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

September 8, 2016

Mr. Jon A. Franke
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SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – STAFF ASSESSMENT OF RESPONSE TO 10 CFR 50.54(f) INFORMATION REQUEST – FLOOD-CAUSING MECHANISM REEVALUATION (CAC NOS. MF6037 AND MF6038)

Dear Mr. Franke:

By letter dated March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The request was issued as part of implementing lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 2 to the 50.54(f) letter requested licensees to reevaluate flood-causing mechanisms using present-day methodologies and guidance. By letter dated March 3, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15063A319), Susquehanna Nuclear, LLC (the licensee) responded to this request for Susquehanna Steam Electric Station, Units 1 and 2 (Susquehanna).

By letter dated November 12, 2015 (ADAMS Accession No. ML15314A747), the NRC staff sent the licensee a summary of the staff's review of Susquehanna's reevaluated flood-causing mechanisms. The enclosed staff assessment provides the documentation supporting the NRC staff's conclusions summarized in the letter. As stated in the letter, because the reevaluated flood hazard mechanisms at Susquehanna are bounded by the current design basis, it is unnecessary for the licensee to perform an integrated assessment or focused evaluation.

Therefore, the NRC staff confirms that the licensee responded appropriately to Enclosure 2 of the 50.54(f) letter. This closes out the NRC's efforts associated with CAC Nos. MF6037 and MF6038).

If you have any questions, please contact me at (301) 415-6197 or e-mail at Tekia.Govan@nrc.gov.

Sincerely,

Tekia Govan, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosure:
Staff Assessment of Flood Hazard
Reevaluation Report

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO FLOODING HAZARD REEVALUATION REPORT
NEAR-TERM TASK FORCE RECOMMENDATION 2.1
SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2
DOCKET NOS. 50-387 AND 50-388

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), 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, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph (f) of Section 50.54 "Conditions of Licenses" (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 Near-Term Task Force (NTTF) report (NRC, 2011a). Recommendation 2.1 in that document recommended that the staff issue orders to all licensees to reevaluate seismic and flooding for their sites against current NRC requirements and guidance. Subsequent staff requirements memoranda associated with SECY-11-0124 (NRC, 2011b) and SECY-11-0137 (NRC, 2011c) directed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f) to address this recommendation.

Enclosure 2 to the 50.54(f) letter (NRC, 2012a) requested that licensees reevaluate the flood hazard for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits (ESPs) and combined licenses (COLs). The required response section of Enclosure 2 specified that NRC staff would provide a prioritization plan indicating Flooding Hazard Reevaluation Report (FHRR) deadlines for each plant. On May 11, 2012, the NRC staff issued its prioritization of the FHRRs (NRC, 2012b).

If the reevaluated hazard for all flood-causing mechanisms is not "bounded" by the plant's current design-basis (CDB) flood hazard, an additional assessment of plant response is necessary, as described in the 50.54(f) letter and COMSECY-15-0019, "Mitigating Strategies and Flooding Hazard Reevaluation Action Plan" (NRC, 2015b).

By letter dated March 03, 2015, Susquehanna, Nuclear, LLC (the licensee), provided its FHRR (Susquehanna, 2015a) for Susquehanna Steam Electric Station, Units 1 and 2 (Susquehanna).

The licensee did not identify any interim actions and stated in FHRR Section 5 (Susquehanna, 2015a) that based on the flood hazard reevaluation results, no interim actions were needed.

On September 9, 2015, the NRC staff conducted an audit of the Susquehanna FHRR in which the staff identified additional information needed to support the conclusions in this staff assessment. The licensee provided this information by letter dated September 24, 2015 (Susquehanna, 2015b).

By letter dated November 12, 2015, the NRC issued an interim staff response letter to the licensee (NRC, 2015d), stating that all the reevaluated flood hazard mechanisms (local intense precipitation (LIP) and flooding from streams and rivers) at Susquehanna are bounded by the CDB. Therefore, the NRC staff does not anticipate that the licensee will perform any additional assessments of plant response.

2.0 REGULATORY BACKGROUND

2.1 Applicable Regulatory Requirements

As stated above, Enclosure 2 to the 50.54(f) letter requested that the licensee reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for ESPs and COLs. This section describes present-day regulatory requirements that are applicable to the FHRR.

Sections 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4) of 10 CFR describe the required content of the preliminary and final safety analysis report, including a discussion of the facility site with a particular emphasis on the site evaluation factors identified in 10 CFR Part 100. The licensee should provide any pertinent information identified or developed since the submittal of the preliminary safety analysis report in the final safety analysis report.

General Design Criterion 2 in Appendix A of 10 CFR Part 50 states that structures, systems, and components (SSCs) important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena, such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches, without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to have sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

Section 50.2 of 10 CFR defines the design bases as the information which identifies the specific functions that an SSC of a facility must perform, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design which each licensee is required to develop and maintain. These values may be (a) restraints derived from generally accepted 'state of the art' practices for achieving functional goals, or (b) requirements derived from analysis (based on calculation, experiments, or both) of the effects of a postulated accident for which a SSC must meet its functional goals.

Section 54.3 of 10 CFR defines the current licensing basis (CLB) as: "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 (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect." This includes 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 52, 54, 55, 70, 72, 73, 100 and appendices thereto; orders; license conditions; exemptions; and technical specifications, as well as the plant-specific design-basis information as documented in the most recent final safety analysis report. The licensee's commitments made in docketed licensing correspondence, which remain in effect, are also considered part of the CLB.

Present-day regulations for reactor site criteria (Subpart B to 10 CFR Part 100 for site applications on or after January 10, 1997) state, in part, that the physical characteristics of the site must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site. Factors to be considered when evaluating sites include the nature and proximity of dams and other man-related hazards (10 CFR 100.20(b)) and the physical characteristics of the site, including the hydrology (10 CFR 100.21(d)).

2.2 Enclosure 2 to the 50.54(f) Letter

Section 50.54(f) of 10 CFR states that a licensee shall at any time before expiration of its license, upon request of the Commission, submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked. The 50.54(f) letter (NRC, 2012a) requested licensees reevaluate the flood-causing mechanisms for their respective sites using present-day methodologies and regulatory guidance used by the NRC for the ESP and COL reviews.

2.2.1 Flood-Causing Mechanisms

Attachment 1 to Enclosure 2 of the 50.54(f) letter (NRC, 2012a) discusses flood-causing mechanisms for the licensee to address in its FHRR. Table 2.2-1 lists the flood-causing mechanisms that the licensee should consider. Table 2.2-1 also lists the corresponding Standard Review Plan (SRP) (NRC, 2007) section(s) and applicable interim staff guidance (ISG) documents containing acceptance criteria and review procedures. The licensee should incorporate and report associated effects per Japan Lessons-Learned Directorate (JLD) JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding" (NRC, 2012c), in addition to the maximum water level associated with each flood-causing mechanism.

2.2.2 Associated Effects

In reevaluating the flood-causing mechanisms, the "flood height and associated effects" should be considered. Guidance document JLD-ISG-2012-05 (NRC, 2012c) defines "flood height and associated effects" as the maximum stillwater surface elevation plus:

- Wind waves and run-up effects
- Hydrodynamic loading, including debris
- Effects caused by sediment deposition and erosion
- Concurrent site conditions, including adverse weather conditions
- Groundwater ingress
- Other pertinent factors

2.2.3 Combined Effect Flood

The worst flooding at a site that may result from a reasonable combination of individual flooding mechanisms is sometimes referred to as a "Combined Effect Flood." Even if some or all of these individual flood-causing mechanisms are less severe than their worst-case occurrence, their combination may still exceed the most severe flooding effects from the worst-case occurrence of any single mechanism described in the 50.54(f) letter (see SRP Section 2.4.2, "Areas of Review" (NRC, 2007)). Attachment 1 of the 50.54(f) letter) describes the "combined effect flood" as defined in American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.8-1992 (ANSI/ANS, 1992) as follows:

> For flood hazard associated with combined events, American Nuclear Society (ANS) 2.8-1992 provides guidance for combination of flood causing mechanisms for flood hazard at nuclear power reactor sites. In addition to those listed in the ANS guidance, additional plausible combined events should be considered on a site specific basis and should be based on the impacts of other flood causing mechanisms and the location of the site.

If two less severe mechanisms are plausibly combined (per ANSI/ANS-2.8-1992 (ANSI/ANS, 1992)), then the NRC staff will document and report the result as part of one of the hazard sections. An example of a situation where this may occur is flooding at a riverine site located where the river enters the ocean. For this site, storm surge and river flooding are plausible combined events and should be considered.

2.2.4 Flood Event Duration

Flood event duration was defined in JLD-ISG-2012-05 (NRC, 2012c), as the length of time during which the flood event affects the site. It begins when conditions are met for entry into a flood procedure, or with notification of an impending flood (e.g., a flood forecast or notification of dam failure), and includes preparation for the flood. It continues during the period of inundation, and ends when water recedes from the site and the plant reaches a safe and stable state that can be maintained indefinitely. Figure 2.2-1 illustrates flood event duration.

2.2.5 Actions Following the FHRR

For the sites where the reevaluated flood hazard is not bounded by the CDB flood hazard for all flood-causing mechanisms, the 50.54(f) letter (NRC, 2012a) requests licensees and construction permit holders to:

- Submit an Interim Action Plan with the FHRR documenting actions planned or already taken to address the reevaluated hazard(s).

- Perform an integrated assessment subsequent to the FHRR to (a) evaluate the effectiveness of the CLB (i.e., flood protection and mitigation systems); (b) identify plant-specific vulnerabilities; and (c) assess the effectiveness of existing or planned systems and procedures for protecting against and mitigating consequences of flooding for the flood event duration.

If the reevaluated flood hazard is bounded by the CDB flood hazard for all flood-causing mechanism at the site, licensees were not required to perform an integrated assessment. COMSECY-15-0019 (NRC, 2015b) 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 an approach in which licensees with LIP hazards exceeding their CDB flood will not be required to complete an integrated assessment, but instead would perform a focused evaluation. As part of the focused evaluation, licensees will assess the impact of the LIP hazard on their sites and then evaluate and implement any necessary programmatic, procedural or plant modifications to address the hazard exceedance. For other flood hazard mechanisms that exceed the CDB, licensees can assess the impact of these reevaluated hazards on their site by performing either a focused evaluation or an integrated assessment (NRC, 2015b).

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the information provided for the flood hazard reevaluation of Susquehanna (Susquehanna, 2015a). The licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews. The NRC staff's review and evaluation is provided below.

To provide additional information in support of the summaries and conclusions in the Susquehanna FHRR (Susquehanna, 2015a), the licensee made several calculation packages available to the staff via an electronic reading room. When the NRC staff relied directly on any of these calculation packages in its review, they or portions thereof were docketed, and cited, as part of the Susquehanna FHRR Audit Summary Report (NRC, 2015c). Other calculation packages were found only to expand upon and clarify the information provided on the docket, and so are not docketed or cited.

3.1 Site Information

The 50.54(f) letter (NRC, 2012a) included the SSCs important to safety and the ultimate heat sink in the scope of the hazard reevaluation. Per the 50.54(f) letter, Enclosure 2, "Requested Information, Hazard Reevaluation Report," Item a, the licensee included pertinent data concerning these SSCs in the Susquehanna FHRR (Susquehanna, 2015a). Enclosure 2 (Recommendation 2.1: Flooding), "Requested Information, Hazard Reevaluation Report," Item a, describes site information to be contained in the Susquehanna FHRR. The NRC staff reviewed and summarized this information as follows in the sections below.

3.1.1 Detailed Site Information

The Susquehanna FHRR (Susquehanna, 2015a) states that the vertical datum used historically at the site is Mean Sea Level (MSL). Additionally, the licensee stated that the MSL datum is equal to the National Geodetic Vertical Datum of 1929 (NGVD29). The licensee stated that unless stated otherwise, all elevations in the Susquehanna FHRR (Susquehanna, 2015a) are referenced to NGVD29. Equivalently, all elevations in this staff assessment are in MSL.

The Susquehanna FHRR (Susquehanna, 2015a) describes the site-specific information related to the flood hazard reevaluation. Figure 3.1-1 shows the location of Susquehanna on the North Branch of the Susquehanna River in Salem Township in the western portion of Luzerne County, Pennsylvania. Wilkes-Barre, PA is located 21 miles (33.8 km) upstream, and Berwick, PA is located 2 miles (3.2 km) downstream from the Susquehanna site.

The Susquehanna River basin is approximately 27,510 mi^2 (71,251 km^2) in size and includes parts of New York, Pennsylvania, and Maryland. The Susquehanna River is approximately 444 miles (714.5 km) in length and discharges into the Chesapeake Bay at Havre de Grace, Maryland.

The Susquehanna site (Figure 3.1-2) is situated on a plateau, sloping to the east towards the Susquehanna River. Approaching the river, the topography is steep, with the elevation dropping quickly. Near the site, small tributaries drain small areas into the Susquehanna River. The largest tributary, named Walker Run drains an area of 4.3 mi^2 (11.1 km^2) two miles southwest of the site.

The site grade elevation at the lowest point is approximately 670 ft (204.2 m) MSL, which is about 175 ft (53.3 m) above the Susquehanna River.

3.1.2 Design-Basis Flood Hazards

The CDB flood levels are summarized by flood-causing mechanism in Table 3.1-1. The licensee stated that Susquehanna is considered to be a "dry site" according to the definitions in Regulatory Guide 1.102, “Flood Protection for Nuclear Power Plants,” Revision 1 (NRC, 1976). The NRC staff reviewed the flood hazard information provided and determined that sufficient information on the CDB was provided to be responsive to the 50.54(f) letter (NRC, 2012a).

3.1.3 Flood-Related Changes to the Licensing Basis

The licensee stated that there are no, known, flood-related changes that have been identified for the Susquehanna site since the determination of the CDB outlined in the Susquehanna final safety analysis report (Susquehanna, 2013). The current site configuration is shown in Figure 3.1-3, Figure 3.1-4, and Figure 3.1-5. The NRC staff reviewed the flood hazard information provided and determined that sufficient information on the flood-related changes to the licensing basis was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.4 Changes to the Watershed and Local Area

The Susquehanna FHRR (Susquehanna, 2015a), documents that the CDB for dam failures considers fourteen dams, six of which were never constructed. The licensee stated that it retained the six unconstructed dams in the current analysis for added conservatism.

The licensee stated that additional areas have been paved and a vehicle barrier system (VBS) has been installed and that these changes have been considered in Section 3 of the FHRR (Susquehanna, 2015a).

The NRC staff reviewed the flood hazard information provided and determined that sufficient information on changes to the watershed and local area was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.5 Current Licensing Basis Flood Protection and Pertinent Flood Mitigation Features

The Susquehanna FHRR (Susquehanna, 2015a), states that the site is protected by permanent barriers intended to protect the site against external floods (flood protection features) and exterior features such as normally closed external flood doors and exterior wall penetrations.

The permanent barriers (flood protection features) are considered to be "Incorporated Barriers" and the exterior features are considered to be "Exterior Passive" as defined in "Guidelines for Performing Verification Walkdowns of Plant Flood Protection," NEI 12-07, Revision 0, May 12, 2012 (NEI, 2012).

The Susquehanna FHRR (Susquehanna, 2015a) refers to the licensee's Walkdown Report (Susquehanna, 2012), in which the Susquehanna flood protection features are credited to prevent water from entering safety-related buildings during all postulated external flooding events. Additionally, the licensee stated that there are no time-dependent actions or mitigating actions needed for flood protection of SSCs important to safety during all external flood events. The NRC staff reviewed the flood hazard information provided and determined that sufficient information on CLB flood protection and pertinent flood mitigation features was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.6 Additional Site Details to Assess the Flood Hazard

The licensee provided information regarding their VBS, which is intended to prevent unauthorized vehicular access. The VBS impact on the flood hazard reevaluation is considered in Section 3 of the FHRR (Susquehanna, 2015a). The NRC staff reviewed the flood hazard information provided and determined that sufficient information on additional site details were provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.7 Results of Plant Walkdown Activities

The 50.54(f) letter requested that licensees plan and perform plant walkdown activities to verify that current flood protection systems are available, functional, and implementable. Other parts of the 50.54(f) letter asked the licensee to report any relevant information from the results of the plant walkdown activities.

By letter dated November 21, 2012, the licensee provided its flood Walkdown Report for Susquehanna (Susquehanna, 2012). The NRC staff prepared a staff assessment Report, dated June 16, 2014 (NRC, 2014), to document its review of the licensee's Walkdown Report. The NRC staff concluded that the licensee's implementation of the flooding walkdown methodology met the intent of the walkdown guidance.

3.2 Local Intense Precipitation and Associated Site Drainage

The licensee reported in "Susquehanna Steam Electric Station Flood Hazards Reevaluation Report Information to support Audit," September 24, 2015 (Susquehanna, 2015b), and "Susquehanna: Follow-on Audit Question," October 2, 2015 (Susquehanna, 2015c), that the reevaluated flood hazard, including associated effects, for LIP and associated site drainage resulted in a maximum stillwater-surface elevation that ranges from 670.91 ft. (204.49 m) MSL to 696.64 ft. (212.34 m) MSL. This flood-causing mechanism is discussed in the licensee's CDB. The CDB for LIP and associated site drainage is based on a stillwater-surface elevation that ranges from 672 ft (204.83 m) MSL to 697.3 ft. (212.54 m) MSL. See Table 3.1-1 for more details.

3.2.1 FLO-2D Model Inputs and Assumptions

The licensee obtained topographic data having a spatial resolution of 3.2 ft (0.98 m) from Pennsylvania Spatial Data Access (PASDA). The licensee used this data to develop a Digital Terrain model of the drainage system using FLO-2D software (Build Number 14.03.07). Using the FLO-2D software, the licensee chose a computational grid size of 10 ft (3.0 m) by 10 ft (3.0 m), stating that this cell size is adequate to capture details needed to consistently represent the local drainage system.

The licensee based the model boundaries on drainage features such as roadways, berms, and ridgelines. The licensee also stated that the FLO-2D model boundaries were located far enough away from the regions of interest near the power block areas and safety-related SSCs to minimize boundary effects and to ensure model stability.

The licensee used two different topographic configurations in their FLO-2D model. The first configuration was used to represent the site under current conditions for the LIP analysis. The second configuration included a modification in the area near the Cooling Tower Basins to represent soil loss due to liquefaction caused by the postulated seismic failure of the basins as discussed in Section 3.8.8 of the FHRR (Susquehanna, 2015a).

The licensee stated that other topographic and man-made features affecting flow were incorporated into the FLO-2D model. Structures such as tanks, buildings, and the VBS were modeled as blockages to flow.

The licensee applied the hierarchical hazard assessment methodology to determine the final scenario used to derive the LIP flood elevations. Five main cases were considered, each case having additional refinements. Once all cases were run and considered, the licensee adopted the following site configuration for estimating the flood elevations for LIP near safety-related SSCs:

- All VBS access points were blocked and assumed the three vehicular access doors on the west side of the turbine building are fully open; and
- Blockage of the pedestrian access points; and
- Lower Manning's Roughness Coefficients intended to represent the current site

In addition, the licensee assumed that the peak intensity of the LIP occurs at the two-thirds point of the event as shown on Figure 3.2-1.

The NRC staff examined the FLO-2D model input files and found the model to be a realistic representation of the Susquehanna site configuration and topography. Structures and roadways were properly located and represented in the model. The NRC staff also concludes that the modeling coefficients such Manning's Roughness n values are reasonable.

3.2.2 Local Intense Precipitation

The licensee used the 1-hour, 1 mi^2 (3 km^2) probable maximum precipitation (PMP) as described in the U.S. National Weather Service Hydrometeorological Report (HMR) No. 52 (HMR 52) (National Oceanic and Atmospheric Administration (NOAA), 1982) to estimate the

PMP depth of 17.5 inches (0.445 m). The licensee varied the timing of the peak precipitation and determined that using the PMP distribution with the peak at the two-thirds point of the event yielded the highest flood elevation.

The NRC staff independently determined the 1-hour, 1 mi^2 (3 km^2) PMP for the Susquehanna site using HMR 52 (NOAA, 1982) and found it to be in agreement with the licensee. Based on the location of the site and the NRC staff's independent estimate of the 1-hour 1 mi^2 (3 km^2) PMP, the NRC staff considers the licensee's response to be reasonable.

3.2.3 FLO-2D Results

The licensee reported the maximum water surface elevation and the available freeboard for eight different onsite locations in the Susquehanna FHRR (Susquehanna, 2015a). Inundation of the plant area is shown in Figure 3.2-2.

The licensee determined that ponding depths in the vicinity of safety-related buildings ranged from 0.31 ft (0.094 m) at the engineered safeguard service water (ESSW) pumphouse to 1.61 ft (0.491 m) near the Unit 1 and Unit 2 reactor buildings. Additionally, the licensee stated that no detailed structural analysis of safety-related buildings were required due to the shallow depth of inundation.

As discussed earlier, the licensee assumed that three vehicular access doors on the west side of the turbine building would be open during the LIP event. This may lead to water entering the turbine building. The licensee stated that the turbine building is not safety-related, but that it is connected to the reactor buildings. The licensee estimated that 2.5 million gallons of water could enter the turbine building on the west side during the LIP event, but that the turbine building has 9.9 million gallons of storage available before the inflow would affect the reactor buildings.

The NRC staff evaluated the FLO-2D results provided by the licensee, and ran three scenarios with FLO-2D Build 14.11.09 to evaluate the performance and stability of the licensee's model. The NRC staff confirmed that the maximum water surface elevation is obtained from the two-thirds back loaded LIP distribution. The rainfall distribution is shown in Figure 3.2-1. The maximum difference in the licensee's results and the NRC staff's was 0.2 ft (0.06 m) on the west side of the turbine building. The NRC staff considers this difference negligible and attributes the difference to the use of the second topographic model and a different FLO-2D Build Number. The NRC staff found that the FLO-2D model conserves volume and maintains numerical stability with no surging of velocities or flood levels.

3.2.4 LIP in the Spray Pond

The CDB for Susquehanna includes the combination of LIP and wind-wave generated run-up in the spray pond. The spray pond is located on the northwest side of the Susquehanna site (Figure 3.1-3 and Figure 3.1-4). The licensee reevaluated this hazard combination assuming the drainage culverts were blocked and determined that the maximum reevaluated still water level in the spray pond under LIP conditions would be 682.02 ft (207.880 m) MSL. Using methods found in the U.S. Army Corps of Engineers (USACE) Coastal Engineering Manual (CEM) (USACE 2011), wind wave run-up values were calculated at the embankment to be 1.3 ft

(0.40 m) and 2.3 ft (0.70 m) at the ESSW pumphouse, giving a total flood elevation of 683.3 ft (208.27 m) MSL at the embankment and 684.3 ft (208.57 m) MSL the pumphouse. The licensee stated that these two flood levels have no impact on the spray pond or the ESSW pumphouse since the top of the spray pond embankment is at elevation 685.5 ft (208.94 m) MSL.

The NRC staff considered the USACE CEM methodology used by the licensee and reviewed the parameter values used to calculate the maximum wave runup such as fetch length, wave run up reduction factors, and significant wave height. The NRC staff independently calculated the wave run-up, obtaining the same result as the licensee. The NRC staff finds that both the approach and parameter values used are appropriate and reasonable.

3.2.5 Sensitivity Analyses

The licensee performed sensitivity tests to determine the impact on the maximum water surface elevation. The LIP flood elevation at safety-related SSCs varied by 0.6 ft (0.2 m) by changing the location of the peak intensity. Changing the Manning's Roughness Coefficients resulted in a change of 0.2 ft (0.06 m) at safety-related SSCs. Blocking the VBS pedestrian access points had no impact on the maximum flood depths.

The NRC staff reviewed the licensee's sensitivity tests including changes to parameters values and their associated impact. The NRC staff finds that changing parameter values had minimal impact on the final results. Based on the minimal impact, the NRC staff considers the response to be reasonable.

3.2.6 Conclusion

The NRC staff agrees that flooding as a result of LIP would not be a flooding mechanism of concern for the Susquehanna site. The NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding from LIP is bounded by the CDB. Therefore, the NRC staff determined that additional assessments for LIP are not required per the guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.3 Streams and Rivers

Due to the large difference in scale between the two (Figure 3.1-2), the licensee treated the flooding hazards from the Susquehanna River and Walker Run separately.

3.3.1 PMF on the Susquehanna River

The licensee reported in the Susquehanna FHRR that the reevaluated hazard, including associated effects, for streams and rivers on the Susquehanna River does not inundate the plant site, but did not report a probable maximum flood (PMF) elevation. This flood-causing mechanism is discussed in the licensee's CDB, but no PMF elevation was reported.

The licensee performed a screening level calculation using flow data from a U.S. Geological Survey gage located at Danville, PA, approximately 30 miles (48.3 km) downstream of the Susquehanna site. The purpose of the calculation is to determine the credibility of flooding of the Susquehanna site from the PMF on the Susquehanna River. The licensee used Hydrologic Engineering Center (HEC) - Statistical Software Package (USACE, 2010a) to fit a Log Pearson Type III distribution to the flow data. The licensee determined that the 95th percentile curve indicated that the return period for a one-million year event was less than 1,000,000 cubic feet per second (cfs) (28,316.8 cubic meters per second (cms)). Additionally, the licensee determined the PMF flowrate at the proposed Bell Bend Nuclear Power Plant, approximately one mile from the Susquehanna site, to be 1,130,000 cfs (31,998.0 cms) (Unistar, 2013). According to the licensee, the maximum flood level due to the PMF discharge of 1,130,000 cfs (31,998.0 cms) is 548.7 ft (167.24 m) MSL, approximately 121 ft (36.9 m) below the lowest site grade elevation of 670 ft (204.2 m) MSL at Susquehanna.

Per Interagency Agreement (NRC-HQ-13-I-03-0021), the USACE assisted the NRC in determining the safety significance of hydrologic and geotechnical issues and other features associated with USACE dams that may affect the safe, reliable operation of downstream or nearby nuclear power plants.

The USACE (USACE, 2015a) estimated the PMF in the Susquehanna River near the Susquehanna site to be approximately 1,800,000 cfs (50,970.3 cms) which corresponds to a flood height of 560.4 ft (170.81 m) MSL using a rating curve developed from a nearby cross section of the Susquehanna River. Using this rating curve, the USACE estimated that a flowrate of approximately 9,500,000 cfs (269,010.0 cms) would have to occur in the Susquehanna River for the water surface elevation to reach the Susquehanna site grade.

The licensee considered different combinations of flood-causing mechanisms in its assessment of the combined effects flood. After screening out combinations involving storm surge, seiche, dam failure, and tsunami, the licensee selected a postulated scenario where the flowrate of the PMF event was doubled, yielding a flood level of approximately 616 ft (187.8 m) MSL, 54 ft (16.5 m) below the Susquehanna site grade of 670 ft (204.2 m) MSL.

Based on the independent screening estimate from both the licensee and the USACE, the NRC staff confirms the licensee's conclusion that the reevaluated flood hazard from the PMF on the Susquehanna River is bounded by the CDB flood hazard.

3.3.2 PMF on Walker Run

The licensee reported in the Susquehanna FHRR that the reevaluated hazard, including associated effects, for streams and rivers on Walker Run is 676 ft (206.0 m) MSL and does not inundate the plant site. This flood-causing mechanism is discussed in the licensee's CDB, but no PMF elevation was reported.

The licensee stated that the PMF on Walker Run would not affect the Susquehanna site due to the fact that Walker Run is located in another sub-basin with a topographic divide located between Walker Run and the Susquehanna site. The lowest point of the topographic divide between the Susquehanna site and Walker Run is 44 ft (13.4 m) above the Walker Run PMF elevation of 676 ft (206.0 m) MSL.

The NRC staff examined the topographic data and confirmed the presence of the topographic ridge between the Susquehanna site and Walker Run. The NRC staff confirms the licensee's conclusion that the Susquehanna site would not be impacted by the PMF on Walker Run.

3.3.3 Conclusions

The NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding due to streams and rivers is bounded by the CDB flood hazard at the Susquehanna site. Therefore, the NRC staff determined that additional assessments are not required per the guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.4 Failure of Dams and Onsite Water Control/Storage Structures

The licensee reported in the Susquehanna FHRR that the reevaluated hazard, including associated effects, for failure of dams and onsite water control or storage structures does not inundate the plant site, but did not report a PMF elevation. This flood mechanism is discussed in the licensee's CDB.

3.4.1 Failure of Dams

The licensee used the volume screening method outlined in JLD-ISG-2013-01 (NRC, 2013b) to evaluate the potential for flooding at the Susquehanna site due to upstream dam breaches. Using the USACE National Inventory of Dams (USACE, 2013), the licensee identified 489 potentially critical dams upstream of the Susquehanna site having a combined storage volume of 1,317,000 acre-ft. (2,139,469.2 km^3). The licensee obtained the 500-year flood level in the Susquehanna River near the Susquehanna site from a USACE study completed for the Federal Emergency Management Agency (FEMA, 2014). The licensee used Geographic Information System data from PASDA to develop a stage-storage relationship of the Susquehanna River upstream of the Susquehanna site.

The licensee determined that maximum flood level near the Susquehanna site from a simultaneous 500-year flood and total failure of all 489 dams upstream of the Susquehanna site would be approximately 611 ft (186.2 m) MSL. This is 59 ft (18.0 m) below the Susquehanna site grade. Based on this analysis, the licensee concluded that flooding at the Susquehanna site from dam failure was not credible.

As part of an Interagency Agreement (NRC-HQ-13-I-03-0021), the USACE used the volume method to estimate the potential for flooding at the Susquehanna site (USACE, 2015a). After removing the inconsequential dams as defined in (NRC, 2013b), the USACE identified 270 potentially critical dams upstream of the Susquehanna site, with a total storage volume of 1,442,202 acre-ft (2,342,860.0 km^3). The USACE estimated a 500-year flood level of 521.4 ft (158.92 m) MSL. The USACE, using GIS data, developed a storage-elevation relationship for the Susquehanna River upstream of the Susquehanna site.

The USACE estimated that 4,184,954 acre-ft (6,798,466.1 km^3) of storage is available in the Susquehanna River upstream of the Susquehanna site. The USACE estimated the maximum flood level near the Susquehanna site from a simultaneous 500-year flood and total failure of the remaining 270 dams upstream of the Susquehanna site would be approximately 568.4 ft (173.25 m) MSL. This is approximately 101 ft (30.8 m) below the Susquehanna site grade.

3.4.2 Cooling Tower Basin Breach

The licensee reported in the Susquehanna FHRR that the reevaluated flood hazard, including associated effects, for failure of dams and onsite water control or storage structures is based on a stillwater-surface elevation of 686.42 ft (209.221 m) MSL.

This flood-causing mechanism is discussed in the licensee's CDB. The CDB PMF elevation for failure of dams and onsite water control or storage structures is based on a stillwater-surface elevation of 694.80 ft (211.775 m) MSL.

The licensee stated that there are two Cooling Towers on the Susquehanna site, each with a six million gallon capacity storage basin below the main structure. Although the basins are built into the ground such that the water surface is near the local site grade, they are located at a higher elevation than the safety-related structures at the Susquehanna site.

For the reevaluated hazard, the licensee postulated a scenario whereby the soil surrounding the basin is assumed to be removed via liquefaction, thereby allowing water to reach critical areas of the Susquehanna site during a postulated seismic breach. The basin breach time was approximately 1 minute.

The licensee considered two failure modes of the cooling tower basin:

1) The collapse of one or more basins panels around the perimeter of one or both basins. The licensee varied the number and location of panel failures to determine the critical scenario.

2) Headwall collapse of the Cold Water Outlet Chamber (CWOC) at one or both basins. These are concrete culvert like structures that provide an outlet from the basin to the cooling water circulation pumps.

For the failure mode 1, the licensee stated that the failure of 15 panels of the Unit 1 cooling tower basin in the northerly direction would result in the greatest flood hazard to the ESSW pumphouse.

The licensee stated in the FHRR (Susquehanna, 2015a) that the most conservative scenario for failure mode 2, is the simultaneous failure of both CWOC headwalls with flow directly toward the turbine building.

The licensee considered four scenarios based on the failure modes that were developed for the Cooling Tower Basins; three assume failure mode 1 and the fourth assumes failure mode 2.

- Mode 1 Scenarios
  - Scenario 1 – failure of 15 panels on the north side of the Unit 1 basin and erosion of the access road north of the Unit 1 cooling tower

- Scenario 2 – failure of four panels on the southeast side of the Unit 1 basin and the northeast side of the Unit 2 basin, directing flow towards the turbine building.
- Scenario 3 – failure of four panels on the northeast side of the Unit 1 basin and the southeast side of the Unit 2 basin, directing flows towards the east side of the power block.

- Mode 2 Scenario

  - Scenario 4 – Collapse of both CWOC headwalls directing flow towards the turbine building.

The licensee stated that the ESSW pumphouse would be the only safety-related structure that would be inundated by any breaching scenario of the cooling tower basin. The licensee stated that scenario 1 (Figure 3.4-1) resulted in the highest flood levels at the ESSW under this scenario, with the south side of the ESSW pumphouse would be inundated by 1.45 ft (0.442 m).

Scenario 4 (Figure 3.4-2) resulted in the highest amount of flow into the turbine building. The turbine building would be flooded internally with approximately 3.1 million gallons of water. As mentioned previously, the turbine building can store approximately 9.9 million gallons of water below elevation 678 ft (206.7 m) before affecting the safety-related SSCs.

The NRC staff, using the licensee's input file, performed a model run for scenario 4, and estimated the volume of water entering the turbine building by integrating the hydrographs from the outflow cells used in the FLO-2D model. The NRC staff verified that the model conserves volume and maintains numerical stability with no surging of flood levels or velocities. The NRC staff's results were consistent with the licensee's.

Based on the independent estimate from the USACE, the NRC staff confirmed the licensee's conclusion that the reevaluated flood hazard for failure of dams and onsite water control or storage structures is bounded by the CDB flood hazard. Therefore, the NRC staff determined that additional assessments for dam failure flood-causing mechanism are not required per the guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.5 Storm Surge

The licensee reported in the Susquehanna FHRR that flooding from storm surge is not considered to be a credible threat due to the site's distance from the Atlantic Ocean and the sites elevation above the Susquehanna River (670 ft (204.2 m)). Flooding from storm surge is screened out in the CDB.

The NRC staff reviewed the Susquehanna location and elevation data. Based on the NRC staff's review of this information, the staff found the licensees response to be reasonable.

In summary, the NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding due to storm surge is not applicable to the Susquehanna site. Therefore, the NRC staff determined that flooding from storm surge does not need to be analyzed in a focused evaluation or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.6 Seiche

The licensee reported in the Susquehanna FHRR that flooding from seiche is not considered to be a credible threat due to the site's distance from the Atlantic Ocean and the site's elevation above the Susquehanna River (670 ft (204.2 m)). Flooding from seiche is screened out in the CDB.

The NRC staff reviewed the Susquehanna location and elevation data. Based on the staff's review of this information, the staff found the licensees response to be reasonable.

The NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding due to seiche is not applicable to the Susquehanna site. Therefore, the NRC staff determined that flooding from seiche does not need to be analyzed in a focused evaluation or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.7 Tsunami Flooding

The licensee reported in the Susquehanna FHRR that flooding from tsunami is not considered to be a credible threat due to the site's distance from the Atlantic Ocean and the sites elevation above the Susquehanna River (670 ft (204.2 m)). Flooding from seiche is screened out in the CDB.

The NRC staff reviewed the Susquehanna location and elevation data. Based on the NRC staff's review of this information, the staff found the licensees response to be reasonable.

The NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding due to tsunami is not applicable to the Susquehanna site. Therefore, the NRC staff determined that flooding from tsunami does not need to be analyzed in a focused evaluation or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.8 Ice-Induced Flooding

The licensee reported in the Susquehanna FHRR that the reevaluated hazard, including associated effects, for ice-induced flooding does not inundate the plant site, but did not report a PMF elevation. This flood-causing mechanism is discussed in the licensee's CDB, but no PMF elevation was reported.

The licensee stated in the Susquehanna FHRR (Susquehanna, 2015a) that based on NUREG/CR-7046 (NRC, 2011d) the hazard from Ice-Induced flooding was bounded by other hazards. Ice induced flooding due to an ice jam on the Susquehanna River was bounded by the dam failure analysis discussed in Section 3.3.3 of the FHRR (Susquehanna, 2015a). The licensee stated that the ice-induced hazard in the spray pond was bounded by the LIP hazard.

The NRC staff confirmed the elevation of the Susquehanna site grade to 670 ft (204.2 m) MSL. This is approximately 150 ft (45.7 m) about the 100-year flood stage of the Susquehanna River. The staff independent searched the USACE Ice Jam Database (USACE, 2015b) for current and historical ice jams near the Susquehanna site. The NRC staff, while finding that ice jams have occurred near the site, found no historical evidence of ice-induced flooding that would exceed flooding from dam failure.

The NRC staff reviewed the licensee's findings in the Susquehanna FHRR (Susquehanna, 2015a) and confirmed the licensee's conclusion that the reevaluated hazard for ice-induced flooding of the site is bounded by the CDB flood hazard. Therefore, the NRC staff determined that ice-induced flooding does not need to be analyzed in a focused evaluation or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a).

3.9 Channel Migrations or Diversions

The licensee reported in the Susquehanna FHRR that the reevaluated hazard, including associated effects, for channel migrations or diversions does not inundate the plant site, but did not report a PMF elevation (Susquehanna, 2015a). This flood-causing mechanism is discussed in the licensee's CDB. The licensee stated that while there have been some historic landslides near Schickshinny Mountain, they have not caused any changes in the course of the Susquehanna River near the site. The licensee also stated that migration of Walker Run is precluded by the topography between Walker Run and the Susquehanna site.

The NRC staff reviewed basin topography and found no evidence of channel migration or diversion along nearby streams or tributaries that could threaten the site. Accordingly, the NRC staff agrees that channel migration or diversion is not a flood causing mechanism of concern for the Susquehanna site. The NRC staff confirmed the licensee's conclusion that the reevaluated hazard for flooding from channel migrations or diversions is bounded by the CDB flood hazard. Therefore, the NRC staff determined that flooding from channel migration or diversion does not need to be analyzed in a focused evaluation or a revised integrated assessment consistent with the process and guidance discussed in COMSECY-15-0019 (NRC, 2015a).

4.0 REEVALUATED FLOOD HEIGHT, EVENT DURATION, AND ASSOCIATED EFFECTS FOR HAZARDS NOT BOUNDED BY THE CDB

4.1 Reevaluated Flood Height for Hazards Not Bounded by the CDB

Section 3 of this staff assessment documents NRC staff review of the licensee's flood hazard water height results. The NRC staff agrees with the licensee's conclusion that all flood hazard mechanisms evaluated in the Susquehanna FHRR (Susquehanna, 2015a) and its supplements (Susquehanna, 2015b and Susquehanna, 2015c) are bounded by the CDB. No further evaluation is warranted.

4.2 Flood Event Duration for Hazards Not Bounded by the CDB

The NRC staff reviewed the Susquehanna FHRR (Susquehanna, 2015a) and agrees with the licensee that all flood-causing mechanisms are bounded by the CDB and an evaluation of flood event duration parameters is not warranted.

4.3 Associated Effects for Hazards Not Bounded by the CDB

The NRC staff reviewed the Susquehanna FHRR (Susquehanna, 2015a) and agrees with the licensee that all flood-causing mechanisms are bounded by the CDB and an evaluation of associated effects not directly related with total water height is not warranted.

4.4 Conclusion

The NRC staff confirmed that the reevaluated flood hazard results are bounded by the Susquehanna CDB hazard. Therefore, no additional assessments of plant response, as described in the 50.54(f) letter and COMSECY-15-0019, "Mitigating Strategies and Flooding Hazard Reevaluation Action Plan" (NRC, 2015b), at the Susquehanna site is necessary at this time.

5.0 CONCLUSION

The NRC staff has reviewed the information provided for the reevaluated flood-causing mechanisms of Susquehanna. Based on its review of the above available information provided in the licensee's 50.54(f) response (Susquehanna, 2015a; Susquehanna, 2015b; and Susquehanna, 2015c), the NRC staff concludes that the licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews.

Based upon the preceding analysis, the NRC staff confirmed that the licensee responded appropriately to Enclosure 2, Required Response 2, of the 50.54(f) letter, dated March 12, 2012. In reaching this determination, staff confirmed the licensee's conclusions that (a) the reevaluated flood hazard results for all flood-causing mechanisms are bounded by the CDB flood hazard, and (b) no additional assessment of plant response are needed.

6.0 REFERENCES

Notes: ADAMS Accession Nos. refers to documents available through NRC's Agencywide Documents Access and Management System (ADAMS). Publicly-available ADAMS documents may be accessed through http://www.nrc.gov/reading-rm/adams.html.

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Table 2.2-1. Flood-Causing Mechanisms and Corresponding Guidance

Flood-Causing Mechanism	SRP Section(s) and JLD-ISG
Local Intense Precipitation and Associated Drainage	SRP 2.4.2 SRP 2.4.3
Streams and Rivers	SRP 2.4.2 SRP 2.4.3
Failure of Dams and Onsite Water Control/Storage Structures	SRP 2.4.4 JLD-ISG-2013-01
Storm Surge	SRP 2.4.5 JLD-ISG-2012-06
Seiche	SRP 2.4.5 JLD-ISG-2012-06
Tsunami	SRP 2.4.6 JLD-ISG-2012-06
Ice-Induced	SRP 2.4.7
Channel Migrations or Diversions	SRP 2.4.9

SRP is the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (NRC, 2007)

JLD-ISG-2012-06 is the "Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment" (NRC, 2013a)

JLD-ISFG-2013-01 is the "Guidance for Assessment of Flooding Hazards Due to Dam Failure" (NRC, 2013b)

Table 3.1-1. Current Design Basis Flood Hazards

Flooding Mechanism	Stillwater Elevation (MSL)	Associated Effects	Current Design Basis (CDB) Flood Elevation (MSL)	Reference
Local Intense Precipitation				SSES Flood Hazards Reevaluation Report Information to Support Audit, ML 15267 A600. SSES: Follow-on Audit Question, ML 15288A563.
Engineered Safeguards Service Water (ESSW) Pumphouse (South side)	694.8 ft	Minimal	694.8 ft	
ESSW Pumphouse Valve Chamber	697.3 ft.	Minimal	697.3 ft.	
Common Diesel Generator Building	679.0 ft.	Minimal	679.0 ft.	
Unit 1 Reactor Building	672.0 ft.	Minimal	672.0 ft.	
Unit 2 Reactor Building	672.0 ft.	Minimal	672.0 ft.	
Common Diesel 'E' Building	678.0 ft.	Minimal	678.0 ft.	
Spray Pond	682.4 ft (208.00 m)	2.4 ft. (0.67 m)	684.8 ft (208.67 m)	FHRR Table 4-3
Dam Failure Flooding	No impact identified	No impact identified	No impact identified	FHRR Section 2.2.3 and 2.2.7
Cooling Tower Basin Breach	694.8 ft.	N/A	694.8 ft.	SSES Flood Hazards Reevaluation Report Information to Support Audit, ML 15267 A600.
Storm Surge	No impact identified	No impact identified	No impact identified	FHRR Section 2.24
Seiche	No impact identified	No impact identified	No impact identified	FHRR Section 2.24
Tsunami	No impact identified	No impact identified	No impact identified	FHRR Section 2.2.4
Ice-Induced flooding	No impact identified	No impact identified	No impact identified	FHRR Section 2.2.5
Channel Migrations or Diversions	No impact identified	No impact identified	No impact identified	FHRR Table 4-3

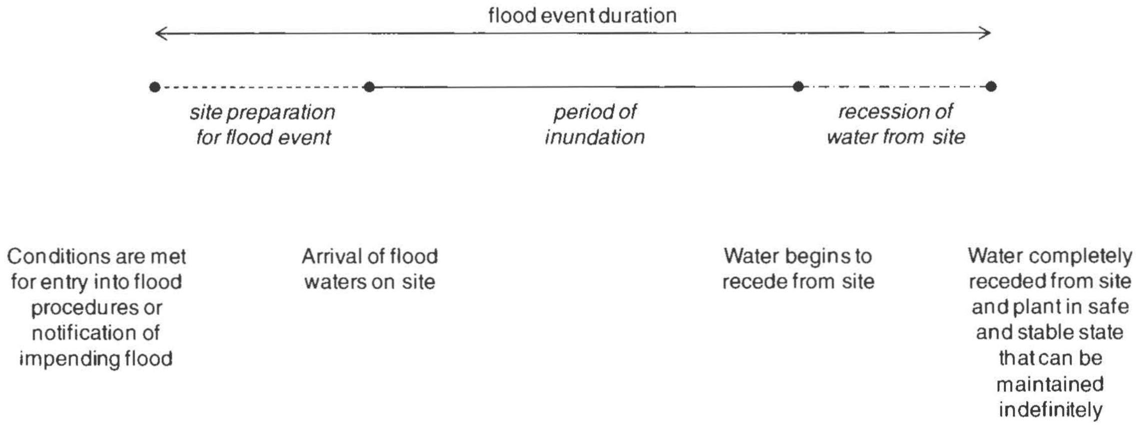

Figure 2.2-1 Flood Event Duration

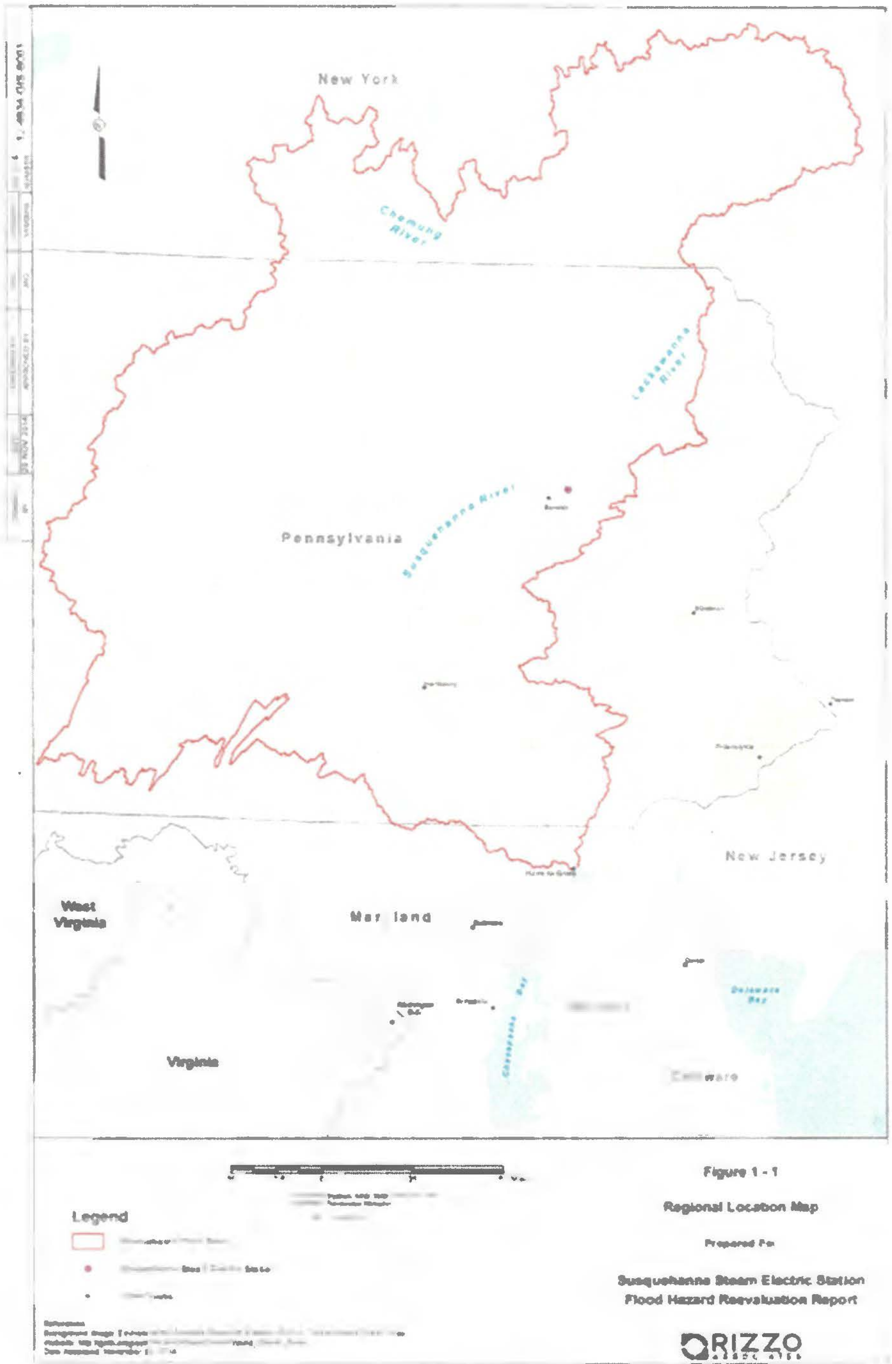

Figure 3.1-1 Regional Location of SSES site (derived from Susquehanna, 2015a).

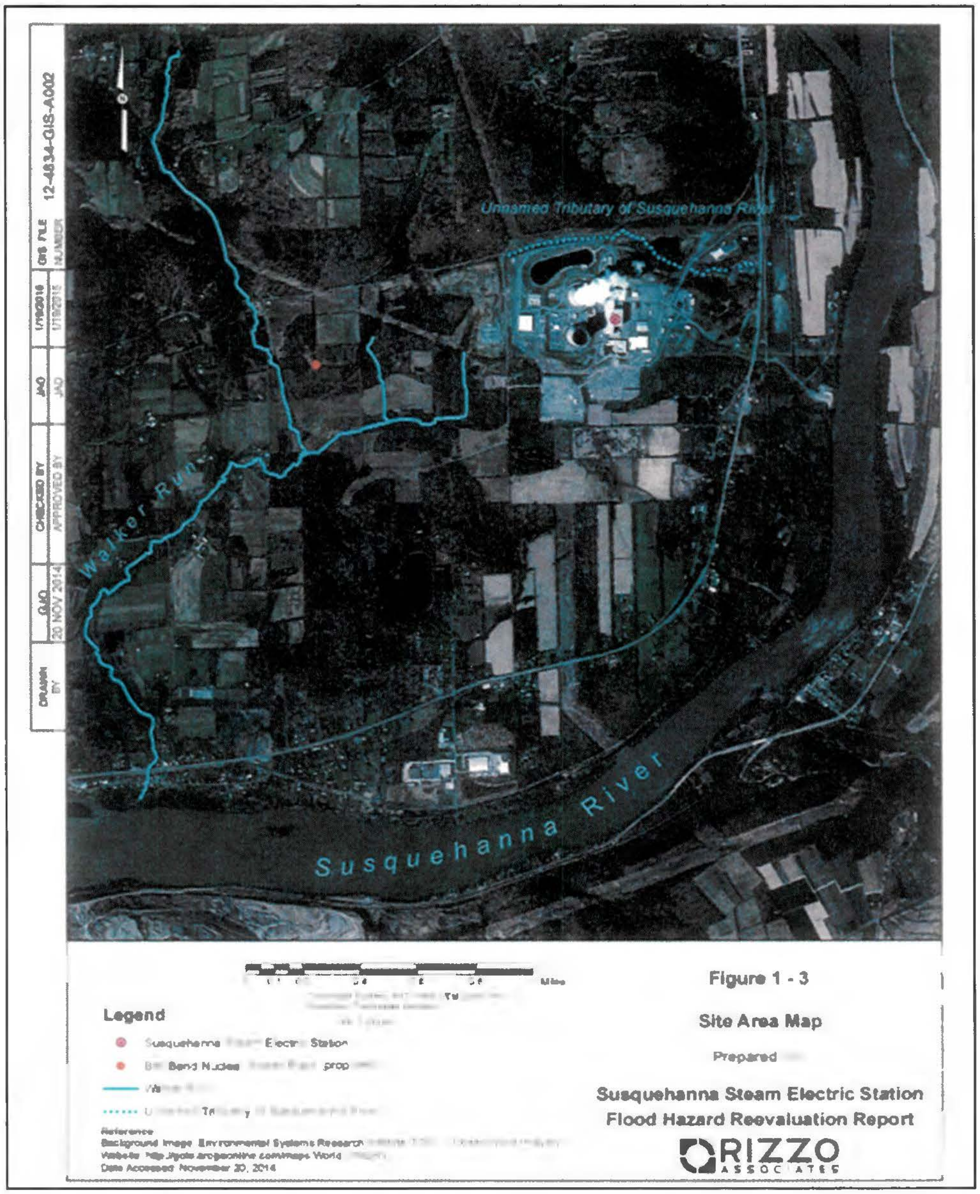

Figure 3.1-2 Site Area Map of the SSES site (derived from Susquehanna, 2015a)

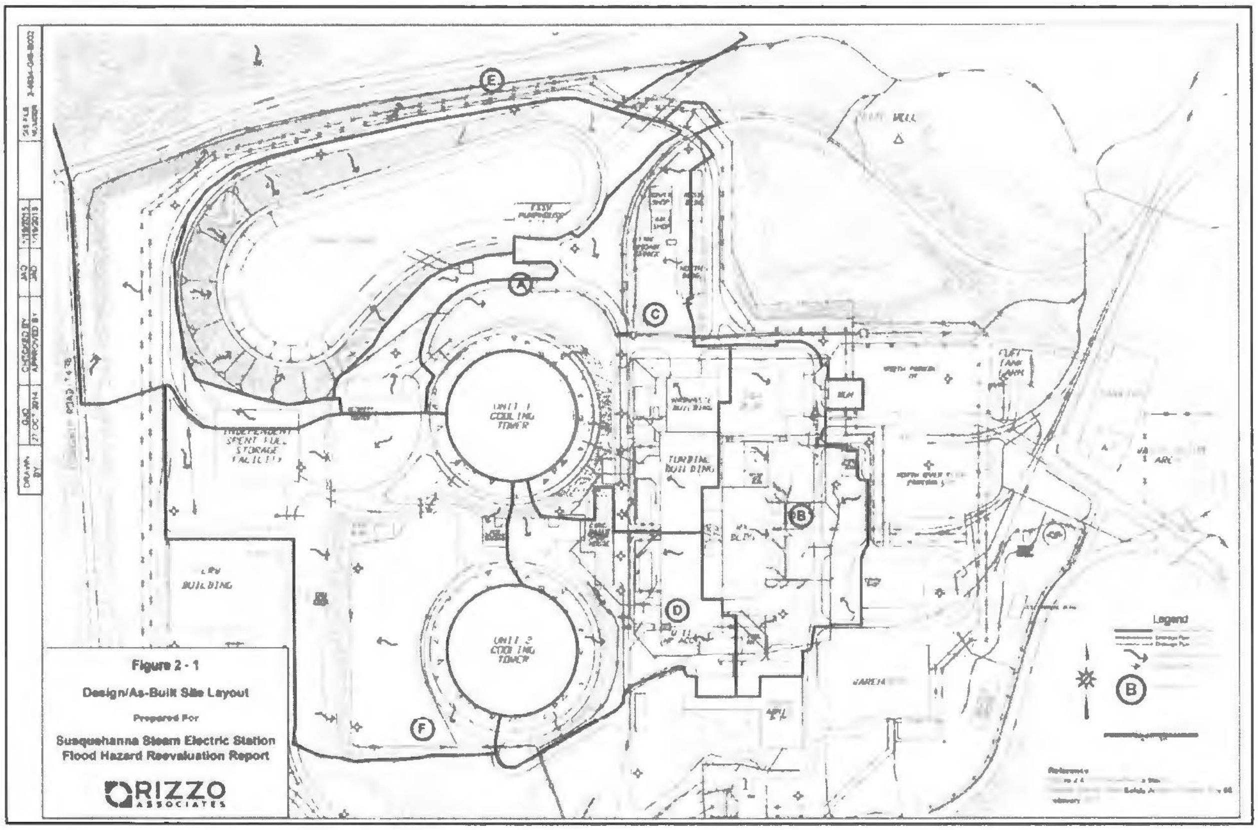

Figure 3.1-3 Present Day Layout of SSES site (derived from Susquehanna, 2015a)

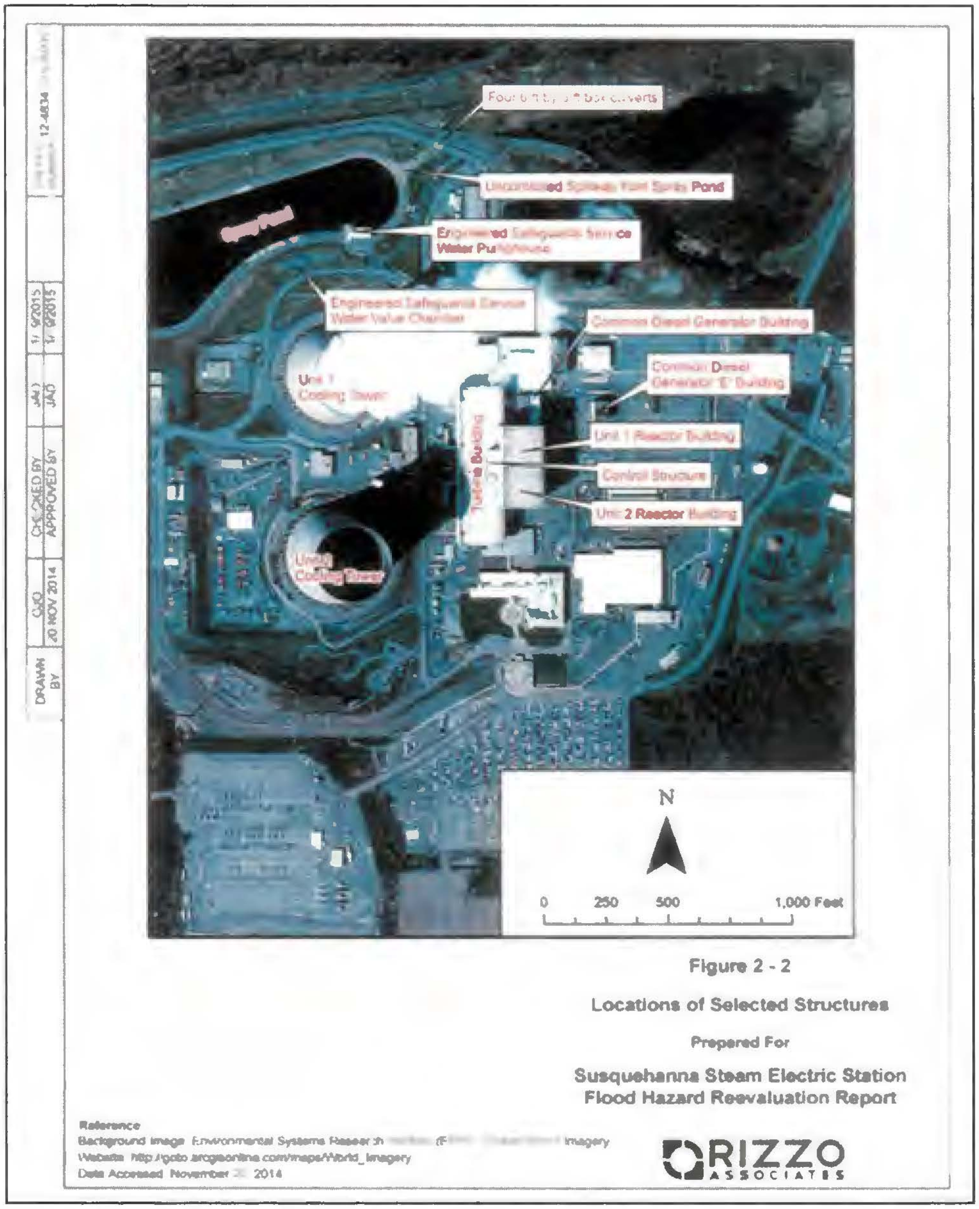

Figure 3.1-4 Location of Selected Structures at the SSES site (derived from Susquehanna, 2015a)

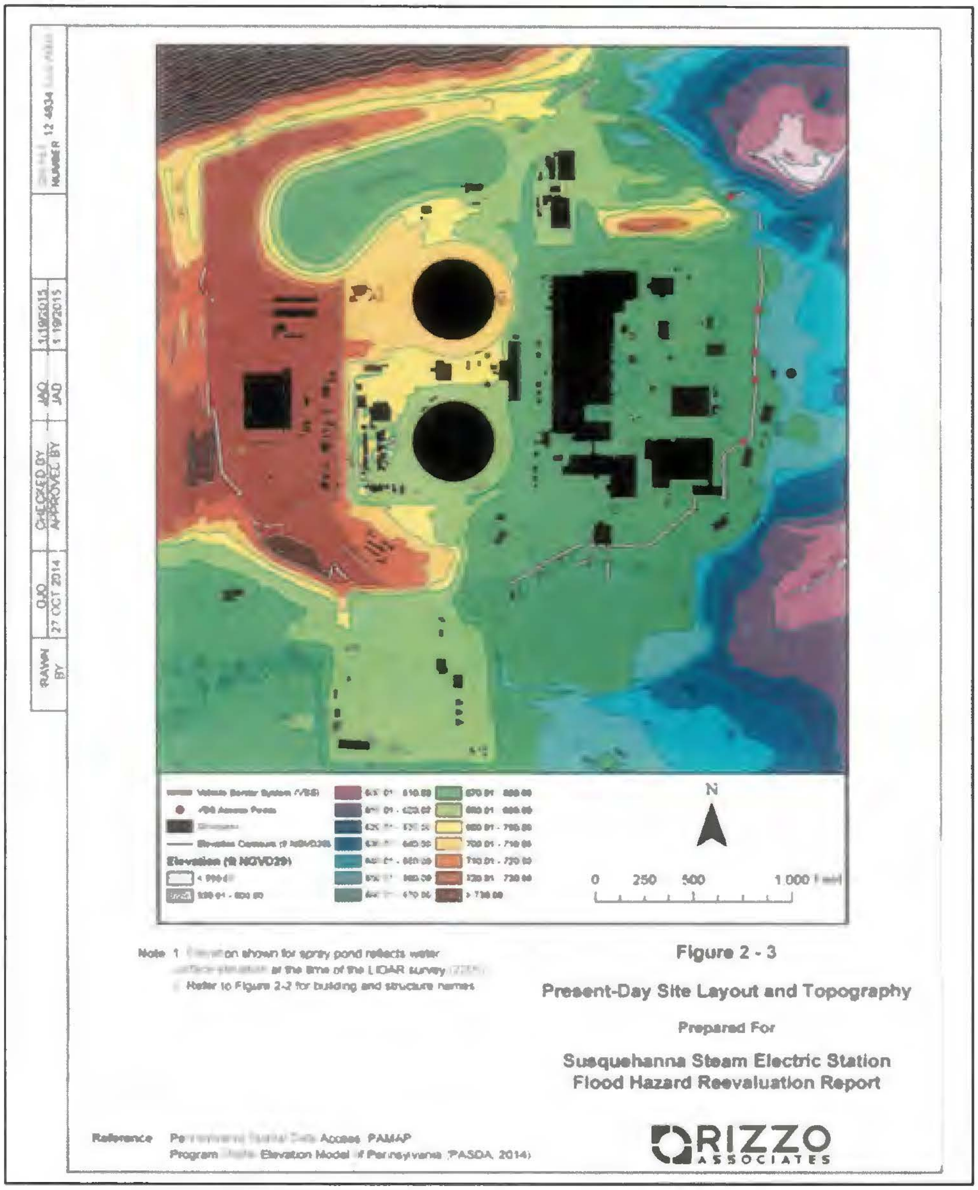

Figure 3.1-5 Layout and Topography of the SSES site (derived from Susquehanna, 2015a)

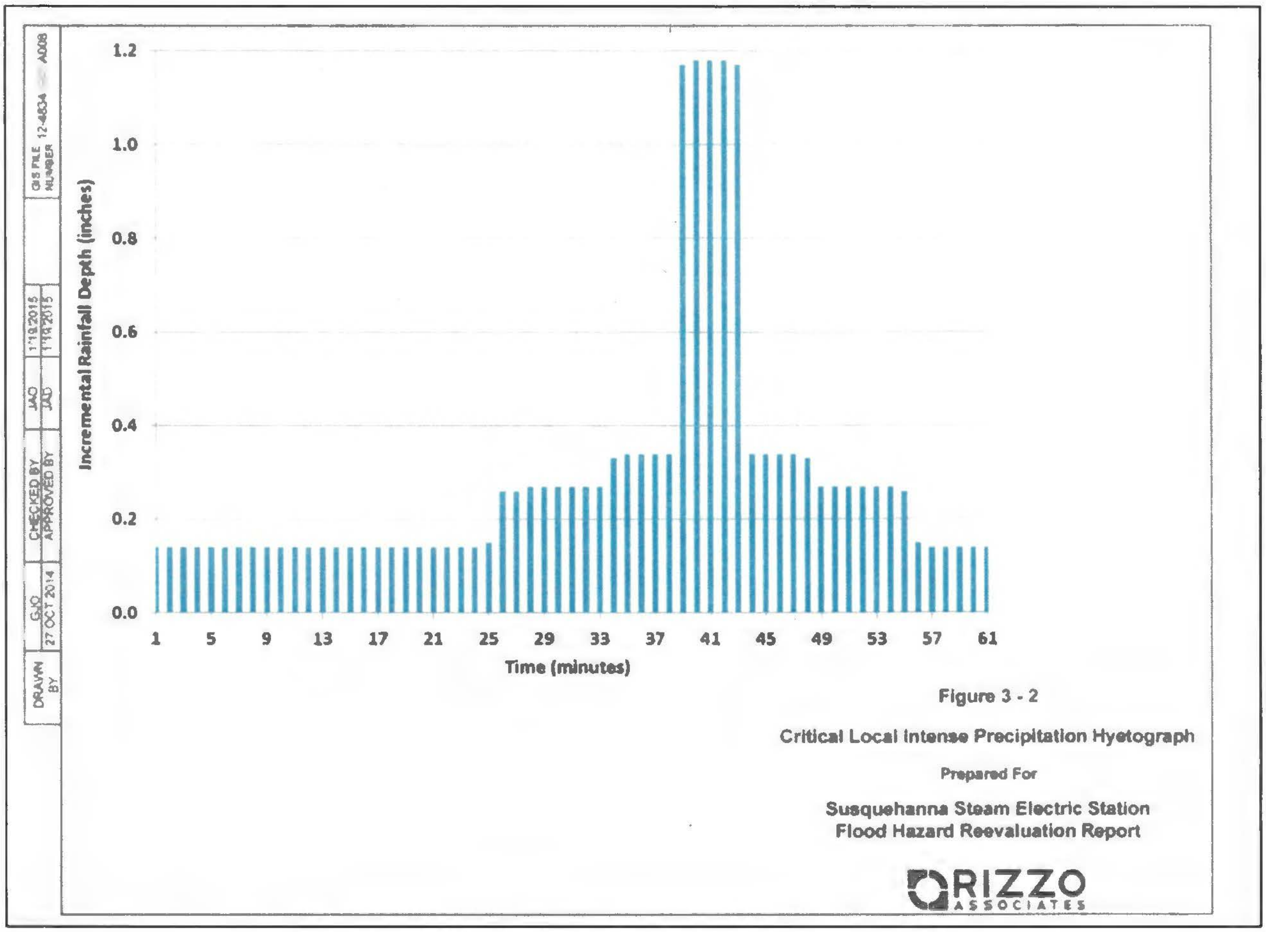

Figure 3.2-1 Selected Precipitation Hyetograph with Peak Value after 2/3 of LIP Event (derived from Susquehanna, 2015a)

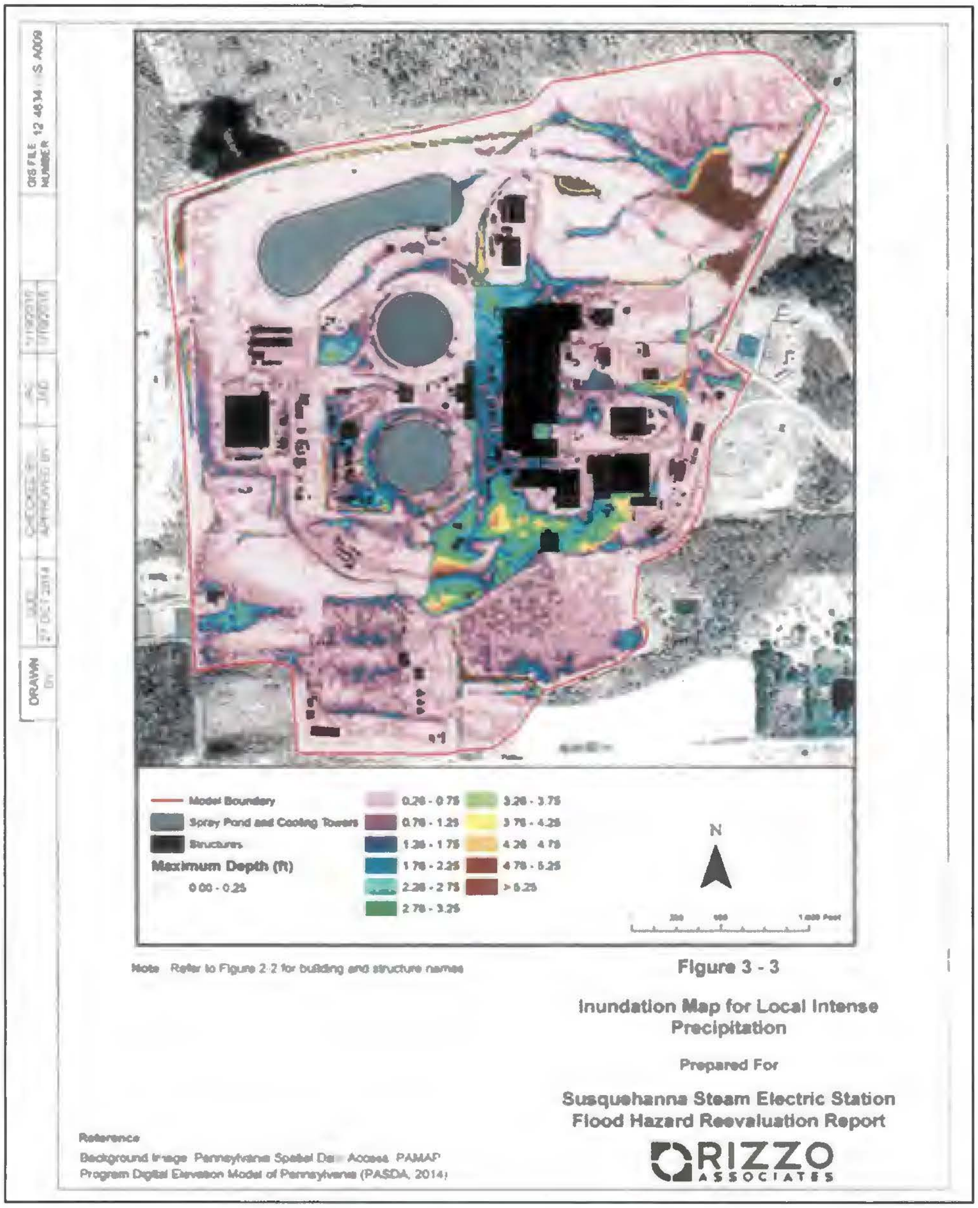

Figure 3.2-2 Inundation Map of the SSES site for Local Intense Precipitation (derived from Susquehanna, 2015a)

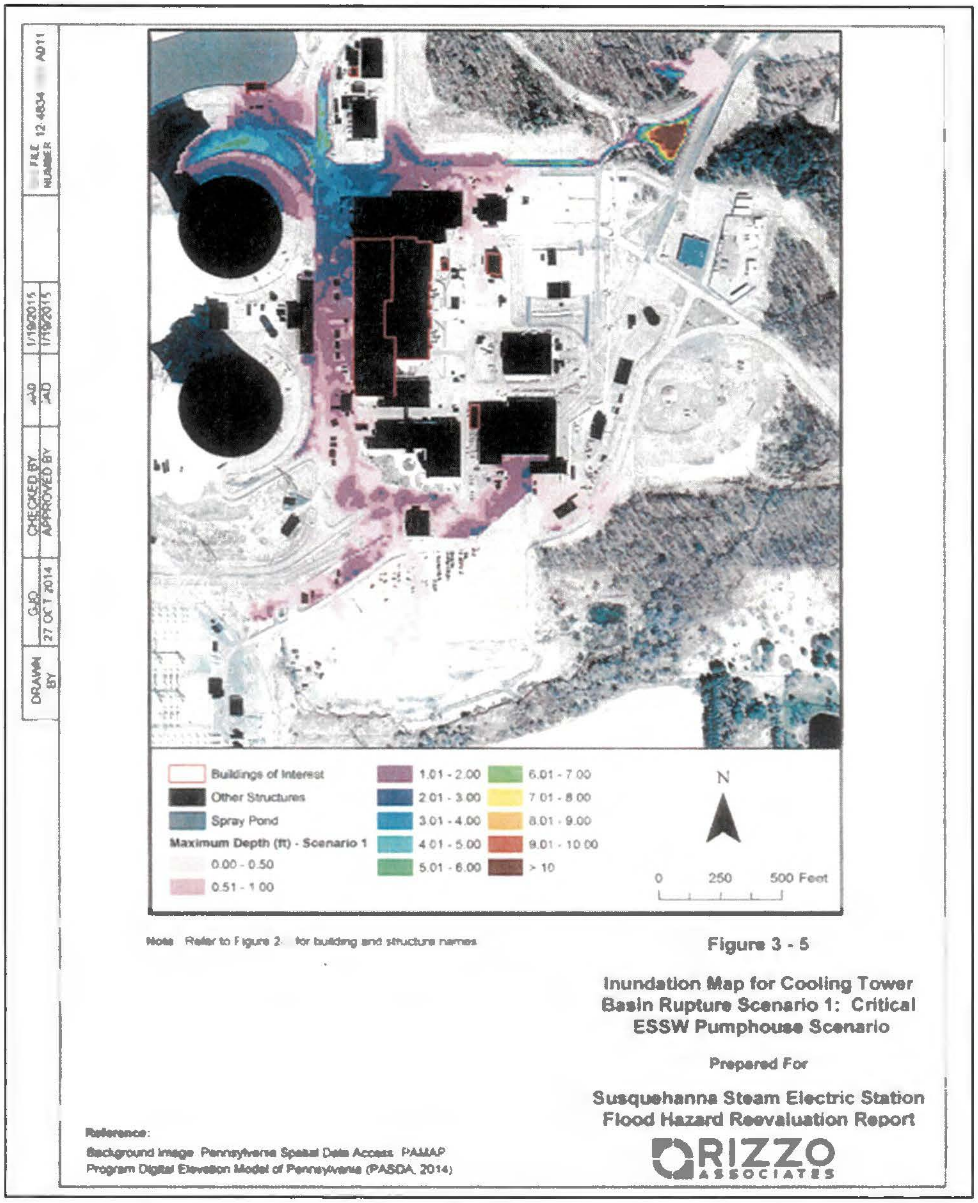

Figure 3.4-1 Inundation Map of the SSES site for Scenario 1 of the Cooling Tower Basin Breach (derived from Susquehanna, 2015a)

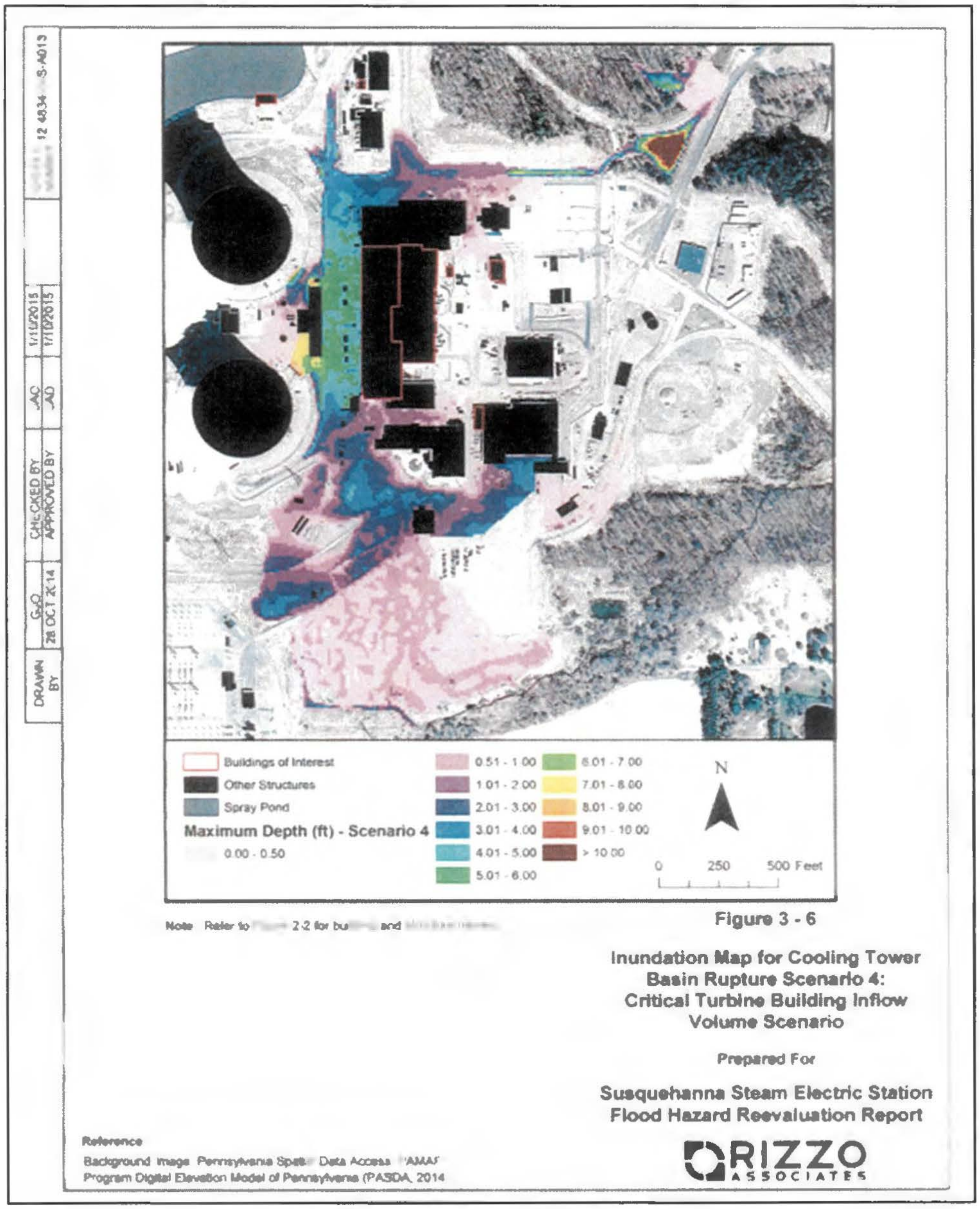

Figure 3.4-2 Inundation Map of the SSES site for Scenario 4 of the Cooling Tower Basin Breach (derived from Susquehanna, 2015a)

If you have any questions, please contact me at (301) 415-6197 or e-mail at Tekia.Govan@nrc.gov.

Sincerely,

/RA/

Tekia Govan, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

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