FENOC
FirstEnergy Nuclear Operating Company

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Peter P. Sena III
President and Chief Operating Officer

November 27, 2012
L-12-347

10 CFR 50.54(f)

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

SUBJECT:
Beaver Valley Power Station, Unit Nos. 1 and 2
Docket No. 50-334, License No. DPR-66
Docket No. 50-412, License No. NPF-73
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
Perry Nuclear Power Plant
Docket No. 50-440, License No. NPF-58
FENOC Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Flooding Aspects of Recommendation 2.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued a letter titled, "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," to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 4 of the 10 CFR 50.54(f) letter contains specific requested actions, requested information, and required response associated with Recommendation 2.3 for Flooding Walkdowns.

By letter dated June 11, 2012 (Accession No. ML12163A318), FirstEnergy Nuclear Operating Company (FENOC) confirmed its intent to use NEI 12-07, *Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features*, as the basis for the flooding walkdowns at Beaver Valley Power Station (BVPS), Unit Nos. 1 and 2; Davis-Besse Nuclear Power Station (DBNPS); and Perry Nuclear Power Plant (PNPP).

This letter submits FENOC's 180-day response to the 10 CFR 50.54(f) letter. The required flooding walkdown reports are provided as Enclosures A, B, and C for BVPS, Unit Nos. 1 and 2, DBNPS, and PNPP, respectively.

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During the flooding walkdowns, certain plant areas were inaccessible due to conditions expected during normal power operation. As a result, additional flooding walkdowns for these inaccessible areas will be scheduled during future plant outages. As provided in the attachment, these future flooding walkdowns are captured as Regulatory Commitment 1 for BVPS, Unit No. 1, and Regulatory Commitments 2, 3, and 4 for DBNPS.

If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 27, 2012.

Sincerely,

Peter P. Sena, III

Attachment: Regulatory Commitment List

Enclosures:

A. Beaver Valley Power Station Verification Walkdowns of Plant Flood Protection Features
B. Davis-Besse Nuclear Power Station Verification Walkdowns of Plant Flood Protection Features
C. Perry Nuclear Power Plant Verification Walkdowns of Plant Flood Protection Features

cc: Director, Office of Nuclear Reactor Regulation (NRR) (w/o Enclosures)
NRC Region I Administrator (w/o Enclosures)
NRC Region III Administrator (w/o Enclosures)
NRC Resident Inspector (BVPS) (w/o Enclosures)
NRC Resident Inspector (DBNPS) (w/o Enclosures)
NRC Resident Inspector (PNPP) (w/o Enclosures)
NRR Project Manager (BVPS) (w/o Enclosures)
NRR Project Manager (DBNPS) (w/o Enclosures)
NRR Project Manager (PNPP) (w/o Enclosures)
Director BRP/DEP (w/o Enclosures)
Site BRP/DEP Representative (w/o Enclosures)
Utility Radiological Safety Board (w/o Enclosures)

The following list identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for the Beaver Valley Power Station, Unit No. 1, and the Davis-Besse Nuclear Power Station. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not Regulatory Commitments. Please notify Mr. Thomas A. Lentz, Manager - Fleet Licensing, at (330) 315-6810 of any questions regarding this document or associated Regulatory Commitments.

Regulatory Commitments

1. **[Applicable to Beaver Valley Power Station, Unit No. 1]**

Inspection of the interior of the Unit 1 Containment Building will be completed during the 22nd refueling outage scheduled in the Fall of 2013.

2. **[Applicable to Davis-Besse Nuclear Power Station]**

The containment building and the containment annulus will be walked down during the 18th refueling outage scheduled in the Spring of 2014.

3. **[Applicable to Davis-Besse Nuclear Power Station]**

Room 102 is scheduled to be inspected again for Boric Acid Corrosion Control before the end of April 2013. This inspection will include a flooding walkdown for ground water intrusion.

4. **[Applicable to Davis-Besse Nuclear Power Station]**

The next inspection of Room 210 is due for completion by the end of December 2014. This inspection will include a flooding walkdown for ground water intrusion.

Beaver Valley Power Station Verification Walkdowns of Plant Flood Protection Features

Based on the NEI 12-07 [Rev. 0-A] Guidelines

November 2012

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FirstEnergy Nuclear Operating Company (FENOC)

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Introduction

In response to the nuclear fuel damage at Fukushima Daiichi due to earthquake and subsequent tsunami, the United States Nuclear Regulatory Commission (NRC) has requested information pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f). As part of this request, licensees are required to perform walkdowns to verify that plant features credited in the current licensing basis (CLB) for protection and mitigation from external flood events are available, functional, and properly maintained.

This report has been written to document the results of the required walkdowns at Beaver Valley Units 1 and 2. These walkdowns tabulated plant features confirming that the features are available, functional and properly maintained.

A. Design Basis Flood

Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.

Hazard Identification

Beaver Valley Power Station (BVPS) is located on the Ohio River at Mile 34.7 for Unit 2 and Mile 34.8 for Unit 1; that is, 3.1 miles downstream from Montgomery Lock and Dam and 19.6 miles upstream from New Cumberland Lock and Dam. Normal pool elevation for the river is 664.5 feet. mean sea level (msl).

The effects of flooding at Beaver Valley were evaluated quantitatively for the following conditions: local intense precipitation, Probable Maximum Flood (PMF) on the Ohio River, potential dam failures, and ice effects. Flood stage profiles have been developed by the Corps of Engineers for the Ohio River reach between Montgomery and New Cumberland Dams, including the effects of all the flood control reservoirs upstream from the site. The following tabulation indicates the characteristic flood stages at the BVPS site, as defined by the Corps of Engineers:

1. Ordinary High Water	El. 678.5
2. Standard Project Flood	El. 705.0
3. Probable Maximum Flood	El. 730.0

The recurrence frequency of the Standard Project Flood is estimated by the U.S. Army Corps of Engineers to be once in 1,000 to 2,000 years. The Corps of Engineers considers the Probable Maximum Flood to be so far beyond reasonable projection limits that it might be termed a geologic era event. (A geologic era can be roughly defined as a period well over one million years. The current geologic era, the Cenozoic, started 65 million years ago) However, the Units will be able to achieve a safe shutdown condition prior to such a flood affecting any safety-related equipment.

Groundwater ingress was considered. The regional groundwater map (BV Unit 1, UFSAR, Figure 2.3-3) indicates the groundwater occurs under hydrostatic conditions with the phreatic surface having a contour approximating the land surface, but of subdued relief. The topographic divides along the ridge crests also mark the local groundwater basin divides. Groundwater levels under the upland surface lie at depths of 10 to 50 feet below surface, averaging 30 feet. In all areas, the groundwater flows downslope and eventually enters the terrace upstream of the plant site or enters the river, downstream of the site. Groundwater migration in the bedrock appears to be constant and slow. Because of the low permeability of the rocks, recharge from rock to the terrace gravels is negligible. There are no known aquifers in the bedrock under the site.

The 6-hour Probable Maximum Precipitation (PMP) is 24.6 inches for the event (Unit 2 UFSAR, Table 2.4-5). Per the table, the 9.3 inches of rainfall occurs in the first hour, 13 inches in two hours, 16.5 inches in three hours, 24.6 inches in six hours and 31.3 inches in 24 hours.

For rainfall intensities greater than the 4 inches per hour used for the design of the yard drainage some puddling will occur. However, since the site pitches through natural drainage lines, to the Ohio River and Peggs Run, surface drainage will aid the yard storm drainage system in minimizing the buildup of water to less than a few inches.

Assumptions

The storm drains are designed to pass, without flooding, a rainfall intensity of 4 inches per hour. Site ground elevation surrounding all buildings is at or above El. 730 feet msl with all safety-related building entrances set 6 inches above ground level, except for one door to the Unit 2 Service Building where the sill is at grade. A runoff analysis was performed for the 10-minute period of highest precipitation intensity (21.0 inches/hour). The yard drains are assumed to be ineffective due to a concurrent high water elevation.

Methodology for Design Basis Development

BVPS is located on the south side of the Ohio River with Unit 1 at Mile 34.8 and Unit 2 at Mile 34.7. The general site area is characterized by sloping topography, with the exception of the northeast corner of the site on which the station is located. Ground elevations vary from 664.5 feet mean sea level (msl) (normal river pool elevation) to a maximum elevation of 1,160 feet msl. Station grades are approximately 730 to 735 feet msl Peggs Run, a small stream flowing through the eastern portion of the site, is channeled through a culvert near the station and enters the Ohio River just west of Route 168.

All Seismic Category I structures are protected from the PMF level of 730.0 feet. All safety-related equipment and connecting piping and wiring is either located above El. 730.0 feet or adequately protected so that its function is unaffected by a flood to El. 730.0 feet.

The BVPS site is located on the New Cumberland Pool, 3.1 river miles downstream of the Montgomery Lock and Dam and 19.6 miles upstream of the New Cumberland Locks and Dam. The total drainage area upstream of the site is approximately 23,000 square miles. The normal pool elevation at the site is maintained at El. 664.5 feet msl by the New Cumberland Dam for river flows up to about 20,000 cubic feet per second (cfs).

The Ohio River is formed in Pittsburgh, Pennsylvania, by the confluence of the Monongahela and Allegheny Rivers. The Ohio River flows southwesterly for 981 miles to Cairo, Illinois, where it joins the Mississippi River. The river is highly regulated by many reservoirs on its tributaries and by numerous navigation locks and dams. The navigation locks and dams on the Ohio River within 50 miles of the site are:

Dam Name	Ohio River Mile	Usable Storage (acre-ft)
Emsworth	6.2	42,700 (upstream)
Dashields	13.3	17,000 (upstream)
Montgomery	31.7	57,500 (upstream)
New Cumberland	54.4	74,000 (downstream)
Pike Island	84.3	89,300(downstream)

The Beaver River joins the Ohio River on the Montgomery Pool, about 9.5 miles upstream of the site. The Beaver River at the Beaver Falls Gauge has a drainage area of 3,106 square miles with an average discharge of 3,530 cfs. The river basin contains eight major reservoirs, most of which are multi-purpose.

The Allegheny River flows southerly from its headwaters in Potter County, Pennsylvania, approximately 270 miles to its confluence with the Monongahela River to form the Ohio River. The Allegheny River at the Natrona Gauge has a drainage area of 11,410 square miles with an average discharge of 19,270 cfs. The river has eight navigation locks and dams on the lowermost 72 miles. The Allegheny River Basin contains nine major reservoirs, many of which are multi-purpose. The East Branch Dam and the Kinzua Dam are equipped for low-flow augmentation.

The Monongahela River is formed at the confluence of the West Fork and Tygart Rivers. The river, which is divided into individual pools by nine navigational locks and dams, flows northward 128 miles to its confluence with the Allegheny River.

The Monongahela River at the Braddock Gauge has a drainage area of 7,337 square miles with an average discharge of 12,260 cfs. The river basin contains three multi-purpose reservoirs located on the Tygart and Youghiogheny Rivers.

Reservoirs Upstream Of The Site

Reservoir	Usable Storage (acre-feet)	Use
Beaver River Basin		
Berlin Lake	91,150	Flood Control, Low Flow Augmentation, Water Supply
Milton Reservoir	29,150	Low Flow Augmentation, Water Supply
Michael J. Kirwan Reservoir	78,660	Flood Control, Low Flow Augmentation
Mosquito Creek Lake	102,200	Flood Control, Low Flow Augmentation, Water Supply
Meander Creek Reservoir	32,410	Water Supply
Pymatuning Reservoir	188,040	Flood Control, Recreation
Shenango River Lake	191,360	Flood Control, Low Flow Augmentation, Recreation
Lake Arthur	37,000	Recreation
Allegheny River Basin		
Allegheny Reservoir	1,180,000	Flood Control, Low Flow Augmentation, Recreation, Power
Conemaugh River Lake	273,600	Flood Control, Recreation
Crooked Creek Lake	93,900	Flood Control, Recreation
East Branch Clarion River Lake	83,300	Flood Control, Low Flow Augmentation, Recreation
Loyalhanna Lake	95,300	Flood Control, Recreation
Mahoning Creek Lake	74,100	Flood Control, Recreation
Tionesta Lake	133,400	Flood Control, Recreation
Union City Reservoir	48,650	Flood Control
Woodcock Lake	20,000	Flood Control, Recreation
Monongahela River Basin		
Deep Creek Reservoir	92,975	Power
Tygart Lake	285,000	Flood Control, Low Flow Augmentation, Recreation
Youghiogheny River Lake	210,250	Flood Control, Low Flow Augmentation, Recreation

The PMF on the Ohio River at the BVPS location has been evaluated by the U.S. Army Corps of Engineers, Pittsburgh District (1970). The Corps of Engineers concludes that the PMF has a peak flow of 1,500,000 cfs. with an elevation of 730.0 feet msl at Ohio River Mile 35.0.

The PMF level and flow was developed in the following manner, since no specific study had ever been performed. The tributary area upstream of BVPS is adjacent to the Susquehanna River basin where a probable maximum storm has been previously developed. This PMP study (U.S. Weather Bureau 1965) presented a storm pattern in the form of isohyetal lines developed for 24,100 square miles of drainage area in the Susquehanna basin above Harrisburg, Pennsylvania. This is about the same size as the area above BVPS. Orientation of the storm pattern over the Pittsburgh District was transposed in a manner that gave a logical coverage for the area and was also conducive to the peak runoff maximization.

The infiltration rates computed for the high intensity storm of August 3, 1964, which occurred over the French Creek basin, were used in the PMP computations performed by the Weather Bureau. This storm possessed typical antecedent characteristics from which the PMP storm is generated. These infiltration rates were applied to several high intensity summer storms that occurred in or near the Stonewall Jackson Lake area, and the losses were found to be in close agreement with the actual losses.

The sub-basin area is shown on Figure 2.4-4 of the BVPS Unit 2 Updated Final Safety Analysis Report (UFSAR). The map has been subdivided into drainage areas. Each numbered area represents an uncontrolled area for which unit hydrographs have been established. Each shaded area is controlled by a dam and named accordingly. Except for Meander and Chautauqua, which are private, all of these dams are operated by the Corps of Engineers. The different routing reaches used in the PMF analysis are indicated by letters. A separate tabulation of drainage areas is included in Table 2.4-8 of the Unit 2 UFSAR.

Individual hydrographs for each of the 61 subareas in the basin and for the areas above the 13 reservoirs were developed from the unit graphs and the 6-hour rainfall values, applicable to the particular areas, modified by infiltration losses. These losses have been found applicable to storms of similar characteristics and seasonal occurrences in this area.

The reservoir inflow hydrographs were developed in a similar manner with unit graphs and the oriented rainfall values. In no case were these flood flows as great as the spillway design floods, which were used to assure the safety of the dam against overtopping and failure. Therefore, no dam failures were required to be postulated.

Reservoir storage during the early storm periods was sustained long enough to permit downstream passage of the flood peak before spillway discharge could appreciably add to its magnitude. Ultimate reservoir storage heights were below structural design levels. After the flow hydrograph for the PMF was computed, a stage-discharge relationship was developed which would accommodate this flow while maintaining all of the hydrologic characteristics. These characteristics require that the valley storage reflect the inflow and outflow into any reach and that the stage-discharge relationship adequately represent the computed flows.

During analysis of a particular reach, the average volume within that reach (the average of the upstream and downstream stages) was the valley storage. Stage capacity relationships developed for these reaches determined a height equalling the maximum volume stored within that reach, which represents the difference between the inflow and outflow. A water surface profile was established from these computations.

The uncontrolled area hydrographs routed to Shippingport resulted in a combined flood hydrograph of 1,430,000 cfs. Reservoir outflows were subsequently routed downstream through the basin and were combined with the uncontrolled flow hydrographs to form the PMF as modified by the 13 existing reservoirs. This flood has a maximum flow magnitude of 1,500,000 cfs. It is almost four times as great as the maximum reduced flood of 200 years of record.

The analysis shows that outflow from the flood control reservoirs would only contribute 70,000 cfs to the flood peak. Reservoirs would operate according to their predetermined schedules and would be in no danger of failure since their own design criteria provide for flows of even greater magnitude. None of the flood control dams are realistically expected to fail during peak flood flow, or at any other time.

Using contour and profile data developed from Unit 1 UFSAR Figures 2.4-8, 2.4-9,2.4-10, 2.4-11, 2.4-12, 2.4-13 and 2.4-14, the U.S. Army Corps of Engineers (Pittsburgh District, 1970) determined that the PMF would attain an elevation of 730.0 feet msl at Ohio River Mile 35.0.

An analysis of the coincident wind and wave activity during the PMF event was requested by the U.S. Nuclear Regulatory Commission (USNRC) during the BVPS-2 Preliminary Safety Analysis Report (PSAR) review. Note, that is applicable only to the Intake Structure. This is the only safety related structure which is subjected to the affects of coincident waves and associated runup.

The following is a summary of that analysis:

1. The maximum wave height is 5.0 feet with a wave period of 4.0 seconds.
2. The maximum overpressure on a vertical wall due to wave action is 360 per square foot (psf) at the still water level.
3. The associated wave runup is 6.7 feet above the standing water level of 730 feet msl.

4. Protection has been provided against wave action, and there will be no loss of ability to maintain a safe shutdown condition. The ventilation air intakes on the intake structure are raised to El. 737 feet to allow for the 6.7 feet runup above the standing water level of 730 feet associated with the 5 feet maximum wave. Ventilation exhaust chimneys have been attached to the ventilating exhaust slots inside the intake structure to protect against the wave and associated runup.

An analysis of the seismically-induced flood potential was requested by the USNRC during the BVPS-2 PSAR review. Detailed information including dam heights, long-term storage volumes and levels, flood control volumes and levels, and channel distances upstream of BVPS for the major flood control reservoirs was presented.

As discussed in the response, failure of the Conemaugh Dam (the most critically located dam with respect to flooding resulting from a dam failure) is not expected to occur due to shear failure or liquefaction for either, the 25-year flood plus the Safe Shutdown Earthquake, or the standard project flood (SPF) plus the historic earthquake. Even though the Conemaugh Dam has been analyzed to be safe against these loading conditions, it was assumed to fail coincident with the SPF. An analysis performed by the U.S. Army Corps of Engineers (Pittsburgh District, 1970) shows that the resultant peak stage at the site would be El. 725.2 feet. This is less critical than the stage resulting from the PMF (El. 730.0 feet).

Consideration was also given to the possibility of more than one dam failing. This situation could arise due to either seismically-induced simultaneous failures or due to the failure of dams downstream from the flood wave caused by a single, seismically-induced upstream dam failure. All dams that could potentially affect water levels at the plant site are located on separate tributaries of the Ohio River. There are no dams in series on a single stream; thus, potential for cascade effects does not exist.

All dams are designed to withstand an earthquake loading of 0.1g horizontal, and safety factors indicate that these structures are safe against the postulated loading systems. Simultaneous failure of two or more dams under these conditions is not considered credible.

The failure of the most critically located dam (Conemaugh) would result in a maximum water elevation of 725.2 feet at the site. In addition, multiple dam failures is not a credible postulated event. The most critical flood condition at the BVPS site of Elevation 730.0 feet results from the PMF, as discussed in Unit 2 UFSAR Section 2.4.3. All safety-related equipment and connecting piping and wiring are either located above that elevation or adequately protected so that their function is unaffected by a flood up to El. 730.0 feet.

The BVPS site is not susceptible to surge and seiche flooding since the site is not located near a large body of water where it would be a significant consideration.

A tsunami is a gravity wave system formed in the sea following any large scale, short duration disturbance of the free surface. Tsunamis usually occur following undersea earthquakes of a certain magnitude, although landslides, bottom slumping, and volcanic eruptions have generated tsunamis in certain cases. A tsunami is not applicable to the BVPS site.

The potential for ice jamming and subsequent flooding on the Ohio River was evaluated based on the statistical summary of ice in the Ohio River at Cincinnati, Ohio for 1874 – 1964. This was prepared by the National Weather Service and is the most complete long-term record of icing on the Ohio River. This summary is regarded as a good average between the colder upstream reaches and the warmer downstream reaches. During the 90 years of record, 62 winters have experienced icing, including 13 winters when the river was frozen over and 28 winters which were ice-free.

Except for a 12-day period in February 1948, the longest periods of continuous river ice at Cincinnati occurred prior to 1919. As development of the Ohio River has increased, the influence of reservoirs and of impurities on ice formation has increased, which may have contributed to shorter periods of continuous ice in more recent times. Frozen-over reservoirs will release warmer flows downstream than would have been released without the reservoir.

Population and industry growth have increased the amount of impurities in the water, thus lowering the freezing point of the river. Tributary storage reservoirs, however, trap some impurities, and there have been major efforts to reduce pollution, including waste heat. The net effect of these factors is unknown at this time.

Icing records at the New Cumberland locks and dam are maintained by the U.S. Army Corps of Engineers. Differences in definitions for various ice conditions prevent detailed comparison of the 17-year record at New Cumberland with the 90-year record at Cincinnati. It can be seen, however, that the majority of ice occurrences are, as expected, in January and February and that the average number of ice occurrences per year are similar, about 12 per year at New Cumberland and 15 per year at Cincinnati. The icing season is shorter at New Cumberland, perhaps reflecting the influences discussed in the preceding paragraph.

Of particular interest is the fact that the New Cumberland data show no occurrences of jamming or gorging or any reports of rising water levels due to ice buildup. It appears that New Cumberland was able to move ice through the locks and maintain sufficient traffic to prevent severe problems.

Ice conditions at Shippingport have changed since construction of New Cumberland Dam in 1959. Prior to 1914 the river at this point flowed in its natural condition and was subject to the many factors that generate ice formation and ice gorging.

Between 1914 and 1959, Dam 7 maintained a navigable pool. This was a wicket type dam. The wickets were lowered to the bottom of the river during periods of high river flow, and sometimes if severe ice conditions existed, the wickets would remain down even after flow had receded. At such times open river gorging conditions could develop. The worst gorge known in this reach of the river was of this type. It occurred in mid-February of 1936 when ice from the Monongahela River moved down into the Ohio and grounded on a shallow sand bar about 6 miles upstream of Shippingport. A subsequent general rise in the river system carried this gorge rapidly on downstream with little damage. Re-occurrence of such a gorge is now impossible as New Cumberland Dam maintains a depth of more than 20 feet of water over the restraining sand bar.

Most critical ice conditions since early 1900 occurred during the severe cold spells of January 1918 and January 1940. During these months ice cover persisted for two to three weeks and was reported to be as much as 6 inches to 8 inches thick. This ice deteriorated, was broken by rising river stages and was carried downstream without gorging in the same manner as generally occurred with less freezing.

Ice cover above the present gated dams on the Ohio River spans the river some distance above the gates. If this ice cover persists without thermal deterioration and breakage by river traffic, it will move downriver past the dams coincidental with the breakage and higher velocities created by a rise of about 3 to 6 feet in the upstream end of the pools. No gorging will occur.

Although it occurred about 500 miles downstream of BVPS, the Markland ice jam of 1978 was reviewed in the Unit 2 UFSAR since it was the most severe ice jam experienced on the Ohio River since the installation of the current dam system (as discussed in a 1999 U.S. Army Corps of Engineers study) and because it occurred at a dam equipped with tainter gates. An unusual combination of extreme meteorological events combined with less than optimum operating decisions contributed to the difficult situation.

During mid- to late January, the lower Ohio River contained heavy ice, including considerable slush ice from tributaries. The river flow at that time was extremely low and the tainter gates at Markland locks and dam, all of which are non-submergible, could not be raised to pass ice. In addition, due to a coal strike and extreme cold, the hydroelectric station at the dam was operating at full power and this further decreased the amount of water available to move ice. The only recourse was to lock ice and barges through sequentially. This made keeping the channel open very difficult.

Simultaneously, an ice jam formed several miles upstream of the Markland, Indiana Dam (downstream of Cincinnati) in a shallow bar area at a narrow point in the Ohio River. Heavy precipitation, meanwhile, had begun causing a rapid rise in the river and associated flooding. The ice jam began moving and some barges moored upstream broke free. By the time Markland Dam had raised several gates to pass ice, a number of barges had already piled up on the dam and some gates were inoperable.

The possibility of this type ice jam forming on the New Cumberland pool is very low for the following reasons. First, the meteorological conditions, that led to the Markland ice jam, extreme cold and low flow followed by severe flooding, are extremely unlikely combined events. Second, some of the tainter gates at the New Cumberland Dam are submergible, permitting ice to be passed even during low flow periods. Third, an Ohio River Industry Ice Committee was formed following the ice jam in order to ensure better communication, operating procedures, and other measures to prevent a recurrence of the problems experienced at Markland.

The characteristics of the river in the vicinity of the plant also contribute to a very low possibility of an ice jam forming. Normally, ice jams form at obstructions and irregularities, which do not exist downstream of the plant. From the preceding discussion of historical events and the conditions in the BVPS vicinity, it can be concluded that the formation of an ice jam that would cause a significant rise in the water elevation in the New Cumberland pool or that would physically block the intake structure is extremely unlikely to occur.

Runoff analysis of PMP effects were performed and the maximum surface water elevations were determined. This analysis was based on total rainfall of 31.3 inches in a 24 hour period. These maximum levels were all below the lowest access elevations to buildings with the exception of one door to the Unit 2 Service Building. (Unit 2 UFSAR, Table 2.4-6) This door has been evaluated to confirm that water seepage around the door during this maximum condition would be insufficient to impact components within the Service Building.

Differences or Contradictions in Flood Hazard Levels

No differences or contradictions were found in review of licensing basis documents

B. Protection and Mitigation Features

Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.

The rising of Ohio River levels to Elevation 670 feet msl causes the site to enter into BVPS-Abnormal Operating Procedure (AOP) 1/2OM-53C.4A.75.2, "Acts of Nature – Flood." This document provides guidance and instructions on required plant responses to rising river water levels in order to assure a safe shut down of both units well in advance of design basis flood conditions.

A plant flood alert will be issued for an Ohio River water level of 690 feet msl or above. Actions to protect safety-related equipment are initiated when the river water level reaches 695 feet msl and water is rising upstream. As the lowest floor levels of all Category I structures are located above ground water level, a permanent dewatering system is not required.

The AOP requires that if river elevation is greater then 695 feet and "IF forecasted peak exceeds 700 feet, THEN Perform normal shutdown and cooldown of Unit 1 and Unit 2." This conservative plan assures that the plant can be shut down safely prior to river levels approaching the SPF or PMF. This procedure is consistent with the BVPS License Requirements Manual 3.7.2, ACTION C which specifies entry into LR 3.0.3 at that point. Since the risk assessment directed by that LR provision could not be performed if river levels are expected to rise to PMF level, the plant would shut down.

Flooding Licensing Basis

Describe the flooding licensing basis including what plant configurations (modes of operation; for example, full power operations, startup, shutdown, and refueling) were considered. This description should be consistent with the scope of the flooding walkdowns.

Flood prevention and mitigation measures are designed to function in all modes of operation including full power operations, startup, shutdown, and refueling.

Flood Duration

Local intense precipitation is the only time dependent flooding hazard considered in the Current Licensing Basis (CLB). The 6-hour probable maximum precipitation was calculated based on 10-square mile values, and in the vicinity of the station, the 6-hour value using standard hydrometeorological procedures. The duration of the Probable Maximum Flood above El. 728.0 feet is approximately 18 hours.

Credited Flood Protection Features

Unit 1

According to Section 2.7.3.2 of the Beaver Valley Unit 1 UFSAR, all safety related structures and the equipment within these structures essential to attain a safe shutdown are designed against any adverse effects from the SPF and the PMF.

The floors and wall of the indicated Flood Protected Areas are constructed with concrete. Penetrations, such as pipes, cables or conduit, which enter these areas and are embedded in concrete, utilize water stop to prevent inleakage. All penetrations that enter through the openings in the concrete are sealed after installation of the item. All flood protected areas have sumps or curbs along walls containing sealed penetrations. Any inleakage, which would occur during an external flood, would be collected in these areas. All sumps and curbs contain either a float-actuated sump pump or a level switch and transmitter with a control room alarm. Portable sump pumps are provided, which can be used wherever needed. Emergency power supply connections are located at each wall curb, and each permanent sump pump is connected to the emergency power supply.

- Containment Structure:

  Reactor containment is the only Unit 1 structure with a mat elevation (692 feet - 11 inches) below the SPF level of 705 feet. It is designed to be watertight against, and to withstand the buoyancy and water pressure of the PMF. As described in BVPS-1 UFSAR Section 5.2.7.3, containment is protected by a waterproof membrane, which was laid under the mat, carried up the sides of the mat and then up the cylinder walls to approximately El. 730 feet. The membrane was continuously cemented to the mat and outer wall surfaces. All joints of the membrane were overlapped and sealed. As a supplementary safety factor described in BVPS-1 UFSAR Section 5.2.1, water relief systems are provided in the floor of the two instruments pits at El. 690 feet – 11 inches, located in the mat outside of the containment wall. In the event of a flood and unexpected leakage through the membrane, water would rise in the sump and then cause an alarm to sound in the control room after reaching a predetermined height. This water would then be removed by a sump pump.

- Cable Vault and Cable Tunnel:

  There are no equipment or floor drains in the cable vault or cable tunnel. There are no sources of water located above these structures that could cause flooding. The elevation of the cable vault is above the probable maximum flood level and not susceptible to flooding.

- Pipe Tunnel to Containment from Auxiliary Building:

  This tunnel does not contain any operable safety related components required for the safe shutdown of the plant following an external flood. The pipe tunnel at Elevation 722' is not protected from ingress of river water during a PMF.

- Main Steam Valve Area:

  The lowest elevation of the BVPS-1 Main Steam Valve Area (at EL. 752 feet) is above PMF levels. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF.

- Pump Room below Main Steam Valve Area:

  The lowest elevation of this pump room is at EL. 735 feet and is thus above PMF levels. Therefore any component required (e.g. Auxiliary Feedwater

Pumps) for the safe shutdown of the plant following a flooding event is protected from external flooding by its location being beyond the extent of the PMF.

- Safeguards Area:

  The lowest elevation of the BVPS-1 Safeguards area containing Class-1E equipment credited for the safe shutdown following a flooding event (735 feet) is above PMF levels. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF.

- Safeguards and Main Steam Valve Ventilation Rooms:

  The lowest elevation of these ventilation rooms is above PMF levels. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF.

- Primary Auxiliary Building:

  With the exception of the lowest level of the BVPS-1 Auxiliary Building (EL. 722 feet), which is not protected against the PMF, all other floors are higher than this level of flood (being at EL. 735 feet and above). The only safety-related equipment required for safe shutdown on the lowest level of the Primary Auxiliary Building are the Charging Pumps. These pumps are individually protected against the PMF. Their cubicles are designed against ingress of water during a PMF. Any penetrations to the cubicles below EL. 730 feet are sealed.

- Fuel Building:

  The lowest elevation of the BVPS-1 Fuel Building (EL. 735'-6") is higher then the level of the PMF. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF. The bottom of the spent fuel storage pool is at El. 727.3 feet, but the structure is designed so as to be unaffected by the flood.

- Duct Lines and Manholes to Intake Structure and Diesel Generator Building:

  The means for routing cable from the main portions of the plant to the intake structure is through cable duct lines extending from the high level terrace (El. 735 feet) to the lower level terrace (El. 675 feet), which is the ground elevation at the intake structure. These cable ducts, including all manholes, from the plant to the intake structure are allowed to flood. The cables and splices installed in the underground duct lines are adequate for the intended service when operating under wet or dry conditions.

- Main Control Room:

The lowest elevation of the main Control Room is at EL. 735 and thus above PMF levels. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF.

- Switchgear, Relay Room, and Cable Tray Area in Service Building:

  The equipment, although located on Elevations 713' and 725' of the BVPS-1 Service Building and is thus below PMF level. However, they are included in flood protected areas and protected as described above.

- Battery Rooms:

  The BVPS-1 Battery Rooms are located on Elevation 713 feet of the Service Building and are thus below PMF. However, they are included in flood protected areas and protected as described above.

- Air Conditioning Equipment Room for Control Room:

  The room is also located on Elevation 713 feet of the Service Building and are thus below PMF, and protected as described above. As also described in BVPS-1 UFSAR 2.7.3.2.5, the control room air conditioning room is protected from flooding by a manually-operated gate valve in series with a check valve in the six-inch drain line from the room. This valve will be closed in accordance with the site AOP when river level reaches El. 695 feet. During the PMF condition, this valve will not be operated again.

- Diesel Generator Building:

  The lowest elevation of the diesel generator building at EL. 735 feet – 6 inches and thus is above PMF levels. Therefore any component required for the safe shutdown of the plant is protected from external flooding by its location being beyond the extent of the PMF.

- Waste Gas Storage Area:

  This area is not required for safe shutdown of BVPS-1. Areas are included in flood protected areas indicated on UFSAR Figures 2-7.17, 2-7.18, 2.7-19 mentioned earlier, and protected as described above.

- Coolant Recovery Tank Structure:

  The lowest elevation of these tanks, in the BVPS-1 Solid Waste Building, is EL. 735 feet and above PMF levels. Therefore the tanks are protected from external flooding by its location being beyond the extent of the PMF. The tanks are not required for the safe shutdown of the Unit.

- Refueling Water Storage Tank and Mat:

  The lowest elevation of the BVPS-1 tank is at EL. 735 feet and above PMF levels. Therefore the tank is protected from external flooding by its location being beyond the extent of the PMF.

- Intake Structure:

  The Intake Structure is unique in the fact that this structure contains both Unit 1 and Unit 2 components, both safety related and non-safety related.

  Described in Unit 1 UFSAR 2.7.3.2.2, the intake structure and equipment housed within the intake structure incorporates various design considerations to withstand the adverse effects of flooding. All equipment operating within the intake structure is protected from SPF by placing the equipment on the operating floor located at El. 705 feet. Equipment required for a safe shutdown, such as river water pumps and service water pumps, is protected by watertight concrete cubicle enclosures extending above the PMF elevation. Each cubicle has a sump pump controlled automatically from an integral float switch and connected to the emergency power source. These pumps discharge through check and gate valves to an elevation above 730 feet.

  There are six types of penetrations into the intake structure cubicles described in the Unit 1 UFSAR 2.7.3.2.2, and all are sealed for water leakage during a PMF as follows:

  1. Ventilation opening: These openings extend to El. 737 feet with no penetrations below that level to prevent water entrance due to wave action coincident with the PMF. Gasketed seal plates are installed over half of the vent area and 7 feet high steel box structures are installed over the other half.
  2. Pump columns and shafts: All pump columns penetrate the compartment floor with a gasket or O-ring sealed double base plate assembly. The assembly consists of a pump base plate which is bolted onto a soleplate, grouted into the floor. A gasket or O-ring prevents leakage between the two plates. All pumps have shaft seals where the shafts penetrate the pump column. Seals are designed to and normally operate at pressures in excess of that which will be experienced during a PMF.
  3. Pipes: All pipes that penetrate the compartment floor or walls are either fitted with a water stop or are sealed against inleakage.
  4. Valve stuffing box floor penetrations: (B and C cubicles only) Closures are installed to prevent inleakage during times of high river flood level conditions.
  5. Sliding Steel Cubicle Flood Doors: The doors consist of 1-inch thick steel plate doors, sliding in an enclosed steel frame, which is embedded in the

concrete opening, and supported by a track mounted above the door. Positive sealing is provided by inflating a seal against contact surfaces by means of a charging tank mounted inside the protected compartment. All electrical panels are a minimum of 10 inches above the cubicle floor. If inleakage rate were 10 times the maximum test inleakage rate of 0.5 cubic feet per hour per flood door, the depth of water in the cubicle would be well below the 10 inches for the duration of the PMF.

The BVPS-AOP *requires that if river elevation is greater then 695 feet* "Perform Attachment 2, 'Flood Door Installation and Removal Procedure'" within 8 hours of exceeding 695 feet." This Attachment describes the process to correctly seal all intake structure flood doors before flood level reaches the cubicle door elevation. Air supplies to the flood door seals are tested for a duration of 100 hours.

6. Electrical cables: The electric cables enter the compartments through floor and wall sleeves cast in concrete with water stops or seals to prevent inleakage around the sleeves.

Finally, a single failure of any flood door during the flood will only affect one cubicle, and therefore adequate river water pump capability remains for plant cooling. No access to the intake structure is required during the PMF.

Unit 2

Table 3.2-2 of the Unit 2 UFSAR lists the Category I Structures necessary for safe shutdown. The following listed buildings have external flood protection by their above grade location (PAG):

Service building
Fuel and decontamination building
Emergency diesel generator building
Cable vault, Main steam valve area
RWST/CAT pad and surrounding shield wall
Primary demineralized water storage tank pad and enclosure
Emergency outfall structure
Equipment hatch platform.

The following buildings are below grade and have external flood protection by design of enclosing structure (PBG):

Reactor containment
Auxiliary building
Safeguards area
Cable tunnel
Control building
Pipe trenches (except north and south interconnecting trenches to BVPS-1)

Service water valve pits.

Safety-related systems and components are protected from external floods by locating them in Seismic Category I buildings. Access to these structures is located above the PMF level of 730 feet. In general, construction joints in the exterior walls and mats below elevation 730 feet, are provided with water stops. In addition, the containment structure has a continuous waterproof membrane below grade.

Penetrations entering these buildings below grade are adequately sealed to prevent in-leakage. For example, piping penetrations in exterior walls and valve pits include flexible, water-tight boots to maintain the integrity of the building.

As an added precaution, potential in-leakage to the containment structure is collected in sumps at the lower building elevation and pumped out. These sump pumps in Containment are powered with emergency power protected from potential impact from external flooding.

- Containment

  The exterior surface of the reactor containment shell and foundation mat has a continuous waterproofing membrane to protect the containment structure against water seepage during flood stages resulting from the Probable Maximum Flood.

  As a supplementary safety factor, water relief systems are provided in the floor of the two instrument pits at elevation 690 feet – 11 inches. The pits are located in the mat outside of the containment wall. A sump extends into the mat from the bottom of the pit to a point above the bottom reinforcement. From the bottom of the sump, a vertical pipe projects through the reinforcement into the underlying porous concrete. In the event of a flood and unexpected leakage through the membrane, the vertical pipe would allow the water to rise in the sump where it would sound an alarm in the control room after reaching the predetermined height. The water would then be removed by a sump pump to prevent buildup of pressure under and behind the steel liner. The instrument pits are enclosed by the waterproofing membrane protecting the containment structure.

- Site Drainage System

  The 10-minute PMP having an intensity of 3.5 inches, which is the maximum based on a 1965 US Army Corps of Engineers Study and listed in BVPS-2 UFSAR Table 2.4-5 was chosen for evaluation. The storm drains are designed to pass, without flooding, a rainfall intensity of 4 inches/hour. Site ground elevation surrounding all BVPS-2 buildings is at or above el 730 feet msl with all safety-related building entrances set 6 inches above ground level, except for one door to the BVPS-2 service building where the sill is at grade. A runoff analysis was performed for the 10-minute period of highest precipitation intensity (21.0 inches/hour). The yard drains were assumed to be ineffective due to a concurrent high water elevation.

Table 2.4-6 of the Unit 2 UFSAR shows the maximum water surface resulting from the PMP is above the sill of only one door to a safety-related structure, the BVPS-2 Service Building at EL. 732 feet. Since the sill to the affected door for the service building is at grade, runoff water from the local site flooding will seep under the door during the PMP until the site drainage system becomes operational or the water level dissipates.

An analysis was performed to calculate the quantity of water entering the service building under the affected door. From the water levels computed, an estimate was made of the quantity of water seeping between the bottom of the door and the sill. The flow rate was calculated by assuming laminar steady flow between fixed-parallel plates. In the most intense 1-hour rainfall, the water depths over the door sill varies from 0.2 to 0.5 feet. The total volume of water seeping through the door was calculated to be 475 cubic feet. Taking into consideration the size of the room, equipment location, and with no credit taken for floor drains and sumps, the accumulation of water in the service building has been calculated to be 1.3 inches deep. Since there are no QA Category I equipment or electrical connections located closer than 2 inches to the floor, there is no impact on the operation of safety-related equipment due to a PMP.

Initiating Weather Conditions

Describe weather conditions or flood levels that trigger procedures and associated actions for providing flood protection and mitigation.

The rising of Ohio River levels to Elevation 670 feet msl causes the site to enter into the site AOP, "Acts of Nature – Flood." This document provides guidance and instructions on required plant responses to rising river water levels in order to assure a safe shut down of both Units well in advance of design basis flood conditions.

Additional Adverse Weather Conditions

An analysis of the coincident wind and wave activity during the PMF event was requested by the U.S. Nuclear Regulatory Commission (USNRC) during the BVPS-2 Preliminary Safety Analysis (PSAR) review. This additional analysis was performed in response to U.S. Atomic Energy Commission (USAEC) Question 2.13 and is included in Amendment 2 to the BVPS-2 PSAR.

The following is a summary of that analysis. The maximum overpressure on a vertical wall due to wave action is 360 psf at the still water level. The associated wave runup is 6.7 feet above the standing water level of 730 feet msl.

C. Warning Systems

Describe any warning systems to detect the presence of water in rooms important to safety.

Containment waterproof membrane leak sensors provide an indication that the waterproof membranes enveloping both containment structures have begun to leak. This condition does not indicate that the containment buildings have been compromised. In the highly unlikely condition that both the concrete shell and the steel liner are leaking, flood waters would flow to the containment sump where regular plant monitoring would acknowledge an unknown leak in the containment. A combination of the leak sensors and sump sensors would document external flooding into containment.

For those other structures that have flood barriers below PMF levels, sumps have sensors that will provide indication to the Control Room that water has entered the sump. This indication will not necessarily differentiate between an internal or external flood source. Existing river water levels combined with Operator investigation of the signal would identify whether the source is an external or internal leak.

D. Effectiveness of Flood Protection Systems and Barriers

Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated.

Conformance with the Current Licensing Basis

The observations made during the walkdown have confirmed the integrity of the site flood protection system and barriers. The basic premise of the original design of the site puts a significant portion of the safety related equipment above PMF elevations. This basic design feature places this equipment within a reliable passive protection feature.

For locations other than the Intake Structure, the building elevations located below PMF levels have barriers created by walls and penetration seals for components passing through the walls. These passive barriers are supplemented by sump system and curbs that capture any small leaks that may not be prevented by a penetration seal. (less than 0.04 gpm per equivalent 5-inch penetration)

The Intake Structure has a robust design including the water tight door system that can seal each pump cubicle individually and allow the Unit 1 and Unit 2 pumps to continue to perform as required during PMF conditions.

The walkdowns and the results found that the flood protection features at BVPS conform to the CLB.

Acceptance Criteria

In developing acceptance criteria for the walkdowns, the primary goal was to confirm that the components meet their original design basis requirements. That, in turn, would assure that the features conform to the Current Licensing Basis as discussed above.

Specific items considered to confirm that the feature was acceptable were:

- No topography changes, including security barrier installations, adversely affect the site drainage plan. These components were reviewed to confirm that the topography remained similar to the original plant layout.
- Flood protection configuration is in accordance with current drawings, as-built installation records, inspection records, vendor documents, etc. Existing drawings were used in the walkdown evaluation to confirm that the features were capable of performing their design function. With a primarily passive system, as is the configuration at BVPS, this was one of the primary criteria for acceptance.
- Visual inspection did not identify any material degradation. The features were visually examined where accessible. The walkdown team had been trained in what to expect during the visual examinations that would confirm acceptance.
- Preventive Maintenance activities (PM) or periodic inspections are in place, within their required periodicity, and of adequate scope. Inspections such as structural examinations, penetration seal reviews, fire seal reviews and PM for components as required were reviewed and found to be acceptable.
- Instructions contained within the implementation procedures can be implemented as written and within the allowed time considering the warning time available for the applicable flood hazard and expected conditions during the event. CR-2012-17244 was written regarding potential deficiencies in the procedure for operating the Intake Structure Cubicle flood doors and seal pressurization system. This is discussed in further detail in the Condition Reports section of this report.
- There are no unresolved adverse PM or periodic inspection implementation results.

BVPS Implementation Process

Exterior barriers were evaluated based on their ability to prevent water ingress and ensure water levels do not exceed elevation 730 feet. The Yard was evaluated to ensure there are no potential obstructions to water flow paths and the overall grading is sloped away from buildings containing safety-related equipment. A walkdown of building structure will confirm the structural integrity of the walls and their ability to prevent inleakage. Examination of building penetrations in the flood zone range will ensure all grout or elastomer filled penetrations have a sufficient bonding between surfaces and are without deep or through separations as appropriate. Grouted penetrations shall have no structural cracks, major spalls or grout degradation. Elastomer filled penetrations shall have no cracks, tears, or degradation. Embedded pipe or pipe sleeves shall have good bonding between the commodity and the concrete without deep or through separations. Doors and openings to exterior structures are required to have the lowest point of the opening at or above elevation 730 feet. Shake spaces were examined, to the extent possible, that the outside of the building is sealed off and the seals have no separations. Roof hatches are checked for signs of degradation and the seals or gaskets are in good condition. Waterproofing membranes and building water stops are below grade and cannot be inspected.

A walkdown of building penetrations in the flood zone range ensured all grout or elastomer filled penetrations have a sufficient bonding between surfaces and are without deep or through separations as appropriate. Grouted penetrations have no structural cracks, major spalls or grout degradation. Elastomer filled penetrations shall have no cracks, tears, or degradation. Embedded pipe or pipe sleeves shall have good bonding between the commodity and the concrete without deep or through separations. Doors and openings to exterior structures are required to have the lowest point of the opening above elevation 730 feet.

The primary barrier for flood protection at BVPS is geography, where most components required for the safe shutdown of the plant are above PMF levels. Procedure 1/2OM-53C.4A.75.2, "Acts of Nature – Flood" lists a number of temporary/active barriers that are installed when external flooding is anticipated. Only one active barrier is installed that protects safety related equipment required for the safe shutdown of the plant. That barrier is the flood doors to pump cubicles in the Intake Structure. Upon flood waters reaching Elevation 695 feet and predicted river levels rising, the doors are closed per steps included in the above procedure. These doors are permanently mounted at each cubicle doorway and the doorways interconnecting Cubicles 'A' & 'B' and 'C' & 'D'. Upon closure of the doors, elastic seals are inflated, effectively sealing the cubicles from rising waters. The doors are designed such that the water pressure build up on the outside adds to the sealing capability of the doors. As a secondary protective level, the cubicles are capable of allowing up to 10 inches of water in without impacting operation of the safety related components in the cubicle. Each cubicle has a sump pump that is capable of discharging water from inside the cubicle during PMF conditions.

<u>Preparations in Advance of Adverse Weather Conditions</u>

Procedure 1/2OM-53C.4A.75.2, "Acts of Nature – Flood" is entered when river water levels reach Elevation 670 feet msl or the Plant Shift Manager is notified that a flood alert has been issued. Various actions are performed to components on the site in preparation for possible flooding. Upon water levels reaching Elevation 690 feet, the Intake Structure is inspected to confirm that there are no openings that may allow flood waters to enter. At Elevation 695 feet, the flood doors on the Intake Structure cubicles are sealed closed following the steps in the AOP. With the river at Elevation 695 feet and river level forecasts indicate that the level will exceed 700 feet, normal shutdown and cooldown of both Unit 1 and Unit 2 is begun.

In addition, Procedure 1/2OM-53.C.4A.75.1, "Acts of Nature – Tornado or High Wind Condition" deals with High Winds and Tornados. However, this procedure does not encompass any actions relative to flooding from external sources.

Evaluation of Effectiveness

The flood protection features as described in the preceding sections are barriers of either passive or active mechanical systems that do not require any operator action to perform their design function with the exception of the Intake Structure. The pump cubicles in the Intake Structure have flood doors that require closure and sealing in the event of an external flood greater than Elevation 705 feet. The site AOP, "Acts of Nature – Flood" is entered when river water levels reach Elevation 670 feet msl or the Plant Shift Manager is notified that a flood alert has been issued. Various actions are performed to components on the site in preparation for possible flooding. Upon water levels reaching Elevation 690 feet, the Intake Structure is inspected to confirm that there are no openings that may allow flood waters to enter. At Elevation 695 feet, the flood doors on the Intake Structure cubicles are sealed closed following the steps in the AOP. Closure of the flood doors is the only operator action that is performed for the protection of safety related equipment required for safe shutdown.

Also in place at Beaver Valley is Procedure 1/2OM-53.C.4A.75.4, "Acts of Nature – Dam Failure." This procedure provided guidance and instruction in the event of a dam failure. For dams located upstream of the plant, the procedure refers the operator to "Acts of Nature – Flood" discussed above. For dams located downstream of the plant, no flooding issues occur and no actions relative to flooding from external sources are required.

E. Walkdown Process Implementation

Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures).

NEI 12-07 Guidance

Confirm that guidance was followed and any exceptions taken to the guidance.

Nuclear Energy Institute (NEI) 12-07 Rev. 0-A "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" dated May 2012 was followed in performing the verification walkdowns at Beaver Valley. Individuals either had sufficient experience or were trained to perform visual inspections in order to identify degraded or adverse conditions to plant structures, systems, and components. The experience and training provided ensured that team members had the ability to determine if the condition of the feature or procedure would need to be entered into the Corrective Action Program (CAP).

The team walked down the perimeter of the site including the river bank. The perimeters of both units' plant buildings were also walked down.

The walkdown also examined visually the general slope of the land surrounding the site. Actual topography could not be verified.

Safety-related buildings were examined on exterior walls for penetrations that have the potential for flooding consequences. The penetrations were for piping as well as conduit.

Data was gathered using electronic tablets. These tablets were configured with forms that allowed direct entry of walkdown data. In addition, the tablet had a camera that allow photos taken during the walkdown to be tied directly to the feature. The electronic form used was designed to conform to Appendix B of NEI 12-07. This increased the efficiency of data gathering and made entry of results into the database easier. This methodology was used throughout the FENOC fleet, providing the opportunity for data to be easily transferred and reviewed.

No exceptions to the guidance was taken.

<u>Walkdown Team Organization</u>

The team was developed with an emphasis on structural engineering expertise within the Design Engineering Department. The core team was formed of three structural engineers from Design Engineering with additional participation from FENOC Fleet and Design Engineering. The primary team was formed of three members for any walkdown, with additional members participating depending on the particular walkdown. For some limited tasks, a two person team was used. However, the majority of inspections were performed with at least three people participating.

Additional secondary support was provided by FENOC Fleet in preparation of the walkdown database and organizing the data gathering process. Additional support for evaluations of penetrations was obtained from the engineers responsible for the Penetration Seal program within Design Engineering.

Team Selection and Training

Team selection was completed by basing the team on a senior member with experience at the site and with the performance of visual inspections with a particular emphasis on structural components. Added to the team were additional engineers with structural backgrounds. Various levels of training were performed based on the experience level of the team member.

Primary training for the inspections were based on the use of the training developed by the NEI Fukushima Flooding Task Force and available on INPO's NANTEL website to familiarize the personnel performing the activities in this guideline. All members of the active team were required to pass this training program.

The team members were required to review both BVPS-1 and BVPS-2 UFSAR documents with particular emphasis on issued dealing with external flooding. Also reviewed were Technical Specifications and License Requirements Manual, again with emphasis on external flooding. This review then turned to procedures and processes that were used regarding weather related and flood related events.

As supplemental training, radiation worker, fall protection, scaffold access and confined space qualifications were confirmed for access into areas where these skills were required.

Subject matter experts were consulted on an as-needed basis to provide guidance regarding conditions expected prior to a walkdown or conditions found that were not anticipated. When unexpected conditions were found, additional walkdowns were performed after obtaining specific guidance from the subject matter expert.

F. Results of Walkdowns

Results of the walkdown including key findings and identified degraded, non-conforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Rev 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

Conclusion

The results of the walkdowns per the guidelines of NEI 12-07 affirm that the structures, systems and components will function as described in the Current Licensing Basis. The NEI walk downs did not identify any deficiencies where a flood protection feature would not be able to perform the intended function. Observations have been documented in the Corrective Action Program (CAP) with no deficiencies identified, therefore these items will not be discussed in detail here.

A listing of the condition reports is provided below for information and completeness. There are no observations awaiting disposition at the time of this report. The documentation of walkdowns has been attached to Notification 600795158 to allow retrieval in the future. One hard copy of all the walkdown reports was created and is maintained with Design Engineering. A number of Condition Reports have been entered into the CAP noting observations found during the walkdowns.

Condition Reports

CR-2012-13252 - Potential Piping Path Into Intake Structure 'B' Cubicle During Maintenance Activities Identified. A 1-inch drain pipe from a strainer was found with only an FME cover over the open flange inside the cubicle. Upon tracing the route of the pipe, it was discovered that this was an open path into the cubicle. The opening in the wall was at approximate elevation 709 feet. This elevation, while within PMF levels, is above the standard project flood elevation of 705 feet. At no time, was the integrity of the cubicle challenged. Once this was discovered, an Order was created to have a blind flange installed on the existing flange. This sealed off the opening and restored the flood barrier.

CR-2012-15371 - Water in curb box of Intake Structure Floor Sleeve. Integrity of box was confirmed and an Order was written to clean up, paint and provide additional sealing. The sealing being requested is not for the purpose of providing a flood barrier. The existing configuration as found continues to provide a acceptable barrier. The work requested will protect the sleeve from further water exposure and potential corrosion issues. Water spillage in the cubicle is a common result from work executed on components within the cubicle. The water paths to the sump for leaking water travels over and past these curb boxes. Sealing these boxes will further protect the sleeve from future corrosion.

CR-2012-15389 - Potential Piping Path Causing Exposure to External Flooding Into Cable Vault 3 (CV-3) Identified. CV-3 is located along the west side of the Control Building between the Control Building and the Unit 1 Service Building. The vault contains plant critical cables. Currently there is a 4-inch drain line in the vault. The inlet to the drain is at Elevation 720 feet. This drain leads to a larger 16 inch drain that leads on to the larger storm lines and eventually to the Ohio River. The 16 inch line is at Elevation 715 feet. In the event that a PMF should occur, it would be expected that the storm drains would fill and eventually back up into the vault. Note that Elevation 720 feet is above the SPF level of 705 feet. This flood level is hypothesized to occur once every 1,000 to 2,000 years. Therefore the likelihood of a flooding issue is small.

The structure was evaluated to determine the impact of external flooding on CV-3. It was found that CV-3 is susceptible to flooding should the river exceed an elevation of approximately 720 feet. An additional 2 feet can flow in before cables begin to be immersed. The penetration seals and sleeves in the tunnel are water proof up to EL.

730 feet (PMF level). Therefore no further leakage into other buildings will occur. Any flooding will be contained within CV-3.

Cables transiting the vault are moisture resistant cable. Specifications for electrical cables installed throughout BV1 & BV2 contain requirements that the cable jackets be constructed of materials that are resistant to; abrasion, moisture, oil, heat, weather, radiation and flame. The construction of these cables provides reasonable assurance of their continued operation during periods of exposure to significant moisture.

Significant moisture is defined as periodic exposure to moisture that lasts more than a few days (e.g., cable in standing water). BVPS position is to minimize exposure of electrical cable to significant moisture. Periodic exposure to moisture which lasts less than a few days (i.e., normal rain and drain), is not considered significant.

Per Section 2.7.3.2.2 of the Unit 1 UFSAR, a flood condition with water levels above EL. 705 feet would have a maximum duration of about 100 hours. If flooding were to enter via the drain, it likewise would drain via the drain once the flood waters recede below El. 720 feet. Flooding above EL. 720 feet would be expected to be significantly less than 100 hours, thus such immersion would not be considered significant. Also, it is anticipated that the below grade cable tunnel area identified as CV3 would be pumped out within a few days after flood conditions have subsided.

Based on the configuration of the vault and its associated components, the vault can be allowed to flood up to Probable Maximum Flood elevations. The moisture resistance of the cables would allow the cables to become immersed without impact.

CR-2012-16289 – Storage of Land/Sea Boxes within Anticipated Flood Areas. Currently, there are a number of Land/Sea boxes stored north of the Unit 1 Turbine Building. Some of these boxes contain radioactive materials. The ground elevation at the storage area is approximately El. 704 feet, which puts the boxes within SPF and PMF levels. This issue does not impact the safe shutdown of the plant.

CR-2012-16321 - Cable Spreading Mezzanine 12 Inch Concrete Curb Is Cracked. A 12 inch curb located along the flood boundary section of the east wall of the Service Building was found with a crack approximately 1/16 inch wide. This crack appears to be completely through the curb. Notification 600792353 has been written to have the crack patched.

This crack presents a very small external flooding risk. The opportunity for a meaningful amount of external flood water to reach the Cable Mezzanine Spreading Area outside the curbed area is limited. First, the flood elevation must be above 725 feet (exceeds SPF by 20 feet) for the flood waters to reach the lowest penetration seals within the curbed area. Second, the design water leakage rate around penetrations (0.04 gpm) is based on 13 pounds per square inch (gage) pressure or about 30 feet of water head behind the seal. A PMF event would only create about 5 feet of head on the lowest seals. Third, with there being around 100 of the penetration seals falling below the PMF level within this curb, taking the worst design leakage condition, the leak rate would be roughly 4 gpm. If Service Building water accumulation is found, the Emergency Flood Control Sump staged by steps in Procedure 1OM-41D.4.AAB, "Service Building Water Accumulation" would be operated to remove water in the curb. The crack itself is narrow (approximately 1/16 inch wide). There is no visible direct path from the inside of the curb to the outside. Any water seepage through the crack would be small. Therefore, this crack allowing enough water through to damage safety related components in the vicinity is extremely unlikely.

CR-2012-16322 – Installation of Sump Pumps in Unit 1 Cooling Tower Pump House. The AOP for flooding states that sump pumps and hoses should be installed in the pump house pit areas. The procedure does not discuss where the pumps and hoses are coming from and how much hose is required for the process. This issue does not impact the safe shutdown of the plant.

CR-2012-16337 - Unit 2 Containment - Open Flanges From Abandoned Hydrogen Recombiner System. During the walkdown of Unit 2 containment, it was discovered that the piping extending in from Penetrations X-87 and X-88 have open flanges. The initial evaluation in the field indicated that the there could be a potential flood path into Containment in the event of a PMF. Further investigation found that the piping was originally for the hydrogen recombiner system that had been retired in place under ECP-04-0261. Review of the piping configuration indicated that the piping is isolated on the outside by a de-energized closed MOV and a locked closed ball valve, ensuring containment isolation. Further review found that the piping is configured to be used by Operations to provide a flow path for water into Containment in the case of a fire. Based on this it was determined that the flanges do not need to be capped since no flood path exists.

CR-2012-16691 – Evidence of Water on Pipe Insulation and Floor from Pipe in Unit 2 Safeguards Pipe Tunnel – BV-2-SWS-004-191-3. During the walkdown of the southern portion of the Safeguards Pipe Tunnel, evidence of water dripping from an insulated pipe was found. At the moment of discovery, there was no active dripping, however, moisture below the pipe was evident. NDE was performed at the location indicated. No evidence of a leak at that location. Additional piping on the line was examined and three pin hole leaks were found. One location has been repaired and restored to its original design basis condition. The other locations are scheduled to be repaired. No evidence of external leakage was found.

CR-2012-16756 - External Flooding Walkdown- Unit 2 Safeguards Pipe Tunnel Corrosion And Coatings Issue. During inspection of the Unit 2 Pipe Tunnel (accessed through north and south plugs outside Unit 2 Safeguards), corroded pipe supports and sections of floor paint bubbling and pealing off were discovered. There are approximately 10-15 pipe supports having patches of surface corrosion with a loss of protective coating present. As well as, approximately 200 square feet of floor area bubbling and pealing off. These conditions are unrelated to an external flooding event.

The walkdown team accessed the north section of BVPS-2 Safeguards Pipe Tunnel followed by the south section on 10/22/2012. Evidence of previous water presence found throughout the tunnel. No current internal or external flooding paths or water leaks were discovered that could be credited for the corrosion.

The supports and floor were examined, and it was concluded that their integrity had not been compromised. While this corrosion has not impacted functionality, the corrosion and loose paint needs to be cleaned off and the components repainted. Nuclear Maintenance Order 200535439 was created to repair the conditions.

CR-2012-17171 - Unit 1 Cable Vault 3 – A less than adequate penetration seal was inspected that could allow ground water to enter into the vault. A penetration seal showed signs of water weepage and slight corrosion where it meets the wall. Additional preliminary investigation lead to the discovery of note 5 on drawing 8700-10.001-0722, "Cable Tunnel El 720 ft-0" Data Sheet" stating seals on this particular wall are not required as flood boundary seals, but are given the status of ones to "prevent nuisance ground water from entering Cable Tunnel." This seal is not required as a flood boundary penetration seal and the as-found condition is not an issue related to external flooding. However, a Notification was written to have corrective maintenance performed on the seal.

CR-2012-17207 - Unit 2 Pipe Tunnel Adjacent to Safeguards Corrosion/Rust on Shake Space Plate. During walkdown of the Pipe Tunnel around Unit 2 Safeguards at EL. 725 feet (accessed through north manhole in yard), presence of water and corrosion of the shake space plate was found on the east wall. The walkdown team also noticed the presence of corrosion/rust on the floor and on other supports and plates near the shake space suggesting the previous presence of water. Notifications were written to clean up corrosion and remove shake space covers to assess the condition of the water stops.

SAP Notification 600795204 was also generated to remove the shake space cover for Engineering to continue the investigation of the water seepage, shake space cavity and the rubber water stop condition.

Engineering will continue the investigation of the water seepage, shake space cavity and the rubber water stop condition. Typically, there are barbell shaped rubber water stops set into the concrete construction of the building walls where shake spaces are required. Engineering will determine the source of the water. If required, Engineering will determine the appropriate fix, issue the necessary documentation to restore the water proofing design features of the pipe tunnel structure.

CR-2012-17230 - Unit 2 Safeguards Deep Pit Water on Floor. During walkdown of the Deep Pit in Unit 2 Safeguards 'C' Recirculation Spray Cubicle, puddled water was found in multiple places on the floor throughout the area. Review of the location concluded that the water puddles are not associated with external groundwater sources since there are no penetrations through exterior walls.

CR-2012-17244 – Main Intake Structure Flood Door Installation and Removal Procedure Review to Resolve Deficiencies. A number of deficiencies were noted during inspections of the Intake Structure Cubicle flood doors and seal pressurization system and a review of Procedures 1/2OST-30.21A "Group 1 Flood Door Seal System Operability Check," 1/2OST-30.21B "Group 2 Flood Door Seal System Operability Check," and AOP 1/2OM-53C.4A.75.2 "Acts of Nature – Flood," Attachment 2 "Flood Door Installation and Removal Procedure." None of the identified deficiencies would challenge the functionality of the flood doors.

Restricted Access

One restricted location was identified during the walkdowns. The Unit 1 Containment Building could not be examined since the plant is on line and at 100% power. Entry into this structure while the plant was running would have required the team to be exposed to unnecessary radiation levels. Inspection of the interior of the Unit 1 Containment Building will be completed during the next refueling outage (1R22). This is scheduled for the fall of 2013. The Containment Building is regularly inspected for structural integrity. Based on these regular evaluations, the delay until a refueling outage is acceptable. Notification 600797294 has been generated to have the walkdown performed during 1R22 in the fall of 2013.

Not Inspected

A number of features could not be completed examined due to their location. For example, the exterior walls of the Containment Buildings and other safety related buildings that had walls underground could not be examined from the outside. These walls were examined from the interior along with any penetrations that went through them. The evidence from the interior examination have indicated that the walls are in good condition and that the integrity of the walls is confirmed. Existing construction drawings were reviewed. These drawings show the construction of the concrete walls and help to demonstrate their integrity. Past excavations near these structures have allowed the outer surfaces to be examined in a number of locations. When exposed, the outer surfaces have not shown any indication of deterioration.

BVPS buildings have shake spaces between seismic structures. These shake spaces have elastic rubber water stops installed to seal the space from water inflow. Each of these spaces is then covered with a metal cover to provide protection for the seal and further prevent ingress. These seals could not be readily examined. Existing concrete drawings indicate their location, orientation and composition. The metal covers were examined to find if there was any indication of water entering the building through the shake space. In general, no evidence of water entry has been found. Two exceptions are listed with the deficiencies listed above.

G. Cliff Edge Effects

There are no cliff edge items identified during the walkdowns.

Available Physical Margins have been collected and documented in the Walkdown Record forms. This information will be used in the flood hazard reevaluations performed in the response to 2.1 Flooding.

H. Changes

Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection.

There have been recent modifications to the Beaver Valley facility to meet security requirements. The effect of these changes on the effects of a probable maximum precipitation event is being reviewed. This analysis is currently under way with final result scheduled to be issued prior to the end of 2012. There are no planned or recommended modifications to flood protection systems or mitigation measures resulting from these walkdowns.

There are no planned or recommended modifications to flood protection systems or mitigation measures resulting from these walkdowns.

Engineering Change Package 12-0092 has been created to fabricate covers to be used when pumps in the Intake Structure are pulled for extended maintenance. These covers are designed to provide a water tight seal over the opening where the pump is installed. Currently, there is no contingency for PMF conditions when a pump has been removed. Upon removal of a pump, a steel cover plate will be installed and a temporary seal until the pump is ready for reinstallation. This change was prompted by Condition Report 2011-91671. This change was being developed prior to the walkdowns.

Davis-Besse Nuclear Power Station Verification Walkdowns of Plant Flood Protection Features

Based on the NEI 12-07 [Rev. 0-A] Guidelines

November 2012

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Introduction

In response to the nuclear fuel damage at Fukushima Daiichi due to earthquake and subsequent tsunami, the United States Nuclear Regulatory Commission (NRC) requested information pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f). As part of this request, licensees are required to perform walkdowns to verify that plant features credited in the current licensing basis (CLB) for protection and mitigation from external flood events are available, functional, and properly maintained. The specific information requests from the NRC letter are repeated in the sections below.

A. Design Basis Flood

Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.

Hazard Identification

Three prospective sources of flooding exist at the Davis-Besse site: Lake Erie, intense local precipitation, and flooding by the Toussaint River, which borders the site to the south. Note: all elevations in this report are referenced to the International Great Lakes Datum 1955 (IGLD).

Flooding from Lake Erie is evaluated in the CLB based on maximum water levels. The station's ground floor elevation of 585 feet (IGLD) will protect the station against the maximum probable static water level of 583.7 feet (IGLD). The area around the station is protected along the north, east, and a partially along the south sides by an earthen breakwall built up to 591.0 feet (IGLD) to protect against wave and wave run-up. The maximum wave run-up on this breakwall will be 6.6 feet above the probable maximum static water level of 583.7 feet (IGLD). This will give a maximum water run-up level on the breakwall of 590.3 feet (IGLD). As a result, no large unbroken waves will reach the station's buildings and none will overtop the wave protection dike.

An evaluation of the effects of intense local precipitation in the CLB shows the resultant flood waters will not exceed the floor elevation of 585 feet (IGLD) in buildings containing safety related equipment. If for any possible reason the main discharge pipe in the sewer system fails to handle the estimated probable maximum runoff effluent into the Toussaint River, the runoff water will build up in the system and on the ground around the station. As a conservative assumption, the discharge pipe is assumed to be failed at the beginning of the rainfall, and the total volume storage capability of the system (pipes, manholes, catch basins, and ditches) is ignored. The average invert elevation of manholes and catch basins is 582 feet (IGLD). The high-point elevation of roads and ground around the buildings is 584.0 feet (IGLD). The probable maximum rainfall estimate for a 6-hour period is estimated to be 24.5 inches, which is six times the amount of rainfall expected at the site in 100 years. With 24.5 inches estimated runoff, theoretically, the water could build up to 584.5 feet (IGLD), but runoff water will overflow to the existing marshes, which are at an approximate elevation of 570.0 to 575.0 feet (IGLD). Since all the structures are protected against water buildup and flooding up to 585.0 feet (IGLD), there will be no threat to the structure for this probable maximum buildup of runoff water.

The Toussaint River empties into Lake Erie southeast of the station's site and this stream flows close to the south of the site. This stream becomes Toussaint Creek about six miles upstream from its mouth. There are no dams on this stream. The lower six miles of the stream are much wider than the remainder, and as a result, its level in this wider section is controlled by the level of Lake Erie.

Assumptions

Relative to external flooding due to a Probable Maximum Precipitation (PMP) event, USAR 2.4.2.3 "Flood Design Considerations At The Site" conservatively assumes that the main sewer discharge pipe fails at the beginning of the rainfall, and the total volume storage capability of the system (pipes, manholes, catch basins, and ditches) is ignored.

Methodology for Design Basis Development

The effects of Local Intense Precipitation is described in USAR Section 2.4.2.3. The 6-hour Probable Maximum Precipitation (PMP) is 24.5 inches, which is six times the amount of rainfall expected at the site in 100 years. The 6-hour probable maximum precipitation was calculated based on 10-square mile values, and in the vicinity of the station, the 6-hour value using standard hydrometeorological procedures. The design of the sewer system was based on a 60-minute rainfall duration, 25-year return period, rolling surface with grass, rainfall intensity of 2.25 inches per hour, and continuous rainfall. However, as previously noted, the sewer system drainage capacity is not credited in the USAR flooding analysis.

For the effects of waves on the site, the factors affecting Lake Erie were considered. The height and period of wind-generated waves in deep water are a function of the fetch, wind speed, and duration. In shallow water, the depth with an allowance for the increase (or decrease) due to wind setup is an additional factor. The total fetch along the longitudinal axis of the lake to the islands off Pelee Point is about 200 nautical miles. The wind speed used for these calculations is 100 miles per hour, which corresponds to the maximum Probable Maximum Meteorological Event (PMME) wind speed over the lake. The average wind speed over the lake's longitudinal axis at the time of maximum winds is only 89 miles per hour. Therefore, the generated wave height is conservative. The water depth over the fetch used for these calculations is the sum of the average depth indicated on the nautical chart of the lake, (referred to low water datum), the maximum mean monthly lake level, and the PMME wind setup. In the western basin, a total water depth of 40 feet was used, and in the portion of the lake east of the islands 65 feet was used. The effect of bottom friction on wave generation and decay is considerable in shallow water. The effect has been considered in the calculation of generated wave heights. However, the effect of wave decay has been neglected, providing conservative results in the shallow portion of the lake near the islands.

Differences or Contradictions in Flood Hazard Levels

No differences or contradictions in flood hazard levels were found in the review of design and licensing basis documentation.

B. Protection and Mitigation Features

Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.

Flood Licensing Basis

Describe the flooding licensing basis including what plant configurations (modes of operation; for example, full power operations, startup, shutdown, and refueling) were considered. This description should be consistent with the scope of the flooding walkdowns.

Davis-Besse USAR section 3.2.1.2 defines the seismic class I structures as those that are necessary to ensure the capability to shutdown the reactor and maintain it in a safe shutdown condition, or the capability to prevent or mitigate the consequence of accidents, which could result in potential offsite exposures comparable to the guideline exposures of 10 CFR 100. USAR section 3.4.1.1 includes a table (summarized below) of seismic category I systems and equipment below elevation 583.5 that are protected by the flood protection features.

Seismic Category I Systems and Equipment Below El. 583.5:

ECCS room sump pumps
ECCS room coolers
High Pressure Injection pumps
Containment Spray pumps
Decay Heat pumps
Decay Heat removal coolers
Waste Gas Surge tank
Waste Gas Decay tanks
Hydrogen Dilution System blower
Makeup pumps
Auxiliary feed pump turbine units
Auxiliary feed pump room vent fans
Containment air coolers

Core Flooding Tanks
Letdown coolers
Motor control centers: MCCE11A; MCCE11D, MCCF11C; MCCF11D; MCCE12C; MCCF12C; and BEF12C
Service Water pumps
Reactor vessel and internals
Reactor coolant pumps
Steam Generators (bottom)
Service Water strainers
Containment isolation valves

Flood prevention and mitigation measures are designed to function in all modes of operation including full power operation, startup, shutdown, and refueling. The design basis does not rely on any active components or require any operator equipment manipulation or mitigation strategies.

Flood Duration

Document the flood duration assumed in the CLB. If the CLB does not provide information on the flood duration, this lack of information should be documented in the walkdown report.

Local intense precipitation is the only time dependent flooding hazard considered in the CLB. The 6-hour probable maximum precipitation was calculated based on 10-square mile values, and in the vicinity of the station, the 6-hour value using standard hydrometeorological procedures.

Credited Flood Protection Features

Describe the flood protection features that are credited in the CLB, such as incorporated, exterior and temporary barriers, time required for credited actions under flood conditions, active flood protection features, procedures, warnings credited for external floods, site drainage plan, etc.

- Site:

  The site areas surrounding the station structures have been built up from 6 to 14 feet above the existing grade elevation to an elevation of 584 feet above sea level, International Great Lakes Datum (IGLD). This provides flood protection from the maximum credible water level conditions of Lake Erie.

  The station is protected along the north, east, and partially on the south side by an earthen breakwall built up to elevation 591.0. There is no effective dynamic force applied on the critical site structures associated with the maximum probable hydrodynamic water level and waves except the front wall of the intake structure, which is designed for this loading condition.

- Structures:

  All seismic class I structures are designed for maximum probable static water level of elevation 584.0.

- Intake Structure and Pipe Tunnel:

  The intake structure is designed to withstand the effect of flooding and wave run up. Water stops are provided at construction joints of seismic class I structures which prevent water from entering the structure. Water tight doors at both access openings complete the barrier against water entering the service water pump rooms. Floor drains and a sump collect seepage which might enter the room during a flood. Seismic class I systems and structures are therefore completely protected from the adverse effects of flooding.

  The service water tunnel and two valve rooms are protected up to 570 feet (IGLD) by a waterproof membrane. The pipe penetrations into the Service Water Tunnel are sealed from inleakage. Therefore, there will be no possibility of flooding the tunnel and valve rooms due to inleakage during the maximum probable external flood.

- Containment and Shield Building:

  The containment has no access openings below 585.0 feet. Consequently, a maximum probable flood water level of 583.7 feet does not have an adverse effect on the structure. The containment is protected from water intrusion by a complete waterproof envelope below elevation 583.6 feet. Articulated joints between structures have continuous flexible water stops embedded in walls and floors, which provide redundant protection from flooding.

  Waterproofing membrane is used around the external portion of the shield building below the groundwater level. Electrical cable penetrations through the shield building are made through leak tight cable seals.

- Auxiliary Building:

  The auxiliary building has no access openings below ground floor elevation 585.0 feet. Consequently, a maximum probable flood water level of 583.7 feet does not have an adverse effect on the structure. The building is protected from water intrusion by a complete waterproof envelope below 583.6 feet. Articulated joints between the auxiliary building and the shield building have a continuous flexible water stop embedded in the concrete walls and floors that provides redundant protection from flooding.

- Borated Water Storage Tank:

  The Seismic Class I Borated Water Storage Tank is founded at 585 feet (IGLD), and consequently is not adversely affected by a flood level of 583.7 feet.

- Station Drains:

  The station storm sewer system collects all site ground rain runoff effluent in addition to the roof drainage. There are many sewer manholes, catch basins, collection boxes, and road drains to collect the maximum possible rainfall runoff. All these facilities are connected by underground sewer piping. The final manhole will discharge the runoff water to the existing ditch, which eventually empties into the Toussaint River, which drains to Lake Erie.

- Penetrations Below 585 feet (IGLD):

  All electrical duct banks with the conduit level at elevation 575 feet or lower that enter safety related buildings are covered by a membrane. This membrane extends to elevation 584 feet at the upper edges and where applicable, the lower end is sealed to the building substructure membrane.

Initiating Weather Conditions

Describe weather conditions or flood levels that trigger procedures and associated actions for providing flood protection and mitigation.

Rising Lake Erie water levels to greater than the 574 foot elevation as observed in the Davis-Besse intake forebay will require the implementation of Emergency Plan Off Normal Occurrence Procedure "Flooding".

A flood watch is initiated by the Operations Shift Manager when Lake Erie water level exceeds 574 feet, causing localized flooding. This initiates notification activities and consultation with local authorities. Mitigation action is for the Operations Shift Manager to verify the condition of the credited (installed or temporary) flood barriers in the Service Water Pump room, and the Diesel Fire Pump room, and to restore or close any unisolated breaches in the pump rooms.

A flood warning is issued by the Operations Shift Manager when Lake Erie water level exceeds 576 feet. This initiates a second set of announcements and notifications, consultation with local authorities, and a decision point for the On-Call Duty Director regarding activation of procedure "Station Isolation". The On-Call Emergency Offsite Manager will also ensure transportation is available to station personnel from station, company, and fleet resources. There are no mitigation actions for a flood warning.

A flood emergency is issued for Lake Erie level greater than 578 foot elevation, causing access to the station to be limited to rail, boat and helicopter. Protective actions are to declare procedure "Station Isolation" in effect, to determine if conditions are appropriate for entry into Emergency Plan Emergency Action Levels (EALs), and maintain station operation utilizing essential personnel until a plant shutdown is determined to be necessary by the On-Call Manager, DB Site Operations, On-Call Plant Manager, and/or the Shift Manager. Notifications are once again made, and transportation is provided for essential station personnel utilizing station, company and fleet resources.

Additional Adverse Weather Conditions

Describe the adverse weather conditions that were assumed concurrent with flood protection features and associated actions.

From section 2.4.2.2.1 of the USAR, a Probable Maximum Meteorological Event (PMME) was used to determine the maximum rise in lake level due to wind tides. This meteorological event would have a maximum east/north east (ENE) wind at any one location of 100 miles per hour for a 10-minute period, and the wind speed could exceed 70 miles per hour during the six-hour period both before and after the maximum wind speed. The ENE 100-miles-per-hour winds associated with the probable maximum meteorological event would produce a maximum wave height of 10.7 feet at the lakes normal shoreline. These larger waves generating in the lake will break when they meet the normal shoreline, as the ground rises to elevation above 575 feet (IGLD) and higher along the shoreline. However, smaller waves generated in the lake up to a height of 6.0 feet, would pass over the beach without breaking at the maximum probable static water level. These smaller waves would build up to a maximum height of about 8.5 feet in the marsh area and will break when they reach the elevated areas around the station. The finished grade and roadways around the station are built up to an elevation of 584 feet (IGLD) for a distance of 250 feet to the west and north of the buildings. This elevated area around the station is protected along the north, east, and a small portion along the south sides by an earthfill breakwall built up to 591.0 feet (IGLD) to protect against the wave and wave run-up. The maximum wave run-up on this breakwall will be 6.6 feet above the probable maximum static water level of 583.7 feet (IGLD). This will give a maximum water run-up level on the breakwall of 590.3 feet (IGLD). As a result, no large unbroken waves will reach the stations buildings and none will overtop the wave protection dike.

Section 2.4.6 of the USAR, pertaining to tsunami flooding, states that wind generating waves and run-up were determined to be as high as five feet above the elevation of the top of the basin wall for the cooling tower. In order to determine the dynamic effect of the wave in terms of static force, an equivalent static force of 5,000 pounds per square foot of exposed area for the height of the wave has been determined. The analysis took into account the effects of such a wave on those elements of the structure, which would receive the impact of the wave, namely the diagonals supporting the veil, the column bents supporting the fill structure, and the prestressed concrete pipe carrying the hot water supply. Based on analysis, it was determined that no serious problem would result from the wave action on the piping and that the design wave, which may be expected under extreme conditions, would not impair the cooling function of the cooling tower. The cooling tower is not credited in any safe shutdown analysis of the plant.

USAR section 2.4.7 addresses ice flooding. Flooding of the safety-related structures and equipment at the Davis-Besse site due to ice jams on the Toussaint River is not considered credible. The probable maximum rainfall in this streams drainage area would cause the water to rise at the station to 580 feet (IGLD) if none of the water reached Lake Erie. However, the station is protected from flooding up to an elevation of 585 feet (IGLD). The elevation of the plant structures is also above normal lake level ice formations. Should PMME occur during the winter months, ice formation over the plant site from residual flood waters would be of no concern as the plant is adequately designed to preclude flooding of any type. Category I wave protection dikes are designed to withstand the impact of ice floes, which might be possibly driven the entire 3,000 feet from the normal shore line to the dike system that guards the station.

C. Warning Systems

Describe any warning systems to detect the presence of water in rooms important to safety.

USAR section 3.4.1 Maximum Probable Water Levels describes that there are floor drains and a sump to collect seepage that might enter the Service Water Pump room during a flood. The sump level is maintained at a level of 20 inches in the sump. Intake Structure Sump Pump Level Switch High High will actuate station computer point L501, Intake Structure Sump Level to alert the operator to an elevated water level in the Intake Structure Sump.

There are no other indications or alarms associated with the external flood design basis.

D. Effectiveness of Flood Protection Systems and Barriers

Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed.

<u>Acceptance Criteria</u>

A basic premise of the Davis-Besse design is that a significant portion of safety related equipment is installed above the design basis flood elevation, with the balance of Seismic Class I equipment protected from the external flood by passive protection features.

In developing acceptance criteria for the walkdowns, the primary goal was to confirm that the structures, systems, or components meet the original design basis requirements.

Items considered to verify the flood protection feature was acceptable were:

1. That the configuration is in accordance with drawings. Existing drawings were used in the walkdown evaluation to confirm the features were capable of performing their design function. Davis-Besse has primarily a passive flood protection system. As such, proper configuration was a primary acceptance criterion.

2. Visual inspection did not identify any material degradation that compromised the flood protection function. Flood protection barriers were inspected by team members who were trained to recognize acceptable and inacceptable conditions.

3. That there are periodic Preventive Maintenance (PM) activities or inspections performed, as applicable, to provide reasonable assurance that the features will maintain the ability to perform the intended function.

- Exterior Barriers

Visual inspections were performed of the wave protection dikes to verify the physical condition of the barrier, that the grade and slopes remain consistent, that rip-rap is in place in accordance with the drawings, that there is not any observed erosion, significant animal burrowing damage, or evidence of construction or modification activities that have altered the height or profile of the dike.

Visual inspection of structures was performed to detect any material degradation of the barriers. Masonry walls were inspected for cracks greater than 0.04 inches wide, spalling, and settlement. Applicable piping or conduit penetrations were inspected for external integrity of the pipe or conduit as well as the associated seal/sealing surface. Sheet pilings were visibly inspected above the water for signs of excessive rusting or corrosion.

The Davis-Besse flood protection design does not contain any active exterior barriers.

- Incorporated Barriers

The "Barrier Functional List" drawing was used to determine the credited external flood barriers. Walls and floors designated as external (EXT) Barriers were included in the walkdown scope. The majority of the Davis-Besse External Flood Barriers are below grade (585 feet) and thus protect equipment from ground water intrusion up to the maximum external flood elevation of 583.7.

The scoped incorporated passive barriers were visually inspected for cracks greater than 0.04 inch in width, spalling, efflorescence, staining, open penetrations or conduits, and cracks or gaps in the sealing around all penetrations. Penetration seals are satisfactory if there are no gaps or cracks greater than 0.04 inch observed in the sealing surface.

Active incorporated barriers at Davis-Besse include two sump pumps in the intake structure and three instrument strings that provide indication and alarm for intake (Lake Erie) water level.

The two flood doors were inspected to verify sealing gaskets were installed and intact. The doors were operated to verify the closure dogs engaged appropriately. The doors do have PM's that perform inspection, periodic maintenance, and testing.

The Intake Structure sump pumps have a PM that inspects and lubricates both the pump and motors. The sump pump check valves do not have PM's. This has been previously evaluated under Condition Report (CR) 2002-07569 and found acceptable. The pump breakers have been previously evaluated as inherently reliable. The two sump pumps are identical and redundant with each receiving power from opposing sides of the 480V AC distribution system.

The remaining incorporated active components are instrument strings that provide Lake Erie level indication and alarms for increases in water level. The "Flooding" procedure references these indications to determine entry into the procedure and flood classification changes during the flood.

- Temporary Barriers

Davis-Besse does not require the activation of any temporary equipment or the installation of any temporary barriers during the Design Basis External Flood.

- Operator Actions

There are no operator equipment flood protection or mitigation actions performed at Davis-Besse for an external flooding event.

<u>Advance Preparations</u>

The site "Flooding" procedure is entered when Lake Erie water level exceeds 574 feet.

The Operations Shift Manager verifies the integrity of the flood barriers for the Service Water Pumps, Cooling Tower Makeup Pumps and the Diesel Fire Pump. There are no required operations of installed plant equipment in response to the rising Lake Erie level.

Emergency Plan Off Normal Occurrence Procedure "Tornado or High Winds" is implemented when weather conditions favor the formation of tornados, thunderstorms, and during periods of high winds. High wind conditions could be concurrent with flood conditions. The procedure does not direct operator actions associated with any external flood barriers or equipment.

E. Walkdown Implementation

NEI 12-07 Guidance

Confirm that guidance was followed and any exception taken to the guidance

NEI 12-07 Rev. 0-A "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" was followed in performing the flood protection walkdowns at Davis-Besse. Individuals performing the walkdowns completed the NANTEL Generic Verification Walkdown Awareness Certification, and have been trained to identify and document degraded or adverse conditions of plant structures, systems, and components.

Data was gathered on electronic tablets that contained Walkdown Record Forms for each barrier that were developed from NEI 12-07 Appendix B. When available, associated penetration drawings were included to facilitate the quick resolution of field questions. Photographs of items of concern were captured by the tablets to be used in further analysis and/or documentation. The Available Physical Margin was recorded on the Walkdown Record Forms for each barrier. The Walkdown Record Forms have been retained in accordance with site processes.

No exception to the NEI 12-07 guidance was taken.

Walkdown Team Organization

The Davis-Besse walkdown teams consisted of degreed engineers from FENOC PRA, Davis-Besse Design Engineering, Mechanical/Structural, Electrical, and the Engineering Analysis sections. The walkdown teams usually consisted of two or more members, with a minimum of one qualified to perform all five parts (A through E) of the NEI 12-07 Appendix B sections. Each team was equipped with the necessary personal protection equipment, portable lights, barrier penetration sketches, and an iPad to capture images as they deemed necessary. Subject matter experts were utilized when necessary.

Walkdown Team Training

Walkdown team members were required to complete walkdown team certification requirements as specified by the walkdown project leader. All walkdown team members were required to read the NEI 12-07 document and complete specified NANTEL Flood Protection walkdown training. The certification documents for the walkdown team members have been retained in accordance with site processes.

Additional qualifications/training were confirmed prior to accessing areas where required (fall protection, scaffold access, confined space).

F. Results of the Walkdowns

Results of the walkdown including key findings (III.B.1) and identified degraded, non-conforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Rev 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

Findings

The NEI 12-07 walkdowns did not identify any deficiencies where a flood protection feature would not be able to perform the intended function. Minor defects were noted, photographed and researched to determine if these are currently documented in the corrective action program (CAP), or in the work process programs as appropriate. These will not be discussed in detail. A listing of the condition reports generated is provided below. There are no observations awaiting disposition at the time of this report.

Condition Reports

Davis-Besse NEI 12-07 flooding walkdown Condition Reports:

CR 2012-16083: A small area of concrete spalling was observed on the east face of the intake structure. The underlying first layer of re-bar was visible. This is an external flood barrier protecting safety related equipment. The spalling was determined to be minor in nature and does not affect the barriers ability to perform its intended flood protection function. Notification has been initiated to correct the defect.

CR 2012-16279: A minor crack was found in Room 114 that was greater than 0.04 inch wide, in places. The crack was found in barrier 114F/EXT and extended up into the corner between 114S and the shield building. There was no leakage observed around the crack. Design Mechanical/Civil determined the crack does not affect the barrier's ability to perform the external flood protection function.

CR 2012-16320: NEI 12-07 step 5.5.2.7 requires features that are included in the scope of the flooding walkdowns be subject to a controlled preventive maintenance program, testing program, or a technical specification surveillance procedure or a corrective action document be initiated. The Auxiliary Building Stairwells AB2, AB3, and AB3A are currently not documented as being inspected in the Maintenance Rule Inspection of Structures. Stairwells AB2, AB3, and AB3A external flood barriers were inspected satisfactorily during the walkdowns. Corrective Action 2012-16320-

01 has been initiated to add Auxiliary Building stairwells AB2, AB3, and AB3A to the structure inspection program for future monitoring by 4/10/2013.

Not Inspected

Flood protection features that could not be inspected, including Features affected by restricted access):
- Justification for delay
- Schedule
- Any necessary special procedures
Inaccessible features
- Basis for reasonable assurance that the feature is available and will perform its credited function or an assessment of the impact of non-performance of the function
- If more than one "inaccessible" flood protection feature with potential loss of function is reported, then an evaluation of the aggregate effect flood protection features must be provided.

There were eight areas/rooms that were not inspected during this walkdown project. All are restricted access areas due to locked high radiation areas with access allowed during certain plant modes of operation, or that are locked high radiation areas that require access through two layers of floor plugs, or associated with spent fuel storage and continuously filled with borated water.

The first two areas not inspected are the containment building and the containment annulus. These areas are only accessible when the reactor is not in operation. These areas will be walked down during the Spring 2014 Refueling Outage. A Notification will track completion of these walkdowns.

The next three areas not inspected are locked high radiation rooms that are floor vaults, which can only be accessed after pulling a series of two floor plugs. These are Room 102, the Spent Resin Storage Tank Room (flood barriers 102F/EXT and EXT/102W); Room 205, Makeup Tank Room (flood barriers 205F/EXT and EXT/205S); and, Room 210, the Clean Waste Polishing and Purification Demineralizer room (flood barrier 210F/EXT). Details for the inspections of these rooms are provided below.

Room 102 was previously inspected for the Boric Acid Corrosion Control Program (BACC) on 12/10/2007 and was found to be satisfactory. This inspection is not being credited for the purpose of this flooding walkdown report. Room 102 is scheduled to be inspected again for BACC before the end of April 2013. This inspection will include a flooding walkdown for ground water intrusion.

Room 205 was inspected on 4/5/2011. Condition Report 2011-92430 was initiated due to the appearance of deposits associated with ground water intrusion on the south wall of the room. The CR evaluation determined that the barrier is capable of performing the intended function. As this inspection documented evidence of ground water intrusion, it will be credited as a flooding walkdown previously completed, for the purpose of this report. The next inspection of Room 205 is currently scheduled by the end of August 2015.

Room 210 was previously inspected on 9/27/2011, with satisfactory results. This inspection is not being credited for the purpose of this flooding walkdown report. The next inspection of Room 210 is due for completion by the end of December 2014. This inspection will include a flooding walkdown for ground water intrusion.

Other areas not inspected due to restricted access were Room 222 Fuel Transfer Tube Area, Room 223 Cask Wash Pit Area and Room 224 Spent Fuel Storage Area. These rooms are portions of the spent fuel storage facilities (pools) that contain a stainless steel liner and a leakage detection system, are open to atmosphere at the 603 foot elevation, and are filled with borated water to an elevation of approximately 600 feet. Any leakage from these features is collected by a leakage detection system that is installed between the stainless steel liner and the structure. Leakage is monitored monthly utilizing procedure "Spent Fuel Pool, Fuel Transfer Pit, and Cask Pit Leak Detection System Monthly Test". Based on these areas being continuously water filled with monthly leakage monitoring, detailed visual inspection is not practical or warranted.

G. Cliff Edge Effects/Available Physical Margin

Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects. Cliff edge effects and physical margins do not need to be reported to the NRC as part of the Walkdown Report. However, the Appendix B walkdown records, which include the collected APM information, need to be retained and available for NRC audits and inspections. Instead of submitting cliff-edge effects, report that Available Physical Margins have been collected and documented in the Walkdown Record form. This information will be used in the flood hazard re-evaluations performed in response to Item 2.1: Flooding in the 50.54(f) letter.

Available Physical Margins have been collected and documented in the Walkdown Record forms. This information will be used in the flood hazard re-evaluations performed in response to 2.1 Flooding.

H. Changes

Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection.

There have been recent modifications to the Davis-Besse facility to meet security requirements and to add buildings, facilities, and parking lots to the site in preparation for the steam generator replacement project in 2014. Condition Report 2011-04127 documents that the local flooding analysis for probable maximum precipitation needs to be reviewed. This analysis is currently in progress with the final result scheduled to be issued in November 2012.

There are no planned or recommended modifications to flood protection systems or mitigation measures resulting from these walkdowns.

I. Conclusions

The Davis-Besse NEI 12-07 walkdowns confirm that structures, systems and components will function as described in the CLB for an external flood. There were no flood feature deficiencies identified that require resolution.

J. References

1. NEI 12-07 Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features (Rev. 0-A)
2. Davis-Besse USAR: 2.4.1, 2.4.2, 2.4.3, 2.4.6, 2.4.7, 2.4.8, 2.4.10, 3.2, 3.4
3. Procedure RA-EP-02810 Tornado or High Winds
4. Procedure RA-EP-02830 Flooding
5. Procedure RA-EP-02870 Station Isolation
6. Drawing C-1594 Barrier Functional List
7. Drawing C-1595 Penetration Schedule
8. Condition Report 2002-07569 Station Sump Pump Check Valves Not Tested
9. Condition Report 2011-04127 Local Flooding Analysis for Probable Maximum Probable Precipitation Needs Review
10. Condition Report 2011-92430 Evidence of Leakage Noted in MU Tank Room Wall

Perry Nuclear Power Plant Verification Walkdowns of Plant Flood Protection Features

Based on the NEI 12-07 [Rev. 0-A] Guidelines

November 20, 2012

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Introduction

In response to the nuclear fuel damage at Fukushima Daiichi due to the earthquake and subsequent tsunami, the United States Nuclear Regulatory Commission (NRC) is requesting information pursuant to Title 10 of the Code of Federal Regulations, Section 50.54 (f). As part of this request, licensees will be required to perform walkdowns to verify that plant features credited in the Current License Basis (CLB) for protection and mitigation from external flood events are available, functional, and properly maintained. The specific information requests from the NRC letter are repeated in the sections below.

A. Design Basis Flood

Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.

Hazard Identification

Four prospective sources of flooding exist at the Perry site: Lake Erie, intense local precipitation, and flooding by two small, nameless streams which border the site to the east and south/west.

Flooding from Lake Erie, while being extremely improbable, is evaluated in the CLB based on maximum water levels. Short-term fluctuations that often occur on the Great Lakes are wind set-up or storm surge, and a phenomenon known as a seiche. Surges and seiches in Lake Erie are due primarily to wind effects. The USAR determined that the wind set-up raises the lake water level 4.3 feet. The site is approximately 45 feet above the maximum monthly mean lake level of 575.4 feet (USGS). With an antecedent water level of 575.4 feet (USGS), a precipitation value of 0.5 feet, a pressure correction of 0.3 feet, and a wind setup of 4.30 feet, the total maximum stillwater surface level at the plant site was computed to be 580.5 feet. Runup occurring coincidentally with the probable maximum setup would extend to about elevation 607.9 feet on the bluff at the lake shore. Therefore, the maximum flood water level from the prospective Lake Erie source of elevation 607.9 is approximately 12 feet below plant grade elevation.

An evaluation of the effects of intense local precipitation in the CLB shows the resultant flood waters will not exceed the elevation 620.5 feet in buildings containing safety related equipment. In case of complete blockage of the storm drainage system, the plant site has been graded so that overland drainage will occur away from the plant site buildings and will not allow the accumulated storm water to exceed elevation 620.5 feet.

A water level worst case scenario for both the major and minor streams was evaluated in the CLB. Studies discussed in USAR Section 2.4.3 have shown that even if a Probable Maximum Flood (PMF) is experienced, the streams will be contained within their natural channels except for the overtopping of the crossings at Lockwood Road and the plant main access road, which would temporarily prevent road access. The probable maximum flood profiles for the major and minor streams are shown in USAR Figure 2.4.6 and 2.4-8 respectively. The presence of a natural, high ridge along the right bank of the major stream will preclude flooding of the site by the PMF, allowing the plant to continue uninterrupted operation. Only two small streams run close to the site, neither of which have any upstream dams.

With respect to the flooding sources listed above, flood elevation pertaining to land structures is not a factor, as the site is graded to carry all surface water away from the safety class structures. The site storm drainage system and plant grading are designed to preclude ponding of water greater than six inches above the nominal plant grade of elevation 620 feet. The floor elevation for buildings containing safety related equipment is designed at elevation 620.5 feet. This, together with the plant location about 45 feet above Lake Erie, results in a negligible possibility of flooding due to surface water.

The plant underdrain system is designed to maintain a groundwater level below elevation 568.5 feet utilizing the underdrain sump pumps. In the unlikely event that the pumps do not function, the system ensures that groundwater level will not exceed elevation 590 feet due to the plant underdrain gravity drain system. The design groundwater inflow rate to the plant underdrain system is 80 gpm.

USAR 3.8.5.1 states that groundwater is prevented from entering the rattle space between buildings by a continuous waterproofing membrane which extends under the foundation mats. In addition, the joints between the safety class foundation mats contain waterstops. Should the waterproofing membrane and waterstops fail for any reason, the walls of adjacent safety class structures are designed for water elevation at 590 feet, corresponding to the design basis groundwater elevation described in Section 3.8.5.3.4.

<u>Assumptions</u>

Relative to external flooding due to a Probable Maximum Precipitation (PMP) event, USAR 2.4.2.3 "Effects of Local Intense Precipitation" credits that in case of complete blockage of the storm drainage system, the plant site has been graded so that overland drainage will occur away from the plant site buildings and will not allow the accumulated storm water to exceed elevation 620.5 feet. For conservatism, the PMP was assumed to fall on fully saturated terrain, with 100 percent runoff. In addition, runoff coefficients of 0.25 for the general site area and 0.90 for roof top areas and pavements are used for the design of the system.

<u>Methodology for Design Basis Development</u>

The effects of local intense precipitation are described in USAR Section 2.4.2.3. As noted in USAR 2.4.3.1, a comparative evaluation was made using the US Army Corps of Engineering Bulletin No. 52.8 (March 1965) and the US Bureau of Reclamation Design of Small Dams (1973). The comparison determined that the method used by the US Bureau of Reclamation was more conservative and was therefore used as the basis for the Perry Site Probable Maximum Precipitation event.

The USAR indicates:

The 6-hour Probable Maximum Precipitation (PMP) of 26.7 inches for the site was distributed into hourly intensities as described in USAR Section 2.4.3. The maximum hourly rainfall of 13.1 inches per hour will be occurring during the first hour. The subsequent rainfall per hour considered for the PMP was 4.0", 2.9", 2.4", 2.2", & 2.1" totaling 26.7 inches for the 6-hour event.

Site storm drainage system was designed for these rainfall amounts

In case of complete blockage of the storm drainage system, the plant site has been graded so that overland drainage will occur away from the plant site buildings and will not allow the accumulated storm water to exceed elevation 620.5 feet. Rainfall intensity of 7.1 inches/hour was used for all overland flow calculations; this value was used because total depth of 6 inches is allowed to build up over the entire plant site. This will result in a flood level not to exceed elevation 620.5 feet. The area surrounding the plant site is traversed by an inner perimeter road which, for the most part, is at elevation 620'-4" (the exceptions are at the northwest plant site corner, where it dips to elevation 616.92 feet, and the area directly east of the Intermediate Building, where it dips to elevation 619.5 feet). The railroad enters the plant buildings at elevation 620.5 feet, although it has been lowered to elevation 620.17 feet (in the vicinities of catch basins W-7 and E-5) so that excess storm water adjacent to the buildings on the east and west sides can be discharged to lower areas.

As a result, overland flow will begin once the ponding has reached an elevation of 620.33 feet (based on all centerline roadway elevations being the same). Assuming the worst case (i.e., complete blockage of the site storm drainage system and using peak discharge from the most intense hour of the PMP), the resulting increase in surface elevation of water flowing over the surrounding roads and railroads (acting as weirs) would not exceed one inch. This ponding elevation of 620.42 feet will have no adverse effect upon safety class equipment because the floors at plant grade are set at elevation 620.5 feet. As the water overflows the inner perimeter road and access railroad at elevation 620.33 feet, the storm water will be carried away by several large drainage swales including:

a. The large swale between the two cooling towers carries water away to the east.
b. The swale south of the Unit 2 cooling tower carries water to the southeast.
c. A major portion of the plant site overland flow at the north area will be carried away by the previously mentioned low area at the northwest corner into the barge unloading ramp area.

USAR 2.4.13.5 states that a pressure relief underdrain system is utilized to reduce the hydrostatic pressure acting on the building structures. All exterior walls and mats of safety class structures in the nuclear island are designed for hydrostatic head due to water elevation of 618 feet under static conditions. The main objective of the pressure relief underdrain system is to ensure that the groundwater level around the nuclear island does not exceed elevation 590 feet. Safety related structures serviced by the underdrain system are designed to withstand all loading conditions at this maximum level. This system includes two discharge systems (pumping and gravity drain). In the pumped discharge system, the design groundwater inflow of 80 gpm flows by gravity through the porous concrete blanket and pipes to collection manholes containing the service underdrain pumps. Three service underdrain pumps are set to maintain a water surface elevation between 566 feet and 568 feet. If for some reason the pumps fail to start or cannot keep up with the rising water level, when the level reaches 568.5 feet, a high water level alarm will sound in the control room and a backup pump in manhole 6 will automatically start, providing an additional 50 gpm nominal of capacity to the pumping discharge system. As described in USAR 2.4.13.5, a Safety Class 3, Seismic Category I underdrain system functions to assure that the groundwater never exceeds elevation 590 feet for all safety class structures except the emergency service water pumphouse which is designed for groundwater at elevation 618 feet for all loading combinations. During normal plant operation, the groundwater elevation is maintained below 568.5 feet by the underdrain pumps.

The following rainfall intensities were utilized for the design of the structures based on 13.1 inches/hour. These are:

a. Rainfall intensity of 4.1 inches/hour for the roof downspout systems leading directly into a catch basin; this value was used because the roof systems are structurally designed to hold 9 inches of water, and therefore, the downspouts were sized to discharge 4.1 inches/hour.
b. Rainfall intensity of 9.1 inches/hour for roof areas with scupper overflows along the sides; this value was used since any rainfall intensity greater than the downspout capacity of 4 inches/hour will pass through the scupper overflows.
c. Rainfall intensity of 7.1 inches/hour for all overland flow calculations; this value was used because total depth of 6 inches is allowed to build up over the entire plant site.

USAR Section 2.4.10 discusses the possibility of flooding caused by the probable maximum surge and ice conditions in the lake. The plant grade is sufficiently high to greatly reduce the probability of general site flooding. On the intake side of the cooling water systems, all safety-related pumps and equipment will be located above Elevation 586'-6" (USGS) in the emergency service water pumphouse. This elevation allows approximately three feet of freeboard over the simultaneous occurrence of the probable maximum setup, the maximum monthly mean lake level of record, and the associated oscillation of the pump chamber water level due to wave action over either the main or alternate submerged offshore intake structure.

<u>Differences or Contradictions in Flood Hazard Levels</u>

The USAR indicates that accumulated storm water will not exceed elevation 620'-6" whereas it also states that surface ponding of water will reach elevation 620'-5". Condition Report 2012-17869 documents these discrepancies in order to provide clarification/alignment. Additionally, as described below, Perry evaluated a case in Condition Report 2009-68678 where some building elevations were surveyed to be below the designed elevation and were determined to be acceptable.

B. Protection and Mitigation Features

Describe protection and mitigation features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs important to safety.

Flooding Licensing Basis

Flood prevention and mitigation measures are designed to function in all modes of operation including full power operations, startup, shutdown, and refueling.

The flooding licensing basis for structures containing safety related equipment is evaluated for a Probable Maximum Precipitation event as well as the Probable Maximum Flood for the major and minor streams as described above. Flooding from Lake Erie is extremely improbable. Floods due to dam failures are not applicable to Perry.

Flood Duration

Local intense precipitation is the only time dependent external flooding hazard considered in the CLB. The 6-hour Probable Maximum Precipitation (PMP) of 26.7 inches for the site was distributed into hourly intensities; with the maximum hourly rainfall of 13.1 inches per hour occurring during the first hour. This is consistent with the overland flow calculations flowing rainfall of 7.1 inches per hour considering an accumulation of storm water to a depth of 6 inches assumed over the entire site. The subsequent rainfall per hour considered was 4.0", 2.9", 2.4", 2.2", & 2.1" for a total or 26.7" over the 6-hour PMP. (USAR 2.4.2.3)

Credited Flood Protection Features

The portions of Safety Related Unit 1 and Common structures considered as part of this walkdown effort are as follows:

Reactor Shield Building: The Reactor Shield Building houses and protects the reactor, steel containment, suppression pool, and some safety class equipment. The Shield Building annulus walkdown targeted the Shield Building wall below the surface flood elevation of 620.5 feet, from the Auxiliary Building to the Fuel Handling Building. This is the section that is exposed to the earth.

Fuel Handling Building: The Fuel Handling Building, for the purposes of this inspection included the elevation at 620.5 feet from which new and spent fuel is handled. Included in this inspection was an exterior walkdown to identify any gaps between the Fuel Handling Building and adjacent structures.

Intermediate Building: The function of the Intermediate Building is to house safety class systems and equipment. The internal building walkdown targeted the exterior building walls below the surface flood elevation of 620.5 feet that are exposed to earth. This included the East wall and portions of the North and South Wall.

Auxiliary Building: The function of the Auxiliary Building is to house safety class systems and equipment. The internal building walkdown targeted the exterior building walls below the surface flood elevation of 620.5 feet that are exposed to earth. This included the East wall and portions of the South wall on the east side of the plant. Penetrations on the West wall where piping exited the building underground were also inspected. Penetrations on the North wall that interface with the Non-safety related Turbine Power Complex were also inspected.

Control Complex: The Control Complex houses plant personnel and electrical controls to monitor and control normal plant functions and safety class systems. The internal building walkdown targeted the exterior building walls below the surface flood elevation of 620.5 feet exposed to earth.

Emergency Diesel Generator Building: The diesel generator building houses generators, day tanks and other equipment necessary to supply standby electric power to operate safety systems in the event of a power failure of the plant generating equipment and offsite power. This building was not inspected as the floor elevation is at 620.5 feet. Penetrations on the west wall are at an elevation greater than 620.5 feet and therefore not subjected to flooding from site surface water.

Emergency Diesel Generator Fuel Oil Tanks: The Fuel Oil tanks are buried and sealed underground. There are no associated items that would be subjected to surface flooding. Flame arrestors/vent line located behind the Fuel Oil fill is a possible source of water intrusion to the fuel oil tanks. Field inspection verified that the bottom of the flame arrestor weather shield were above elevation 620.5 feet.

Service Water Valve Pit: The service water valve pit is an underground reinforced concrete structure housing safety class valves for the service water system. The function of this structure is to protect the service water valves from a seismic event. These service water valves have a safety related function to close on a high water level signal in the Turbine Building in response to a Circulating Water expansion joint break in the Turbine Building. This event is not postulated to occur coincident with a PMP event and therefore does not need to be protected for the PMP event. The valve pit does not house equipment required to shut down the plant or provide decay heat removal. Therefore the valve pit does not require protection for a PMP event.

Electrical Manholes 1 through 4. The electrical manholes are reinforced concrete boxes used as distribution points for cable routing Four electrical manholes around the site allow cabling to enter safety related buildings. The manholes provide a pathway into the Control Complex west wall at elevation 599 feet, the Intermediate Building east wall at elevation 599 feet and into the Emergency Service Water Pumphouse. The manholes currently have temporary curbing installed for the purpose of preventing flood water intrusion from a Probable Maximum Precipitation event. A Design Change Package has been issued and is being implemented to install the permanent curbing around the manholes to mitigate flood water intrusion into the manhole.

Radwaste Building: The safety class portion of this building is a reinforced concrete structure. The Radwaste Building houses equipment used in the storage and processing of liquid and solid radioactive wastes. This facility is not an engineered safety feature and does not affect the ability to safely shut down the unit. The Radwaste Building is designed to preclude accidental release of radioactive materials to the environs.

Emergency Service Water Pumphouse: The Emergency Service Water Pumphouse houses the Emergency Service Water pumps which serves to provide a reliable source of water to safety related components required for certain modes of normal reactor operation, as well as for accident conditions and loss of normal auxiliary power, It also houses the plant fire protection pumps. All safety-related pumps and equipment is located above elevation 586'-6". This elevation allows approximately three feet of freeboard over the simultaneous occurrence of the probable maximum setup, the maximum monthly mean lake level of record, and the associated oscillation of the pump chamber water level due to wave action over either the main or alternate submerged offshore intake structure.

From USAR 2.4.1, protection against flooding from Lake Erie, surface runoff, and local intense precipitation is provided for safety-related structures, exterior systems and access equipment. This is accomplished by location, arrangement and design of these structures, systems and equipment. Plant features considered in the license basis include:

Shore Line protection and Bluff
Shoreline protection is used to control erosion of the bluff due to wave action or seiche in order to ensure that plant systems such as Service Water, Emergency Service Water and the plant in general are not adversely impacted.

Site grading and storm drains
From USAR 2.4.2.3, the plant site is drained by three separate storm drainage systems, two draining to the west and the third draining to the east. The entire site area is subdivided into discrete sub-basins, each having storm water inlets referred to as catch basins. In case of complete blockage of the storm drainage system, the plant site has been graded so that overland drainage will occur away from the plant site buildings and will not allow the accumulated storm water to exceed elevation 620.5 feet. As stated above, storm water will be carried away by several large drainage swales including:

a. The large swale between the two cooling towers carries water away to the east.
b. The swale south of the Unit 2 cooling tower carries water to the southeast.
c. Overland flow at the north area will be carried away by the low area at the northwest corner into the barge unloading ramp area.

Plant finished floor elevation
As described above, the grade elevation of the plant floors were designed to be at elevation 620.5 feet. This is 6" above the nominal grade elevation to ensure that flood water from a Probable Maximum Precipitation event would not enter the buildings.

Waterproofing Membrane and Waterstops
From USAR 3.4.1, the portions of land safety class structures located below finished grade are protected on their outside surfaces by a continuous waterproofing membrane. Adjacent safety class structures are separated by a sufficient space (rattle space) to accommodate seismic movements. Groundwater is prevented from entering the rattle space by a continuous waterproofing membrane, which extends under the foundation mats. In addition, the joints between the safety class foundation mats contain waterstops.

Floordrain System
In the unlikely event that the waterproofing of the structures is insufficient thereby allowing minor leakage, additional flood protection for safety class components, equipment and systems located below grade is provided; this is accomplished by floors that slope to floor drains per USAR 3.4.1.1. USAR section 9.3.3 states that floor drains will collect water and discharge to the floor drain sumps.

Penetration Seals
Implicit to the protection features is that piping penetrations below grade on external walls are generally sealed by incorporation of a 'Link-seal' at the external face of the building in order to provide a barrier for water intrusion into plant buildings. Other penetrations are sealed by either grout or elastomer between the pipe and the building.
Electrical penetrations into safety related buildings below grade from the electrical manholes are sealed except as noted.

Underdrain System
Relative to groundwater, the plant incorporates an underdrain system to keep the normal groundwater elevation below elevation 568.5 feet utilizing sump pumps.

Roof Downspouts and Roof Scuppers
Roofs of all buildings are drained to the storm water drainage system, which discharges into natural streams that feed into Lake Erie. Building roofs incorporate a downspout and roof scupper system provided to ensure that the water level on the roof will not result in loads in excess of the structural design limits.

Major and Minor Stream
Two nameless, parallel streams run close to the plant area. The larger has a drainage basin of 7.16 square miles and runs northwestward within 1,000 feet of the southwest corner of the plant. The smaller stream, which has a drainage area of only 0.76 square mile, borders the plant area to the east and north. The drainage areas are shown in USAR Figure 2.4-1. The safety-related structures of the plant are located within the drainage basin of the small stream.

There are no current mitigating procedures relative to external flooding events caused by a large amount of precipitation. Also, there are no active external flood protection features or credited actions under external flooding conditions. The Control Room monitors local weather forecasts and would be appraised of potential significant rainfall approaching.

Initiating Weather Conditions

Describe weather conditions or flood levels that trigger procedures and associated actions for providing flood protection and mitigation.

There are no current mitigating procedures related to external flooding events due to natural phenomena.

Additional Adverse Weather Condition

Describe the adverse weather conditions that were assumed concurrent with flood protection features and associated actions.

Strong winds and intense precipitation were considered for setup of Lake Erie to produce waves of 17 feet for a period of seven seconds per USAR 2.4.5.4 with a corresponding level change in the Emergency Service Water pumphouse of 1.19 feet. With the floor of the Emergency Service Water pumphouse at elevation 586.5 feet and a maximum stillwater surface level of the lake to be 580.5 feet, flooding of the Emergency Service Water pumphouse is precluded.

The plant grade is approximately 45 feet above the normal lake level and there are no safety-related structures within 380 feet of the lake shoreline (toe of bluff). Damage to the shoreline bluff by an individual storm would not affect the operation of or the safe operation of the facility.

The Probable Maximum Precipitation event did not consider the concurrent effects of high winds on the ground water levels. Regarding the Probable Maximum Flood of the two streams on the East and West side of the plant, USAR 2.4.3.4 concluded that the concurrent high wind wave action was of no concern on the streams concurrent with the Probable Maximum Precipitation event.

C. Warning Systems

Describe any warning systems to detect the presence of water in rooms important to safety.

In the event of a condition where water external to the plant would enter the buildings, water would be carried via the floor drain system or under doors into stairwells to building sumps. Sump level alarms would alert operators in either the Main Control Room or the Radwaste Control Room of a potential issue. The following water level instrumentation would be utilized in the safety related buildings alerting Plant operators of a potential flooding issue.

Control Complex:
Control Complex laundry sump at elevation 574'-10" alarms via level switches. A Maintenance Plan is in place to verify floor drains in the Control Complex are not plugged on a 4-year frequency. Floor drains on this elevation are not necessarily credited as the water can migrate directly into the sump from the floor. The Control Complex Laundry sump pumps are provided to pump flood water. An Alarm Response Instruction provides the instruction for the sump alarm. Maintenance Plans are in place for calibration of the level switches. The Control Complex laundry sump pumps are maintained via Maintenance Plans on a two year interval with refurbishment or replacement performed on a 14-year interval. The preventive maintenance or periodic inspections are in place, within their required periodicity and of adequate scope.

No sumps are installed on elevation 599 feet. The majority of the floor drains are routed to the Intermediate Building sump with the others routed to the Control Complex sump. Additionally, gaps under doors and into the elevator shaft (both on the west side of the building) will drain to the Control Complex 574'-10" elevation.

No sumps are installed elevation 620.5 feet of the Control Complex. Similar to elevation 599 feet, water entering this elevation would be routed to the lower elevations via gaps under the doors and into the elevator shaft leading into the 574'-10" elevation of this building.

Intermediate Building:
The floor drains for the Intermediate Building elevations 620.5', 599', and 574'-10" are routed to the Intermediate Building Floor drain sump located on the 574'-10" elevation. Instrumentation provides for a sump pump running and sump level alarm. Radwaste Alarm Instruction contains the response to this alarm. The Fuel Handling Area floor drains are also tied into the Intermediate Building floor drains. A Maintenance plan is also in place to calibrate the level instrument. (Calibration checked last performed 9/29/05). The Intermediate Building floor drain sump pumps are maintained via Maintenance Plans on a two year interval with refurbishment/replacement performed on a 14-year interval.

Auxiliary Building:
All floor drains in the Auxiliary Building are routed to the Auxiliary Building sump. Flood detection switches are located on the 599' and 568'-4" elevation and alarm in the Control Room when the water level reaches 2 inches. Flooding of the Auxiliary Building sump will cause the water to back out of floor drains in the corridor of the 568'-4" elevation in the event that the sump pumps are not working (assumed for internal flooding considerations). An

Alarm Response Instruction contains the response to the alarms signaled by level switches on both the 599 foot and 568'-4" elevations. Maintenance Plans are in place to ensure floor drains function properly. Maintenance Plans are in place to ensure operation of the flood alarm on the 568'-4" and 599 foot elevation. The Auxiliary Building floor drain sump pumps are maintained via Maintenance Plans on a two year interval.

Turbine Power Complex:
Floor drains in the non safety/non seismic Turbine Power Complex are routed to the Turbine Power Complex sump. Flood detection is located in the sump and alarms in the Radwaste Control Room. A Radwaste Alarm Instruction contains the response to the alarms signaled by the sump level switch. A Maintenance Plan is in place to ensure floor drains function properly on a quarterly basis. A Maintenance Plan is in place to ensure operation of the level switch as well as the actuation signals for sump pumps. The three Turbine Power Complex floor drain sump pumps, 1G61C00014 A, B, and C are maintained via Maintenance Plans on a frequency of 2-year, 2-year, and 4-year interval respectively.

Groundwater Level:
Alarms are provided in the Control Room to alert the Control Room Staff of ground water levels exceeding the design water level of elevation 568 feet for the pumped underdrain discharge system. An Alarm Response Instruction provides the response to such alarms. There is an alarm for manhole No. 6 and for manhole No. 11, which triggers when water level exceeds elevation 568 feet. The Alarm Response Instruction directs operators to verify proper operation of all underdrain pumps and refers them to an Off Normal Instruction for a potential leak in underground piping. It also directs operators to record ground water elevation if the annunciator is in continuous alarm and ground water elevation readings have not been performed in the previous 24 hours.

Maintenance Plans were found to be in place, and are scheduled within their required periodicity.

D. Effectiveness of Flood Protection Systems and Barriers

Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated.

Acceptance Criteria

In developing acceptance criteria for the walkdowns, the primary goal was to confirm that the components meet their original design basis requirements. That, in turn, would assure that the features conform to the Current Licensing Basis.

Specific items considered to confirm that the feature was acceptable were:

- No topography changes, including security barrier installations, adversely affect the site drainage plan. These components were reviewed to confirm that the topography remained similar to the original plant layout.
- Flood protection configuration is in accordance with current drawings, as-built installation records, inspection records, vendor documents, etc. Existing drawings were used in the walkdown evaluation to confirm that the features were capable of performing their design function. With a primarily passive system, this was one of the primary criteria for acceptance.
- Visual inspection for any material degradation was performed. The features were visually examined where accessible. The walkdown team had been trained in what to expect during the visual examinations that would confirm acceptance.
- Preventive Maintenance activities (PM) or periodic inspections are in place, within their required periodicity, and of adequate scope. Inspections such as structural examinations, penetration seal reviews, fire seal reviews and PM for components as required were reviewed
- Instructions contained within the implementation procedures can be implemented as written and within the allowed time considering the warning time available for the applicable flood hazard and expected conditions during the event
- There are no unresolved adverse PM or periodic inspection implementation results.

Operator Actions

The flood protection features as described in the preceding sections are barriers or either passive or active mechanical systems that do not require any operator action to perform their design function. No operator actions are credited in the Current License Basis. Regarding weather related procedures, a Perry procedure provides guidance and directions for High Wind and Tornado events. This procedure does not encompass any actions relative to flooding from external sources.

Exterior Barriers

Exterior barriers were evaluated based on their ability to prevent water ingress up to elevation 620.5 feet. The Yard was evaluated to ensure there are no potential obstructions to water flow paths and the overall grading is sloped away from buildings containing safety-related equipment. The site rail road tracks were examined for potential obstructions preventing water from flowing away from safety-related buildings. A walkdown of building penetrations in the flood zone range ensured all grouted, elastomer filled, or link seal penetrations have a sufficient bonding between surfaces and are without deep or through separations as appropriate. Grouted penetrations were inspected to have no through cracks, major spalls, or grout degradation. Elastomer filled penetrations were inspected to have no cracks, tears, or degradation of any significance. Embedded pipe or pipe sleeves were inspected to have good bonding between the commodity and the concrete without deep or through separations. Doors and openings to exterior structures were inspected to ensure that the lowest point of the opening is at or above the external flood level. Damming structures were evaluated to ensure the damming structure seals the opening and it is structurally sound. A damming structure is also required to have a minimum elevation of 620.5 feet and be capable of resisting water pressure at the minimum elevation. Rattle spaces were examined, to the extent possible, that the outside of the building is sealed off and the seals have no separations. Roof hatches were checked for signs of degradation and the seals or gaskets are in good condition. Waterproofing membranes and building water stops are below grade and cannot be inspected.

Incorporated Barriers

A walkdown of building penetrations in the flood zone range were inspected to ensure all grout or elastomer filled penetrations have a sufficient bonding between surfaces and are without deep or through separations as appropriate. Grouted penetrations were inspected to have no through cracks, major spalls or grout degradation. Elastomer filled penetrations were inspected to have no cracks, tears, or degradation. Embedded pipe or pipe sleeves were inspected to have good bonding between the commodity and the concrete without deep or through separations. Doors and openings to exterior structures were inspected to ensure that the lowest point of the opening is at or above the external flood level.

Building waterproofing membrane and building waterstops could not be evaluated as they were below grade and not able to be visually examined. Only waterstops between buildings that were above grade could be visually examined.

Temporary Barriers

Temporary external flooding barriers currently installed at Perry are those surrounding electrical manholes 1 through 4. These barriers (sandbag wall) were walked down and were noted to be in place. The sandbags were visually inspected for signs of degradation and to ensure height are appropriate. Sandbags for electrical manholes 1 through 4 are being checked once a shift on Outside Operator rounds as a monitoring requirement.

Advance Preparation

Perry does not have procedures in the event of a condition that could create external surface water conditions (i.e., Probable Maximum Precipitation event).

Other Available

The plant site is drained by three separate storm drainage systems, two draining to the west and the third draining to the east. The entire site area is subdivided into discrete sub-basins, each having storm water inlets referred to as catch basins. The site drainage system (catch basins) is described but not credited in the CLB in regard to external flooding protection but will provide drainage away from safety-related structures. The walkdown of the site drainage system was performed to identify any potential obstructions to water flow paths.

E. Walkdown Process Implementation

Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures).

<u>NEI 12-07 Guidance</u>

Confirm that guidance was followed, and any exception to the guidance.

NEI 12-07 Rev. 0-A "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" dated May 2012 was followed in performing the verification walkdowns at Perry. Individuals either had sufficient experience or were trained to perform visual inspections in order to identify degraded or adverse conditions of plant structures, systems, and components. The experience and provided training ensure that team members had the ability to determine if the condition of the feature or procedure would need to be entered into the Corrective Action Program (CAP).

The team walked down both the East and West Streams. The Minor stream on the east side of the plant was walked down from the south-east corner of the protected area to the lake. The Major stream on the south and west side of the plant was walked down from the rail road track to the lake.

Accessible portions of the shore line were walked down just east and west of the barge slip.

The perimeters of the Unit 1 plant buildings were walked down, including examination of spaces between the buildings (rattle space) to ensure these rattle spaces between buildings were sealed as designed to prevent surface water from entering these spaces.

The walkdown also examined visually the general slope of the land on the east side of the plant to the minor stream. Similar walkdowns were performed on the north and west side of the plant.

Internal walkdowns of safety-related Unit 1 buildings was performed. The walkdown concentrated on exterior walls with penetrations that would lead to outside having the potential for inleakage from the outside. The penetrations consisted of piping as well as raceway penetrations. Penetrations from a safety related building to adjoining non-safety related buildings below elevation 620.5 feet were also inspected.

Data was gathered using electronic tablets (iPads). These tablets were configured with forms that allowed direct entry of walkdown data and compilation into an access database. In addition, the tablet had a camera that allowed photos to be taken during the walkdown and tied directly to the flood protection feature. Digital cameras were also utilized. The electronic form used was designed to conform to Appendix B of NEI 12-07. This increased the efficiency of data gathering and made entry of results into the database easier. This methodology was used throughout the FENOC fleet, providing the opportunity for data to be easily transferred and reviewed.
No exception to the NEI 12-07 guidance was taken.

Walkdown Team Organization

The walkdown team consisted of two members from the Design Engineering Section and selected based on their background and familiarization with plant design each with many years in Design Engineering. Both members were knowledgeable and experienced with the Current Licensing Basis. One member is a Senior Licensed Professional Structural Engineer and the other a member is a Senior Mechanical Engineer in the Engineering Analysis Unit. In addition, various individuals from the Probabilistic Risk Assessment group accompanied the team on the walkdowns.

Walkdown Team Selection and Training

Team members completed the NANTeL training module followed by a proctored written examination demonstrating they met the knowledge requirements for performing walkdowns as given in NEI 12-07. This training covered the purpose and intent of NEI 12-07, reviewed the requirements for field walkdowns and observations as well as familiarized walkdown members with the current licensing bases. In addition, two of the individuals from the Probabilistic Risk Assessment Unit also completed the NANTeL training module including passing the proctored written examination.

F. Results of Walkdowns

Results of the walkdown including key findings and identified degraded, non-conforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Rev 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.

Findings

The following provides the results of the walkdowns. The NEI 12-07 walkdowns did not identify any deficiencies where a flood protection feature would not be able to perform its intended function. Observations which were identified have been documented in the Corrective Action Program. These observations will not be discussed in detail. A listing of the condition reports generated is provided for completeness and accuracy. There are no observations awaiting disposition at the time of this report.

Shoreline:

A limited walkdown of the shoreline identified no sign of degradation when compared to figures in the CLB. The walkdown of the shoreline and the shoreline protection confirmed it is capable of preventing Lake Erie waters from eroding away the bluff and potentially jeopardizing safe shutdown equipment as documented in the CLB.

The barge slip area is a credited path for drainage of storm water from the site to Lake Erie. The Vehicle Barrier System (VBS) extends to the barge slip and turns eastward at the lake. The VBS as well as the shore protection does act as somewhat of a weir to the lake, but it is considered unlikely that this could have any effect on the ability of storm water to flow to the lake given the elevation drop from the site to the lake. Condition Report 2012-17868 was initiated to investigate this further.

Major and Minor stream:

A walkdown of the major stream and minor stream confirmed that the alignment of the stream channels appeared consistent with drawings in the CLB over the distance from the plant to the Lake Erie shoreline. Actual stream bed elevations were not confirmed as part of this walkdown.

The major stream was walked down from the railroad track to the lake. Access was limited in the area of the transmission yard due to flowing water and vegetation in the stream bed. Obstructions identified were limited to vegetation and trees that had fallen over the years. These obstructions were not judged to be significant in blocking flow to Lake Erie. Water in the major stream was observed flowing at the access road and at the outlet to the lake. The shoreline was free of debris and other possible obstructions to water flow paths from the stream into the lake.

The minor stream on the east side was walked down from the Vehicle Barrier System to the lake. The Vehicle Barrier System (VBS) could impede flow into the minor stream and is further discussed below. The stream bed could not be walked down due to vegetation. The minor stream incorporates an 8 foot diameter culvert in the proximity of Lockwood Road and discharges directly into the Lake Erie. This culvert was verified to be free of debris. The minor stream appeared to be consistent with plant design documentation. The swale east of the Unit 1 Auxiliary Building appeared sloped to this stream without obstructions, although a chain link and razor wire fence was noted to bisect the swale flowpath. Condition Report 2012-17868 was initiated to investigate this further.

The walkdown of the major and minor streams was inconclusive on determining if the streams are capable of maintaining water levels within their channels as described in the CLB. In addition to the potential impact of the Vehicle Barrier System on the minor stream, one item identified in the walkdown of both the major and minor streams was the amount of vegetation. The vegetation appeared to be a reed type growth typical of marsh areas. This had not been expected given a review of the applicable drawings. Based on the magnitude of the flow in the streams associated with a PMP event, the effect of the vegetation to restrict flow is small. Condition Report 2012-17303 was initiated to investigate this further.

Vehicle Barrier System:
A Vehicle Barrier System (VBS) was installed south of the plant running east and west bisects the minor stream south-east of the Unit 2 Cooling Tower and continues east of the minor stream then heads north. The presence of these concrete blocks in the stream flow path could impede the water flow in the minor stream south of the protected area. This is a change from the original plant design and flow path. South of the protected area, the installation of VBS blocks across the south side of the Unit #2 Turbine Building. This VBS also extends through the warehouse and runs west of the Administration Building toward Lake Erie and may have altered the storm water drainage paths. Flood protection features are not considered to be affected. Condition Report 2012-17868 was initiated to investigate this further.

Yard:
A walkdown of the Yard showed that the plant grading has been modified from that given in the CLB, particularly at the area where the Dry Cask Spent Fuel Storage Pad east of the Fuel Handling Building. A calculation was prepared to verify that the installation of the Independent Spent Fuel Storage Installation (ISFSI) concrete pad and related structures, and the relocated portions of the storm drainage system will sufficiently drain the affected area of the property under the conditions of the 24-hour, 50-year storm event and the Probable Maximum Precipitation (PMP) event (13.1 inches/hour). The calculation documents the considerations made regarding the impact to site flooding. The calculation did not appear to have evaluated the overland flowpath presuming the storm drainage system was blocked, although this criterion was stated in an attachment to the calculation. Overall adequacy of site drainage is not considered to be affected. Condition Report 2012-17868 was initiated to investigate this further.

The Yard appeared free of debris that could obstruct water flow paths. The topography of the Yard could not be verified by the walkdown effort and no conclusions are made regarding its conformance to the topography drawing. However, the recent installations of security barriers in and around the site perimeter did not appear to be reflected on plant standard drawings and formalized calculations were not identified by this effort. Items identified by the yard walkdown are:

- The site contains a significant amount of additional paved surfaces installed since construction. The walkdown was not able to validate if the paved surfaces are at the elevations shown on drawings.
- The flowpath from the north-west side of the plant down to the barge slip appears to have been raised in the vicinity of the double security fence. Drawing 043-0013 notes that the space between the double fence is raised 0.5 feet above finished grades.
- The Vehicle Barrier System (VBS) concrete blocks located around the site may have an impact on the storm drainage flow path.
- A roadway had been constructed west of the transmission yard. Curbing and Jersey Barriers have been installed at the road west of the Transmission Yard which has the potential to impact the storm drainage flow to the west to the major stream.
- Security has installed Tee-walls in various areas of the site which may impact the drainage flow path.
- As discussed above, security fence and razor wire in the vicinity of the cooling towers generally running north-south has the potential to impede floodwater flow in the swale to the minor stream if obstructed by debris. The walkdown did not note debris that would impede storm water flow to the minor stream.
- Jersey barriers were noted to be installed over catch basins reducing the amount of water that could flow into the catch basins during a storm. Although the CLB states that the catch basins are presumed not functional, this represents a reduction in margin.

  Condition Report 2012-17868 was initiated to document these items. Separate reviews for each of the implemented site changes have been performed. No evidence was found that challenges the adequacy of site drainage.

The perimeter of the plant was walked down to determine if surface water could enter building spaces. The walkdown examined rattle space joints above ground elevation between the following:
On the west side of the plant:
Service Building to Intermediate Building
Emergency Diesel Generator Building and Service Building
Emergency Diesel Generator Building and Radwaste Building
Radwaste Building and Auxiliary Building
Auxiliary Building and Turbine Power Complex
Unit 2 Auxiliary Building to Unit 2 Turbine Power Complex
On the East side of the plant:
Turbine Building to Steam Tunnel
Steam Tunnel to Auxiliary Building
Auxiliary Building to Unit 1 Reactor Building
Unit 1 Reactor Building to Fuel Handling Building
Fuel Handling Building to Unit 2 Reactor Building
Unit 2 Reactor Building to Unit 2 Auxiliary Building
These rattle spaces above grade were observed to have seals intact such that surface water would not be able to flow into the rattle spaces.

Elevations of doors and openings could not be validated as part of the walkdown. However, Condition Report 2009-68678 documented that the elevation of the Fuel Handling Building was surveyed at 620'-5" with other building doors potentially as low as 620'- 5.5". The condition report investigation concludes that the condition is acceptable based on statements in the USAR indicating that surface ponding due to a Probable Maximum Precipitation event will reach an elevation of 620'-5". Also, for the east side of the plant, the results of a calculation indicating that surface water levels due to Emergency Service Water discharge to the swale reaches 620'-3.4", which would include the east doors of the Auxiliary Building.

For the west side of the plant, the calculation for surface water levels due to a Service Water line crack would reach elevation 620'-5.7" whereas the door elevations exceed this value for the areas affected by this line crack.

Building Walls:
Exterior walls of the Control Complex, Auxiliary Building, Intermediate Building, and Reactor Shield Building were walked down for indication of major water inleakage or paths for water to enter the buildings. No evidence of major inleakage pathways were identified. Previous instances of minor water inleakage have been reported and documented in the corrective action program, such as that reported for a minor water leak in Unit 1 Auxiliary Building. Such inleakage were minor, in most cases with minimum weeping or no measurable flow (i.e., accumulated moisture), and well within the floor drainage system capabilities. This is within the design basis of Perry.

In addition, the walkdown targeted close inspection of penetrations on walls leading to the outside where water has the potential to enter the building. In two instances, due to dose considerations near the Control Rod Drive re-build area, the inspection was performed utilizing binoculars. That combined with a high powered flashlight provided sufficient detail to observe the condition of the penetrations.

The walkdown also targeted inspection of penetrations on walls leading to buildings not containing safe shutdown and decay heat removal equipment. Specifically, wall penetrations between the Auxiliary Building to Turbine Power Complex, Auxiliary Building to Radwaste Building, Control Complex to Radwaste Building, and Control Complex to Service Building. Additionally, the Intermediate Building to the abandoned Unit 2 Auxiliary Building was also walked down.

Exterior walls of Unit 1 Safety and Non-Safety related buildings were inspected from the outside. No water paths into buildings at grade elevation were found to exist. As such, unimpeded water flow into the plant from the surface would not occur. The intent of inspecting the non-safety-related building exteriors was to ensure a PMP will not cause potential rapid flooding of these buildings. For this reason, considering the large volume available to flood, and relatively short duration of the PMP, the flood water level in buildings not containing safe shutdown equipment or decay heat removal systems is judged not to exceed elevation 590 feet. Condition Report 2012-17867 has been generated to formally document this basis.

Pipe penetrations:
Exterior wall piping penetrations were found to be either grouted into the wall, or contained in pipe sleeves. For pipes grouted into the wall, there was no indication of through cracks in the grout and no gaps were identified. Other pipes were contained within piping sleeves. These pipes were found to have a link-seal installed appearing to be near or at the exterior face of the building. Some penetrations could not be visually verified for the entire 360 degrees

circumference around the pipe due to either clearance between the pipe and sleeve or due to structural steel obstructing the view, but all were observed to contain a link seal. An exception to this was in penetration PIB1125 and PIB1126, which are noted as a potential issue (reference CR 2012-17305). Further, an exception was for Emergency Service Water piping penetrating the Auxiliary Building at approximately the 607 foot elevation in the north corridor. These pipes were welded to a wall cover plate/support 360 degrees around the pipe at the interior wall face covering the interior of the penetration. Although there was a minor gap between the cover plate and pipe sleeve, observation of a link seal could not be made. These were at approximately elevation 607 feet and above a level that ground water would reach. Observable pipe penetrations did not note any water in the penetrations. Some penetrations were noted to have water stains running down the wall indicating either minor inleakage or more likely condensation from the pipe. In no instance was water noted on the wall or floor.

Electrical Penetrations:
Electrical penetrations on exterior walls had various inspection criteria. Typically, electrical penetrations consist of cable inside conduits and filled with an elastomeric sealant material. The conduits are embedded in a concrete duct bank and grouted in place. The duct banks penetrate through the concrete wall, with a gap between the duct bank and the concrete wall and are either sealed or have a waterstop installed. The waterstops are inside the wall and not visible to be inspected. However, penetrations were inspected for signs of water leakage. There was some evidence of leakage in the past; however, no active duct bank leakage was identified. These penetrations were inspected on exterior walls for cables routed to the yard. The following was found:

For the duct bank seals, there were no identified sealing issues. The grouted duct banks appeared to be in acceptable condition. In some cases, where gaps were noted between the cork material and concrete, a dark material, appearing to be a sealant, could be observed further inside the penetration. The conduit-to-duct bank joints were acceptable with no indication of through cracks. The sealant inside the conduit was acceptable. Cases of a slight gap between the cable and the sealant was noted and appeared to be where the sealant pulled away from the cable as it exited the conduit. These were not considered deficiencies. In some cases, penetrations leading to electrical manholes No. 1 and No. 4 were required to have weep holes installed in the sealant for the purpose of permitting drainage in order to prevent the cable from being submerged. The weep holes were installed per Engineering Change Package (ECP) 09-0747. The modification included an evaluation of the water that could enter the building from a flooding perspective. To limit the amount of surface flood water entering the building through these penetrations, sandbags were placed around electrical manholes 1 through 4. Permanent curbing is being implemented around these electrical manholes in place of the sandbags.

In some cases, conduits with no cable were fitted with a PVC threaded cap to the conduit. Some of these caps were observed to have Teflon tape as a thread sealant as shown on the underground duct sealing and plugging drawing. From a flooding perspective, the PVC Schedule 40 threaded cap was considered adequate as the pressure rating for Schedule 40 PVC piping exceeds a working pressure of 68 psi at 100 degrees according to vendor literature whereas these penetrations will see a static head of less than 15 feet (~6.5 psi). Thus the caps provide an adequate seal for flooding.

In one instance, cable shielding (foil covering) covered the conduit opening obstructing visual observation into the conduit. The foil shielding is banded to the cable and part of the cable design. Therefore it was not removed as it would have needed to be destroyed. The electrical drawing requires that this conduit penetration be sealed. This conduit is safety related, and its installation (including seal) would have been subjected to QC inspection. Walkdown of other penetrations did not reveal any degradation of the seal. The visual inspection of this conduit and cable did not indicate evidence of any water leak. Based on the above, it was judged that this conduit required no further inspection.

Abandoned conduit penetrations on the south side of the east wall of the Intermediate Building elevation 599 feet were identified that terminate in the north east corner of the Dry Cask Storage Building which are also unsealed. If the dry cask storage building were to accumulate in excess of 4 inches of water, the water would enter the conduits and flow largely unimpeded to the Intermediate Building. Any water infiltration into the Intermediate building from this source would be routed to the Intermediate building floor drains. Operator rounds or sump level detection would identify this issue. Condition report 2012 -17308 has been initiated to address this condition. The expected action at this point is to plug these penetrations in the Dry Cask Storage Building.

Unsealed conduits were found on Control Complex elevation 599 feet. These conduits are routed underground into the Unit 2 Offgas building. The conduits do not contain cables. Since these conduits are located above elevation 590, they are not susceptible to groundwater inleakage. Condition Report 2012-17314 was written for further evaluation.

An exception to this was for the conduit penetration in the Auxiliary Building north wall at elevation 612.58 feet (EAB2036). This penetration was covered by a junction box in the overhead and could not be inspected. This penetration is above the design basis ground water level of 590 feet and as such, would not result in leakage into the building. Based on a review of drawings, the conduits contained in the junction box are routed to the Condensate Storage Tank. Based on field walkdown, these conduits are embedded in a concrete duct bank. The duct bank extends more than 12 inches above the ground level. The conduit extends upwards approximately 4 inches as it exits the duct bank. The conduit extends further up, via flexible conduit, to a junction box greater than 6 feet above grade. Based on this, this will not introduce a water pathway through the conduit into the Auxiliary Building. The interfaces between the duct bank to building and duct bank to conduit were not inspected. Based on plant records, this penetration had been grouted, staining on the wall supports that the penetration had been grouted. The penetration is at elevation 612 feet which exceeds the maximum ground water elevation. Based on this, it was judged that this penetration required no further inspection.

Piezometer tubes

The Piezometer tubes are located in the bottom elevation to determine the elevation of the ground water. Daily measurement of the ground water is directed by PTI-P72-P0005 daily if the ground water alarm annunciates continuously in the Control Room. Peizometer tubes were verified to have their threaded caps installed in the Intermediate Building, Auxiliary Building and Control Complex ensuring that an elevated groundwater would not flow into the building unimpeded. Leak tightness of the cap to tube connection could not be tested. Operations has indicated that the caps are installed hand tight.

Building Roof
A walkdown of the building exterior and roofs was performed. The roofs of the Intermediate Building, Diesel Generator Building, Fuel Handling Building and Auxiliary Building (including roof hatch plugs where applicable) were inspected. The Control Complex roof had standing water of a minor depth and was able to be visually observed from the adjoining Intermediate Building. Hatch plugs on the Auxiliary Building roof were observed to be completely sealed. The building parapets contained scupper openings credited for allowing rain water to drain from the roof to handle rainfall in excess of 4.1 inches per hour. These scupper openings were visually inspected to be fully open. The roofs were observed to be in good repair with no major defects observed. Rattle spaces between buildings above ground were sealed with no deficiencies noted. There were no signs of degradation to the flooding design features. The exceptions noted are as follows:
- Standing water was noted to be on the roof of the Control Complex indicating potential blockage of the roof drain.
- A tear was noted in the rattle space seal between the parapet of the Fuel Handling Building roof and the Unit 2 Reactor Building.
- Minor gaps in the sealant of the roof flashing between the Control Complex and Intermediate Building has the potential to allow rain water to seep into the rattle space between these two buildings. Evidence of rainwater seepage was noted in the Intermediate Building in the area of the door leading to the Control Complex on elevation 574'-10". This was also identified between the Fuel Handling Building Roof and the Unit 2 Reactor Building. Rainwater seepage was also noted on elevation 599 feet of the Intermediate Building at the northern periphery of the Unit 2 reactor shield building. Condition Report 2010-72250 documents roof leaks and identified the orders to repair Intermediate Building and Control Complex roof leaks.

Deficiencies/Condition Reports

None of the following identified conditions rise to the level of a deficiency as defined in NEI 12-07.

Condition Report 2009-68678 was written prior to issuance of the NEI guidance to document that the floor elevation for the Fuel Handling Building was surveyed to be at 620'-5" versus the design of 620.5 feet. This Condition Report has since been closed. The condition report investigation concludes that the condition is acceptable based on statements in the USAR indicating that surface ponding due to a Probable Maximum Precipitation event will reach an elevation of 620'-5". Also, for the east side of the plant, the results of a calculation indicating that surface water levels due to Emergency Service Water discharge to the swale reaches 620'-3.4", which would include the east doors of the Auxiliary Building. For the west side of the plant, the calculation for surface water levels due to a Service Water line crack would reach elevation 620'-5.7" whereas the door elevations exceed this value for the areas affected by this line crack.

Condition Report 2012-17301 was written to investigate flooding of the abandoned Unit 2 Auxiliary Building. The current condition has approximately 4 feet of standing water presumably from either rain or ground water infiltration. This condition could ultimately result in flow into the Intermediate Building through the adjoining doorway on elevation 574.83 feet in the unlikely event that the pumped portion of the plant underdrain system fails. Any water infiltration from the Unit 2 Auxiliary Building to the Intermediate Building would be routed to the Intermediate Building floor drains. Operator rounds or sump level detection would identify this issue. The Condition Report will further investigate possible sources of the water and establish required corrective actions.

Condition Report 2012-17303 was written to document the amount of vegetation in the Major and Minor streams located on the West and East side of the plant respectively. The Condition Report was written to investigate and document what, if any, impact the vegetation has on the ability of the streams to permit adequate flow as credited in the CLB and establish corrective actions if needed. Based on the magnitude of the flow in the streams associated with a PMP event, the effect of the vegetation to restrict flow is judged to be small.

Condition Report 2012-17304 was written to identify a small area in the Unit 2 Interbus Transformer Alley at the intersection of the Unit 2 Auxiliary Building and the Unit 2 Turbine Power Complex at the ground level did not appear to be sealed and could have allowed water to enter a space between the buildings. Plant drawings indicate a waterstop is installed between the buildings; however, it was not in view. Given the size of the opening, the CR noted that the water entering the rattle spaces between the Unit 2 buildings would not be significant.

Condition Report 2012-17305 was written to document Penetrations PIB-1125 located at elevation 588.83 feet and PIB1126 located at elevation 590.83 feet in the Intermediate Building south east corner did not have any observable seals. The penetration appears to have a black plastic cap on the Building's exterior face, although the details could not be verified. The planned action is to determine the acceptability of what is installed or otherwise plug the penetration. Based on margin available within the underdrain gravity drain system, the effect of this condition is not considered to affect the Intermediate building.

Condition Report 2012-17306 was written to identify that the asphalt paving on the west side of the plant adjacent to the Diesel Generator Buildings topped over the railroad track by approximately 0.5 inches. The elevation of the Railroad track is credited to permit drainage away from the plant buildings in the event of a Probable Maximum Precipitation event as well as the postulated failure of the Service Water Piping in the Unit 2 Interbus Transformer Alley. Also, a security tower has been erected on the track in close proximity to the low point. Consistent with USAR section 2.4.2, this condition is below the elevation of the perimeter road, such that excess storm water adjacent to the buildings can be discharged to lower areas.

Condition Report 2012-17308 was written to document lack of conduit sealant for abandoned conduit penetrations in the east wall of the Intermediate Building elevation 599 feet south side that terminate in the north east corner of the Dry Cask Storage Building which is also unsealed. If the dry cask building were to accumulate in excess of 4 inches of water, the water would enter the conduits and flow largely unimpeded to the Intermediate Building. Any water infiltration into the Intermediate Building from this source would be routed to the Intermediate building floor drains. Operator rounds or sump level detection would identify this issue. The expected action at this point is to plug these penetrations in the Dry Cask Storage Building.

Condition Report 2012-17309 was written to document water ponding of Control Complex Roof, potentially due to blockages in roof drains. Any excess storm water would be discharged by the roof scuppers.

Condition Report 2012-17314 was written to document unsealed conduits found on Control Complex elevation 599 feet. These conduits are routed underground into the Unit 2 Offgas building. The Conduits do not contain cables. Since these conduits are located above elevation 590 feet, they are not susceptible to groundwater inleakage.

Condition Report 2012-17867 was written to ensure that an evaluation is performed to document that the Turbine Power Complex and the Radwaste Building will not be subjected to flood levels exceeding elevation 590 feet from a PMP event.

Condition Report 2012-17868 identified that the current Site Probable Maximum Precipitation (PMP) event evaluation for external flooding does not reflect several changes to site since original construction. The effects of changes to the yard should have been reflected in a single collective site PMP evaluation, in order to facilitate assessment of new changes or emergent conditions. Separate reviews for each of the implemented site changes have been performed. No evidence was found that challenges the adequacy of site drainage. The purpose of this CR is to optimize configuration control.

Condition Report 2012-17869 documents that USAR sections 2.4.2 and 3.4.1 requires clarification/alignment regarding the maximum external flood levels due to a Probable Maximum Precipitation (PMP) event.

The deficiencies identified above have been entered into the Corrective Action Program and are being investigated.

Not Inspected

The following items were not inspected:

- The Diesel Generator Building was not inspected as the grade elevation doorways are at elevation 620.5 feet and the building has no elevations below grade. Additionally noted from the yard walkdown were various penetrations near the ground on the west face of the Diesel Generator Building. These penetrations were also found on drawings to be at greater than elevation 620.5 feet.

-The Emergency Service Water pumphouse was not inspected from any impacts of surface flooding. The building does contain greater than 50 square feet of open area at elevation 586'-6" to the pump forebay and is judged sufficient to ensure that flooding of the operating floor would not occur.

- Penetration EAB-2036 located at elevation 612'-7" on the north wall of the Auxiliary Building could not be inspected due to it being covered by a wall mounted junction box and located in the overhead. The circuits in this penetration are associated with the Condensate

Storage Tank level instrumentation for High Pressure Core Spray and Reactor Core Isolation Cooling. These circuits are routed to the south side of the Condensate Storage Tank (CST) dike wall. Based on field walkdown, these conduits exit the ground and are embedded in a concrete duct bank on the south side of the CST dike. The duct bank extends more than 12 inches above the ground level. The conduit extends upwards approximately 4 inches as it exits the duct bank. The conduit extends further up, via flexible conduit, to a junction box greater than 6 feet above grade. Based on this, this will not introduce a water pathway through the conduit into the Auxiliary Building. A review of plant drawing for underground duct sealing and plugging also does not indicate that these conduits were required to be sealed. The interfaces between the duct bank to building and duct bank to conduit were not inspected. Based on plant records, this penetration had been grouted, staining on the wall supports that the penetration had been grouted. The penetration is at elevation 612 feet which exceeds the maximum ground water elevation. Based on this, it was judged that this penetration required no further inspection.

- While not within the scope of the walkdown, the Unit 2 Auxiliary Building was walked down. Portions of the Unit 2 Auxiliary Building elevation 568'-4" could not be walked down due to flooding in that elevation presumably from ground water. There is a potential flooding concern in the Unit 2 Auxiliary Building particularly with ground water. In the event of a failure of the pumped portion of the plant Underdrain system to maintain ground water within its design elevation, ground water intrusion into the Unit 2 Auxiliary Building could begin to impact Unit 1 Buildings if allowed to exceed an elevation of 574'-10". Based on a design groundwater inflow of 80 gpm into the plant Underdrain, this would be expected to be a slow intrusion into the Intermediate Building through the adjoining door between the Intermediate Building and Unit 2 Auxiliary Building at elevation 574'-10". Condition Report 2012-17301 was written to evaluate this concern and determine the necessary corrective actions.

-Penetrations PCC-1049 and PCC-1050 located on the Control Complex north wall at elevation 587'-11" could not be visually inspected up close. The penetrations are in the overhead and the pipe is insulated right up to the control complex wall. The penetration sealing packages, found on microfilm, documents that the penetrations originally contained a link seal which was subsequently replaced by silicon foam SF60. Based on review of manufacturer's test report contained in Reference IV, this material for a similar application has a pressure capacity of 30 psi which is in excess of 69 feet of static head. The available physical margin for these penetrations is in excess of 66 feet.

- Some penetrations between the Control Complex/Radwaste Building and Control Complex/Service Building on elevation 599 feet could not be inspected as they were located in the overhead above drywall ceilings or walls. These penetrations were not located on exterior walls exposed to ground but to adjacent buildings. These penetrations were all above the design basis groundwater elevation 590 feet and were not considered to be credited as external flood barriers in the CLB. As such, no further inspection is deemed required.

G. Available Physical Margin

Available Physical Margins have been collected and documented in the Walkdown Record Forms. This information will be used in the Flood Hazard Re-evaluations performed in response to item 2.1: Flooding.

H. Changes

Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection.

No changes to flood protection systems or flood mitigation measures are currently being planned. Potential changes may result from corrective actions from the items noted above.

I. References

I. NRC letter dated March 12, 2012 "Request for Information Pursuant to Title 10 of Code of Federal Regulation 50.54(f) Regarding Recommendation 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident"

II. NEI 12-07 "Guidelines for Performing Verification Walkdown of Plant Flood Protection Features" May 2012

III. Calculation CN 1.1 Post Foundations, Site Roads, Catch Basins

IV. Calculation 1:38 (also attached BISCO Test report 748-147) Evaluation Of Penetration Seal

V. Updated Safety Analysis Report

VI. Calculation P41-033 Evaluate Effects Of A Line Break in the New 42-Inches Service Water Piping in the Unit 2 Transformer Alley

VII. Calculation FL-003 'ESW Discharge-To-Swale and Probable Maximum Precipitation Event'

VIII. Technical Assignment File #081991 'External Flooding Walkdown Records'