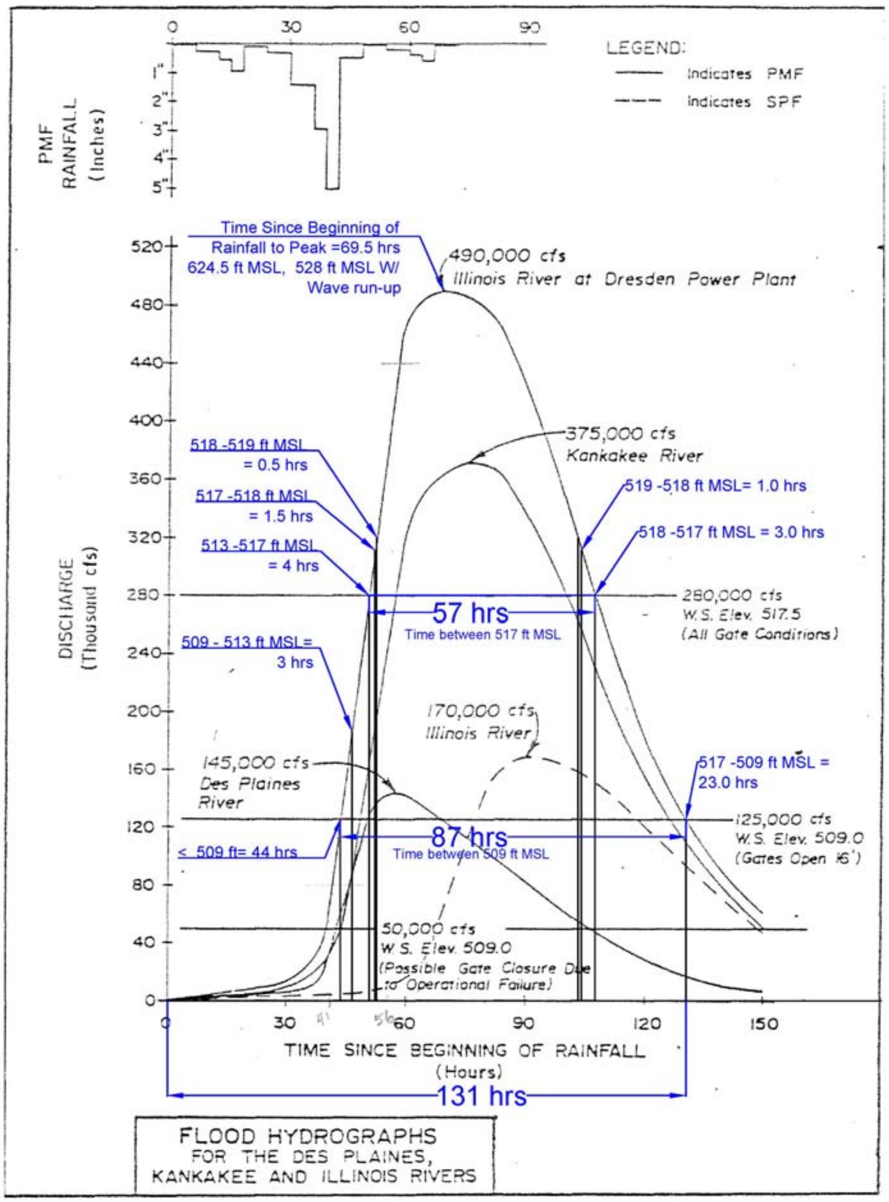


**Figure 2: PMF Hydrograph from the SEP report (annotated with the corresponding flood elevations and timing).**

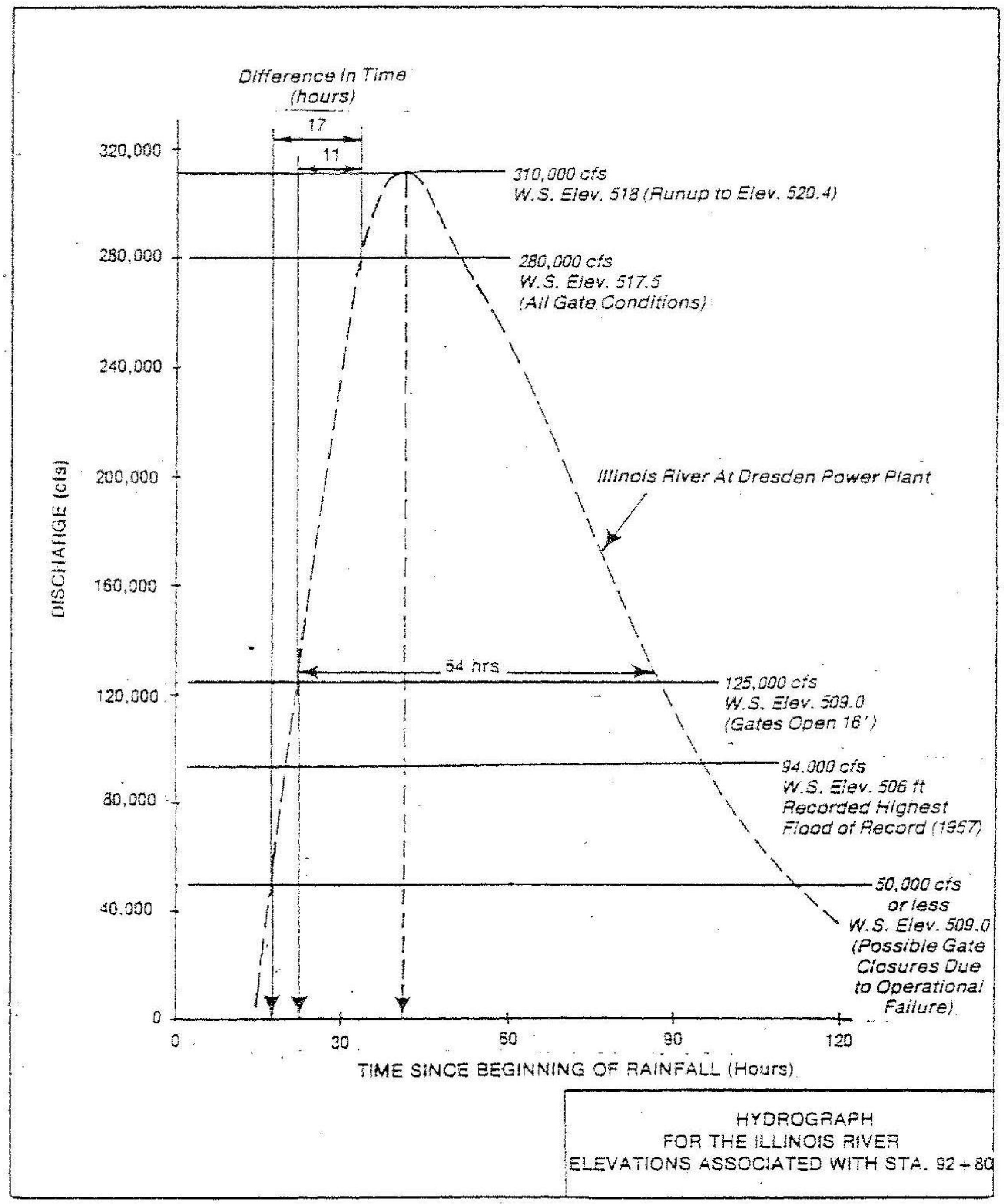


**Figure 3: Critical-Time Hydrograph from the SEP report.**

## 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 Dresden Station is inundated during the PMF event and external flood mitigation efforts are directed toward the prevention of damage to the reactor core during flooding conditions. In addition, the structures for Units 2 and 3 are designed to withstand hydrostatic loads, combined with other applicable loads, up to grade elevation of 517 ft MSL. The external flood protection procedure for Dresden makes use of onsite equipment to achieve a safe shutdown of the reactor and requires the opening of all doors to permit free flow of water through the plant. Along with this, the procedure utilizes the reactor cooling systems to discharge decay heat throughout the term of the PMF.

The flood emergency procedure (DOA 0010-04) is credited in the CLB documents as the protection measure available to minimize the impact of an external flood event. The procedure requires that actions or other procedures are initiated when the flood waters reach certain elevations to successfully maintain the reactor core in a safe and stable condition. The following paragraphs provide a summary of the flood emergency procedure and the main actions that are initiated when flood waters reach a certain elevation.

The procedure is initiated by a flood forecast by the U.S. Weather Service, notification of predicted rainfall exceeding 2 inches in 6 hours or for actual water levels exceeding elevation 506 ft MSL in the Unit 2/3 Crib House. Consequently, flood monitoring is conducted at least once every 2 hours. Since the lowest opening to equipment important to safety is at elevation 509 ft MSL, procedures for Unit Shutdown (DGP 02-01) and Vessel Slow Fill (DGP 02-02) are invoked when river levels are predicted to exceed elevation 509 ft MSL within three days. Reactor Scram (DGP 02-03) and Vessel Slow Fill (DGP 02-02) are initiated should the flood levels reach elevation 509 ft MSL and a sufficient flood warning was not issued to allow normal unit shutdown. In, addition, a flood protection sandbag berm is constructed around the isolation condenser make-up pumps building. When flood levels reach elevation 509 ft MSL additional steps are initiated, including:

- Removal of two Unit 2 service water pump motors to relocate above 530 ft MSL to allow them to be available for service once the flood recedes.
- Staging of the diesel-driven emergency make-up pump in the center of Unit 2 Reactor Building equipment hatch on elevation 517.5 ft MSL and setting up the pump for operation, including lifting of the pump using a crane and building of scaffolding.
- Configuring of valves in the fire protection system to allow for connection of pump to the system.

Once flood water levels reach an elevation of 513 ft MSL, additional procedures are initiated to secure service water pumps (DOP 3900-01), transfer reactor cooling to isolation condenser (DOP 1300-03), and to initiate plans to address loss of fuel pool cooling (DOA 1900-01) and Attachment C of the flood protection procedure (DOA 0010-04).

Once flood water levels reach an elevation of 517 ft MSL, all transformers and electrical equipment will be de-energized and reactor doors will be opened to permit uninhibited water flow through the plant. Several other actions are performed prior to this when the river levels are predicted to exceed 517 ft MSL, including sealing of vents on below ground diesel oil storage tanks, filling of below-ground water storage tanks with de-mineralized water, and securing of motor boats for transportation.

The diesel-driven emergency make-up pump would be started providing make-up water to the isolation condenser used for cooling of the reactors when the flood level reaches elevation 518 ft MSL. The pump will continue to operate until water recedes below an elevation 509 ft MSL and two service water pumps are installed and made operational. The pump will be attached to a crane and raised and lowered as the flood level rises and recedes.

Based on the critical-time hydrograph, approximately 33 hours after the onset of the limiting rainfall event water levels will reach an elevation of 517.5 ft MSL and begin flooding safety-related equipment located in the main reactor building. As such, it is critical that available instrumentation and forecasting data pertaining to regional precipitation and water level rise are monitored to ensure advanced warning in the event of the PMF or the critical flood.

While not specifically mentioned in the CLB, below-grade walls and slabs of the reactor and turbine buildings were considered to be flood protection features at Dresden Station. These structures and the associated penetrations are intended to prevent groundwater ingress into the space credited as dry before flood waters reach elevation 517.5 and before exterior doors are opened to allow free flow of water into the building. It is critical, however, that the below-grade structures provide protection against groundwater ingress since safety-related SSCs are located in basement areas of reactor and turbine buildings. These SSCs are credited with maintaining reactor cooling until the emergency pump is used to provide make-up water for the isolation condensers and groundwater ingress prior to the shutdown of both units could affect plant's implementation of the flood emergency procedure. The CLB documents do not indicate that Station sump pumps were installed to control groundwater ingress. Furthermore, the sump pumps do not penetrate through basement floor slabs and, therefore, they were not included in the scope of the flooding walkdown.

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

<u>Describe any warning systems to detect the presence of water in rooms important to safety.</u>

Since the site is allowed to be flooded, warning systems in rooms important to safety are not credited in the plant's external flooding licensing basis and were not identified as part of the walkdown. According to the flood emergency procedure, rising flood levels would be monitored at least once every two hours once the intake canal level exceeds 506 ft MSL. Frequent monitoring of flood levels is critical for initiation of certain flood emergency actions and the successful implementation of the flood emergency procedure. In addition to frequent monitoring of flood levels at the intake bay, plant staff would communicate with the Dresden Lock Master on a regular basis to determine actual flood levels on site. It is expected that once the Unit 2/3 Crib House is flooded, the site would have to rely on the Dresden Lock Master to report actual flood levels on site.

## 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."*

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

As described in Section 4 b, Dresden Station's flood protection strategy against external flooding is governed by a flood emergency procedure. The flood emergency procedure invokes other procedures and actions intended to safely shut down the reactor, protect the reactor core and provide make-up cooling during the design-basis flood when other cooling systems are not operational. The evaluation of the flood emergency procedure was performed in accordance with NEI 12-07 guidelines using the acceptance criteria developed prior to the execution of the walkdown. Due to the complexity of the flood emergency procedure, the evaluation of its effectiveness was performed by first evaluating individual procedural steps and actions during the walkdown, followed by a desktop evaluation of the procedure as a whole. The individual procedural steps and actions were drilled or simulated during the walkdown to verify that the actions can be completed in the credited time and to estimate the manpower resources required to complete the task. The desktop evaluation of the flood emergency procedure included evaluation of available resources based on past staffing logs and estimates of staff available to respond to emergency. This section is divided into the following sub-sections:

1. Field evaluation of Flood Emergency Procedure – evaluation of effectiveness of procedural steps and actions based on reasonable simulations. Times stated for performing each procedure or procedural step were based on the actual performance of the drill/exercise or, in case of simulations that were performed in the past, on an estimate provided by the staff responsible for execution of the procedure.

2. Desktop evaluation of Flood Emergency Procedure – evaluation of overall effectiveness of the entire flood emergency procedure.

3. Evaluation of Incorporated Passive Barriers – evaluation of below-grade walls and slabs against ground water ingress.

4. Site Topography – evaluation of site topography (i.e. contours, slopes, grades, imperviousness, structures, fences, etc.) against that assumed in the CLB site drainage evaluation.

***<u>FIELD EVALUATION OF FLOOD EMERGENCY PROCEDURE</u>***

**Flood Warning and Flood Watch**

- Flood warning and flood watch are two critical components of the flood emergency procedure. The flood emergency procedure requires that Operations Supervisor monitors weather and flood forecast using available sources such as the National Weather Service (NWS) - Chicago Office, USACE, and Exelon's own weather monitoring system. In addition, Exelon's Transmission System Operator would alert Dresden Station of any severe weather conditions to occur in the area. The flood emergency procedure specifies what actions need to be taken if adverse weather conditions or flood conditions are forecast within a certain time period.

  Plant Operators also monitor river levels at the Unit 2/3 Crib House every 24 hours. The monitoring frequency increases when river levels exceed certain elevation to ensure that there is sufficient flood warning and time for implementation of flood emergency actions.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 1 | Continuous monitoring of flood levels |
| 2) | Operations Supervisor | 1 | Continuous monitoring of flood & weather forecast |

- The walkdown team interviewed the Operations Support Manager to evaluate whether plant staff is knowledgeable of procedural steps related to flood warning and flood watch and whether the plant can receive sufficient flood warning to allow for successful implementation of the flood emergency procedure. Based on AMEC's evaluation, the site has resources and ability to monitor weather conditions and flooding in real time; however, the ability to predict flood levels at the site appears to be limited. This is due in part to variables that affect the ability to predict river levels at the Dresden Intake, such as operation of the lock and dams both upstream and downstream of the site. The flood emergency procedure states that Unit 2 and Unit 3 reactors should be shut down using the Unit Shutdown (DGP 02-01) standard operating procedure and subsequent tasks are initiated when the river levels are predicted to exceed elevation 509 ft MSL within 72 hours. However, current river forecasting tools are not able to reliably predict exactly when 509 ft MSL will be exceeded at the Dresden intake. When reviewing available information, if Station personnel anticipate water levels exceeding 509 ft MSL any time within the next 72 hours a plant shutdown is initiated.

- The Flood Warning and Flood Watch procedural step can be implemented successfully by plant staff. The Operations Support Manager interviewed during the walkdown was knowledgeable of the procedure and was able to perform the required actions as specified. While resources are not available to accurately predict river levels at the Dresden intake, it is reasonable to assume that a limited flood warning can be obtained from Dresden Lock Master or using river forecasting tools for the Illinois River watershed. In addition, the Flood Emergency Procedure is entered following a notification from Transmission System Operator predicting rainfall of ≥ 2 inches in 6 hours. This allows the site to initiate flood protection measures based on a rainfall forecast and/or limited flood warning.

**Diesel-driven Emergency Make-up Pump (moving and staging)**

- The diesel-driven emergency make-up pump (Godwin Model HL80) is used to provide make-up cooling for the isolation condensers once flood waters exceed elevation 518 ft MSL per step 14.c. The make-up pump is connected to plant's fire suppression system and uses river water as source of make-up water. The pump is located in the Emergency Response Organization barn and hoses and fittings, which are required to connect the pump to the fire suppression system, are located in the Sea-Vans storage container. Once the flood waters are predicted to reach or exceed elevation 509 ft MSL, the pump, hoses, and fitting are moved to the center of the Unit 2 Reactor Building equipment hatch. The hoses are then connected to the pump and the fire suppression system is disengaged to allow for connection of the hoses to the fire suppression system. Finally, the pump is rigged to the reactor building crane (or the jib crane) with a chain fall to ensure that it can be manually moved up and down as the flood waters rise and recede. Scaffolding is built up to a 15-ft height to allow for operation of pump controls and the chain fall. Since the pump is expected to operate for extended period of time, additional diesel fuel supply is staged on the floor at elevation 545 ft MSL. The diesel fuel would be then transferred to the emergency make-up pump tank using a hand pump, hose, and a funnel.
- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Mechanical Maintenance Staff | 4 | **3.6 hours** |
| 2) | Mechanical Maintenance Supervisor | 1 | |
| 3) | Equipment Operators | 4 | |
| 4) | Operations Supervisor | 1 | |

- The walkdown team observed a drill of this procedural step, which included moving the make-up pump and hoses inside the protected area, connecting the hoses, and hoisting the pump on a crane and raising/lowering the pump using the chain fall. An alternative location in the Maintenance Shop was selected to perform the drill for hoisting the pump so plant operations were not impacted. Connection of the pump and valve manipulation was reasonably simulated since the fire suppression system cannot be disengaged under full reactor operation. During the reasonable simulation, the Maintenance staff walked AMEC evaluators through the procedure, gathered the necessary tools, and walked to the location where the make-up pump would be connected to the fire suppression system. The time for completion of the task was estimated based on previous performance completed as part of station's maintenance program. The Operations staff identified the valves that need to be closed prior to connecting to the fire suppression system and opened once the make-up is connected. The Operations staff also demonstrated how the valves would be opened and closed manually. The plant has sufficient supply of diesel fuel for the make-up pump. Diesel fuel is stored in a 4,000-gallon above-ground storage tank from which it would be transferred into empty 55-gallon barrels. The flood emergency procedure assumes that, based on the full-load fuel assumption, four 55-gallon barrels would conservatively provide a two-day supply of diesel fuel. However, the PMF hydrograph indicates that the make-up pump would have to operate at minimum of approximately 78 hours (duration of flood from elevation 519.5 ft MSL until the river recedes to elevation 509 ft MSL) and additional 12 hours until service water pumps are installed. Therefore, the supply of diesel fuel staged in the reactor building at elevation 545 ft MSL may not be sufficient to provide continuous operation of the make-up pump for at least 90 hours before the flood waters recede below elevation 509 ft MSL and service water pump motors are re-installed.

- The observed drills/exercises and reasonable simulations indicate that the Diesel-driven Emergency Make-up Pump procedural step can be performed within the specified timeframe. The Operations and Maintenance Staff performed drills/exercises or procedure walk-throughs and demonstrated that they have a good understanding of the procedure and can perform the tasks as specified. The minimum resources available to perform the procedure are adequate; however, it was noted that the flanged elbow fitting used as an alternate connection to the fire suppression system was missing an identification tag. The fitting was available in the Sea-Van storage and the missing tag did not impact the staging of the makeup-up pump. Based on the simulation it is anticipated that if needed, this procedural step could be performed in a shorter period of time by utilizing additional staff that would respond to an emergency within 4 hours.

**Construction of Sandbag Berm around the Isolation Condenser Make-up Pumps Building**

- The sandbag berm is constructed around the isolation condenser make-up pumps building to prevent flooding up to elevation 519.5 ft MSL when flood waters are high enough to be used as a source of make-up water for the isolation condensers. The flood emergency procedure states that supplies for construction of the berm (i.e., sand and sandbags) would be obtained from the Grundy County Emergency Operations Center; however, approximately 3,000 bags were obtained prior to conducting the drill and will be stored on site for future use. Supply of sand is stored adjacent to the contractor parking lot and it is mixed with salt for use during the winter months. While not specified in the flood emergency procedure, the required length of the sandbag berm to protect the non-watertight doors to building is 50 linear feet.
- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Mechanical Maintenance Staff | 5 | **8.5 hours** |
| 2) | Mechanical Maintenance Supervisor | 1 | |

- The Mechanical Maintenance staff constructed a representative sample of the sandbag berm in the contractor parking lot. The walkdown team used the representative sample to estimate the time to construct the 50-ft long berm during the flood emergency. The Mechanical Maintenance staff were able to follow the instructions in the flood emergency procedure and construct the berm as specified.
- Based on the observed drill/exercise, the sand bag berm can be constructed as specified. However, conditions during a major flood are expected to be significantly more challenging and staff may experience fatigue and exhaustion, which might result in utilization of a greater number of resources. High winds anticipated during a major flood could potentially disperse sandbag materials

throughout the site and rain will likely make sand heavier and more difficult to handle. In addition, a chain-link gate in front of the make-up pump building would have to be removed prior to constructing the sandbag berm. These additional constraints and adverse conditions may increase resource requirements; however, the duration of the task should not be affected significantly. In addition, construction of the sandbag berm does not require any specific skills or knowledge and any available staff could be deployed to perform this task successfully.

**Deenergize Motor Control Centers (MCCs)**

- Section D.14.a requires that all transformers and MCCs on elevation 517 ft MSL be de-energized when the river level reaches elevation 517 ft MSL. This part of the procedure is completed in the Control Room.
- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operators | 2 | **20 minutes** |

- The Operations staff demonstrated the knowledge of the procedural step and the ability to successfully perform the procedural step as written; however, this procedural step does not clearly state which Bus should be de-energized nor does it explicitly state which transformers and MCCs on elevation 517 ft MSL are impacted.

- Based on the reasonable simulation, the evaluated procedural step can be performed successfully per Section D.14.a and the Operation staff showed sufficient knowledge of the action needed to be performed.

**Manual Operation of the Isolation Condensers**

- Section D.12.b.(1) requires the transfer of Unit 2(3) cooling to the Isolation Condensers and to monitor and control operation of the Isolation Condensers when river level reaches elevation 513 ft MSL. This step was evaluated for a worst case scenario in which the site has loss of offsite and back up battery power.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operators | 2 | **45 minutes** |

- The Operations staff was able to successfully simulate procedural steps as written and no conflicts/issues were found. The process of transferring cooling water to the isolation condensers is an independent process for each unit, which can be done in parallel, if needed. The 45–minute estimate to perform the task is the time duration for completing the task in parallel using one operator for each Unit.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Section D.12.b. (1) and the Operation staff showed sufficient knowledge of the action needed to be performed.

**Prepare for the Removal of SWP Motors and Secure 2-3 SWPs**

- Section D.9.c requires the preparation and removal of two Unit 2 Service Water Pump (SWP) Motors to be relocated to an area above elevation 530 ft MSL. This step is initiated when the river level reaches or is predicted to reach elevation 509 ft MSL. An Electrical Maintenance Supervisor and a Senior Electrician walked AMEC evaluators through the process step-by-step, showing how components would be secured, disconnected, and transported to an area above elevation 530 ft MSL. Since the motors have been previously removed, a drill was not required. However, the electrician and the supervisor provided reasonable estimates of time durations for completion of each step. Past maintenance records were also reviewed to verify the estimated times and a consideration was given to the fact that certain actions may be performed faster during a flood emergency than during a scheduled maintenance outage.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Mechanical Maintenance | 1 | **11.17 hours** |
| 2) | Electrical Maintenance | 9 | |

- The Electrical Maintenance staff was able to successfully simulate completion of the procedural step per Section D.9.c. It should be pointed out, however, that the floor of Unit 2/3 Cribhouse is at elevation 509.5 ft MSL and the procedure can be initiated as late as when river levels reach elevation 509 ft MSL. Under this scenario, it is likely that there would not be enough time to move the motors to the upper level before the flood waters inundate the lower levels of the crib house. For instance, the PMF hydrograph estimates that the flood levels would rise from elevation 509 ft MSL to elevation 513 ft MSL in as little as 3 hours and the estimated required time to move the motors to the upper level is approximately 8 hours (9 hours and 11 hours, respectively, to move both motors to the Turbine Building). This task is NOT critical for ensuring that the reactor is safely shut down and cooling of the reactor is maintained.

- Based on the reasonable simulation, the Electrical Maintenance staff showed sufficient knowledge and skills to successfully execute the task. However, assuming the that flood waters are rising according to the PMF hydrograph and the Station cannot rely on the flood warning, the Electrical Maintenance staff may not have sufficient time to move the motors to the upper level before the Crib House is inundated. In addition, this task could only be initiated after the sufficient Electrical Maintenance staff has responded to the flood emergency (between 1 and 4 hours after the issuance of flood emergency).

**Raise Water Storage Tank Level & Check/Fill Below-ground Water Storage Tanks**

- Sections D.13.a and D.13.b state the level in above-ground water storage tanks will be raised to a level at least 10 feet above the ground and the level in below-ground water storage tanks will be checked and the storage tanks will be filled with water, if needed, when river levels are predicted to exceed elevation 517 ft MSL.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operator | 1 | **2 hours** |

- The Operations staff was able to successfully simulate the procedural step as written; however, the procedure does not specifically state which tanks the actions should be performed on. The above-ground water storage tanks are maintained above 50% capacity and, therefore, they will already be filled to the required 10 feet.
- Based on the reasonable simulation, the evaluated procedural step can be performed successfully per Sections D.13.a, b and the Operations staff showed sufficient knowledge and skill and would be able to successfully execute the task.

**Restore Reactor Vessel to Normal Water Level**

- Section D.12.b requires the site to restore reactor vessels to normal water level when river levels reach elevation 513 ft MSL and before reactor cooling is transferred to the isolation condensers. The Reactor Water Cleanup (RWCU) Blowdown method would be used to lower the reactor water level from 140 inches to 30 inches. However, reactor cooling could be transferred to isolation condensers when reactor water level is below the isolation condenser steam line (at 66 inches).

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operator | 2 | **74 minutes** |
| 2) | Senior Reactor Operator | 1 | |

- The Operations staff were able to successfully simulate the procedural step as written with no conflicts or issues. The duration of this task was based on an estimated maximum blowdown of 200 gpm (per DOP 1200-02) and reactor volume of 200 gal/in.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Section D.12.b. The Shift Unit Supervisor showed sufficient knowledge and ability to perform this step in the procedure.

**Seal Diesel Oil Storage Tank Vents**

- Section D.13.c states when river levels are predicted to exceed elevation 517 ft MSL, the site will seal the vents on the below-ground diesel oil storage tanks.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Mechanical Maintenance | 1 | **30 minutes** |

- The Mechanical Maintenance staff were able to successfully simulate the procedural step as written with no conflicts or issues.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Section D.13.c. The Mechanical Maintenance staff showed sufficient knowledge of the action being performed.

**Secure Isolation Condenser Pumps**

- Section D.14.h states that if the diesel-driven emergency make-up pump is providing make-up to the isolation condensers, then the isolation condenser make-up pumps should be secured. This action would occur the earliest when river levels are above elevation 519 ft MSL. The isolation condenser pumps are secured from the control room. If the control room does not have power, the pumps can be secured manually. This step was evaluated for the worst case scenario by having the site secure the pumps manually.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 1 | **25 minutes** |

- The Operations staff were able to successfully simulate the procedural step as written with no conflicts or issues. The possible concern is that during flooding conditions the access to the isolation condensers make-up pump building would likely require a boat, which could delay the execution of the task. Securing of the isolation condenser pumps is, however, NOT a critical item for successful implementation of the procedure.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Section D.14.h. The Operations staff showed sufficient knowledge of the action being performed.

**Unit 1 – DFP Control Switch Off Secure Equipment, Secure Power to PC-5**

- Section D.10.a-c states that if the river level reaches elevation 508 ft MSL, then the site will place the Unit 1 DFP control switch in the off position to prevent automatic start on loss of power, secure all of the Unit 1 equipment from PC-5 in the Unit 1 Cribhouse basement, and verify two breakers are open to secure power to PC-5.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 1 | **20 minutes** |

- The Operations staff was able to successfully simulate the procedural step as written. However, there were four additional cubicles that needed securing in the Unit 1 Cribhouse but were not listed in the procedure. Also, some breakers' nomenclature varied from what was specified in the procedure. The breakers were still labeled sufficiently enough to ensure that the correct breakers are secured.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Sections D.10.a.-c. The Operations staff showed sufficient knowledge of the action being performed.

**Unit 1 Post Incident Pump**

- Section D.13.e states that mechanical maintenance is to be directed to remove one Unit 1 post incident pump out of its well to provide flow path into the Unit 1 sphere and to equalize pressures on sphere walls. This procedural step is to be initiated when river levels are predicted to exceed elevation 517 ft MSL.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Mechanical Maintenance | 2 | **3.08 hours** |

- These actions are performed to protect Dresden Unit 1 equipment. They are not required to support Dresden Unit 2 and Unit 3 and are not required to be addressed in the 10 CFR 50.54(f) information request. The Mechanical Maintenance staff were able to successfully simulate the removal of the post incident pump; however, there is no set procedure for removal of the pump. The Mechanical Maintenance personnel showed sufficient knowledge to perform this task but there may be minor difficulties setting up rigging since the task has not been performed in the past. The estimated time to remove the pump is based on input provided by the Mechanical Maintenance supervisor. The time allocated for this procedural step ensures a detailed and thorough removal of the pump.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Sections D.13.e. The Mechanical Maintenance staff showed sufficient knowledge of the action being performed.

**Close/Open Fire Protection System Valves**

- Section D.9.f states six (6) fire protection valves will be closed and two (2) opened once other tasks are completed. This step will be initiated when the river level is at elevation 509 ft MSL. A visual inspection of these valves was done to evaluate physical appearance of the valves and accessibility of the valves.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 2 | **40 minutes** |

- The Operations staff were able to successfully simulate the procedural step as written and no conflicts or issues were found.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Section D.9.f. The Operations staff showed sufficient knowledge of the action being performed.

**Open Plant Doors**

- Step D.14.b calls for the opening of doors as necessary to permit the free flow of water through the plant. This action is intended to allow for the floodwaters to evenly fill the plant and equalize the pressure on building walls.
- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Radiation Protection but could include any available onsite personnel | All available staff minimum 2 teams of 2 (4 staff)* | **1.5 hours** |

*Once the Operations Control Center is staffed all 14 Radiation Protection Staff are mobilized to the plant. There is a minimum of 2 Radiation Protection staff on site at all times.

- A simple simulation of opening the doors involved a visual inspection of the reactor and turbine buildings led by an Operations Supervisor pointing out the doors in Units 2 and 3 that would be opened in a flooding event. In addition, a Radiation Protection (Rad Pro) Supervisor was interviewed. Once notified by the Operation Supervisor, the Rad Pro department would lead this effort with assistance from any available onsite staff. The Rad Pro supervisor interviewed during the reasonable simulation estimated that it would take 1.5 hours to open and secure all doors in the plant. The estimate was based on previous performance of the task during the annual outage.

  All doors appeared in good condition and did not show signs that they could malfunction in a flood event. However, the procedure does not specify how the doors would be secured to remain opened. If the doors are not secured correctly, the incoming flood water could force the doors to close and prevent the free flow of water between rooms. There were no potential obstructions observed that would prevent the doors from being opened and secured, Rad Pro and Operations staff were knowledgeable to properly secure the doors, and there are sufficient quantities of rope to secure the doors.

  Based on the existing PMF hydrograph, the river levels will rise from elevation 517 ft MSL to elevation 518 ft MSL in approximately 1.5 hours and the rising flood waters could make opening doors more difficult.

- Based on the reasonable simulation, the plant doors are in a condition that would allow them to be opened and secured as specified. Opening of the doors could, however, be impeded due to the rising waters if it is initiated when river levels reach elevation 517 ft MSL.

**Place Local Isolation Condenser Sightglass into Service**

- Step D.13.g calls for placing the isolation condenser sightglass into service and using it to monitor the reactor temperature to estimate the cool down/heat up rate.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 1 | **25 min for both units** |

- The Operations staff walked through the steps to place the isolation condenser sightglass into service and demonstrated how the procedure would be executed. The equipment was visually inspected and there were no signs of material degradation or non-conformance.

- Based on the reasonable simulation, the evaluated procedural step can performed successfully per Sections D.13.g. The Operations staff showed sufficient knowledge of the action being performed.

**Loss of Spent Fuel Pool Cooling**

- Step D.14.i calls for adding of make-up water to the spent fuel pool using the fire system water via hose stations located adjacent to the spent fuel pool.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Equipment Operator | 2 | **20 min for both units** |

- The Operations staff walked through the steps required to fill the spent fuel pool and identified the hose station that would be used to add water to the spent fuel pool. The initial time to set up the hose and initiate adding water would require approximately 20 minutes for both units. However, the Operations staff would then be required to continue to monitor spent fuel pool levels and add water as needed. This task would NOT require continuous staffing by Operations.

- Based on the reasonable simulation, the evaluated procedural step can be performed successfully per Sections D.14.i. The Operations staff showed sufficient knowledge of the action being performed.

**Reactor Scram**

- DGP 02-03, Reactor Scram is a procedure that is initiated when the water levels reach elevation 509 ft MSL[1]. This procedure is a Standard Operating Procedure that has been performed in the past and, therefore, a desktop review of the procedure was performed to evaluate the timing and resources needed for the execution of the procedure. DGP 02-03 is typically performed in response to an automatic reactor scram or when a manual scram is desired prior to reaching an automatic trip set point.

[1] The version of the procedure evaluated during the walkdown (rev. 32) incorrectly stated that Unit Shutdown (DGP 02-01) rather than Reactor Scram (DGP 02-03) would be used to shut down both units. The issue was identified prior to the walkdown (AR 01393890) and the procedure has been revised accordingly (rev. 34).

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operator | 2 | **5 minutes** |

- The Operation staff presented operator logs, outage schedules and data trend graphs to support the determination whether Reactor Scram (DGP 02-03) can be performed in the credited time. The procedure will not be challenged by flooding conditions since it is performed from the control room before flood waters inundate the site.

- Based on the provided operator logs, outage schedules, and data trend graphs, Reactor Scram can be performed in the credited time.

**Reactor Vessel Slow Fill**

- DGP 02-02, Reactor Vessel Slow Fill is a procedure that is initiated following a Reactor Scram or Unit Shutdown. This procedure is a Standard Operating Procedure that has been performed in the past and, therefore, a desktop review of the procedure was performed to evaluate the timing and resources needed for the execution of the procedure. Reactor Vessel Slow Fill is a procedure implemented to provide cooldown to the reactor by flooding the reactor vessel.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operator | 2 | **45 minutes** |
| 2) | Mechanical Maintenance | 1 | |

- The Operation staff presented operator logs, outage schedules and data trend graphs to support the determination of whether Reactor Vessel Slow Fill (DGP 02-02) can be performed in the credited time. The procedure will not be challenged by flooding conditions since it is performed from the control room before flood waters inundate the site.

- Based on the provided operator logs, outage schedules, and data trend graphs, Reactor Vessel Slow Fill can be performed in the credited time.

**Unit Shutdown**

- DGP 02-01, Unit Shutdown, is a procedure that is initiated when river level is predicted to reach elevation 509 ft MSL within 72 hours (i.e., the procedure would be initiated when Station personnel anticipate water level exceeding elevation 509 ft MSL any time within the next 72 hours). This procedure is a Standard Operating Procedure that has been performed in the past and, therefore, a desktop review of the procedure was performed to evaluate the timing and resources needed for the execution of the procedure.

- Manpower resources required for implementation of this task are as following:

| | Type of Resources | Required Quantity of Resources | Duration of Resources Required to Perform Task |
|---|---|---|---|
| 1) | Reactor Operator | 2 | **11.75 hours** |

- The Operation staff presented operator logs, outage schedules and data trend graphs to support the determination whether Unit Shutdown (DGP 02-01) can be performed in the credited time. The procedure will not be challenged by flooding conditions since it is performed from the control room before flood waters inundate the site.

- Based on the provided operator logs, outage schedules, and data trend graphs, Unit Shutdown can be performed in the credited time.

***DESKTOP EVALUATION OF FLOOD EMERGENCY PROCEDURE***

Following the completion of reasonable simulations and evaluation of individual procedural steps and actions, AMEC performed a desktop evaluation of the flood emergency procedure. During the desktop evaluation, timing and resource data obtained during the walkdown were analyzed and compiled together. The major emphasis of the desktop evaluation focused on answering the following questions:

1. Are required resources available during overlapping tasks?
2. Is there a sufficient flood warning available to allow for safe reactor shutdown and staging of the diesel-driven emergency make-up pump and the associated components and consumables?
3. Are consumables available for the entire durations of the design basis flood?
4. Can the flood emergency procedure be performed under simultaneous adverse weather conditions or if there is a loss of off-site power?

**Availability of Resources**

Actual staffing logs, EP Dialogics Database, and interviews with Operations staff were used to determine whether sufficient resources are available to implement the entire flood procedure. Based on the staffing logs, the staffing at the Station is at its minimum levels during the weekend shifts and typically only Operations staff would be available to immediately respond to an emergency. The remaining staff would report to the plant based on the Emergency Classification Level and following the procedure for emergency response. The logs provided by the Station indicate that 191 staff, which includes Mechanical Maintenance, Electrical Maintenance, Instrument Maintenance, and Radiation Protection staff, is available to respond to an emergency and an additional 59 off-shift Operations personnel are available for short notice call-out. To quantify the number of staff available for implementation of the procedure, the following assumptions were used (based on interviews with Station staff):

1. Response time less than one hour – 10% of all available personnel.
2. Response time less than four hours – additional 70% (80% total) of all available personnel.
3. Unable to respond to an emergency due to adverse weather conditions or due to other reasons – 20% of all available personnel.

A summary of available staff based on the above-mentioned assumptions and the staffing logs is presented in Table 2 below.

**Table 2: Summary of Staff Availability**

| Source - EP Dialogics Database | | | Response Time | | |
|---|---|---|---|---|---|
| Group | Number | Total | <1 hr | <4 hrs | Unable to Respond |
| Mechanical Maintenance (craft) | 67 | | 7 | 47 | 13 |
| Mechanical Maintenance (supervisors) | 9 | | 1 | 7 | 1 |
| Electrical Maintenance (craft) | 34 | | 4 | 24 | 6 |
| Electrical Maintenance (supervisors) | 8 | | 1 | 6 | 1 |
| Instrument Maintenance (craft) | 34 | | 4 | 24 | 6 |
| Instrument Maintenance (supervisors) | 7 | | 1 | 5 | 1 |
| Radiation Protection (craft) | 27 | | 3 | 19 | 5 |
| Radiation Protection (supervisors) | 5 | 191 | 1 | 4 | 0 |
| | | | | | |
| Source - Operations Staffing | | | Response Time | | |
| Normal on-shift staffing | Number | Total | <1 hr | <4 hrs | Unable to Respond |
| Senior Reactor Operators | 5 | | | | |
| Reactor Operators | 4 | | | | |
| Equipment Operators | 9 | 18 | Always on site | | |
| | | | | | |
| Off-shift personnel available for short notice call-out (estimate based on general work-hour rules and normal department staffing levels) | | | Response Time | | |
| Off-shift personnel | Number | Total | <1 hr | <4 hrs | Unable to Respond |
| Senior Reactor Operators | 15 | | 2 | 11 | 2 |
| Reactor Operators | 17 | | 2 | 12 | 3 |
| Equipment Operators | 27 | 59 | 3 | 19 | 5 |

In general, all personnel responding to a flood emergency would be available to assist with implementation of the flood emergency procedure without being required to perform tasks related to their usual job duties. Based on the results of reasonable simulations, all overlapping tasks could be staffed as needed using the available resources or initiated after additional staff reports to the site. The only task that appears to have limited resource availability within the first hour of declared flood emergency is the removal of service water pumps. This task is NOT required for the Station to respond to rising water level and, therefore, NOT considered a critical path item. Table 3 provides a summary of resources needed for implementation of the procedure, which were cross-referenced with available resources.

**Table 3: Resource Utilization based on Availability**

| | Response Time | | | | | |
|---|---|---|---|---|---|---|
| | <1hr | | | <4 hr | | |
| | Available | Utilized | Delta | Available | Utilized | Delta |
| Mechanical Maintenance (craft) | 7 | 7 | 0 | 47 | 18 | 29 |
| Mechanical Maintenance (supervisors) | 1 | 0 | 1 | 7 | 1 | 6 |
| Electrical Maintenance (craft) | 4 | 8 | -4 | 24 | 9 | 15 |
| Electrical Maintenance (supervisors) | 1 | 1 | 0 | 6 | 1 | 5 |
| | | | | | | |
| Senior Reactor Operators | 5 | 0 | 5 | 5 | 1 | 4 |
| Reactor Operators | 4 | 2 | 2 | 4 | 4 | 0 |
| Equipment Operators | 9 | 3 | 6 | 9 | 4 | 5 |

The flood emergency procedure would be initiated by the Shift Manager, who would coordinate with Unit Supervisors and determine the actions needed to be performed immediately. The Shift Manager would also determine whether conditions of an Emergency Action Level are met and declare Emergency Classification Level, as appropriate. Depending on the Emergency Classification Level, an Emergency Response Organization would likely be activated to coordinate emergency activities on site.

**Flood Warning**

As described previously, the flood warning and the flood watch are two critical components of the flood emergency procedure. The flood emergency procedure relies on an assumption that flood warning of river levels exceeding elevation 509 ft MSL would be available to provide sufficient time to shutdown both reactors using standard operating procedure and implement dependent activities. However, it could not be readily concluded that current flood warning/watch procedures provide adequate flood predictions for the required mitigating actions. Furthermore, current river forecasting tools are not able to accurately predict exactly when elevation 509 ft MSL will be exceeded at the Dresden intake.

The procedure does take into consideration the possibility that sufficient flood warning will not be available and that the flood levels could reach elevation 509 ft MSL without such warning. Under this scenario, both units would be shut down using a Reactor Scram standard operating procedure, which would allow the reactor systems to be cooled to the lowest practical temperature in a much shorter period of time. Since the procedure acknowledges that a sufficient flood warning may not available, it was assumed that the subsequent procedural steps would also be initiated once river levels reach elevation 509 ft MSL. The critical time duration to complete these tasks is based on the PMF hydrograph, which predicts that river levels would rise from elevation 509 ft MSL to 517 ft MSL in 7 hours. The majority of the actions could be accomplished during this time; however, the construction of the sandbag berm would require longer duration and could potentially affect the implementation of the procedure. Note that the construction of the sandbag berm is not required to ensure plant safety. The intent is to extend the availability of the Isolation Condenser makeup pumps. The berm does not need to be completed up to 519.5 ft MSL.

**Availability of Consumables**

The plant has sufficient supply of diesel fuel for operation of the make-up pump during the flood emergency. The diesel fuel is stored in a 4,000-gallon above-ground storage tank and the tank is refueled when the fuel level is below approximately 1,000 gallons. The fuel from the storage tank would be transferred into 55-gallon barrels during the early stages of the flood emergency. Once the barrels are filled with diesel fuel, they would be transported into the reactor building and staged at an elevation above the design-basis flood to ensure that diesel fuel is available for the entire duration of the storm. The flood emergency procedure states that four (4) 55-gallon barrels would be staged in the reactor building; however, full-load fuel consumption estimates of 3.82 gallons per hour, suggest that 344 gallons (6.25 barrels) of diesel fuel would be required for a continuous operation of the pump. Filling the barrels with diesel fuel before the site is inundated and/or loses off-site power would also ensure that the fuel can be transferred from the above-ground storage tank.

**Evaluation of Overall Effectiveness of the Flood Emergency Procedure**

The overall effectiveness of the flood emergency procedure is dependent on accurate flood warning and flood prediction at the intake bay. As demonstrated during the reasonable simulation, the Station flood prediction capabilities are currently limited. Therefore, it could not be readily concluded that a flood warning, on which the flood procedure relies, would be adequate to allow for a safe shutdown of both rectors using the Unit Shutdown standard operating procedure. The more likely scenario is that both reactors would have to be shutdown using the Reactor Scram standard operating procedure once river levels reach elevation 509 ft MSL. As a result, the time needed for implementation of the procedure would be reduced. Given the available resources, the installation of the sandbag berm could likely be accomplished in a shorter period of time to ensure that the isolation condenser make-up pumps are protected when flood levels rise to plant grade. Modifications to the sandbag berm configuration could also be considered.

The subsequent procedural steps can be accomplished efficiently (as described earlier in this section) and would support the overall implementation of the flood emergency procedure. The sequence of the procedural steps allows for proper staffing with available resources. Given that the subsequent procedural steps are initiated at certain flood stages and the Station does not have a proper river gage, the Shift manager or the ERO would have to communicate with the Dresden Lock Master on a regular basis to determine when certain tasks need to be initiated. Alternatively, river levels could be determined using computer point E354, Discharge Canal Water Level and/or by measuring flood waters in the Crib House using a tape measure and reference drawing B-320 Crib House Elevations. Once the river levels reach plant grade, rising flood levels could be determined using the plant grade a reference point.

Adverse weather conditions (e.g., high winds, localized flooding, and freezing temperatures) can be expected during the execution of the flood emergency procedure. However, the majority of the procedural steps would likely not be affected by these conditions, since they are performed from the control room or inside. For procedural steps performed outside, site conditions were evaluated to determine whether adverse weather conditions could delay the completion of the task. The task most likely to be affected by adverse weather conditions is the construction of the sandbag berm. As described above, this task is a critical path item that should be initiated early enough during response to a flood to ensure that it can be completed in the specified time. Early initiation of this task would also provide additional margin of safety, with respect to adverse weather conditions. All procedural steps were simulated assuming a loss of off-site power. Emergency Diesel Generators would be used to power the equipment and systems required for the execution of the procedure up to a flood level of 517 ft MSL.

***EVALUATION OF INCORPORATED PASSIVE BARRIERS***

The exterior below-grade structures of reactor and turbine buildings were included on the walkdown list as incorporated passive barriers. The structures were evaluated for their effectiveness to prevent groundwater ingress and withstand hydrostatic loads associated with extreme groundwater conditions. The penetrations through the exterior walls were also inspected as part of the visual inspection of the walls and basement slabs. Any degraded and non-conforming conditions were entered into the CAP for disposition. The penetrations and the associated seals were, however, not treated as separate features and were recorded as observations associated with the Walkdown Record Form for the wall or slab feature.

The following acceptance criteria were used for visual inspections of below-grade walls and penetrations seals:

**Below–Grade Walls / Basement Floor Slabs**

- No signs of degradation of structural members.
- No significant surface cracks.
- No signs of significant degradation.
- No significant spalling, scaling, or cracking of concrete surfaces

**Penetrations / Seals:**

- No indication of degradation that would allow flood waters to penetrate into the flood protected area. Conditions that should be recorded include (but are not limited to) damage, undocumented openings or holes (such as those due to abandoned equipment), etc.
- Visible penetrations are sealed with no visible gaps.
- Penetration sleeves, link seals, piping, and conduit should have an absence of corrosion on the exposed steel surface.
- Conduit seal material should have an absence of water stains below the penetrations.
- Material should appear to be as indicated in plant documents and in generally good condition.

Based on the visual inspection, the condition of below-grade walls Unit 2/3 Reactor Buildings and Unit 2/3 Turbine Buildings were considered to be acceptable. Overall, AMEC determined that the incorporated passive barriers would be able to perform their intended flood protection function and withstand the hydrostatic loads associated with extreme groundwater conditions per the CLB. However, during the visual inspection, AMEC observed wall segments with evidence of spalling, mineral deposition, and concrete degradation possibly caused by groundwater seepage. In addition, several penetration seals in the Unit 2/3 Emergency Diesel Generation Room were degraded and could not be readily judged as acceptable. These conditions were identified on the Field Observation Reports and reported to Exelon. AMEC does not believe that these non-conforming conditions would compromise the walls' ability to withstand hydrostatic loads and keep the below-grade areas dry.

As part of the evaluation of incorporated passive barriers, AMEC performed a desktop evaluation of structural and flood drawings to provide a reasonable assurance that conduits entering the building below grade would not become a pathway for groundwater. AMEC has identified two electrical conduits in a 20-inch sleeve located in the southeast corner room of Unit Reactor Building. These two conduits were inaccessible for visual inspection during the walkdown due to a pull box on the inside of the basement wall. The facility drawings indicate that a seal ring was installed in the center of the sleeve to prevent potential groundwater ingress and the conduits were sealed as well. In addition, there was no indication of past groundwater ingress below the penetration. No other below-grade electrical conduits were identified during the walkdowns.

The flood emergency procedure does not specifically state modes of operation for which the procedure is applicable. For this evaluation full power mode operation was considered the most critical plant failure mode, which would require the highest number of resources and the longest duration. During other modes of operation, e.g. refueling outage, additional resources would be available to assist with implementation of the procedure.

***SITE TOPOGRAPHY***

Detailed description of site topography used for the LIP analysis was not provided in the SEP report or other CLB documents. The SEP report only described the size of drainage areas, average Manning "n" values, and an average slope between the buildings and the drainage channel. Dimensions of the channel or other detailed measurements were not provided. The available freeboard around the buildings was based on the difference between the PMF discharge depth and elevations of non-watertight openings in walls of safety-related structures (517.5 ft MSL), which have not changed since the completion of the LIP analysis. The plant grade elevation (517 ft MSL) used in the analysis is consistent with existing grade elevation.

## 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.

The members of the walkdown team were carefully selected to ensure that the team includes individuals who are experienced in conducting visual inspections of plant structures, systems and components and flood protection features. The team for Dresden Station included two Water Resources Engineers, an Electrical Engineer, and a Structural Engineer. Both water resources engineers are flooding specialists and have significant experience with inspections and evaluations of flood protection features. The remaining two engineers are employees of AMEC's Nuclear Services division and are experienced in conducting visual inspection of plant SSCs.

Each member of the team completed Exelon's Walkdown Training, Nuclear Generation Employee Training (NGET), and NANTeL's generic verification walkdowns of plant flood protection features course, including passing the NANTeL exam. In preparation for the walkdown, the team members became knowledgeable of the site's current licensing basis and operating procedures by thoroughly reviewing them during the first phase of the project. Where specific knowledge was necessary to inspect a flood protection feature/procedure, at least one member of the walkdown team had the ability to determine if the condition of the feature/procedure needed to be entered into the CAP.

The approach used for implementation of the walkdown process was to break down the evaluation of the procedures and features based on staff's individual experience and expertise. All team members had a thorough understanding of the procedures and the actions required to be accomplished to mitigate the design basis flood; however, AMEC's staff with relevant nuclear inspection experience focused predominately on nuclear specific tasks (e.g., Standard Operating Procedures) and on assessing majority of control room actions. The flooding specialists focused predominately on evaluation of flood prediction warnings and on visual inspection of penetrations and below-grade walls/slabs. The remaining reasonable simulations were divided by individuals with specific knowledge of the evaluated task/action.

A pre-job brief was performed at the beginning of each workday. The subjects discussed in the pre-job briefs included but were not limited to positive component verification, inspection methodology, acceptance criteria, field documentation requirements, reporting degraded conditions and previous walkdown lessons learned. A high-radiation pre-job brief was performed with the walkdown team and radiation protection personnel, as necessary. Subjects discussed in high-radiation pre-job briefs included but were not limited to tasks required to complete the job, time required to complete the tasks, dose rate surveys, maximum dose rates and total allowable dose.

A ladder and a "camera on a stick" were used to perform visual inspection of flood protection features that were not accessible from the plant floor.

Observations captured during the walkdowns were documented using the Walkdown Inspection Tool Smartphone application and using the paper copies of the Field Observation Reports. Two members of the walkdown team completed the visual inspections to comply with the peer review requirements. Walkdown Record Forms provided in Appendix B of NEI 12-07 (Rev 0-A) were completed based on the observations made during the visual inspection. Degraded or non-conforming conditions were documented using a camera. Completed Walkdown Record Forms were peer reviewed and signed as required.

A daily project report was generated at the end of each workday documenting the following:

- Industrial Safety/First Aid
- Radiological Information
- ALARA Information
- Production Performance
- Deficiencies Identified
- Operability Issues Identified
- General Problems
- IRs
- Items Requiring Further Review
- Lessons Learned

Observations not immediately judged as acceptable were reported to Exelon personnel immediately and entered in the CAP, as necessary.

## 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.

**Observations not Immediately Judged as Acceptable**

*Below-Grade Walls and Basement Slabs*

During the flooding walkdown, AMEC did not identify degraded or non-conforming conditions of below-grade basement walls that would prevent the walls from performing their flood protection function. As such, the overall condition of the basement walls was considered acceptable; however, several wall segments with evidence of spalling and concrete degradation, possibly resulting from groundwater seepage, were observed during the walkdown (as noted on Field Observation Reports). These conditions were previously identified and entered in the CAP (AR numbers 1290630, 1054344, 1068074, 1070652, 1108699, 1249329, 1249834, and 1376704). In addition, two penetration seals in the 2/3 Emergency Diesel Generator (EDG) Room could not be readily judged as acceptable. However, these conditions were previously identified during a Structures Monitoring Walkdown per ER-MW-450 and dispositioned through the CAP as acceptable (AR 01131053).

None of the individual flood protection features (below-grade walls or basement slabs) were considered inaccessible. However, three penetrations/seals were not visually inspected during the walkdown and are considered inaccessible. One penetration is a 20-inch sleeve with two electrical conduits. Based on the review of facility drawings, a seal ring was installed in the center of the sleeve to prevent potential groundwater ingress and both conduits daylight at above-ground junction boxes at the contaminated condensate storage tanks. In addition, there was no evidence of leakage below the penetration sleeve. Therefore, it is reasonable to conclude that the condition of the penetration seal is acceptable and would not compromise the below-grade wall's ability to function as a flood protection barrier. In addition, conduits themselves would not become pathway for groundwater since they do not lead to any manholes and daylight above the ground.

Two additional inaccessible penetrations are located in the Unit 2 CCSW Pump Area (Vault) and Unit 3 CCSW Pump Area (Vault), respectively. The penetrations could not be visually inspected without breaking the plane due to the configuration of the pipe. There was no indication of groundwater ingress below the penetration sleeve. A desktop evaluation was conducted to determine whether a penetration seal is present. However, the information provided in the drawings is contradictory. For instance, the Flood Barrier Drawings (FL-8 and FL-24) indicate that both penetration sleeves have a seal and refer to M-151 and M-476 drawings for seal type but the latter drawings indicate that the penetration sleeves were not equipped with seals. This discrepancy was resolved through AR 00127680. In addition, the absence of past and current evidence of groundwater seepage below the penetration indicates that the sleeves would not become pathway for groundwater. The penetrations are also inspected on a regular basis during the Structures Monitoring Walkdown. The overall effectiveness of the basement wall to provide flood protection against groundwater ingress should not be affected.

*Flood Emergency Procedure*

Based on the reasonable simulations and desktop evaluation of the flood emergency procedure and the associated operating procedures, the walkdown team determined that the Station has the required resources to effectively implement the minimum critical path actions required to safely shutdown the reactor using a Reactor Scram standard operating procedure and provide alternative cooling of the reactor core during a flood emergency. AMEC has, however, identified several procedural steps that rely on knowledge-based actions and lack sufficient specificity, rely on flood warning that may not be available, or cannot be implemented as written due to the insufficient flood warning. A summary of these items is provided below.

1. Resources are not available to accurately predict river levels at the Dresden intake. However, the flood emergency procedure is entered following flood forecast by NWS, notification from Transmission System Operator predicting rainfall of ≥ 2 inches in 6 hours, or river level ≥ 506.5 ft MSL at the Crib House. Furthermore, it is reasonable to assume that a rainfall of the design-basis magnitude would be predicted in advance, which would allow the site to initiate flood protection measures based on a rainfall forecast. But it is possible that the normal shutdown per Unit Shutdown (DGP 02-01) may not be completed prior to the flood waters elevation 509 ft MSL. Shutdown per Reactor Scram (DGP 02-03) would then have to be initiated once flood waters reach elevation 509 ft MSL to reduce decay heat to the lowest possible level and allow for the use of isolation condensers make-up pumps and the diesel-driven emergency make-up pump for reactor cooling. In addition, the version of the procedure evaluated during the walkdown (rev. 32) did not state that Reactor Scram would be used to shut down both units. The issue was addressed by AR 01393890 and the procedure has been revised accordingly (rev. 34).
2. The flood emergency procedure addresses removal of two (2) Service Water Pump (SWP) Motors to aid in recovery after the flood waters recede. However, motor removal is NOT required for the Station to respond to rising water level, safely shutdown both reactors, and maintain alternate cooling during the duration of the flood. Given the indefinite flood warning and the importance of maintaining equipment redundancy on the Service Water System, it is possible that the removal of two SWP Motors would be initiated only once river levels reach elevation 509 ft MSL. Under this scenario, the Electrical Maintenance staff would not have sufficient time to move the motors to the upper level before flood waters inundate the lower levels of the crib house. The PMF hydrograph estimates that the flood levels would rise from elevation 509 to elevation 513 in 3 hours and the estimated time to move the motors to the upper level is approximately 8 hours (9 hours and 11 hours, respectively, to move both motors to the Turbine Building). In addition, this task appears to have limited resource availability within the first hour of declared flood emergency. Removal of two SWP motors requires 9 Electrical Maintenance staff while only 5 staff would be available to report to duty within the first hour. While this task is NOT critical for ensuring that the reactor is safely shutdown and cooling of the reactor is maintained, the inability to perform the task may affect the recovery stage and require additional resources to be employed (e.g., continuous cooling using the make-up pump). The issue was addressed by AR 01393890 and procedure revision is in process.
3. Construction of the sandbag berm is initiated when the river levels are predicted to exceed elevation 509 ft MSL. As stated above, resources are not available to accurately predict river levels at the Dresden intake in advance. However, the flood emergency procedure is entered following flood forecast by NWS, notification from Bulk Power Operations predicting rainfall of ≥ 2 inches in 6 hours, or river level ≥ 506.5 ft MSL at the Crib House. Furthermore, it is reasonable to assume that a

rainfall of the design-basis magnitude would be predicted in advance, which would allow the site to initiate flood protection measures based on a rainfall forecast. Since the minimum time to construct the sandbag berm is 8.5 hours, there is a possibility that the berm would be not be constructed in time before flood waters reach the plant grade if construction does not begin before river levels reach elevation 509 ft MSL. Rising flood waters could then impact the operation of the isolation condenser make-up pumps. However, initiation of sandbagging preparations when the flood emergency procedure is entered due to weather forecast will aid the Station in timely construction of the sandbag berm. The issue was addressed by AR 01393890 and procedure revision is in process.

4. The procedure states that four (4) 55-gallon barrels of diesel fuel staged in the reactor building will conservatively provide a 2-day supply of diesel fuel for the emergency make-up pump. However, based on the PMF hydrograph the emergency make-up pump would have to be used for a minimum of 78 hours before flood levels recede to elevation 509 ft MSL and additional 12 hours before service water pumps are allowed to be re-installed. Based on the full-load fuel consumption of 3.82 gallons per hour, 344 gallons (6.25 barrels) of diesel fuel would be required for a continuous operation of the pump. The Station has additional diesel fuel barrels available for use during flood emergency. The issue was addressed by AR 01422791 and procedure revision is in process.
5. The opening of plant doors is initiated when flood water reach elevation 517 ft MSL. However, based on the existing PMF hydrograph flood waters could reach elevation 518 ft MSL in approximately 1.5 hours. As a result, rising flood waters could make opening doors more difficult. The issue was addressed by AR 01422791 and procedure revision is in process.
6. The procedure requires that all transformers and MCCs on elevation 517 ft MSL be de-energized when the river level reaches elevation 517 ft MSL. While the Operations staff demonstrated the knowledge of the procedural step and the ability to successfully perform the procedural step as written, the procedural step does not clearly state which Bus should be de-energized down or does not explicitly state which transformers and MCCs on elevation 517 ft MSL are impacted. The issue was addressed by AR 01422791 and procedure revision is in process.
7. The procedure states (D.13.a, D.13.b) that the level in above-ground water storage tanks will be raised to a level at least 10 feet above the ground and the level in below-ground water storage tanks will be checked and the storage tanks will be filled with water, if needed, when river levels are predicted to exceed elevation 517 ft MSL. While the Operations staff was able to successfully simulate the procedural step as written, the procedure does not specifically state which tanks the actions should be performed on. The issue was addressed by AR 01422791 and procedure revision is in process.

**Observations Designated through CAP as Deficient**

None

**Observations Awaiting Final Disposition in CAP**

All observations not readily judged as acceptable are currently awaiting final disposition in the CAP.

**Features in Restricted Access Areas**

None

**Features in Inaccessible Areas**

Three (3) penetrations were considered inaccessible for visual inspection. Reasonable assurance that the components can provide their intended function was provided by absence of past and current evidence of groundwater seepage below the penetration and by review of available drawings.

**Actions Taken or Planned to Address Deficiencies**

None

## 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 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. Furthermore, observations of "small margin and significant consequences" were entered into the CAP for further evaluation.

Since the walkdowns were completed prior to the final resolution of FAQ-006 (September 13, 2012), 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.

The Station is currently considering changes that would streamline the existing flood emergency procedure, reduce the need for manpower resources to implement the procedure, and enhance flood protection. The following items are being considered:

1. Obtaining a floating dock that would be used for staging of the emergency diesel make-up pump, reducing the need for raising and lowering of the pump during a flood. During a flood, the floating dock would be staged and secured at the center of the Unit 2 Reactor Building equipment hatch. This dock has been procured by the Station and a procedure revision is in process.
2. Floodproofing of isolation condenser make-up pumps building access doors to eliminate the need for construction of the sandbag berm.
3. Floodproofing of additional building access doors to maintain equipment availability and personnel safety as long as possible in other locations such as the reactor buildings.
4. Initiation of sandbag berm installation based on a combination of actual river levels at the Dresden intake and flood predictions from the two closest river gauges with flood forecasting capabilities (Kankakee River at Wilmington and Illinois River at Morris).
5. Development of a method to provide additional water into the below-grade areas being used by the diesel-driven emergency make-up pump once flood waters recede below elevation 518 ft MSL. Based on an interview with the Operations Support Manager, the Station could utilize FLEX pumps to divert water from cooling canals into the reactor building basement or the fire header could be reconfigured to divert water from the canal to the fire suppression system to be used for make-up cooling water. This would allow for flexibility during recovery efforts by maintaining the continued availability of the diesel-driven emergency make-up pump.

# 5. CONCLUSIONS

The flooding walkdown at Dresden Station was conducted between August 8 and August 16, 2012 and included a visual inspection of below-grade walls and the associated penetrations, a visual inspection of basement slabs, and reasonable simulations of the flood emergency procedure and the associated tasks and procedures.

A summary of the flooding walkdown results is provided in Table 4 through Table 9. The below grade-walls and slabs were inspected and arranged by areas or rooms for a total of fifteen (15) features. Associated penetrations/seals were visually inspected during the walkdown; however, they were not considered individual flood protection features and only penetrations/seals not readily judged as acceptable or inaccessible penetrations/seals were listed in Table 7 and Table 9, respectively.

Nineteen (19) reasonable simulations of the flood emergency procedure and the associated procedures (including standard shutdown procedures) were performed to ensure that they can be performed as specified and protect the reactor from core damage during flooding conditions. Based on the evaluation of reasonable simulations and review of operator logs, the critical path items of flood emergency procedure can be implemented to ensure that both units are safely shutdown and reactor cooling is provided to remove decay heat. During the evaluation it was determined that resources are not available to accurately predict river levels at the Dresden intake in advance. Assuming only a short flood warning is available, the construction of the sandbag may not be implemented in time or using the available resources. However, initiation of sandbagging preparations at an earlier point in the Flood Emergency Procedure due to weather forecast will aid the Station in timely construction of the sandbag berm and provide an additional margin of safety.

**Table 4: Summary – Features Included in the Walkdown Scope**

| Feature Type | Total Number |
|---|---|
| Passive – Incorporated | 15 |
| Passive – Temporary | 0 |
| Active – Incorporated | 0 |
| Active – Temporary | 0 |

**Table 5: Reasonable Simulations**

| # | Description | Purpose |
|---|---|---|
| 1 | Flood Warning & Flood Watch | Provide sufficient flood warning to safely shutdown both reactors and implements dependent flood emergency actions. |
| 2 | Diesel-driven Emergency Make-up Pump (moving and staging) | Provide make-up cooling water for the isolation condensers when permanently installed equipment is inoperable. |
| 3 | Construction of Sandbag Berm around the Isolation Condenser Make-up Pumps Building | Designed to protect the isolation condensers make-up pump building until flood waters reach high enough to provide suction for the emergency diesel-driven make-up pump. |
| 4 | Deenergize MCCs | Disconnect all electrical equipment prior to flood water reaching plant grade elevation. |
| 5 | Manual Operation of the Isolation Condensers | Provide cooling of the reactor systems when other systems are inoperable and isolation condensers have to manually operated (e.g., during loss of offsite and back up battery power). |
| 6 | Prepare for the Removal of SWP Motors and Secure 2-3 SWPs | Protect SWP motors for recovery phase when SWP will be used for cooling of reactor systems. |
| 7 | Raise Water Storage Tank Level & Check/Fill Below-ground Water Storage Tanks | Prevent the tanks from becoming buoyant. |

| # | Description | Purpose |
|---|---|---|
| 8 | Restore Reactor Vessel to Normal Water Level | Restore normal water levels before reactor cooling is transferred to the isolation condensers. |
| 9 | Seal Diesel Oil Storage Tank Vents | Prevent introduction of river water into diesel oil storage tanks. |
| 10 | Secure Isolation Condenser Pumps | Takes pump motors offline once the diesel driven emergency pump is used to provide make-up to the isolation condensers. |
| 11 | Unit 1 – DFP Control Switch Off Secure Equipment, Secure Power to PC-5 | Prevent automatic start on loss of power. |
| 12 | Unit 1 Post Incident Pump | Provide flow path into the Unit 1 sphere to equalize pressures on sphere walls. |
| 13 | Close/Open Fire Protection System Valves | Allow the connection of the emergency diesel-driven make-up pump to the fire protection system and the use of river water as make-up water source. |
| 14 | Open Plant Doors | Allow free flow of water through plant to equalize hydrostatic pressure and prevent collapse of exterior walls. |
| 15 | Place Local Isolation Condenser Sightglass into Service | Monitor Isolation Condenser level to maintain a heat sink. |
| 16 | Loss of Spent Fuel Pool Cooling | Provide make-up water for spent fuel pools when safety-related equipment is inoperable. |
| 17 | Reactor Scram | Fast shutdown of the reactor when sufficient flood warning is not available. |
| 18 | Reactor Vessel Slow Fill | Cool reactor systems to lowest practical temperature as quickly as possible. |
| 19 | Unit Shutdown | Normal shutdown procedure in case of a flood emergency when sufficient flood warning is available. |

**Table 6: List of Features Immediately Judged as Acceptable**

| # | Feature ID # | Description | Passive/Active Incorporated/Temporary |
|---|---|---|---|
| 1 | D02-RB-476-W001-FW<br>DO2-RB-476-W002-FW | East and south below-grade walls of U2 southeast corner room | Incorporated Passive |
| 2 | RB2-TORUS | East and south below-grade walls of U2 torus | Incorporated Passive |
| 3 | D02-RB-476-W005-FW | South below-grade wall of U2 southwest corner room | Incorporated Passive |
| 4 | D23-RB-476-W006-FW<br>D23-RB-476-W007-FW<br>D23-RB-476-W008-FW | East, south, and west below-grade walls of U2/3 HPCI Room | Incorporated Passive |
| 5 | RB3-TORUS | West and south below-grade walls of U3 torus | Incorporated Passive |
| 6 | D03-RB-476-W002-FW<br>DO3-RB-476-W001-FW | West and south below-grade walls of U3 southwest corner room | Incorporated Passive |
| 7 | D02-TB-469-W001-FW<br>D02-TB-469-W002-FW<br>D02-TB-469-W003-FW<br>D02-TB-469-W004-FW<br>D02-TB-469-W005-FW<br>D02-TB-469-W006-FW | Below grade walls of U2 Condensate Booster Pump Area | Incorporated Passive |
| 8 | D02-TB-495-W007-FW<br>D02-TB-495-W008-FW<br>D02-TB-495-W009-FW<br>D02-TB-495-W010-FW<br>D02-TB-495-W014-FW<br>D02-TB-495-W015-FW<br>D02-TB-495-W016-FW<br>D02-TB-495-W017-FW<br>D02-TB-495-W018-FW | Below-grade walls of U2 CCSW Pump Area | Incorporated Passive |

| # | Feature ID # | Description | Passive/Active Incorporated/Temporary |
|---|---|---|---|
| 9 | D03-TB-469-W001-FW<br>D03-TB-469-W002-FW<br>D03-TB-469-W003-FW<br>D03-TB-469-W004-FW<br>D03-TB-469-W005-FW<br>D03-TB-469-W006-FW | Below-grade walls of U3 Condensate Booster Pump Area | Incorporated Passive |
| 10 | D03-TB-495-W007-FW<br>D03-TB-495-W008-FW<br>D03-TB-495-W009-FW<br>D03-TB-495-W010-FW<br>D03-TB-495-W014-FW<br>D03-TB-495-W015-FW<br>D03-TB-495-W016-FW<br>D03-TB-495-W017-FW<br>D03-TB-495-W018-FW | Below-grade walls of U3 CCSW Pump Area | Incorporated Passive |
| 11 | D23-EDG | Below-grade walls of U2/3 Emergency Diesel Generator Room | Incorporated Passive |
| 12 | D02-RB-SLAB | Floor slabs of U2 Reactor Building | Incorporated Passive |
| 13 | D03-RB-SLAB | Floor slabs of U3 Reactor Building | Incorporated Passive |
| 14 | D02-TB-SLAB | Floor slabs of U2 Turbine Building | Incorporated Passive |
| 15 | D03-TB-SLAB | Floor slabs of U3 Turbine Building | Incorporated Passive |

**Table 7: List of Features Not Immediately Judged as Acceptable**

| # | Feature ID # | Description | Observation | Component Operability | Resolution |
|---|---|---|---|---|---|
| 1 | 15-PEN (Penetration #2, drawing FL-34) | 20-in sleeve w/ 16-in capped pipe | Penetration seal showed signs of water seepage, bacterial growth, and material degradation. | Yes – previously documented in AR 01131053 | Based on the walkdown associated with AR 1131053, plant personnel determined that the flood seals are acceptable and capable of performing their intended function. |
| 2 | 17-PEN (Penetration #4, drawing FL-34) | 20-in sleeve w/ 16-in capped pipe | Penetration seal showed signs of water seepage, bacterial growth, and material degradation. | Yes – previously documented in AR 01131053 | Based on the walkdown associated with AR 1131053, plant personnel determined that the flood seals are acceptable and capable of performing their intended function. |
| 3 | DOA 0010-04, Floods (W-4) Rev. 33 | Flood Emergency Procedure | Several procedural steps, as described in Section 4 f | N/A – documented in AR 01422791 and AR 01422880 | Procedure revision in progress to enhance station response to issues identified in this report |

**Table 8: List of Features in Restricted Access Areas**

| # | Feature ID # | Description | Reason | Resolution |
|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A |

**Table 9: List of Features in Inaccessible Areas**

| # | Feature ID # | Description | Reason | Resolution |
|---|---|---|---|---|
| 1 | 3-PEN (Penetration #1, drawing FL-8) | 12-in sleeve | Seal not visible due to pipe connection. Would require intrusive methods to inspect. | Reasonable assurance that the component can provide its intended function was provided by absence of past and current evidence of groundwater seepage below the penetration. |
| 2 | 6-PEN (Penetration #1, drawing FL-24) | 16-in sleeve w/ 6-in hypochlorite pipe. | Seal not visible due to pipe configuration and elbow connection. Would require intrusive methods to inspect. | Reasonable assurance that the component can provide its intended function was provided by absence of past and current evidence of groundwater seepage below the penetration. |
| 3 | 18-PEN (Penetration #1, drawing FL-39) | 20-in sleeve w/ 2 electrical conduits | Covered with pull box. | Reasonable assurance that the component can provide its intended function was provided by absence of past and current evidence of groundwater seepage below the penetration and by review of drawings. |

## 6. REFERENCES

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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.
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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.
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12. DOA 0010-04, Floods (W-4), Rev. 32, Rev. 33, and Rev. 34
13. DGP 02-01, Normal Unit Shutdown
14. DGP 02-02, Vessel Slow Fill
15. DGP 02-03, Reactor Scram
16. DOP 1300-03, Manual Operation of Isolation Condenser
17. DOS 1300-04, Operation of the Isolation Condenser External Flood Emergency Make-up Pump
18. DOP 1300-05 Isolation Condenser Level Monitoring Using the Local Sight Glass
19. ER-AA-450, Structures Monitoring, Rev. 1