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

October 10, 2019

Mr. Mark Bezilla
Site Vice President-Nuclear
FirstEnergy Nuclear Operating
Company
c/o Davis-Besse NPS
5501 N. State Route 2
Oak Harbor, OH 43449-9760

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1 - STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION (EPID NO. L-2019-JLD-0007)

Dear Mr. Bezilla:

The purpose of this letter is to document the staff's evaluation of the Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse) flooding focused evaluation (FE) which was submitted in response to Near-Term Task Force (NTTF) Recommendation 2.1 "Flooding." The U.S. Nuclear Regulatory Commission (NRC) has concluded that based on the licensee's evaluation and the staff's independent assessment that no further response or regulatory actions are required to address the reevaluated flood hazard at the site.

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the NRC issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's NTTF report (ADAMS Accession No. ML111861807). Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A048).

By letter dated March 11, 2014 (ADAMS Accession No. ML14070A108), as supplemented by a letter dated July 17, 2014 (ADAMS Accession No. ML14198A400), FirstEnergy Nuclear Operating Company (the licensee) responded to this request for Davis-Besse by providing its flood hazard reevaluation report (FHRR). The licensee revised the local intense precipitation (LIP) analysis to correct a software error and provided an FHRR revision that included the LIP analysis correction in a February 25, 2015, letter (ADAMS Accession No. ML15057A023). The February 25, 2015, letter also clarified door seal information described in the licensee's July 17, 2014, letter.

By letter dated September 3, 2015 (ADAMS Accession No. ML15239B212), the NRC issued an interim staff response (ISR) letter for Davis-Besse. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Davis-Besse that are a suitable input for further assessments as the site's response to the 50.54(f) letter. As stated in the ISR letter, because the LIP and storm surge at Davis-Besse were not bounded by

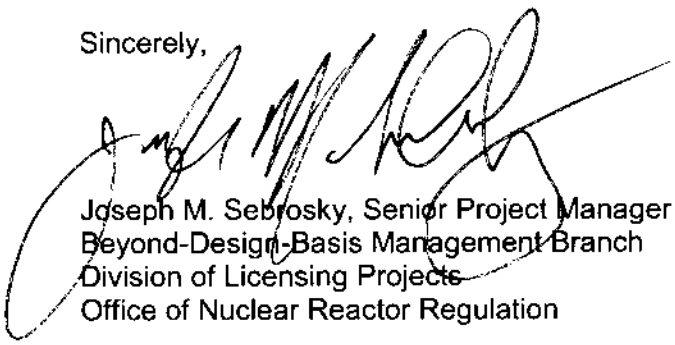
the plant's CDB, additional assessments of those flood hazard mechanisms are expected to be performed by the licensee.

By letter dated July 11, 2017 (ADAMS Accession No. ML17192A069), the licensee submitted an FE for Davis-Besse. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. The purpose of this letter is to provide the NRC's assessment of the Davis-Besse FE. The staff notes that the review of the FE was suspended and then restarted as a result of the licensee's notification and then subsequent withdrawal of its plans to permanently cease operations at Davis-Besse in May 2020. An NRC letter dated September 9, 2019 (ADAMS Accession No. ML19248B606), acknowledged the restart of the Davis-Besse FE review based on the licensee's decision to withdraw the notification of cessation of operations at the site.

The NRC staff performed its review of the Davis-Besse FE in accordance with the guidance described in Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178). Guidance document NEI 16-05, Revision 1, has been endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16090A140). The NRC staff concludes that the licensee has effective flood protection during beyond-design-basis external flooding events at Davis-Besse. This closes out the licensee's response for Davis-Besse for the reevaluated flooding hazard portion of the 50.54(f) letter and the NRC's efforts associated with EPID No. L-2019-JLD-0007.

If you have any questions, please contact me at 301-415-1132 or by email at Joseph.Sebrosky@nrc.gov.

Sincerely,



Joseph M. Sebrosky, Senior Project Manager
Beyond-Design-Basis Management Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket No: 50-346

Enclosure:
Staff Assessment Related to the
Flooding Focused Evaluation for
Davis-Besse

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE FOCUSED EVALUATION FOR

DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1

AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE

RECOMMENDATION 2.1 - FLOODING

EPID NO. L-2019-JLD-0007

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f)(hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 of the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A048). If the reevaluated hazard for any flood-causing mechanism is not bounded by the plant's current design basis (CDB) flood hazard, an additional assessment of plant response would be necessary. Specifically, the 50.54(f) letter states that an integrated assessment should be submitted, and describes the information that the integrated assessment should contain. By letter dated November 30, 2012 (ADAMS Accession No. ML12311A214), the NRC staff issued Japan Lessons-Learned Project Directorate (JLD) interim staff guidance (ISG) JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding."

On June 30, 2015 (ADAMS Accession No. ML15153A104), the NRC staff issued COMSECY-15-0019, describing the closure plan for the reevaluation of flooding hazards for operating nuclear power plants. The Commission approved the closure plan on July 28, 2015 (ADAMS Accession No. ML15209A682). COMSECY-15-0019 outlines a revised process for addressing cases in which the reevaluated flood hazard is not bounded by the plant's CDB. The revised process describes a graded approach in which licensees with hazards exceeding their CDB flood will not be required to complete an integrated assessment, but instead will perform a focused evaluation (FE). As part of the FE, licensees will assess the impact of the hazard(s) on their site and then evaluate and implement any necessary programmatic, procedural, or plant modifications to address the hazard exceedance.

Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178), has been endorsed by the NRC as an appropriate methodology for licensees to perform the FE in response to the 50.54(f) letter. The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16162A301). Therefore, NEI 16-05, Revision 1, as endorsed, describes acceptable methods for

demonstrating that Davis-Besse Nuclear Power Station, Unit 1 (Davis-Besse) has effective flood protection.

2.0 BACKGROUND

This NRC staff assessment is the last staff assessment associated with the information that the licensee provided in response to the reevaluated flooding hazard portion of the 50.54(f) letter. Therefore, the background section includes a discussion of the reevaluated flood information provided by the licensee and the associated staff assessments. The reevaluated flood information includes: 1) the flood hazard reevaluation report (FHRR); 2) the mitigation strategies assessment (MSA); and 3) the FE.

Flood Hazard Reevaluation Report

By letter dated March 11, 2014 (ADAMS Accession No. ML14070A108), FirstEnergy Nuclear Operating Company (the licensee) responded to the 50.54(f) letter for Davis-Besse and submitted the FHRR. In a second letter dated July 17, 2014 (ADAMS Accession No. ML14198A400), the licensee provided additional information related to its FHRR. In October 2014, the licensee identified a software error in the FLO-2D computer code used to model flooding due to local intense precipitation (LIP). In light of this vendor error, the licensee performed new LIP flood hazard calculations and provided an FHRR revision in a third letter dated February 25, 2015 (ADAMS Accession No. ML15057A023). The February 25, 2015, letter also clarified door seal information described in the licensee's July 17, 2014, letter.

By letter dated September 3, 2015 (ADAMS Accession No. ML15239B212), the NRC issued an interim staff response (ISR) letter for Davis-Besse. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the CDB for Davis-Besse and parameters that are a suitable input for the MSA and other assessments associated with NTTF Recommendation 2.1 "Flooding." The ISR letter is also referred to as the Mitigating Strategies Flood Hazard Information (MSFHI) letter in the licensee's FE submittal. As stated in the ISR letter, because the LIP, and the storm surge flood-causing mechanisms at Davis-Besse are not bounded by the plant's CDB, additional assessments of the flood hazard mechanisms are expected to be performed by the licensee. The staff issued a final staff assessment of the FHRR by letter dated December 14, 2016 (ADAMS Accession No. ML16323A236). As detailed in the FHRR assessment, the staff's conclusions regarding the LIP and storm surge flooding mechanisms exceeding the Davis-Besse CDB remained unchanged from the information provided in the NRC's ISR letter.

Mitigation Strategies Assessment

By letter dated December 12, 2016 (ADAMS Accession No. ML16348A010), the licensee submitted its MSA for Davis-Besse. The MSAs were intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events that were put in place to meet NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events." The NRC staff's safety evaluation for the licensee's compliance plans for Order EA-12-049 was issued on January 31, 2017 (ADAMS Accession No. ML17017A340). By letter dated April 12, 2017 (ADAMS Accession No. ML17086A499), the NRC issued its assessment of the Davis-Besse MSA.

In SECY-16-0142, "Draft Final Rule – Mitigation of Beyond-Design-Basis Events [MBDBE] (RIN 3150-AJ49)," (ADAMS Accession No. ML16291A186) provisions were proposed that would have required mitigation strategies to address the reevaluated flood hazard information on a

generic basis. As reflected in the Affirmation Notice and Staff Requirements Memorandum (SRM) dated January 24, 2019 (ADAMS Accession No. ML19023A038), associated with SECY-16-0142, the Commission determined that sites addressing the reevaluated hazards on a generic basis was not needed for adequate protection of public health and safety but should instead be assessed on a plant-specific, case-by-case basis under the requirements of 10 CFR Section 50.109, "Backfitting," and Section 52.98, "Finality of combined licenses; information requests."

The January 24, 2019, Affirmation Notice and SRM directed the staff to use the 50.54(f) process to ensure that the NRC and its licensees will take the needed actions, if any, to ensure there is no undue risk to public health and safety due to the potential effects of the reevaluated flood hazards. The SRM further directed that the staff should continue these efforts, utilizing existing agency processes to determine whether an operating power reactor license should be modified, suspended, or revoked considering the reevaluated hazard.

In a letter dated August 20, 2019 (ADAMS Accession No. ML19067A247), the NRC staff provided a path forward to treat the reevaluation of flood hazards in light of the Commission's direction in the January 24, 2019 Affirmation Notice and SRM. The staff assessment documented in this letter was performed in accordance with the information in the August 20, 2019, staff letter including a plant-specific determination on whether additional regulatory actions are warranted to address the reevaluated hazard.

As discussed below, in its FE the licensee revised the LIP and storm surge analyses from that provided in the February 25, 2015, letter. The revised FE LIP and storm surge analyses were used to support the licensee's assessment of structures, systems, and components (SSCs) to provide key safety functions (KSFs) of core cooling, containment integrity, and spent fuel pool cooling. Table 2.0-1 provides a summary of the Davis-Besse FE hazard refinement changes in water surface elevations. Note that the values in this table, as with the rest of this staff assessment, are reported in International Great Lakes Datum of 1955 (IGLD55)

Table 2.0-1 - Summary of Hazard Refinement Changes in Water Surface Elevations

Flood Mechanism	CDB	ISR/MSA	Revised FE
LIP -Turbine Building	584.5'	585.5' (TB) 585.5' (intake) 585.4' (Aux Bldg.)	585.1'
Storm Surge -Powerblock	583.7' +6.6' (w&w) 590.3'	585.8' +0.1' (w&w) 585.9'	583.8' +3.4' (w&w) 587.2'[1]

As described in the licensee's MSA the period of inundation and period of recession for the LIP event in the power block area are 0.5 hours and 1.0 hours, respectively. For the storm surge event the licensee's MSA states that the period of inundation in the power block area is 2.5 hours and the time for the flood waters to recede from the controlled area range from 14 to 44 hours. In the MSA staff assessment, the staff concluded that that the licensee demonstrated the capability to implement FLEX strategies against the reevaluated hazards described in the ISR letter. The NRC staff made its determination based on:

[1] The revised FE wind wave runup is at the wave protection dike and not in the powerblock area. The revised FE wind wave runup at the wave protection dike is discussed further in Section 3.3.1 of this staff assessment.

- All Phase 1 and 2 FLEX strategies, as currently designed, contain sufficient margin to allow local floodwaters to recede prior to any required FLEX "N" actions or equipment deployment.

- All FLEX "N" equipment (except two debris removal trucks), which is stored in the emergency feedwater facility and the auxiliary building, should be available and not impacted as a result of a LIP and/or reevaluated storm surge.

- Alternate staging areas for Phase 3 equipment have been identified to allow the completion of Phase 3 actions.

- Revised trigger points, which allow for FLEX "N+ 1" equipment to be deployed prior to the deployment path being flooded, have been identified.

Although no longer a proposed requirement, the staff concludes that FLEX strategies can be implemented assuming a LIP or storm surge event of the magnitude described in the ISR letter. The staff concludes that implementation of FLEX strategies assuming the ISR flood conditions provide an important defense-in-depth function should the installed SSCs be unable to maintain the KSFs during the conditions associated with the flood levels found in the ISR letter.

Focused Evaluation

By letter dated July 11, 2017 (ADAMS Accession No. ML17192A069), the licensee submitted the Davis-Besse FE. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. These three options associated with performing an FE are referred to as Path 1, 2, or 3, respectively, as described in NEI 16-05, Revision 1. The purpose of this staff assessment is to provide the results of the NRC's evaluation of the Davis-Besse FE.

The staff notes that the review of the FE was suspended and then restarted as a result of the licensee's notification and then subsequent withdrawal of its plans to permanently cease operations at Davis-Besse in May 2020. An NRC letter dated September 9, 2019 (ADAMS Accession No. ML19248B606), acknowledged the restart of the Davis-Besse FE review based on the licensee's decision to withdraw the notification of cessation of operations at the site.

As discussed above, the licensee's FE contains a reevaluation of the LIP event and the storm surge event that lowered the ISR LIP flood levels by approximately 0.4 feet (ft.) and lowered the storm surge ISR stillwater level by approximately 2 ft. The FE reevaluated storm surge level with wind wave runup was raised by 1.3 ft. from the ISR value. The licensee's FE provided a "Path 2" LIP evaluation (i.e., the licensee has effective flood protection for this event), and a "Path 1" storm surge evaluation (i.e., this event is bounded by the current design basis for the plant).

The staff did not perform an evaluation of the methodology associated with the reevaluated FE LIP and storm surge mechanisms. Rather, the staff evaluated whether the licensee has effective flood protection (without reliance on FLEX) for the ISR LIP levels, the ISR storm surge stillwater level, and the FE storm surge wind-wave runup level. The staff chose to evaluate the FE storm surge wind-wave runup since it is reported as higher than the wind-wave runup associated with the ISR storm surge wind-wave runup level in Table 2.0-1 of this assessment.

3.0 TECHNICAL EVALUATION

This technical evaluation addresses the following topics: characterization of flood parameters; evaluation of flood impact assessments; evaluation of available physical margin (APM); reliability of flood protection features; and overall site response.

3.1 Characterization of Flood Parameters

The LIP parameters that are used as inputs to the Davis-Besse FE staff's assessment are based on the February 25, 2015, FHRR and the NRC ISR letter. The staff's assessment credits active and passive protection features to demonstrate that key SSCs and the associated KSFs are protected from the LIP flooding mechanism. Since the peak flooding elevation of 585.5 ft. exceeds the safety-related building entry elevations of 585 ft. the staff assessed the applicable buildings regarding the lowest key SSC elevation and determined that the key SSCs remain protected during the LIP event.

Regarding the storm surge mechanism, the staff evaluated the 585.9 ft. ISR stillwater plus wind water run-up elevation and the 587.2 ft. revised FE wind-wave runup elevation. Like the LIP evaluation, the ISR storm surge elevation exceeds the safety-related building entry elevations of 585 ft., so the staff assessed the applicable buildings using the 585.9 ft. ISR level and the FE 587.2 ft. wind-wave runup elevation since it is higher than the ISR level. The staff determined that the key SSCs remain protected against this storm surge scenario.

3.2 Evaluation of Flood Impact Assessment for LIP

3.2.1 Description of Impact of Unbounded Hazard

The ISR LIP evaluation generated a maximum ponding level of 585.5 ft, which exceeds the safety-related building entry point levels of 585 ft. Based on this potential for in-leakage, the staff reviewed the key SSCs in each potentially affected building. Figure 3.2-1 provides a site layout. The staff also considered the February 25, 2015, FHRR and ISR LIP flood elevations at key doors that are summarized in Table 3.2-1.

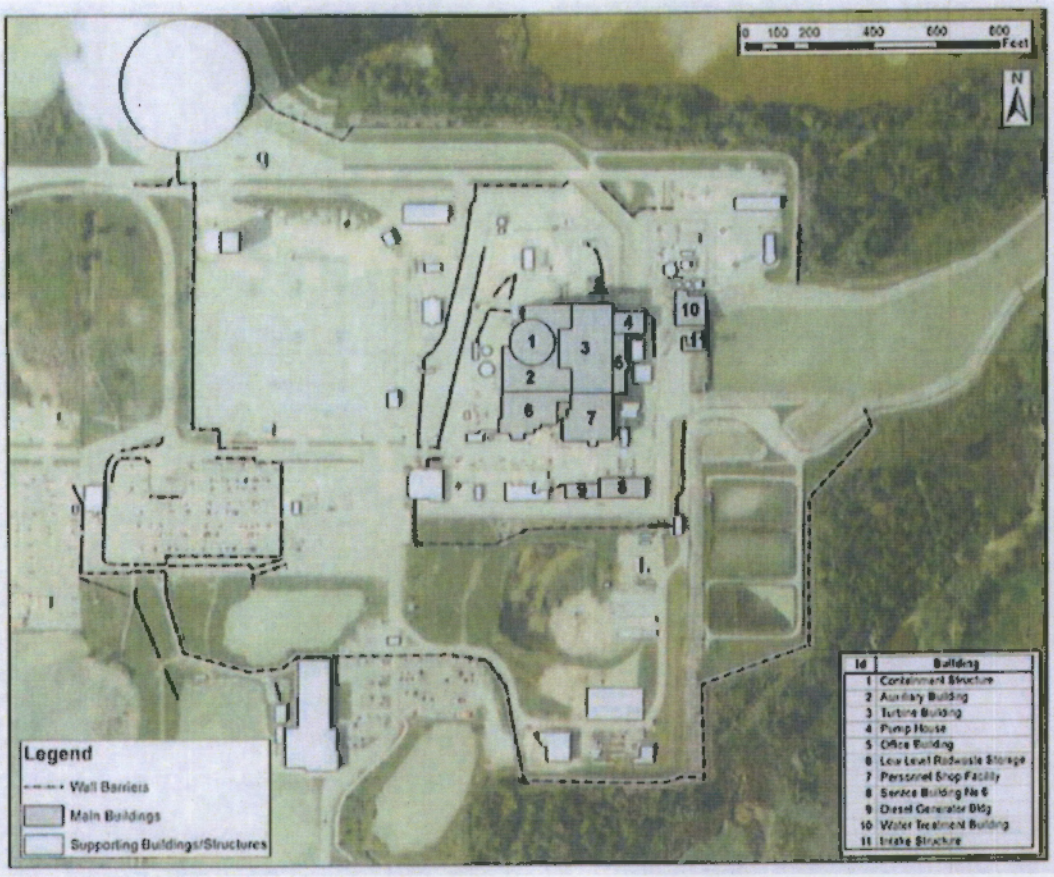


Figure 3.2-1 Davis-Besse Site Layout (taken from licensee's February 25, 2015, FHRR)

Table 3.2-1 – FHRR LIP Flooding Elevations and Duration

Structure	Door Number	Maximum Water Surface Elevation	Flood Duration above 585 ft. (minutes)
Auxiliary Building	300	585.4	24
Auxiliary Building	361	585.4	33
Auxiliary Building	362	585.4	33
Auxiliary Building	315	585.3	33
Auxiliary Building	320A	585.3	33
Auxiliary Building	324	585.3	33
Turbine Building	330	585.4	33
Turbine Building	399A	585.4	33
Turbine Building	399	585.4	33
Turbine Building	333	585.4	33
Turbine Building	334	585.5	75
Intake Structure	224	585.5	48

In Section 5 of the February 25, 2015, FHRR the licensee stated that walkdowns were performed to verify the potential impact of the LIP flood height of 585.5 ft. and the storm surge powerblock stillwater flood height of 585.8. ft with a wind wave runup of 585.9 ft. The walkdowns included all exterior doors, interior doors and building/equipment curbs that would acts as barriers to prevent flood water from reaching safety-related equipment. The licensee inspected for the following: the door state (open or closed), door operating direction, presence

of door position monitoring equipment, door and door sealing capability, nearby safety-related equipment location and installed elevation, and the height and extent of protective curbs.

The areas of the plant that contain safety-related equipment that could potentially be affected by FHRR LIP and storm surge flooding and, thus, included in the walkdowns were:

- high voltage switchgear rooms
- emergency diesel generator rooms
- mechanical penetration rooms No. 3 and No. 4
- component cooling water heat exchanger and pump room
- auxiliary feedwater pump room entrance and ventilation curbs
- intake structure

The walkdowns confirmed that the exterior doors have minimal gaps and/or have weather seals on the sides and at the bottom of the doors, that the exterior personnel doors open outward and are normally closed, and that the doors in safety-related rooms are closed and instrumented to control access and detect unauthorized opening. Because the exterior personnel doors open outward flood waters would force the doors into the jambs, which would minimize door leakage during a flood event. The walkdowns also confirmed that the inspected interior doors are in good condition but only some interior doors have seals. Those interior doors with seals are doors that provide for internal flooding or ventilation barriers. The walkdowns confirmed the noted interior door seals are in good condition.

The licensee noted during the walkdown that should the turbine building rollup doors be open, flood curbing in the turbine building and auxiliary building with a minimum height of 6 inches would prevent ISR LIP flood waters from entering safety-related areas and equipment. Additionally, within the turbine building there is a large volume available below the 585 ft. elevation that would provide capacity for accumulation of water from the LIP event. The licensee's MSA dated December 12, 2016, further clarifies that doors are closed as part of site response to increasing water levels and that there are many drainage paths to the lower elevations and the volume is sufficient to hold in-leakage from closed doors during a LIP flood event such that flooding of safety-related equipment is precluded.

The staff reviewed Calculation NORM-LP-7221, Revision 0, "Davis-Besse Mitigating Strategy Support Document," as part of the audit process for flooding focused assessments in accordance with a generic audit plan dated July 18, 2017 (ADAMS Accession No. ML17192A452). The calculation package notes that as part of the revised LIP analysis (which would later be referenced in the July 11, 2017, FE) additional door locations were modeled. These door locations included three doors at the water treatment building, which contains no safety-related equipment. However, flooding of this structure could expose the intake structure to potential flooding via a tunnel that connects the water treatment facility to the intake structure.

In its FE dated July 11, 2017, the licensee discusses a possible path for water during a LIP event entering the intake structure from the water treatment building. The water treatment building exterior doors are closed during a LIP event but leakage past these doors could migrate from the floor elevation at grade 585 to the lower elevation of the water treatment building. If enough water accumulates in the lower elevations of the water treatment building, the intake structure valve room could be impacted. A louver, located 2 ft. 6 inches above the floor, provides a direct communication path into the intake structure valve room. However, it is not anticipated that enough water would accumulate to the louver height given the limited amount of

time the water from a LIP event is above 585 ft. and the limited leakage past the doors. The staff notes that the FE assessment of this leakage path is based on LIP flood levels that are lower than those found in the February 25, 2015, FHRR. Nevertheless, the staff concludes that if slightly higher flood levels from a LIP event are assumed at the water treatment building doors safety-related equipment is unlikely to be impacted because of the following:

- the closed water treatment building doors would limit inleakage to the building
- the limited amount of time the LIP flood levels are above the finished floor elevation minimize the amount of water available to flood the water treatment building, and
- the amount of volume available to contain the inleakage in the bottom of the water treatment building before safety-related equipment could be impacted.

The staff's also audited RA-EP-02810, Revision 13, "Emergency Plan off Normal Occurrence Procedure Tornado or High Winds," and RA-EP-02830, Revision 5, "Emergency Plan off Normal Occurrence Procedure Flooding." The staff confirmed that these procedures ensure that the licensee monitors the weather and takes appropriate action in the event of severe weather that could cause site flooding (e.g., severe thunderstorm, high wind flood alert (the potential for a storm surge flood event), increasing lake levels etc.). Actions described in these procedures include:

- closing exterior doors and hatches
- installation of flood barriers
- consideration of relocating FLEX N+1 equipment to higher ground prior to the flood reaching the site because the haul path from this location is susceptible to flooding
- consideration of implementing station isolation procedures if access to the station is challenged
- increased frequency of monitoring in areas of the plant below grade to detect water intrusion including the service water pump house, turbine building, water treatment building, auxiliary building, and the service water pump tunnel.

As shown in Table 3.2-1 the total inundation period in the power block area is approximately 30 minutes with the exception of door 224, which is approximately 48 minutes and door 334 which is approximately 75 minutes. As discussed above, should water enter the turbine building, water would be prevented from entering safety-related areas by curbing in the turbine building and auxiliary building, and the available free volume in turbine building to hold water. The staff concludes that the key SSCs and their associated KSFs are effectively protected against the ISR LIP flood levels because:

- Exterior doors would minimize water intrusion into safety-related areas of the plant.
- In some cases, plant curbing would direct water away from entering safety-related portions of the plant. For example, water entering into the plant through the turbine building would be directed away from safety-related portions of the plant by both turbine building curbing and curbing inside the auxiliary building. In cases where curbing does

not exist (e.g., exterior door to the high voltage switchgear rooms) the safety-related equipment could reasonably be expected to continue to function with a small amount of water on the floor. This is because the functional portion of the equipment is elevated above the floor grade.

- There are multiple drainage paths to direct water that leaks into the turbine building and sufficient volume to preclude flooding of safety-related equipment.

- There is a small amount of time that the water levels exceed the power block grade elevation of 585 ft.

Therefore, the staff concludes that the licensee meets the guidance in NEI 16-05, Revision 1, as endorsed by the NRC, of a Path 2 evaluation (i.e., "effective flood protection") for the ISR LIP flood mechanism such that KSFs (without reliance on FLEX) can reasonably be expected to be met with installed plant equipment.

Defense-in-Depth

In addition to the staff concluding that Davis-Besse meets Path 2 guidance in NEI 16-05, Revision 1, for the ISR LIP event, the staff also concludes that Davis-Besse meets Path 3 guidance for this event by demonstrating a feasible flood response for LIP. The feasible flood response for this LIP event was evaluated by the staff and found to be acceptable as documented in the staff assessment dated April 12, 2017.

The staff concludes that because the licensee meets both Path 2 and Path 3 FE guidance in NEI 16-05, Revision 1, as endorsed by the NRC, for the ISR LIP flood event, an integrated assessment is not needed to support NRC phase 2 decision-making. The staff further concludes that additional regulatory actions are not warranted for this event and that a detailed evaluation of the lower LIP flood elevations referenced in the licensee's FE is not needed.

3.2.2 Evaluation of Available Physical Margin

Guidance document NEI 16-05, Revision 1, Appendix B, states that negligible or zero APM can be justified as acceptable if the use of conservative inputs, assumptions and/or other methods in the flood hazard evaluation can be established. The licensee's February 25, 2015, FHRR discusses conservatisms imbedded in the determination of the LIP event. These conservatisms include that active and passive drainage features are non-functional and that the entire roof drainage is assumed to be contributing to the surface runoff. Based on these conservatisms, the NRC staff concludes that adequate APM is available for the ISR LIP event.

3.2.3 Reliability of Flood Protection Features

Demonstrating reliability of the flood protection features is described in NEI 16-05, Appendix B, for both passive and active features. The features that the staff credited in its analysis include closed doors and concrete curbing around safety-related areas of the plant. The door and door seals are not credited for being water tight, rather they are credited to prevent a large influx of water. The doors in Table 3.2-1 open outward and are normally closed. The exterior doors are equipped with seals on the sides and at the bottom of the doors or have minimal gaps. Depending on the leakage path, the concrete curbing provides protection for the safety-related equipment against the door leakage. The staff also considered that the doors in safety-related rooms are closed and instrumented to control access and detect unauthorized opening. Some

of these doors provide for internal flooding or ventilation barriers. Such doors are robust and maintained to fulfill these functions ensuring that they will continue to prevent a large influx of water into safety-related areas of the plant. In other areas of the plant that do not have curbing protecting SSCs from inleakage through doors (e.g., exterior door inleakage into the high voltage switchgear room), the safety-related equipment could reasonably be expected to continue to function with a small amount of water on the floor. This is because the functional portion of the equipment is elevated above the floor grade. The NRC staff concludes that the Davis-Besse doors and concrete curbing and location of equipment off of the floor grade are reasonably reliable to maintain KSFs for the ISR LIP event, as described in Appendix B of NEI 16-05, Revision 1, as endorsed.

3.2.4 Overall Site Response

As described in Section 3.2.1 of this assessment the staff audited the licensee's severe weather procedures. The licensee's December 12, 2016, MSA does not credit a specific warning time but states that actions described in these procedures, such as ensuring exterior and interior doors are closed, commence based on weather reports or on external agencies contacting the control room with notification of impending severe weather. Based on the run-up time of the flood levels associated with a LIP (which is on the order of an hour for most doors), there is sufficient time to ensure doors are closed to prevent water ingress. One door (Door 334), has water that rises above the floor elevation at approximately 21 minutes. This door opens into the turbine building, and, as discussed above, in the event the door is not closed (even though the severe weather procedures directs the licensee to close this door) water would be directed to lower elevations of the turbine building that would preclude flooding of safety-related equipment. Depending on the leakage path, concrete curbing around safety-related areas of the plant is higher than the flood elevation.

Regarding defense-in-depth capabilities, the staff audited RA-EP-02830, Revision 5, which directs the licensee's staff to take immediate actions to ensure that the FLEX N+1 equipment is relocated to higher ground prior to flood waters arriving on site. This step is performed because the haul path used to transport the equipment from this location is at the 579 ft elevation, which makes this area prone to early flooding. The procedure directs that this relocation shall be completed within two hours of notification of a chance of 6 inches of rain in 3 hours at the site as reported from FirstEnergy Meteorological Services. The staff concludes that this should allow sufficient time to mobilize and deploy the equipment to staging areas of the plant unaffected by the ISR LIP flood event. The staff further concludes that the FLEX N equipment is not affected by the ISR LIP flood event and would be available to support the defense-in-depth function under the ISR LIP flood conditions. Only one set of FLEX equipment is needed to ensure that core cooling, containment integrity and spent fuel pool cooling are maintained.

The staff concludes that, based on the warning time associated with the ISR LIP flood event and the run-up time associated with this event that there is sufficient time for the licensee to adequately respond to this event. The staff further concludes that the licensee's plans for responding to an ISR LIP type event meet the guidance in NEI 16-05, Revision 1, as endorsed by the NRC.

3.3 Evaluation of Flood Impact Assessment for Storm Surge

3.3.1 Description of Impact of Unbounded Hazard

The ISR storm surge elevation with wind wave run-up of 585.9 ft. results from a probable maximum storm surge (PMSS) stillwater elevation of 585.8 ft with a 0.1 ft. wind wave runup from the probable maximum wind storm (PMWS) at the intake forebay location. The maximum PMSS water surface elevation in the vicinity of the power block due to the critical PMWS is 585.8 ft. The February 25, 2015, FHRR PMSS water surface elevations will remain above the site finish floor elevation of 585 ft. for approximately 2.5 hours. The FE PMSS plus wind wave runup of 587.2 ft. is discussed briefly in this section since it is higher than the ISR level of 585.9 ft.

Focused Evaluation Probable Maximum Storm Surge

As described in Chapter 2 of the Davis-Besse updated safety analysis report the areas around the Davis-Besse plant are protected along the northern, eastern, and along a small portion of the southern sides by an earth-filled wave protection dike built up to 591 ft. This protection dike is 15 ft. wide at the top. The design-basis storm surge is 583.7 ft. with a maximum water run-up of 6.6 ft. on the dike protection breakwall for a total height of 590.3 ft. The dike protection breakwall ensures that no large unbroken waves will reach the station's building and none will overtop the wave protection dike. The FE PMSS has a maximum stillwater elevation of 583.8 ft. with a maximum wave runup of 587.2 ft. at the wave protection dike. The FE PMSS stillwater is below the power block grade elevation of 585 ft. and the FE PMSS wave runup at the location of the protection dike is below the current design basis for the site. Therefore, the staff concludes that the FE PMSS values are bounded by the design basis of the plant and that keys SSCs and the associated KSFs are not affected by this flood mechanism. No further evaluation of the FE PMSS is provided in this staff assessment.

Interim Staff Response Probable Maximum Storm Surge

The ISR water depth is slightly greater than the ISR LIP levels that are evaluated in Section 3.2 of this assessment. The PMSS development requires high winds to occur. Based on the length of time required to establish a storm surge, the high wind conditions needed, and the antecedent lake level required, the site would have ample warning time to prepare by shutting doors, hatches and other actions to preclude flooding of vital areas of the plant.

The staff audited procedure RA-EP-02830, Revision 5, and notes that this procedure includes direction to monitor and take appropriate actions based on the following definitions:

- Flood Watch – lake water elevations between 574 ft. and 576 ft.
- Flood Warning – lake water elevation between 576 ft. and 578 ft.
- Flood Emergency – lake water elevation greater than 578 ft.

In addition, procedure RA-EP-02810, Revision 13, directs the licensee to take specific actions for a high wind flood alert. A high wind flood alert is issued by FirstEnergy Meteorological Services to the site if there is the potential for development of a storm surge flooding event. As described in the procedure, such an event could occur if sustained winds greater than 40 miles per hour for two hours or more are expected with wind direction coming from a location that supports

development of a storm surge as indicated by on-site meteorological tower instrumentation or off-site equivalent indications.

Consistent with the staff's conclusions for the ISR LIP event found in Section 3.2.1 of this assessment, the staff concludes that key SSCs and their associated KSFs are effectively protected against the ISR storm surge flood levels because:

- Exterior doors would minimize water intrusion into safety-related areas of the plant.

- In some cases, plant curbing would direct water away from entering safety-related portions of the plant. For example, water entering into the plant through the turbine building would be directed away from safety-related portions of the plant by both turbine building curbing and curbing inside the auxiliary building. In cases where curbing does not exist (e.g., exterior door to the high voltage switchgear rooms) the safety-related equipment could reasonably be expected to continue to function with a small amount of water on the floor. This is because the functional portion of the equipment is elevated above the floor grade.

- There are multiple drainage paths to direct water that leaks into the turbine building and sufficient volume to preclude flooding of safety-related equipment.

- There is a small amount of time that the water levels exceed the power block grade elevation of 585 ft.

Therefore, the staff concludes that Davis-Besse meets the guidance in NEI 16-05, Revision 1, as endorsed by the NRC, of a Path 2 evaluation (i.e., "effective flood protection") for the ISR storm surge mechanism such that KSFs (without reliance on FLEX) can reasonably be expected to be met with installed plant equipment.

Defense-in-Depth

In addition to the staff concluding that Davis-Besse meets Path 2 guidance in NEI 16-05, Revision 1, for the ISR storm surge, the staff also concludes that mitigation strategies equipment (i.e., FLEX) would provide a defense-in-depth function to ensure core cooling, containment integrity, and spent fuel pool cooling are maintained in the unlikely event KSFs cannot be maintained with installed plant equipment during a ISR PMSS type event. The FLEX response for the ISR PMSS event was evaluated by the staff and found to be acceptable as documented in the staff assessment dated April 12, 2017.

Conclusion

The staff concludes that because the licensee meets Path 2 FE guidance in NEI 16-05, Revision 1, as endorsed by the NRC, for the ISR PMSS event, an integrated assessment is not needed to support NRC Phase 2 decision-making. The staff further concludes that the licensee has additional defense-in-depth capabilities for such an event using FLEX equipment as documented in the April 12, 2017, staff assessment. Therefore, the staff concludes that additional regulatory actions are not warranted for this event and that a detailed evaluation of the lower stillwater flood levels associated with the FE PMSS event is not needed.

3.3.2 Evaluation of Available Physical Margin and Reliability

Guidance document NEI 16-05, Revision 1, Appendix B, states that negligible or zero APM can be justified as acceptable if the use of conservative inputs, assumptions and/or other methods in the flood hazard evaluation can be established. The staff audited calculation C-CSS-020.13-017, dated February 5, 2014, "Surge and Seiche Analysis for Davis-Besse Nuclear Power Station," that supported the licensee's February 25, 2015, FHRR. This calculation notes that the time and space varying wind and atmospheric pressure fields are maximized to conservatively predict the PMSS and wave characteristics at Davis-Besse. In addition, the licensee's FE notes that it refined the ISR storm surge levels to account for those storms that are physically capable of occurring over Davis-Besse. Original storm parameters were conservative as they did not account for the Appalachian Mountains or other geographical conditions. While the staff did not assess the magnitude of the reduction in the storm surge such an assumption provides, the staff concludes that this conservatism is embedded in the licensee's February 25, 2015, FHRR storm surge analysis. Based on these conservatisms, the NRC staff concludes that adequate APM is available for the ISR storm surge event.

3.3.3 Overall Site Response

As described in Sections 3.2.1 and 3.3.1 of this assessment, the staff audited the licensee's severe weather procedures. The licensee's December 12, 2016, MSA does not credit a specific warning time, but states that actions described in these procedures, such as ensuring exterior and interior doors are closed, commence based on issuance of a high flood alert from FirstEnergy Meteorological Services.

Regarding defense-in-depth capabilities, the staff audited RA-EP-02810, Revision 13, which directs the licensee's staff to take immediate actions to ensure that the FLEX N+1 equipment is relocated to higher ground when FirstEnergy Meteorological Services issues a high wind flood alert. The procedure directs that this relocation shall be completed within two hours of this notification. The staff concludes that this should allow sufficient time to mobilize and deploy the equipment to staging areas of the plant unaffected by the ISR storm surge event. The staff further concludes that the FLEX N equipment is not affected by the ISR storm surge event and would be available to support the defense-in-depth function under the ISR storm surge flood conditions. Only one set of FLEX equipment is needed to ensure that core cooling, containment integrity and spent fuel pool cooling are maintained.

The staff concludes that based on the warning time associated with the ISR storm surge flood event there is sufficient time for the licensee to adequately respond to this event. The staff further concludes that the licensee's plans for responding to a storm surge type event meet the guidance in NEI 16-05, Revision 1, as endorsed by the NRC.

4.0 AUDIT REPORT

The generic audit plan dated July 18, 2017, describes the NRC staff's intention to issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's FE. The NRC staff's audit for the Davis-Besse FE included a review of the selected procedures and calculations as described above. Because this staff assessment appropriately summarizes the results of the audit, the NRC staff concludes a separate audit report is not necessary, and that this document serves as the audit report described in the NRC staff's letter dated July 18, 2017.

5.0 CONCLUSION

Based on the staff's review that was performed in accordance with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01, the staff concludes that the Davis-Besse site has effective flood protection for the ISR LIP and storm surge levels. Furthermore, the staff concludes that Davis-Besse screens out for an integrated assessment based on the guidance found in JLD-ISG-2016-01. As such, the staff concludes that in accordance with Phase 2 of the process outlined in the 50.54(f) letter, additional regulatory actions associated with the reevaluated flood hazard are not warranted. The staff further concludes that the licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.

SUBJECT: DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1 - STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION (EPID NO. L-2019-JLD-0007) DATE: October 10, 2019

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