Entergy

Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530
Tel 269 764 2000

Charles F. Arnone
Site Vice President

PNP 2016-063

December 19, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: Mitigating Strategies Assessment for Flooding Submittal

Palisades Nuclear Plant
Docket 50-255
Renewed Facility Operating License No. DPR-20

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 (ADAMS Package Accession No. ML12056A046)
2. Entergy Nuclear Operations, Inc. letter, PNP 2015-018, *Required Response 2 for Near-Term Task Force Recommendation 2.1: Flooding – Hazard Re-Evaluation Report*, dated March 11, 2015 (ADAMS Accession No. ML15106A681)
3. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A736)
4. NRC memorandum, *Staff Requirements - COMSECY-14-0037 - Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards*, dated March 30, 2015 (ADAMS Accession No. ML15089A236)
5. NRC letter, *Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events*, dated September 1, 2015 (ADAMS Accession No. ML15174A257)
6. Nuclear Energy Institute (NEI) report NEI 12-06, *Diverse and Flexible Coping Strategies (FLEX) Implementation Guide*, Revision 2, dated December 2015 (ADAMS Accession No. ML16005A625)

7. NRC Interim Staff Guidance JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, *Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events*, dated January 22, 2016 (ADAMS Accession No. ML15357A163)
8. NRC letter, *Palisades Nuclear Plant – Interim Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request - Flood-Causing Mechanism Reevaluation (TAC No. MF6128)*, December 23, 2015 (ADAMS Accession No. ML15356A765)

Dear Sir or Madam:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a 50.54(f) letter to all power reactor licensees and holders of construction permits in active or deferred status (Reference 1). The letter contained in Enclosure 2 specific requested actions, requested information, and required responses associated with Recommendation 2.1: Flooding. One of the required actions was to submit the Hazard Reevaluation Report, which Entergy Nuclear Operations, Inc. (ENO) provided for Palisades Nuclear Plant (PNP) in Reference 2.

Concurrent with the Hazard Reevaluation Report, ENO developed and implemented mitigating strategies for PNP in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (Reference 3). In Reference 4, the NRC affirmed that licensees need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events, and this expectation was confirmed by the NRC in Reference 5. Guidance for performing a mitigating strategies assessment (MSA) for flooding is contained in Appendix G of Reference 6, which was endorsed by the NRC in Reference 7. For the purpose of the MSA for flooding and in Reference 5 the NRC termed the reevaluated flood hazard as the "Mitigating Strategies Flood Hazard Information" (MSFHI).

In Reference 8, the NRC concluded that the "reevaluated flood hazards information, as summarized in the Enclosure, is suitable for the assessment of mitigating strategies, developed in response to Order EA-12-049" for PNP.

The enclosure to this letter provides the Mitigating Strategies Assessment for Flooding Documentation Requirements at PNP. The assessment concluded that the existing FLEX strategy can be successfully implemented and deployed as designed for all applicable flood causing mechanisms, with the exception of the probable maximum storm surge (PMSS) combined event. The periods of inundation for the PMSS combined event scenarios are greater than the period of inundation in the FLEX strategy. ENO plans to address these increased flood durations with changes to the FLEX strategy and procedural updates under the ENO condition reporting system.

This letter contains no new or revised regulatory commitments.

This letter contains no proprietary information.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 19, 2016.

Sincerely,

p.p.

for Charles F. Arnone

CFA/jse

Attachment: Mitigating Strategies Assessment for Flooding Documentation Requirements at Palisades Nuclear Plant

cc: Director of Office of Nuclear Regulation, USNRC
Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC

PNP 2016-063

ATTACHMENT

MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS AT PALISADES NUCLEAR PLANT

22 Pages Follow

Entergy

ENTERGY NUCLEAR
Engineering Report Cover Sheet

Engineering Report Title:

MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS AT PALISADES NUCLEAR PLANT

Engineering Report Type:

New ☒ Revision ☐ Cancelled ☐ Superseded ☐
Superseded by: ______

Applicable Site(s)

IP1 ☐	IP2 ☐	IP3 ☐	JAF ☐	PNPS ☐	VY ☐	WPO ☐
ANO1 ☐	ANO2 ☐	ECH ☐	GGNS ☐	RBS ☐	WF3 ☐	PLP ☒

EC No. 66744

Report Origin: ☐ Entergy ☒ Vendor
Vendor Document No.: ENTCORP037-REPT-002

Quality-Related: ☐ Yes ☒ No

Prepared by: Prepared, Reviewed, and Approved by Enercon — Date: 11/18/16
Responsible Engineer (Print Name/Sign)

Design Verified: N/A — Date: N/A
Design Verifier (if required) (Print Name/Sign)

Reviewed by: Greg Hubers [signature] — Date: 11/30/16
Reviewer (Print Name/Sign)

Approved by: Brian Sova / See AS for EC66744 — Date: See AS
Supervisor / Manager (Print Name/Sign)

PROJECT REPORT COVER SHEET

Title:	MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS AT PALISADES NUCLEAR PLANT	REPORT NO.: ENTCORP037-REPT-002
		REVISION: 0
		Client: Entergy
		Project Identifier: ENTCORP037

Item	Cover Sheet Items	Yes	No
1	Does this Project Report contain any open assumptions, including preliminary information that require confirmation? (If **YES**, identify the assumptions.)	☐	☒
2	Does this Project Report supersede an existing Project Report? (If **YES**, identify the superseded Project Report.) **Superseded Project Report No.** ____________	☐	☒

Scope of Revision:
Initial Issue

Revision Impact on Results:
N/A

Safety-Related ☐ Non-Safety-Related ☒

Originator:	Brian Froese	[signature]	
Reviewer:	Mickey Hamby	[signature]	
Approver:	Jared Monroe	[signature]	Date: 11/18/2016

PROJECT REPORT REVISION STATUS

REVISION	DATE	DESCRIPTION
0	11/18/2016	Initial Issue

ATTACHMENT REVISION STATUS

APPENDIX NO.	NO. OF PAGES	REVISION	ATTACHMENT NO.	NO. OF PAGES	REVISION
A	2	0			
B	2	0			
C	4	0			

Mitigating Strategies Assessment
Flooding Documentation Requirements
Palisades Nuclear Plant

Acronyms:

- AWL – Antecedent Water Level
- CDB – Current Design Basis
- ELAP – Extended Loss of AC Power
- EST – Empirical Simulation Technique
- FHRR – Flood Hazard Re-evaluation Report
- FLEX DB – FLEX Design Basis (flood hazard)
- FSB – FLEX Storage Building
- FSG – FLEX Support Guideline
- HHA – Hierarchal Hazard Assessment
- ISR – Interim Staff Response
- LIP – Local Intense Precipitation
- LUHS – Loss of Ultimate Heat Sink
- MSA – Mitigating Strategies Assessment
- MSFHI – Mitigating Strategies Flood Hazard Information (from the FHRR and MSFHI letter)
- NGVD29 – National Geodetic Vertical Datum of 1929
- NRC – Nuclear Regulatory Commission
- NSRC - National SAFER Response Center
- PCS – Primary Containment System
- PMSS – Probable Maximum Storm Surge
- SFP – Spent Fuel Pool

Definitions:

FLEX Design Basis: the flood hazard for which FLEX was designed.

FLEX Design Basis Flood Hazard: the controlling flood parameters used to develop the FLEX flood strategies.

1. Summary

The MSFHI provided in the Palisades FHRR (Ref. 1) evaluates the eight flood-causing mechanisms and Combined Event PMSS flood, identified in Attachment 1 to Enclosure 2 of the NRC information request (Ref. 6). The ISR provided by the NRC (Ref. 2) identified the flood mechanisms listed below as not bounded by the CDB:

- (1) LIP
- (2) Storm surge (H.4 Combined Event)

For Mechanism (2), the Combined Event PMSS, Revision 1 of the Palisades Combined Event calculation (Ref. 3) is evaluated in this MSA instead of what was included in the FHRR (Ref. 1). Revision 1 of the Combined Event calculation was developed using the depth limited wave criterion and stillwater elevation that was calculated in new AREVA calculation No. 32-9255682-

000, “Palisades Nuclear Plant Flooding Hazard Re-Evaluation – Probable Maximum Storm Surge (EST analysis) and Duration” (Ref. 4). Revising the calculation to use the EST is a refinement to the analysis, similar to the Hierarchal Hazard Assessment (HHA) discussed in NUREG-7046 (Ref. 17).

For Mechanism (1), the LIP, the FLEX strategies can be implemented as designed. For Mechanism (2), the period of inundation impacts the FLEX strategy, as it was designed around a 30-minute seiche. Modifications to the FLEX strategy and procedural updates can be made to address these increased flood durations. The FLEX pump and associated hosing, located outside the Intake Structure per EC 46465 (Ref. 5), will be pre-staged and protected from wave run-up with temporary flood protection features such as Tiger Dams. Procedures for accomplishing this will be modified or developed and integrated into the FLEX strategy.

Other re-evaluated flood hazard mechanisms (i.e.: tsunami, seiche, channel migrations/diversions, etc.), are bounded by the CDB and have no impact on the FLEX strategies. Additionally, Phase 3 activities were evaluated. These activities are also not impacted by the re-evaluated flood levels since they will have sufficiently receded by the time the Phase 3 strategy is implemented. Details of the FLEX strategies along with the bounding flood will be discussed later in this document.

2. Documentation

2.1. NEI 12-06, Rev. 2, Section G.2 – Characterization of the MSFHI

Characterization of the MSFHI is primarily summarized in Table 2 of the NRC's Interim Staff Response (Ref. 2) to the flood hazard re-evaluation submittal (Ref. 1). Subsequent to the ISR, the Combined Event PMSS flood was revised for use in the Mitigating Strategy Assessment only. A more detailed description of the flood mechanisms identified in the MSFHI, along with the basis for inputs, assumptions, methodologies, and models, is provided in the following references:

- LIP: Reference 1, Section 3.1.
- Flooding in Streams and Rivers: Reference 1, Section 3.2.
- Dam Breaches and Failures: Reference 1, Section 3.3.
- Probable Maximum Storm Surge: Reference 1, Section 3.4.
- Seiche: Reference 1, Section 3.5.
- Tsunami: Reference 1, Section 3.6.
- Ice-Induced Flooding: Reference 1, Section 3.7.
- Channel Migration or Diversion: Reference 1, Section 3.8.
- Combined Event PMSS: This MSA evaluates Revision 1 of the Palisades Combined Event calculation (Ref. 3), which calculates the wind generated wave action from the PMSS developed using the EST Analysis (Ref. 4). See Table 1.

Based on the results of the flood hazard re-evaluation, the ISR issued by the NRC (Ref. 2) identified that the flood mechanisms described below are not bounded by the Palisades CDB. Therefore, these mechanisms are included in this MSA developed in response to Order EA-12-049. All other mechanisms evaluated in the MSFHI (i.e.: tsunami, seiche, channel migrations/diversions, etc.) are bounded by the design basis flood level and have no impact on the site. Note that all elevations presented here and throughout the MSA are reported in NGVD29.

Local Intense Precipitation

The LIP is included in the CDB but does not bound the MSFHI. LIP flooding depths range from 592.5 ft to 594.4 ft at the critical locations identified on the lower level. The LIP flood elevations on the upper level of the site range from 626.0 ft to 626.1 ft at the critical locations identified. This results in maximum flood depths that range from 1.8 ft to approximately 5.3 ft above grade.

Storm Surge

The revised Combined Event PMSS (Ref. 3) is based on a stillwater elevation calculated using a hybrid deterministic-probabilistic frequency indexed total storm surge water level analysis (Empirical Simulation Technique (EST)) (Ref. 4). The depth-limited wave heights vary from 1.1 to 1.7 ft at important locations within the Palisades site. The standing wave crest elevation on top of the combined stillwater elevation ranged from an elevation of 592.1 ft to 595.0 ft and was calculated to be 593 ft at the lake-facing side of the Intake Structure. The north and south doors of the Intake Structure are exposed to minor waves moving parallel or away from the structure and result in a maximum water surface elevation of 592.2 ft. The lake-front dune just southwest of the Intake Structure also is expected to erode completely during the Combined Event PMSS.

Table 1 presents the main differences between Rev. 0 and Rev. 1 of the Combined Event PMSS calculation, which was revised as a refinement for this MSA.

Table 1 – PMSS Comparison

Comparison Parameter	Combined Event PMSS Rev. 1 (Ref. 3) – Evaluated in this MSA	Combined Event PMSS Rev. 0 - Evaluated in the FHRR (Ref. 1) and ISR (Ref. 3)
Analysis Type	EST	Deterministic
Stillwater El. (ft NGVD29)	591.3	593.9
Wave Crest El. at the Intake Structure (ft NGVD29)	592.1	594.2
Reflected Wave Crest El. at the lake-facing side of the Intake Structure (ft NGVD29)	593.0	N/I*

*Since the stillwater elevation is above the bottom of the circulating water pipe, reflected waves do not form at the lake-facing side of the Intake Structure.

2.2. NEI 12-06, Rev. 2, Section G.3 – Comparison of the MSFHI and FLEX DB Flood

A complete comparison of the CDB, the FLEX DB and re-evaluated flood hazards is provided in the tables listed below:

- Table 2 reflects data from the MSFHI for the LIP.
- Table 3 reflects data from Revision 1 of the Combined Event PMSS calculation (Ref. 3) that uses a stillwater elevation based on the EST analysis.

Table 2 - Flood Causing Mechanism (LIP) or Bounding Set of Parameters

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI LIP	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft NGVD29)	See Note 1	594.1	See Note 2	NB
	2. Max Wave Run-up Elevation (ft NGVD29)	N/I	594.1	See Note 3	B
	3. Max Hydrodynamic/Debris Loading (psf)	N/I	N/A	See Note 4	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/A	See Note 4	B
	5. Concurrent Site Conditions	N/I	N/A	See Note 5	B
	6. Effects on Groundwater	N/I	N/A	N/I	B
Flood Event Duration	7. Warning Time (hours)	N/I	N/I	N/I	B
	8. Period of Site Preparation (hours)	N/I	N/I	N/I	B
	9. Period of Inundation (hours)	N/I	N/I	See Note 6	NB
	10. Period of Recession (hours)	N/I	N/I	See Note 7	NB
Other	11. Plant Mode of Operations	Modes 1-6	Modes 1-6	Modes 1-6	B
	12. Other Factors	N/A	N/A	N/A	N/A

N/A = Not Applicable N/I = Not Included

Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination.

1. East side of Service Building is 601.0 ft. Ponding depth of 0.5 ft in other areas.
2. East side of Service Building is 605.8 ft, upper level is 626.1 ft and lower level is 594.4 ft.
3. Consideration of wind-wave action for the LIP event is not explicitly required by NUREG/CR-7046 and is judged to be negligible because of flow depths.
4. The FHRR (Ref. 1) did not identify any hydrodynamic loading, debris loading, sediment deposition or erosion. These were not considered credible effects due to the relatively low flow velocities in general for a LIP event and limited debris sources within the protected area. There were a few areas with higher velocities, however these will be short in duration and significant erosion is not anticipated (Ref. 1, Section 3.1.2.1.5).
5. No antecedent storm was considered with the LIP event.
6. 0.2 to 0.5 hours at critical locations. Since the Period of Inundation was not included in the CDB or FLEX DB, this parameter is not bounded.
7. Flood depths mostly recede within the first two hours, plateau until six hours, then continue to decrease to marginal heights beyond the 24 hour range analyzed. Since the Period of Recession was not included in the CDB or FLEX DB, this parameter is not bounded.

Table 3- Flood Causing Mechanism (Storm Surge) or Bounding Set of Parameters

	Flood Scenario Parameter	Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	32-9226981-001 Rev. 1 (Ref. 3) Storm Surge	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft NGVD29)	594.1	594.1	591.3	B
	2. Max Wave Run-up Elevation (ft NGVD29)	See Note 1	594.1	See Note 2	B
	3. Max Hydrodynamic/Debris Loading (psf)	See Note 3	N/A	See Note 3	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/A	See Note 4	NB
	5. Concurrent Site Conditions	N/I	N/A	See Note 5	B
	6. Effects on Groundwater	N/I	N/A	See Note 6	B
Flood Event Duration	7. Warning Time (hours)	N/I	N/I	N/I	B
	8. Period of Site Preparation (hours)	N/I	N/I	N/I	B
	9. Period of Inundation (hours)	0.5	0.5	See Note 7	NB
	10. Period of Recession (hours)	0.5	0.5	See Note 7	NB
Other	11. Plant Mode of Operations	Modes 1-6	Modes 1-6	Modes 1-6	B
	12. Other Factors	N/A	N/A	N/A See Note 8	N/A

N/A = Not Applicable N/I = Not Included

Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination.

1. Maximum wave run-up is not independently evaluated in the current design basis. The intake structure has been evaluated for approximately 8 ft of run-up.
2. Revision 1 of the Combined Event calculation (Ref. 3) lists a maximum elevation resulting from wave action as 593.0 ft at the Intake Structure, 595.0 ft at the Discharge Structure, 593.0 ft at the feedwater purity building, and 593.2 ft at the auxiliary building addition. Since the relevant outdoor FLEX activities that could be impacted by wave run-up will be at the Intake Structure, the maximum of 593.0 ft is bounded by the FLEX DB.
3. The capacity of the Intake Structure to withstand dynamic water loading up to elevation 597.0 ft bounds the calculated maximum Combined Event PMSS water surface elevation of 593.0 ft (standing wave crest elevation) at the Intake Structure. The circulating water pipes have been evaluated for debris loads and it was found that the pipes can withstand debris loads imposed by a 2,000 pound object (Ref. 3, Section 6.2). The area of shallow flooding adjacent to the Intake Structure is shielded from large debris by the circulating water pipes. The other structures affected by debris loads (feedwater purity building and

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	32-9226981-001 Rev. 1 (Ref. 3) Storm Surge	Bounded (B) or Not Bounded (NB) by FLEX DB
	service building) are not used for FLEX. 4. The coastline near PLP is not within a high risk erosion area as defined by the Michigan Department of Environmental Quality. However, the lake-front dune just southwest of the Intake Structure is expected to completely erode. Sand from this dune is expected to be deposited in the paved yard area immediately inland of the dune, potentially blocking the southern deployment route (Ref. 3). Therefore this parameter is not bounded. 5. Wind wave effects are added on top of an AWL of 583.4 ft, which is the 100 year lake elevation, and a probable maximum surge height of 2.17 meters, resulting in a Combined Event PMSS stillwater elevation of 590.5 ft (Ref. 4). Since the maximum stillwater and wave run-up elevations are bounded, this is also bounded. 6. Because of the relatively short duration of flooding and slow percolation rate of the underlying soil, short term water level changes (i.e., storm surge) is unlikely to affect groundwater levels in the vicinity of Palisades and therefore is bounded (Ref. 3). 7. Using the more conservative Combined Event flood from the FHRR (Ref. 1), the flood is at its peak 2 ft of elevation for ~10 hours total. This should be representative of the EST based Combined Event PMSS, where the stillwater elevation is a maximum of 1.3 ft above grade. 8. The wind effects resultant from the PMWS extra-tropical storm identified in the FHRR (Ref. 1, Section 3.4) are not applicable. Revision 1 of the Combined Event PMSS calculation based on the EST (Ref. 3) did not identify any concerns associated with wind effects.				

2.3. NEI 12-06, Rev. 2, Section G.4 – Evaluation of Mitigating Strategies for the MSFHI

2.3.1. NEI 12-06, Rev. 2, Section G.4.1 – Assessment of Current FLEX Strategies

2.3.1.1. LIP

Three flooding scenario parameters for the LIP are not bounded by the FLEX strategy: Max Stillwater Elevation, Period of Inundation, and Period of Recession. See Appendix A for the location of deployment paths and Appendix B for critical locations 19 and 20 described below.

The equipment stored in FSB A, which is located on the north side of the plant (Ref. 10), is protected to a minimum elevation of 594 ft 1 in. (Ref. 9). The LIP maximum flooding depths (Ref. 8, Appendix F-4) in this area remain below this elevation and therefore storage of the equipment will not be impacted. However, the maximum flooding levels along the deployment routes from FSB A to the staging areas identified in FSG-5 (Ref. 7) exceed 3 ft for large sections. Hydrographs along the deployment route from FSB A were not included in the LIP calculation (Ref. 8), however, using the hydrographs created for other areas of the plant as a basis suggest flood levels will recede to <2 ft by two hours into the event, remain stable until six hours, then decrease to <1 ft by eight hours. Therefore, deployment of equipment from this FSB can potentially be impacted during this period of inundation. The accessibility of FSB A will be evaluated during the Initial Assessment in FSG-5 (Ref. 7), which includes assessment of external plant flooding.

The equipment stored in FSB B, located near the abandoned security gate east of the employee parking lot (Ref. 10), is at elevation 647.5 ft (Ref. 9). This is significantly above the maximum flooding elevations identified in the ISR (Ref. 2) and therefore storage of the equipment is not impacted. The LIP maximum flooding depths between this FSB and the security entrance (Ref. 8, Appendix F-4) are generally low (<1 ft maximum).

The deployment route from FSB B along the south side of the plant (Ref. 7) is the least flooded path. The depths along this route are also generally low (<1 ft maximum), with the exception of the stretch (~400 ft) along the southwestern, shore-side of the plant where they can reach a maximum of ~4 ft. At these maximum flood heights, deployment and staging of the FLEX pump at the southwest or northwest corners of the Intake Structure (Ref. 10) could potentially be impacted. However, these maximum flood heights occur at the beginning of the LIP event and deployment of the FLEX equipment starts at 2 hours (Ref. 10, Table 1). Per Appendix C, hydrographs at three locations along this deployment stretch were created from the FLO-2D LIP model. From these hydrographs, after 2 hours the flood elevations are reduced to <2.1 ft. These flood elevations level off until approximately 6 hours, then decrease such that at 8 hours the flood elevation is <1 ft. The FLEX pump, which is the only piece of equipment deployed through this deployment path early into the event (i.e. before 8 hours), has a ground clearance of 26" or 2.2 ft (Ref. 19). This is higher than the maximum flood height of 2.1 ft at 2 hours into the event. For the FLEX truck, the dealership was consulted and it is capable of towing through this flood height. As an alternative, the front-end loader is also equipped with a tow hitch (Ref. 5) and could be utilized to tow equipment if needed. Therefore, deployment is not impacted by the LIP flood. Similarly, critical locations 19 and 20 outside the Intake Structure doors, where the FLEX pump is staged, recede to <1.5 ft flooding after 2 hours. Thus, staging can be accomplished as intended without impacting the sequence of events timeline (Ref. 10).

With the exception of the doors in the Intake Structure and Turbine Building, the primary FLEX strategy does not open any exterior doors that are at ground elevation. Section 5.1.1 of the FHRR (Ref. 1) discusses flooding through doorways and concludes flooding from the LIP is not a concern. For the Turbine Building and Intake Structure, all FLEX equipment is above the maximum flood height of 594.4 ft and therefore is not impacted. Note that AOP-38 (Ref. 13) already includes actions to place sandbags outside the Turbine Building South roll-up door. This, in combination with the short duration and recession of a LIP event provides reasonable assurance that operators will be able to able to accomplish actions in the Turbine Building early (<1 hr) into the event.

Other time sensitive activities listed in the FIP sequence of events timeline (Ref. 10, Table 1) were reviewed. All activities, including debris removal and deployment of equipment as described in the paragraph above, can be implemented as intended.

Revision 1 of PLP-RPT-15-00010 (Ref. 15) provided minor markups to the FHRR. It should be noted that two additional actions are being implemented as a result. First, conduits leading from Manhole #4 to the 1C Switchgear Room will be sealed (tracked per ECR 19874, Ref. 16). Second, an action in AOP-38 (Ref. 13) was added to protect Door 107 in the event of heavy rainfall.

Access to the 1C Switchgear Room for deployment of the Phase 2 generator is part of the alternate strategy (Ref. 10) and therefore is not required since the primary generator location is available. However, access to this room is required for establishing SFP makeup, which is needed by 11 hours. This will not be impacted given the LIP recession times of 2-8 hours.

2.3.1.2. Storm Surge

Three flooding scenario parameters for the storm surge are not bounded by the FLEX strategy: Effects of Sediment Deposition/Erosion, Period of Inundation, and Period of Recession. The storm surge maximum stillwater elevation of 591.3 ft and reflected wave height at the Intake Structure of 593 ft is bounded by the FLEX DB elevation of 594.1 ft. However, the FLEX DB recession time of 30 minutes does not bound this event. The maximum Combined Event PMSS duration data ranges up to 30 hours, although the stillwater elevation is expected to recede below grade after ~10 hours as indicated in Table 3. This inundation period impacts the deployment and staging of the FLEX pump located on the southwest or northwest corners of the Intake Structure (Ref. 10), since the reflected wave height is a maximum of 3 ft. The area along the north and south side of the Intake Structure where hoses from the FLEX pump will be run will also be impacted, as they are exposed to minor waves moving parallel or away from the structure. This results in a maximum water surface elevation of 592.2 ft, or maximum flood depth of 2.5 ft. These locations need to be accessed by operators as well to connect the FLEX pump used to establish SG makeup (Ref. 10, Section 2.17).

Since this stillwater elevation is below that for the LIP on the lower level, the discussion on flooding through doorways and impact to the sequence of events timeline is also applicable to the storm surge event.

Similar to Section 2.3.1.1, access to the 1C Switchgear Room for deployment of the Phase 2 generator is part of the alternate strategy (Ref. 10) and therefore is not required since the primary generator location is available. Access to this room is required for establishing SFP makeup, which is needed by 11 hours. This will not be impacted since the storm surge is only above grade for 10 hours total.

2.3.1.3. Phase 3

For Phase 3, the NSRC's ability to transport equipment to Staging Area B (site location where equipment will be pre-staged, parked, or placed prior to movement into the final location) is covered in the Palisades SAFER Response Plan (Ref. 11), which includes multiple means and pathways of transporting NSRC equipment to the site. Therefore, since Phase 3 begins no sooner than 72 hours into the event (Ref. 10, Section 2.3.3), transportation of NSRC equipment to the site is bounded given the recession times discussed in Sections 2.3.1.1 and 2.3.1.2. The primary and secondary Staging Area B are located east of the site nearby FSB B and use the same deployment pathway to get to the site. As such, the Phase 3 strategy can be implemented as intended and is not impacted by the flooding mechanisms evaluated in this MSA.

2.3.2. NEI 12-06, Rev. 2, Section G.4.2 – Assessment for Modified FLEX Strategies

The overall plant response strategies to an ELAP and LUHS event using the current FLEX procedures, equipment, and personnel can be implemented as intended with modifications to the strategy. Below is a summary of the current Entergy plan for addressing the MSFHI related impacts to FLEX. Note, with the concurrent work on the Seismic MSA, Entergy may choose to modify this plan or implement an alternative:

- The FLEX pump and corresponding connections will be pre-staged at the southwest corner of the Intake Structure. The pump, hoses, and operator access pathway from the south side of the Turbine Building will be protected with temporary flood protection features such as Tiger Dams. These use water filled bladder technology, are stackable, capable of being joined together to create a dam of any length, and can be filled in minutes with minimal manpower (Ref. 14). Pre-staging actions will be validated by Entergy.

- Trigger-point entry conditions will be developed for the storm described in Revision 1 of the Combined Event calculation (Ref. 3) to allow these pre-staging activities to be accomplished. Entry conditions for acts of nature, such as a lake level above 585 ft, high winds, sustained heavy rain, etc. are already included in procedure AOP-38 (Ref. 13). It is expected entry conditions for prestaging the FLEX pump will be comparable and provide at least 48 hours of advanced warning, which is less than the 72 hour high wind warning already included in AOP-38.

Figure 1 provides a general depiction of where these dams are expected to be placed. Note the locations are not final. Based on this configuration, it is estimated that a total of nine (9) 50 ft long Tiger Dams would be required, stacked three high by three long. In total, this would require approximately 6800 gallons of water and can be filled in multiple ways such as from a 2 inch pump, a fire hydrant (fastest) or a garden hose. Given the expected warning time of at least 48 hours, this is adequate to fill and set up this system.

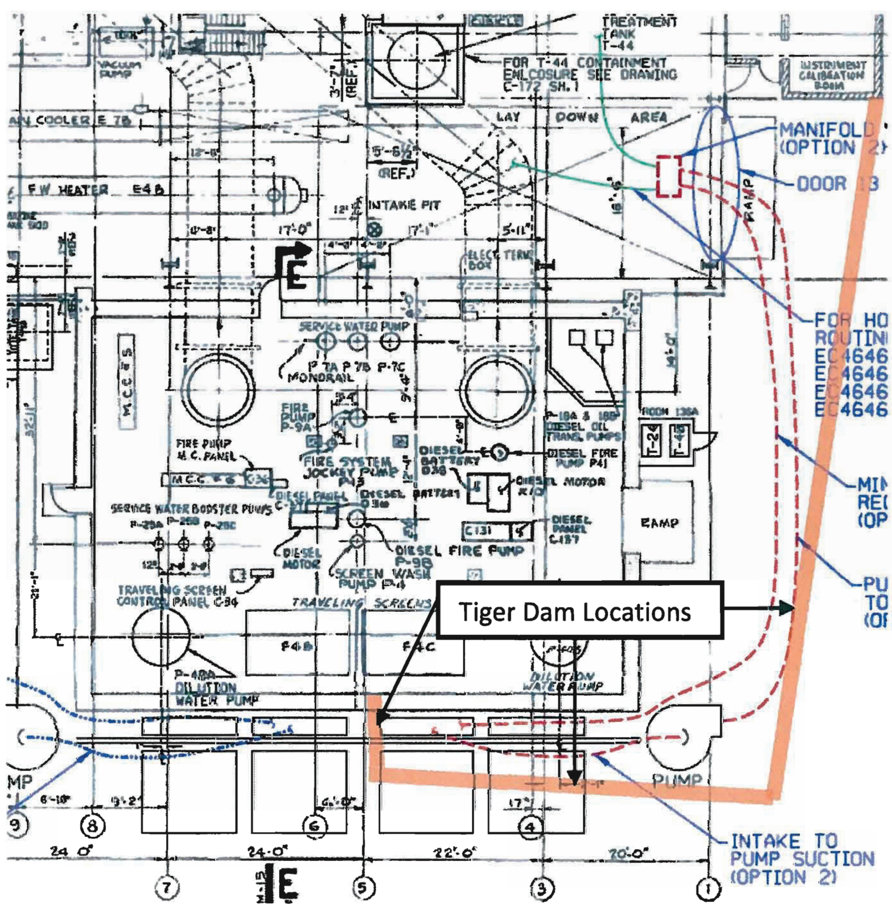

Figure 1: Expected Tiger Dam Locations

2.4. References

1. PNP 2015-018, Required Response 2 for Near-Term Task Force Recommendation 2.1: Flooding - Hazard Re-Evaluation Report, March 11, 2015
2. Palisades Nuclear Plant – Interim Staff Response To Reevaluated Flood Hazards Submitted In Response To 10 CFR 50.54(f) Information Request - Flood-Causing Mechanism Reevaluation (TAC No. MF6128), December 23, 2015 (ML15106A681)
3. 32-9226981-001, Rev. 1, Palisades Nuclear Plant Flooding Hazard Re-Evaluation – Combined Events
4. 32-9226982-000, Rev. 0, Palisades Nuclear Plant Flooding Hazard Re-Evaluation – Probable Maximum Storm Surge (EST analysis) and Duration
5. EC 46465, Rev. 0, (FLEX EC#2) - Basis (Base EC)
6. 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, U.S. Nuclear Regulatory Commission, March 2012.
7. FSG-5, Rev. 0, Initial Assessment and FLEX Equipment Staging
8. EA-EC54930-05 Rev. 0, 32-9226944-002 – Palisades Nuclear Plant Flooding Hazard Re-Evaluation – Local Intense Precipitation
9. EC 46467, Rev. 0, (FLEX EC#11) – Storage Buildings
10. PLP-RPT-15-00049, Palisades Final Integrated Plan for FLEX Implementation, Rev. 0, (ML15351A360)
11. 38-9237574-000, Rev. 1, SAFER Response Plan for Palisades Nuclear Plant
12. EA-EC46467-01, Rev. 0, Drainage Analysis for FLEX Storage Buildings
13. AOP-38, Rev. 3, Acts of Nature
14. Tiger Dam System, http://www.usfloodcontrol.com/TigerDamBrochure.pdf, Accessed 8/26/2016
15. PLP-RPT-15-00010, Rev. 1, 51-9226987-000 - Palisades Nuclear Plant Flooding Hazard Re-Evaluation Report
16. ECR 19874, Seal Ten Conduits in Manhole MH-4. Provide Drain, and Supporting Calculations (CR-PLP-2015-784)
17. NUREG/CR-7046, PNNL-20091, Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America
18. EC 66744, Rev. 0, Admin EC to Issue PLP FLEX Flood MSA Report
19. VTM M767 SH 2, Hale Fire Pump Co Operation and Service Maintenance Manual for PSM Single Stage Pump

Appendix A: FLEX Equipment Deployment Paths

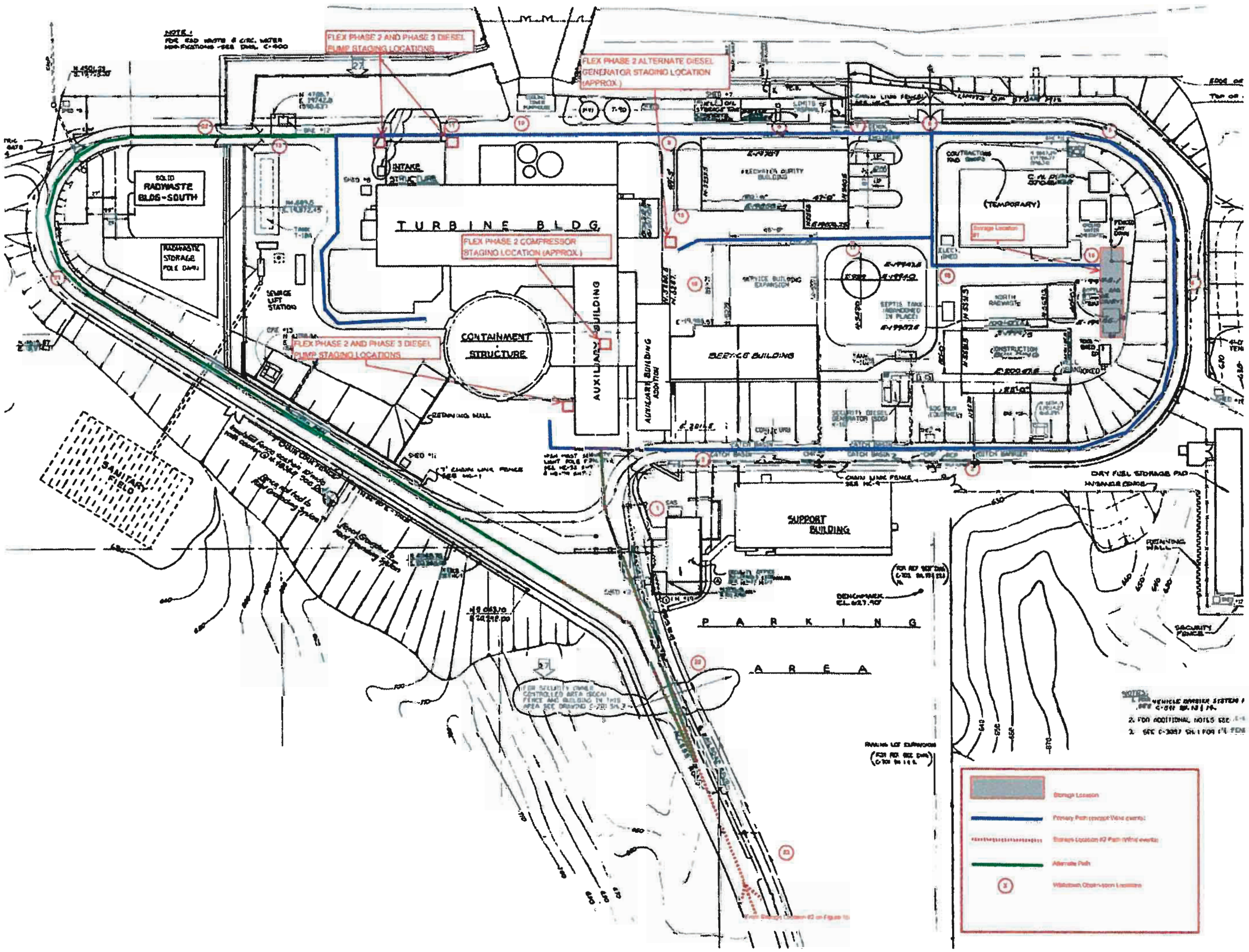

Figure A-1: Deployment Route Part 1 (Ref. 10)

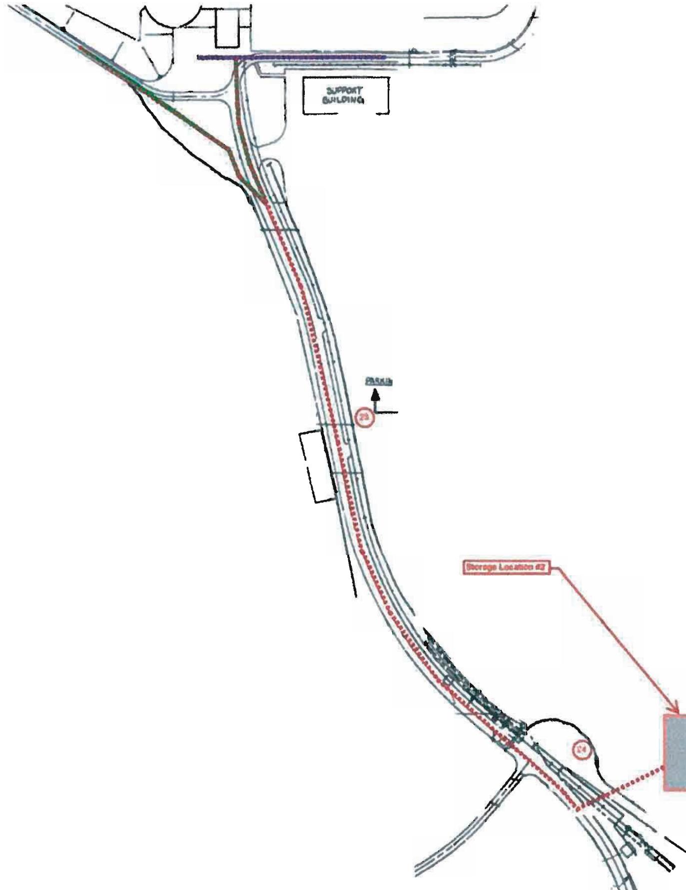

Figure 1b - Site Deployment Pathways

Figure A-2: Deployment Route Part 2 (Ref. 10)

Appendix B: FLEX Pump Staging Locations

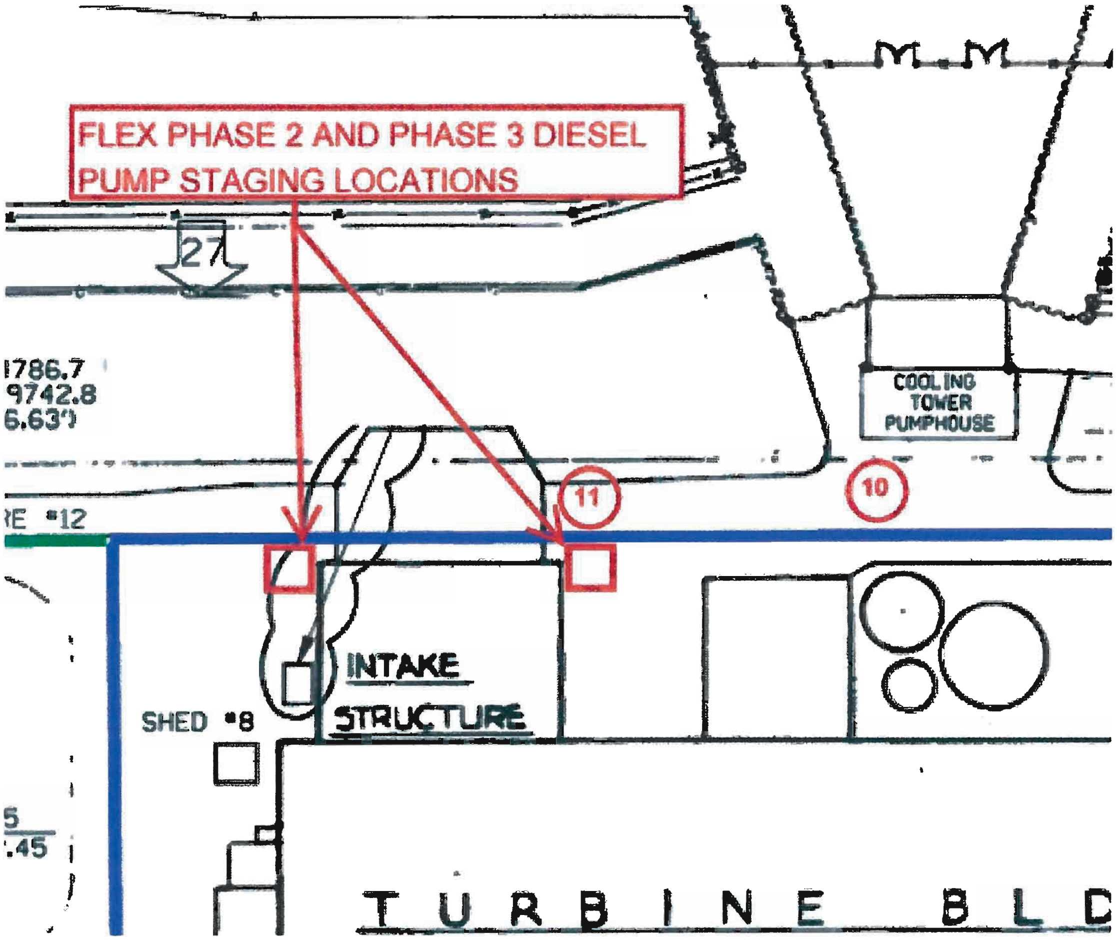

Figure B-1: FLEX Pump Staging Locations (Ref. 10)

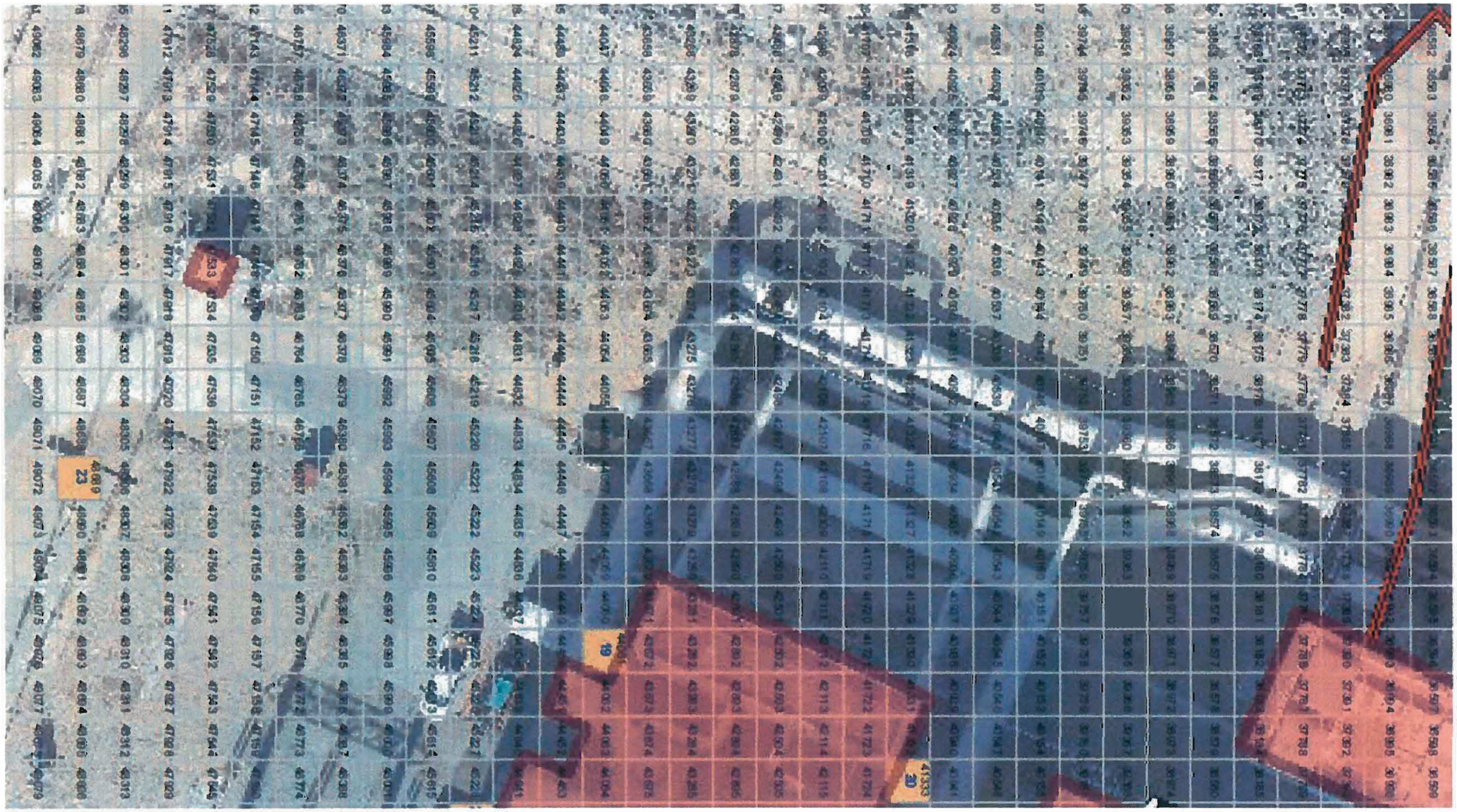

Figure B-2: Location of Critical Points 19 & 20 (Ref. 8, Appendix F-2)

Appendix C: Additional LIP Hydrographs

To evaluate the southwestern section of the FLEX deployment path where maximum flood heights are >4 ft, several locations along this route are selected. These are identified in the figure below, taken from Page F.1 of the LIP calculation (Ref. 8). Hydrographs at these three selected grid elements (46379, 49833, and 54757) are created from the FLO-2D model.

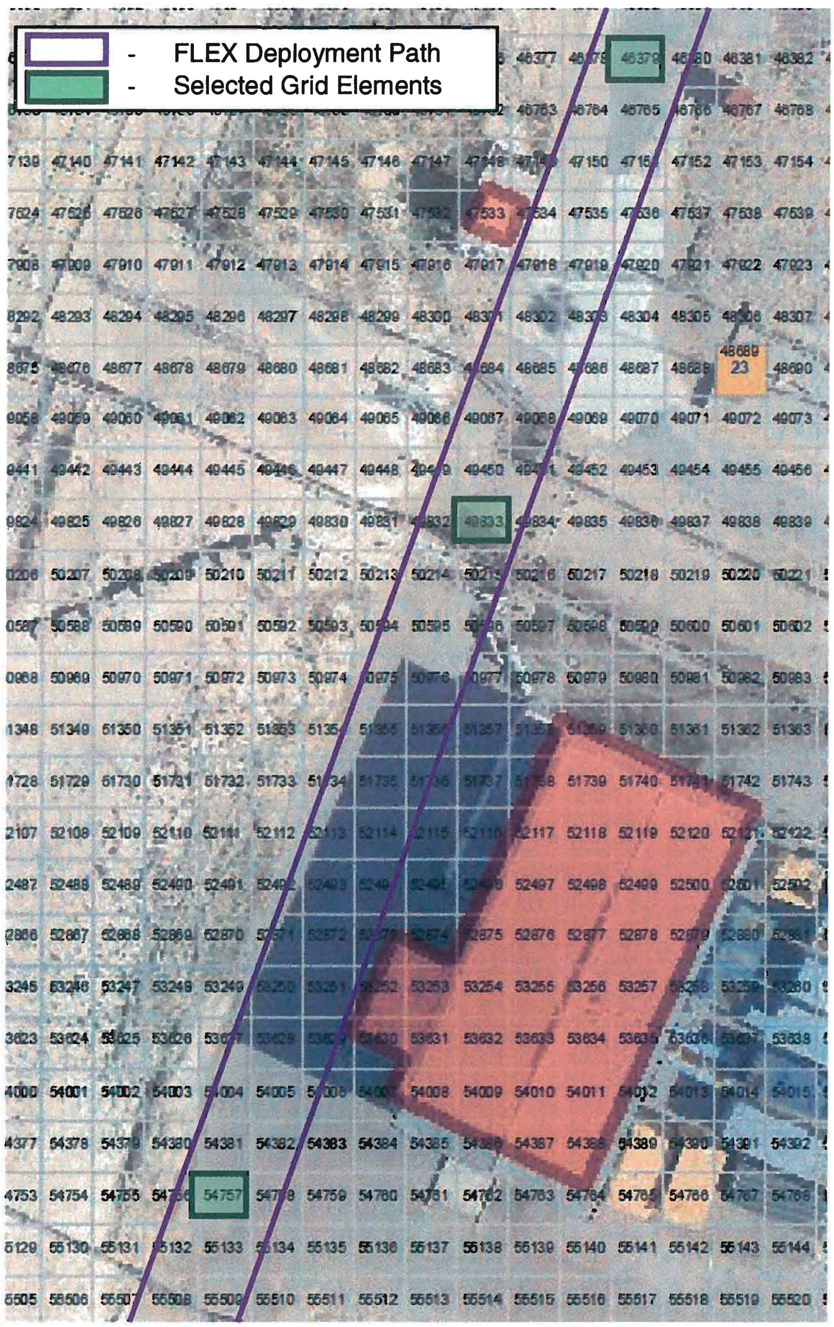

Figure C-1: Selected Grid Elements

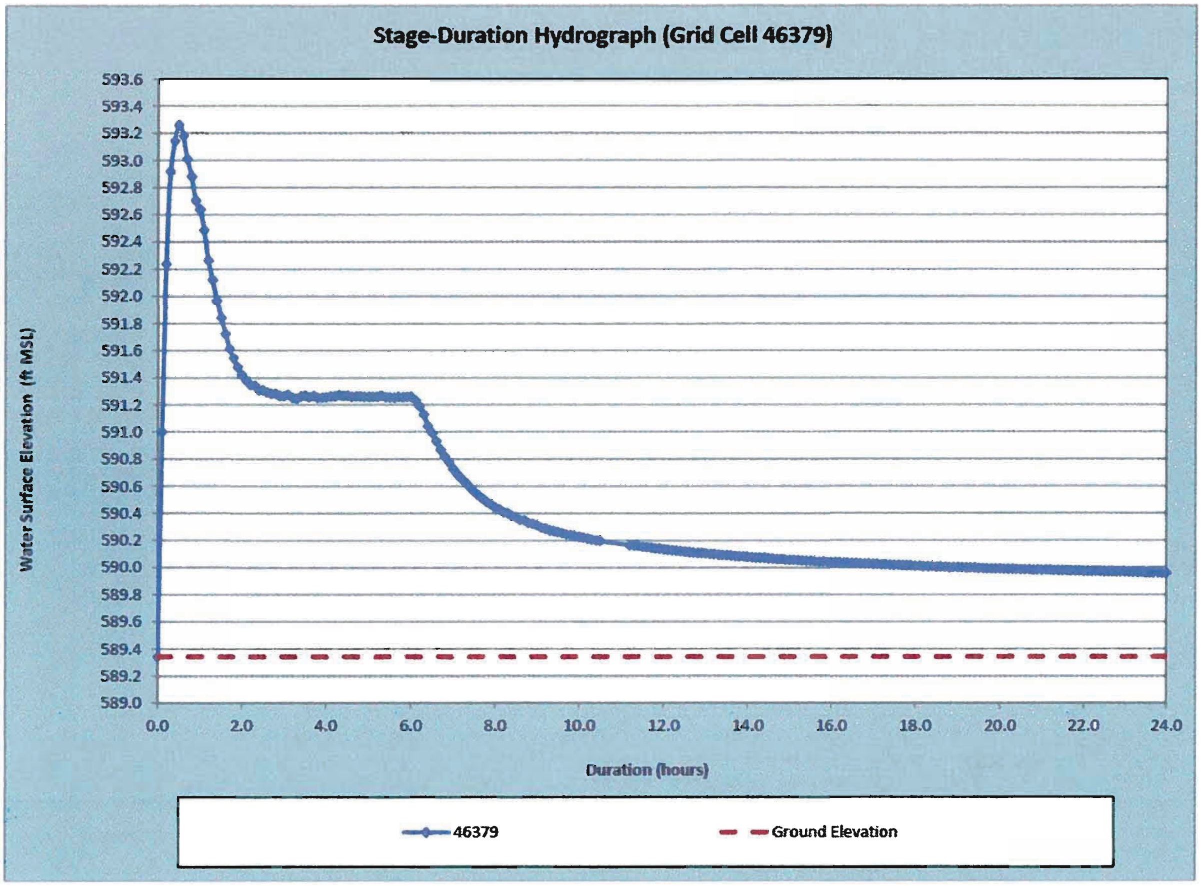

Figure C-2: Grid Element 46379 Hydrograph

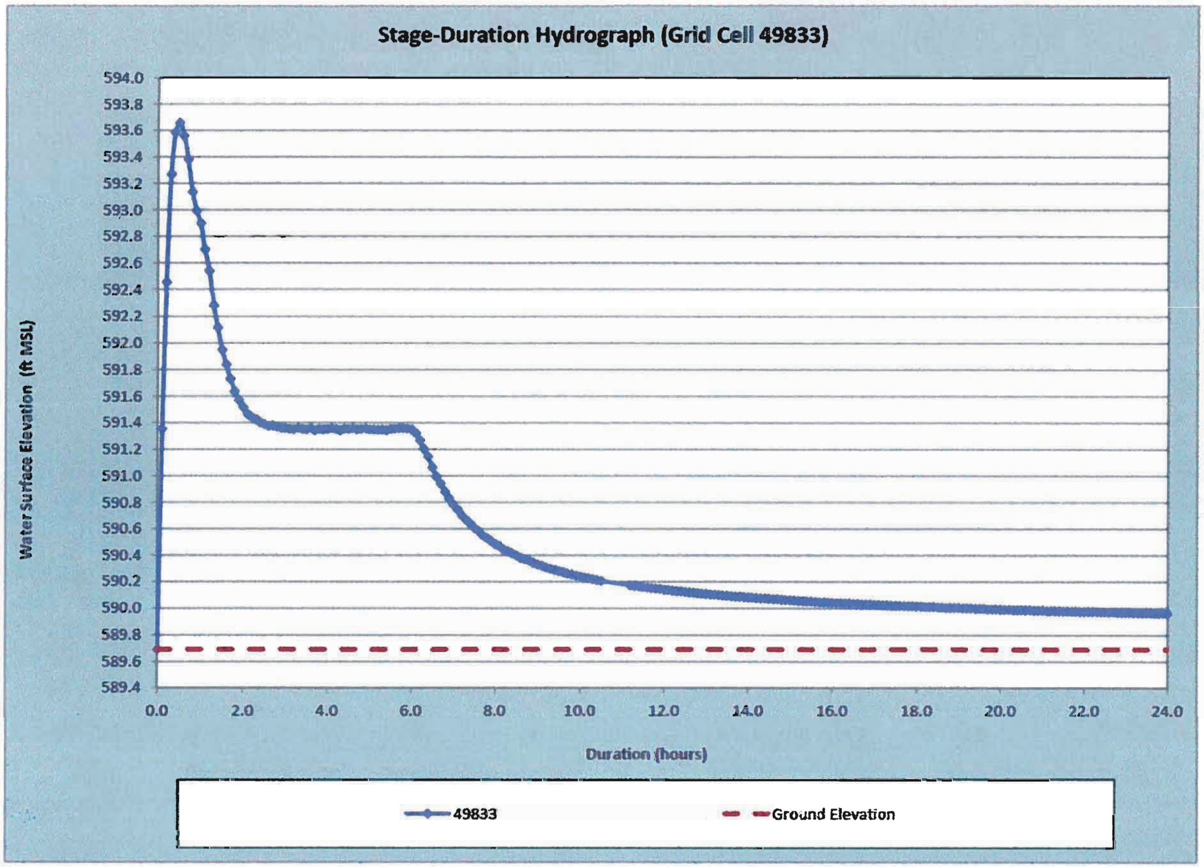

Figure C-3: Grid Element 49833 Hydrograph

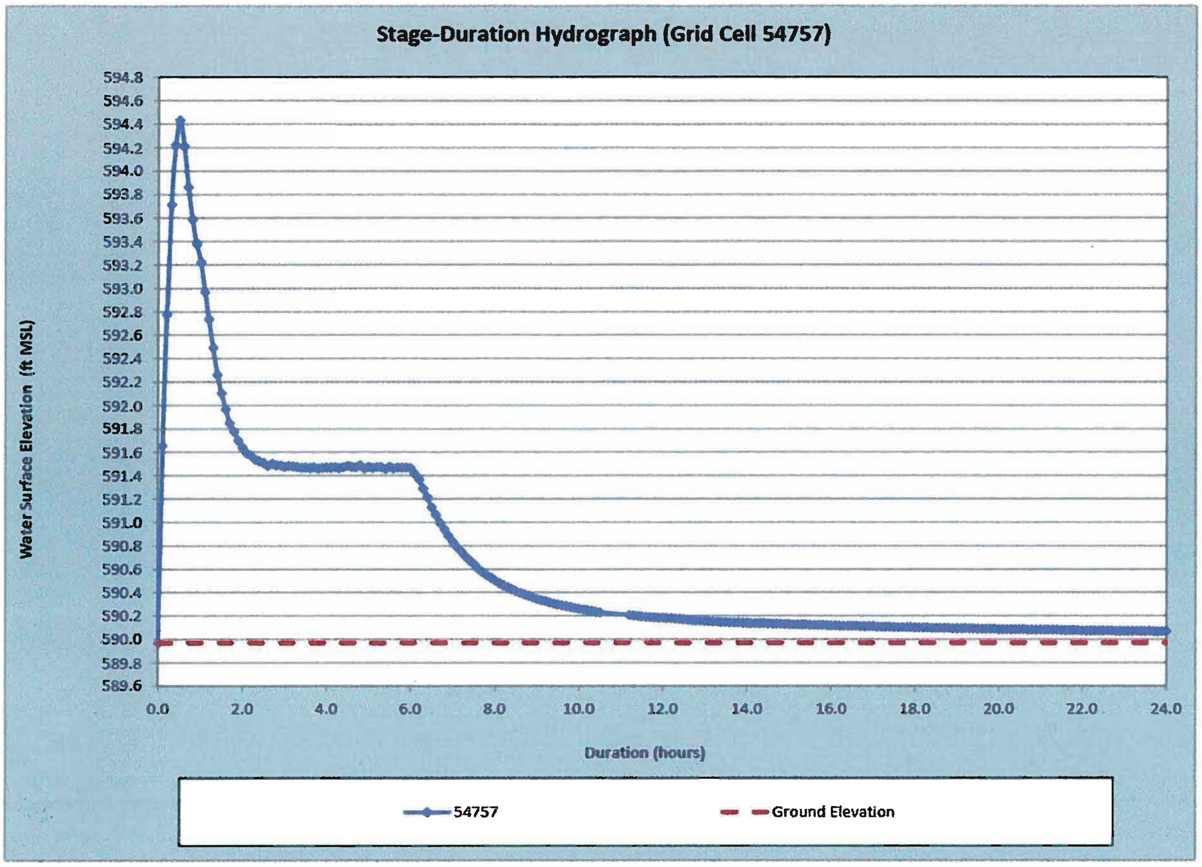

Figure C-4: Grid Element 54757 Hydrograph