



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

June 23, 2014

Vice President, Operations  
Entergy Operations, Inc.  
Grand Gulf Nuclear Station  
P.O. Box 756  
Port Gibson, MS 39150

SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 – STAFF ASSESSMENT OF THE FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF0232)

Dear Sir or Madam:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information letter per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter). The 50.54(f) letter was issued to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions that may be taken in response to lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. The request addressed the methods and procedures for nuclear power plant licensees to conduct flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures.

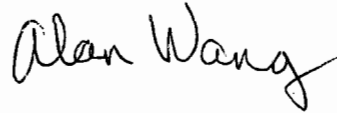
By letter dated November 26, 2012, Entergy Operations, Inc. (the licensee), submitted a Flooding Walkdown Report as requested in Enclosure 4, "Recommendation 2.3: Flooding," of the 50.54(f) letter for the Grand Gulf Nuclear Station site. By letter dated January 31, 2014, the licensee provided a response to the NRC staff's request for additional information dated December 23, 2013, for the staff to complete its assessments.

The NRC staff reviewed the information provided and, as documented in the enclosed staff assessment, determined sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

- 2 -

If you have any questions, please contact me at (301) 415-1445 or by e-mail at [Alan.Wang@nrc.gov](mailto:Alan.Wang@nrc.gov).

Sincerely,

A handwritten signature in black ink that reads "Alan Wang". The signature is written in a cursive, flowing style.

Alan Wang, Project Manager  
Plant Licensing IV-2 and Decommissioning  
Transition Branch  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:  
Staff Assessment of Flooding  
Walkdown Report

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STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT  
NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO  
THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

1.0 INTRODUCTION

On March 12, 2012,<sup>1</sup> the U.S. Nuclear Regulatory Commission (NRC) issued a request for information per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter) to all power reactor licensees and holders of construction permits in active or deferred status. The request was part of the implementation of lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 4, "Recommendation 2.3: Flooding,"<sup>2</sup> to the 50.54(f) letter requested licensees to conduct flooding walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions using the Corrective Action Program (CAP), verify the adequacy of monitoring and maintenance procedures, and report the results to the NRC.

Enclosure 4 of the 50.54(f) letter requested licensees to include the following:

- a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
- b. Describe protection and migration features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs [structures, systems, and components] 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.

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<sup>1</sup> Agencywide Document Access and Management System (ADAMS) Accession No. ML12053A340.

<sup>2</sup> ADAMS Accession No. ML12056A050.

Enclosure

- 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 guidance in Regulatory Issues Summary 2005-20, Revision 1, Revision to the 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.
- 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.

In accordance with the 50.54(f) letter, Enclosure 4, Required Response Item 2, licensees were required to submit a response within 180 days of the NRC's endorsement of the flooding walkdown guidance. By letter dated May 21, 2012,<sup>3</sup> the Nuclear Energy Institute (NEI) staff submitted NEI 12-07, Revision 0-A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," to the NRC staff to consider for endorsement. By letter dated May 31, 2012,<sup>4</sup> the NRC staff endorsed the walkdown guidance.

By letter dated November 26, 2012,<sup>5</sup> the Entergy Operations, Inc. (the licensee), provided a response to Enclosure 4 of the 50.54(f) letter Required Response Item 2, for the Grand Gulf Nuclear Station, Unit 1 (GGNS). The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013.<sup>6</sup> The licensee responded by letter dated January 21, 2014.<sup>7</sup>

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report met the intent of the walkdown guidance and if the licensee responded appropriately to Enclosure 4 of the 50.54(f) letter.

## 2.0 REGULATORY EVALUATION

The SSCs important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," Criterion 2, "Design bases for protection against natural

<sup>3</sup> ADAMS Package Accession No. ML121440522.

<sup>4</sup> ADAMS Accession No. ML12144A142.

<sup>5</sup> ADAMS Accession No. ML12332A334.

<sup>6</sup> ADAMS Accession No. ML13325A891.

<sup>7</sup> ADAMS Accession No. ML14022A038.

phenomena," and Appendix A "Seismic and Geological Criteria for Nuclear Plants," to 10 CFR Part 100, a. Criterion 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions to be performed by an SSC, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design.

The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area. The design bases also reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The current licensing basis (CLB), as defined in 10 CFR 54.3(a), is the set of NRC requirements applicable to a specific plant, and a licensee's written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis that are in effect.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Design Basis Flooding Hazard for Grand Gulf Nuclear Station

The licensee reported that the design basis flood hazard for the GGNS site is a probable maximum precipitation (PMP) event with a precipitation rate of 16.4 inches per hour. The calculated maximum water surface elevations due to local PMP storm runoff attributed to this event is 133.25 feet (ft) above mean sea level (MSL) in the vicinity of the Radwaste Building. The finished floor elevations for Powerblock Structures are 133 ft MSL; hence, this maximum estimated flood elevation exceeds the finished floor elevation of the GGNS Power Block by 0.25 ft. The licensee reported that all the safety-related structures at the GGNS site are protected against this PMP event.

The licensee noted that the GGNS site is not considered to be susceptible to flooding by rivers, dam failures, ice flooding, or channel migration. The site is also not adjacent to any coastal area and, therefore, not vulnerable to flooding by tsunami, tidal surge, or seiche.

The licensee reported that the maximum design ground water level at the site is at an elevation of 114.5 ft MSL.

Based on the NRC staff's review, the licensee appears to have described the design basis flood hazard level(s) as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.2 Flood Protection and Mitigation

#### 3.2.1 Flood Protection and Mitigation Description

The GGNS site is located on a floodplain along the eastern bank of the Mississippi River. The licensee reported that the plant yard has an average elevation of 132.5 ft MSL and the finished floor elevations for plant buildings are 133.0 ft MSL. The licensee stated that the management of surface water due to rainfall is accomplished through a combination of site grading and a network of storm drains and culverts. The licensee reports that the plant yard is graded to direct runoff away from the buildings, and toward Stream A (to the north) and Stream B (to the south) by way of a combination of drainage swales, ditches, and overland flow. As the calculated maximum flood water elevation is 133.25 ft MSL, some water is expected to enter certain GGNS buildings following a PMP event.

The licensee reported that any flood water entering the Auxiliary (Railroad Bay only), Turbine, Radwaste, and Water Treatment Buildings would not affect the safe operation of the GGNS site as floor drains were installed in these buildings at the time of construction, which would carry water to existing sumps where it is pumped away by sump pumps; however, these features are not credited in the CLB. The licensee also reported water leaking into the Control and Diesel Generator Buildings could affect safety-related equipment; consequently, the licensee reported that seals have been installed at exterior doorways for these buildings to ensure safe plant operation during a flooding event. The Standby Service Water (SSW) pump houses are also identified as being susceptible to flooding as water can enter through doorways, equipment hatches, and various floor penetrations could affect floor mounted safety-related electrical equipment. The licensee reported that prior to the walkdown request, design modifications had been made to the floor, exterior walls, and doors of the SSW pump houses to prevent water from reaching the floor mounted safety-related equipment and to ensure safe plant operation. The modifications identified include the installation of seals, toe plates, and curbs at potential water entrance locations to provide flood protection to a maximum flood elevation of 133.625 ft. The licensee reported that a total of 11 exterior PMP doors were installed with watertight seals in the buildings described above. The door seal system consists of a gasket system extending a minimum of 14 inches up the sides of the door from the threshold, and is expected to limit leakage due to a 1-ft water head to 2 pints/hour.

Lastly, the licensee reported that the effect of indirect floodwater leakage into GGNS through adjacent structures had also been previously considered during licensing since there were interconnecting (non-watertight) doorways at several power block locations at or below grade. The total accumulation of flood water assumed in the analysis was distributed throughout the 93-ft level of the Control, Turbine, and Radwaste Buildings, as well as the 93-ft level of adjacent structures. Analysis revealed that flood water could accumulate in the bottom of the power block to an elevation no greater than 99.0 ft MSL. The licensee reported that an analysis of the design revealed that, with one exception, no safety-related equipment exists below an elevation of 103.0 ft MSL in the buildings in question. The one exception was a secondary containment isolation valve in the Turbine Building. In the Updated Final Safety Analysis Report for the site, the licensee noted that effects of flooding on the valve, if any, would cause the valve to fail in the safe position.

### 3.2.2 Incorporated and Exterior Barriers

In general, any flood protection measures intended to protect safety-related systems and equipment are passive features that were incorporated into the original GGNS site design. The licensee reported that no safety-related systems or equipment are affected by flooding by virtue of the hardening of all Category I structures at the GGNS site in reinforced concrete capable of withstanding both the static and dynamic effects of a flood. Specific features that provide flood protection at the site include: below-grade walls and penetrations (less than 114.5 ft), above-grade walls and penetrations (elevations up to 135 ft), the installation of equipment hatches below the maximum estimated flood level elevation, and watertight piping and electrical penetrations below the maximum flood level elevation. Eleven PMP doors are also identified in the walkdown report and have been designated to limit surface water inflow into certain structures during a local intense PMP event with a water level elevation of 133.25 ft MSL. These doors are located in the following locations: Auxiliary (Railroad Bay only) Buildings, Turbine Buildings, Radwaste Buildings, Water Treatment Buildings, and the SSW pump houses. Should meteoric water enter any of these structures, it would eventually be routed down to their respective basements and subsequently collected by the floor drain system and removed via sump pumps.

The licensee stated that the site has no incorporated barriers that are permanently in place that require manual operator actions in the event of a flood.

The licensee did not identify any exterior flood prevention barriers permanently in-place that would require operator manual actions.

### 3.2.3 Temporary Barriers and Other Manual Actions

The licensee did identify temporary manual actions in its walkdown report that would be implemented in the event of a flood threat. That temporary manual action included the placement of sandbags at the 11 designated PMP doors.

The licensee also noted that the GGNS CLB does not directly discuss the specific mode of operation in which the plant is to be maintained during a flooding event. However, the licensee reported that an existing Off-Normal Event Procedure for the site identifies those actions to be taken in the event of plant flooding caused by natural phenomena. The procedure requires the installation of sandbags at all PMP doors whenever the 24-hour forecast calls for 12 inches or more of rain. The procedure further requires the licensee to shut down if the river level is reported to reach an elevation of 97 ft MSL. In the event of flooding due to other natural phenomena, such as PMP, specific doors at the site are to be closed and the site's Emergency Plan is to be implemented.

### 3.2.4 Reasonable Simulation and Results

The purpose of performing reasonable simulations is to verify that the required flood protection procedures or activities can be executed as specified/as written.

The licensee performed one Reasonable Simulation. According to the GGNS Off-Normal Event Procedure, sandbags are to be installed in front of all 11 designated PMP doors when the weather forecast calls for 12 inches of rain in a 24-hour period. As part of the simulation, the licensee reported that it is first necessary to ensure that there are a sufficient number of sandbags available onsite to protect all 11 PMP doors, and that the sandbags themselves are maintained in a condition which would allow them to be installed, thereby satisfying their intended flood protection function. As part of the simulation, only one PMP door was sandbagged, and then the total time necessary to complete that task was multiplied by 11 to ensure that all designated PMP doors could be sandbagged within a 24-hour time frame. The licensee assumed no adverse weather conditions in the placement of the sandbags.

### 3.2.5 Conclusion

Based on the NRC staff's review the licensee appears to have described protection and mitigation features as requested in the 50.54(f) letter and consistent the walkdown guidance.

### 3.3 Warning Systems

The licensee reported that there are no internal warning systems credited for external flooding at the GGNS site.

Based on the NRC staff's review, the licensee appears to have provided information to describe any warning systems as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.4 Effectiveness of Flood Protection Features

The licensee defined the acceptance criteria for the flood protection features by the requirements in the CLB using guidance from NEI 12-07. The licensee visually inspected the flood protection features to identify any material degradation as well as verifying the configuration with design documents.

All flood protection features at the GGNS site are intended to protect safety-related equipment structures, and components against external sources of flooding. These features include reliance on the existing topography, grading of the existing ground surface, hardened reinforced concrete building design, designated waterproof doors, and a drainage/sump collection system drainage system.

Based on the NRC staff's review, the licensee appears to have discussed the effectiveness of flood protection features as in the 50.54(f) letter and consistent with the walkdown guidance.



### 3.5 Walkdown Methodology

By letter dated June 8, 2012,<sup>8</sup> the licensee responded to the 50.54(f) letter that it intended to utilize the NRC-endorsed walkdown guidelines contained in NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features."<sup>9</sup> The licensee's walkdown submittal dated November 26, 2012, indicates that the licensee implemented the walkdowns consistent with the intent of the guidance provided in NEI 12-07. The licensee did not identify any exceptions from NEI 12-07.

Based on the NRC staff's review, the licensee appears to have presented information related to the implementation of the walkdown process as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.6 Walkdown Results

#### 3.6.1 Walkdown Scope

The licensee performed walkdowns of currently-credited flood protection features at the GGNS site. For the GGNS site, the number of as-built features visually inspected was approximately 46. The walkdown scope was developed by the licensee to confirm that flood protection features credited in the CLB were acceptable and capable of performing their credited flood protection functions. Those passive features generally reported to have been inspected included: exterior and interior walls, floors, roofs, penetrations; and sumps, and elements of the onsite drainage system (both natural and man-made). The active features inspected included doors and manhole covers.

The licensee noted that flood protection features at the GGNS site do include certain temporary actions that would require the implementation of a procedure for the performance of those manual/operator actions. Consequently, the licensee performed a reasonable simulation of the manual actions necessary to install sandbags and stated that the operator actions necessary to perform this action could be completed.

Lastly, the licensee also reported that visual inspections were performed at all exterior areas of the site to verify that plant modifications implemented since original construction, such as security barrier installation and changes to topography, do not adversely affect plant flooding protection.

The licensee used acceptance criteria consistent with the intent NEI 12-07. Items that did not meet the NEI 12-07 acceptance criteria were documented in the CAP.

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<sup>8</sup> ADAMS Accession No. ML12163A551.

<sup>9</sup> ADAMS Accession No. ML12173A215.

### 3.6.2 Licensee Evaluation of Flood Protection Effectiveness, Key Findings, and Identified Deficiencies

The licensee performed an evaluation of the overall effectiveness of the GGNS's flood protection features. By virtue of its walkdown inspections, the licensee verified that permanent safety-related SSCs at the GGNS site were acceptable, not degraded, and capable of performing their intended design function as credited in the CLB.

NEI 12-07 defines a deficiency as follows: "a deficiency exists when a flood protection feature is unable to perform its intended function when subject to a design basis flooding hazard." The licensee reported that it identified three deficiencies during the course of the flood walkdowns which were entered into the CAP. Two of these deficiencies were door seals, which after an operability determination were found to be non-functional. The licensee further stated that a risk to the site does not exist and necessary compensatory measures are in place for both door locations to prevent water from entering the structures. The licensee stated that no action had been taken to correct either door seal at the time the walkdown report was submitted. The third deficiency was related to the topography west of the control building, which slopes towards, not away from, the control building. The licensee's operability determination was that no flooding concerns exist because existing flood barriers are sufficient to provide the necessary protection.

NEI 12-07 specifies that licensees identify observations in the CAP that were not yet dispositioned at the time the walkdown report was submitted. Three observations were made of items through the course of the walkdowns of credited flood protection features that were not immediately judged as acceptable. These items were entered in the licensee's CAP but none of these were determined to be a deficiency that causes the feature to be unable to perform its intended flood protection function as defined in NEI 12-07.

### 3.6.3 Flood Protection and Mitigation Enhancements

The licensee reported that there are no recently implemented or planned enhancements to the CGS site that are intended to improve or increase flood protection and/or mitigation.

### 3.6.4 Planned or Newly Installed Features

The licensee did not determine that changes were necessary by the flood walkdowns.

### 3.6.5 Deficiencies Noted and Actions Taken or Planned to Address

Several deficiencies identified by the licensee and the actions taken or planned to address those deficiencies. The deficiencies are discussed in Section 3.6.2 of this report.

### 3.6.6 Staff Analysis of Walkdowns

The NRC staff reviewed the walkdown report dated November 26, 2012, focusing on those items related to the GGNS CLB. The staff concludes that the licensee adequately evaluated the CLB flood protection features and the features are functional and in good condition. The licensee simulated the installation of sandbags at designated flood-protection doors.

Based on the NRC staff's review the licensee appears to have provided results of the walkdown and described any other planned or newly installed flood protection systems or flood mitigation measures as requested in the 50.54(f) letter and consistent with the walkdown guidance. Based on the information provided in the licensee's submittals, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

### 3.6.7 Available Physical Margin

The NRC staff issued an RAI to the licensee regarding the APM dated December 23, 2013. The licensee responded by letter dated January 21, 2014. The licensee has reviewed its APM determination process and entered any unknown APMs into the CAP. The staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

Based on the NRC staff's review, the licensee appears to have documented the information requested for any cliff-edge effects, as requested in the 50.54(f) letter and consistent with the walkdown guidance. Further, the staff reviewed the response, and concludes that the licensee met the intent of the APM determination per NEI 12-07.

## 3.7 NRC Oversight

### 3.7.1 Independent Verification by Resident Inspectors

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187, "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns."<sup>10</sup> In accordance with the TI, NRC inspectors independently verified that the GGNS licensee implemented the flooding walkdowns consistent with the intent of the walkdown guidance. Additionally, the inspectors independently performed walkdowns of a sample of flood protection features. The inspection report dated February 11, 2013,<sup>11</sup> documents the results of this inspection. No findings were identified.

## 4.0 SSCS NOT WALKED DOWN

The licensee did not identify any restricted access features; however, several inaccessible features were identified as not being inspected.

### 4.1 Restricted Access

No restricted access features were identified by the licensee.

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<sup>10</sup> ADAMS Accession No. ML12129A108.

<sup>11</sup> ADAMS Accession No. ML13042A373.

#### 4.2 Inaccessible Features

The licensee reported that an unspecified number of conduits within the GGNS physical plant were not inspected. They were associated with existing duct banks of the Control Building. These conduits are located below grade but are reported to be above the maximum water table elevation associated with the site. The licensee reported that the internal seals are inaccessible for the purposes of visual inspection from a nearby service manhole (Electrical Manhole 1). The licensee also reported that the Manhole 1 cover is located on grade and is not sealed; consequently, this creates a condition for surface water to potentially enter the manhole and then continue into the Control Building through the conduit(s). Because the seals are encased within the Control Building wall, they cannot be inspected. During the walkdowns, the licensee reported that there were visual signs of leakage around three conduits common to Manhole 1 and the west wall of the Control Building; water staining was observed on the concrete wall below several conduits. A review of the GGNS CAP indicated that the condition had already been identified; the licensee's condition report (CR) determined that there was no degraded or non-conforming issue and that the leak did not present an operability concern at the site as it had been repaired. The licensee reported that GGNS design drawings were reviewed; those drawings indicate that all remaining conduits entering the Control Building are internally sealed to prevent water inflow into the manhole and then into the structure via the conduits. No other signs of water intrusion were observed at any elevations in the structures walked down. Consequently, the NRC staff concludes that the licensee provided assurance that, although inaccessible, these flood protection features are available, functioning, and capable of performing their credited flood protection functions.

#### 5.0 CONCLUSION

The NRC staff concludes that the licensee's implementation of flooding walkdown methodology meets the intent of the walkdown guidance. The staff concludes that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the licensee's walkdown results, which were verified by the staff's inspection, identified no immediate safety concerns. The NRC staff reviewed the information submitted and determined that sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

If you have any questions, please contact me at (301) 415-1445 or by e-mail at [Alan.Wang@nrc.gov](mailto:Alan.Wang@nrc.gov).

Sincerely,

/RA/

Alan Wang, Project Manager  
Plant Licensing IV-2 and Decommissioning  
Transition Branch  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure:  
Staff Assessment of Flooding  
Walkdown Report

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