Entergy

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Christopher J. Wamser
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BVY 12-081

November 21, 2012

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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SUBJECT: Flooding Walkdown Report - Entergy's 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

Vermont Yankee Nuclear Power Station
Docket No. 50-271
License No. DPR-28

REFERENCES:
1. NRC Letter, *Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, dated March 12, 2012 (ML12053A340)
2. Entergy letter to NRC, *Entergy's Response to NRC Request for Information (RFI) Pursuant to 10CFR50.54(f) Regarding the Flooding Aspects of Recommendations 2.1 and 2.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident*, BVY 12-038, dated June 11, 2012

Dear Sir or Madam:

On March 12, 2012, the NRC issued Reference 1 to all power reactor licensees. Enclosure 4 of Reference 1 contains specific requested actions, requested information, and required responses associated with Recommendation 2.3 for flooding walkdowns. Entergy Nuclear Operations, Inc., (Entergy) confirmed in Reference 2 that it would use the flooding walkdown procedure (Nuclear Energy Institute 12-07, *Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features*) as endorsed by the NRC as the basis to conduct the walkdowns and develop the needed information at Vermont Yankee.

Pursuant to Required Response 2 of Reference 1, Enclosure 4, Entergy is providing the Flooding Walkdown Report for Vermont Yankee in Attachment 1.

Should you have any questions regarding this submittal, please contact Mr. Robert J. Wanczyk at (802) 451-3166.

This letter contains no new regulatory commitments.

A001
NRR

I declare under penalty of perjury that the foregoing is true and correct; executed on November 21, 2012.

Sincerely,

CJW/JTM

Attachments: 1. Vermont Yankee Flooding Walkdown Submittal Report

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ATTACHMENT 1

BVY 12-081

VERMONT YANKEE
FLOODING WALKDOWN SUBMITTAL REPORT

Entergy

ENTERGY NUCLEAR
Engineering Report Cover Sheet

Engineering Report Title:
Flooding Walkdown Submittal Report
for Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Flooding
Per NEI-12-07 and NRC 10CFR50.54(f)

Engineering Report Type:

New ☒ Revision ☐ Cancelled ☐ Superseded ☐

Applicable Site(s)

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

EC Number 40620

Report Origin: ☐ Entergy ☒ Vendor
Vendor Document Number: VY-RPT-12-00020
Quality-Related: ☐ Yes ☒ No

Prepared by: Enercon Services (See Page 2) Date: _____
Responsible Engineer (Print Name/Sign)

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

Reviewed by: Gregory S Brede / Gregory S Brede Date: 11/19/12
Reviewer (Print Name/Sign)

Reviewed by*: N/A Date: _____
ANII (if required) (Print Name/Sign)

Approved by: Scott Goodwin / S D Goodwin Date: 11-19-2012
Supervisor (Print Name/Sign)

ENGINEERING REPORT

VERMONT YANKEE NUCLEAR POWER STATION WALKDOWN SUBMITTAL REPORT FOR RESOLUTION OF FUKUSHIMA NEAR TERM TASK FORCE RECOMMENDATION 2.3: FLOODING PER NEI-12-07 AND NRC 10CFR50.54(F)

Prepared By: _____ Date: 11/19/12
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Peer Reviewed By: _____ Date: 11/19/12
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Tom Xhelo (Enercon Services)

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1.0 SCOPE AND OBJECTIVE

This report was developed to provide information requested by the United States Nuclear Regulatory Commission (NRC) pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f) on March 12, 2012 for Vermont Yankee Nuclear Power Station (VYNPS). In response to the NRC request, Entergy performed walkdowns to verify that plant features credited in the current licensing basis (CLB) and current design basis for protection and mitigation from external flood events are available, functional, and properly maintained. The walkdowns were performed to verify that structures, systems, and components (SSCs), portable flood mitigation equipment, and the procedures needed to install and or operate them during a flood are acceptable and capable of performing their design function as credited in the CLB.

This report presents the findings of the flooding walkdown inspections completed at VYNPS. The walkdowns were completed in accordance with the United States Nuclear Regulatory Commission (NRC) endorsed guidance of NEI 12-07, Rev. 0A, Guidelines for Performing Verification of Plant Flood Protection Features, dated May 31, 2012 and Entergy Nuclear procedure EN-DC-170 that was developed to provide instructions for implementation of the NRC endorsed guidelines. The walkdowns completed at VYNPS were performed to verify that the structures, systems, and components (SSCs) credited for flood protection are capable of performing their design function as described in the current licensing basis. The walkdowns were also used to verify that plant modifications implemented since original construction, such as changes to topography, do not adversely affect flooding protection.

This report identifies the flooding hazards that comprise the current licensing basis and the protection and mitigation features that are credited with preventing the ingress of external water into SSCs important to safety at VYNPS. The effectiveness of the flood protection features is evaluated against a set of acceptance criteria set forth in EN-DC-170. Results of the walkdowns, including key findings, available physical margin, and any identified degraded, or nonconforming conditions are addressed and a description of the actions taken or planned to address these conditions is provided.

2.0 DESIGN BASIS FLOOD HAZARD LEVEL

Section 2.4 of the VYNPS UFSAR describes the current licensing basis and flood protection features provided at VYNPS for protection against an external flood.

2.1 Flood Hazards Identified

The safety-related facilities, systems, and equipment at VYNPS are capable of withstanding the worst flooding caused by several hypothetical events. The controlling source of flooding at the site during the licensing process was identified as a Probable Maximum Precipitation (PMP) induced Probable Maximum Flood (PMF) of 252.5 feet Mean Sea Level (MSL) stillwater and 254.0 feet MSL including wave effects on the Connecticut River and on shore near the plant per the 1971 AEC Safety Evaluation. Upstream dam failures of the Moore, Townsend and Ball Mountain Dams were also considered and shown not to produce the controlling flood, however were shown to impact the Intake Structure due to river elevation exceeding 237.0 feet MSL.

2.1.1 General Site Information

Vermont Yankee Nuclear Power Station (VYNPS) is located on the west shore of the Connecticut River, some 138 miles from the river mouth, immediately upstream of the Vernon Hydroelectric Station, in the town of Vernon, Vermont, which is in Windham County. The river in the vicinity of the station is comprised of a series of ponds formed by dams constructed for the generation of hydroelectric power. The plant is adjacent to the pond formed by Vernon Dam, named Vernon Pond. Nominal plant grade is 252.0 feet MSL. The station is located on about 125 acres which are bounded by privately owned land on the north, south, and west and by the Connecticut River on the east. Between 75% and 80% of the area within 5 miles of the station is wooded. The remainder is occupied by farms and small industries. All local surface streams drain to the Connecticut River, and the site is in the direct path of natural drainage to the east of the local watershed. In the vicinity of the site there is also a considerable amount of groundwater which several municipalities utilize as one source of water supply. Under normal conditions, the flow of river water is largely determined by operation of the hydroelectric stations and by the upstream reservoirs and lakes.

2.1.2 Connecticut River Flood

The flood of March 19, 1936, was the greatest and most destructive flood on the reach of the Connecticut River. The discharge on that day was 176,000 cfs, reaching a river stage at Vernon of 231.4 feet MSL. Other major floods were those of November 5, 1927, 155,000 cfs at elevation 229.0 feet MSL; and on September 22, 1938, 132,500 cfs at elevation 226.6 feet MSL. Since the floods of 1936-1938, extensive flood control works, consisting of some five projects with 247,800 acre-feet of flood storage, have been designed and constructed by the Corps of Engineers in the Connecticut River Basin upstream from the Vernon Dam.

2.1.3 Wind Wave Activity

The Vermont Yankee Nuclear Plant is located on the west bank of the Connecticut River; therefore, an east-northeast wind across the river would be the critical wind

direction for wave runup. The Probable Maximum Flood (PMF) is most likely to occur during the warm season (June through September). Meteorologically, this storm would be characterized by a north-south stationary front just west of the Connecticut River Valley and along the Green Mountains of Vermont, followed by a secondary disturbance such as a hurricane. Incoming waves from the river will break at the riprap slope in the front of the plant, which will dissipate a considerable amount of energy. Further damping of wave energy will occur when waves travel around the plant for about 700 feet at a depth of 0.25 feet to 0.50 feet. It is felt that these two energy dissipating processes will be sufficient to attenuate waves running up the plant. The effect of wind-generated waves on the PMF stillwater elevation was concluded to be negligible. However, the AEC Safety Evaluation dated 1971 postulates that the site could be subjected to a wave run up of 254 feet MSL and must be considered as the MPF level for mitigation efforts.

2.1.4 Potential Dam Failures

The failure of the Moore Dam is determined to be the controlling scenario for the river level to exceed 237.0 feet MSL. The failures of the Townshend and Ball Mountain Dams could cause the river elevation to exceed 237.0 feet MSL, depending on the exact scenario.

The hypothetical failure of Moore Dam was assumed to coincide with the peak of the PMF inflow hydrograph. The dam is about 145 miles upstream from the Vermont Yankee site. Four downstream dams, Comerford, McIndoes, Dodge Falls and Wilder, were assumed to fail in cascade. The results of the Moore Dam failure analyses at Vernon Dam are a peak inflow of 305,600 cfs and a peak flood elevation of 240.1 feet MSL. The Vermont Yankee site is subject to the same flood elevation as the Vernon Dam. The arrival time at the site for the leading edge of the Moore Dam failure flood wave is about 22 hours after the postulated failure of the dam. The time of the peak flood at the site is about 47 hours after the postulated dam failure.

There are also five flood control reservoirs on Connecticut River tributaries, upstream of the VYNPS site. The owners (currently TransCanada Hydro Northeast, Inc.) have developed dam breach profiles for each of the five dams. A review of these analyses showed that the impacts of dam failure for three of the dams, Union Village, North Hartland, and North Springfield do not reach the Vermont Yankee site. Two of the dams, Townshend and Ball Mountain, do produce flood levels downstream that reach the site. Both of these dams are located on the West River, which is a tributary of the Connecticut River.

For an assumed failure of Townshend Dam, the peak stage at Vernon Dam is elevation 230 feet MSL. The time from the start of dam failure until the peak stage is reached at the Vermont Yankee site is 9.2 hours. The time from the start of dam failure until the initial rise at the site is 5.2 hours. This analysis used assumed pre-breach high flows in both the West and Connecticut Rivers.

For an assumed failure of Ball Mountain Dam, the peak stage at Vernon Dam is elevation 235 feet MSL. The Ball Mountain Dam is upstream of the Townshend Dam. The Townshend Dam fails as a result of the assumed failure of the Ball

Mountain Dam. The time from the start of dam failure until the peak stage is reached at the Vermont Yankee site is 10.0 hours. The time from the start of dam failure until the initial rise at the site is 7.6 hours.

The effects of these three dam failures would impact the intake structure and require the use of the Alternate Cooling System (ACS).

2.1.5 Probable Maximum Precipitation (PMP)

The controlling source of flooding at the site during the licensing process was identified as a Probable Maximum Precipitation (PMP) induced Probable Maximum Flood (PMF). The PMF analysis for the Connecticut River upstream of the site was based on procedures and information contained in the analytical studies for the Susquehanna River in Pennsylvania. The VYNPS UFSAR utilizes Hydrometeorological Report (HMR) No. 33 to analyze PMP values for the site. The 6-, 12-, 24-, 48- and 72-hour PMP values were obtained by adjusting the Susquehanna River values by an index based on maximum persisting dewpoints. The maximum persisting 12-hour, 1,000-millibar dewpoints used were 75.3 degrees F and 73.3 degree F at Harrisburg, PA and Vernon, VT, respectively. The PMP values in the VY UFSAR are shown below.

Table 1: UFSAR PMP Values

Duration (hours)	PMP (inches)
6	6.1
12	8.3
24	10.7
48	13.5
72	14.4

The natural PMF flood flow was then adjusted to reflect the effect of the five upstream flood control reservoirs. The natural hydrograph was modified by assuming that about 68 percent of the flow reduction due to the upstream reservoirs would be available for storage. The final modified peak PMF discharge was estimated to be 480,100 cfs. The modified peak PMF flow of 480,100 cfs was then converted to a flood elevation using a rating curve that was developed from a step backwater analysis. For the peak modified PMF discharge of 480,100 cfs, the PMF stillwater level at the site is 252.5 feet MSL.

2.1.6 Probable Maximum Surge and Seiche Flooding

Based on the location of the site and Section 2.4 of the UFSAR, VYNPS is not located in a coastal region. Therefore, the site is not subject to hurricane surge or seiche flooding.

2.1.7 Probable Maximum Tsunami Flooding

Based on the location of the site and Section 2.4 of the UFSAR, VYNPS site is far removed from the Atlantic Ocean and any source of tsunami activity. Therefore, the site is not subject to tsunami flooding.

2.1.8 Ice Effects

Per IPEEE Section 5.2.1.2, the normal maximum Vernon Pond operating elevation is 220.13 feet MSL level. The operating procedures used by Transcanda Hydro Northeast Inc. for Vernon Dam address spillway operation with ice in the pond so as to safely pass the ice without damaging the spillway appurtenances. The site design basis PMF stillwater elevation of 252.5 feet MSL is about 32 feet above normal maximum pond levels. It is therefore concluded that the PMF level is much greater than any conceivable ice flooding in the pond adjacent to the plant. At ice flooding levels below that of the PMF, one could postulate that the Intake Structure could be flooded. In this case, the ACS would still be available to perform its cooling function since it would not be subject to ice flooding.

2.1.9 Cooling Water Canals and Reservoirs

IPEEE Section 5.2.1.2 addresses the hydraulic design of any reservoirs used to impound plant cooling with regards to flooding concerns.

During normal operation, VYNPS relies on Vernon Pond to provide plant cooling water needs. However, an alternate means of shutdown cooling is provided in the unlikely event of a failure of the Vernon Dam or a major flood that exceeds the level of the Intake Structure. The ACS is credited to provide long term cooling for Residual Heat Removal Service Water (RHRSW), EDG cooling, and Fuel pool Cooing in the event that Service Water (SW) is lost. The water supply for the ACS is a seismic cooling tower basin.

All active components of the ACS are designed for the PMF levels. The curb around the cooling tower basin is at elevation 250.5 feet MSL. This elevation is 2 feet below the maximum PMF elevation. Therefore as noted in the UFSAR, the basin will be inundated by the PMF. The UFSAR also notes that since no active components are within the basin, there should be no interruption of cooling water flow.

2.1.10 Roof Drainage

IPEEE Section 5.2.1.2 concludes that there are no vulnerabilities for building inleakage via roof penetrations from roof ponding.

2.1.11 Maximum Water Table

Based on UFSAR section 2.4.2.3.2, groundwater levels varied between about 5 feet to 18 feet below ground surface in the northern portion of the site. In the vicinity of the major plant structures, groundwater was determined to be about 20 feet below ground surface. Along the southern portion of the site, depth to groundwater is about 30 feet.

The local water table level fluctuates differentially depending on the amount of precipitation. It is also affected by level changes in the Connecticut River. Hydraulic gradients, as computed from water level elevations measured in monitoring wells, bedrock water supply wells and the river, demonstrate that groundwater flow in the overburden and bedrock is from west to east.

2.2 Assumptions

2.2.1 Wind Wave Activity

In assessing the effects of wave runup due to wind, several assumptions were made in the analysis and stated in the UFSAR. In order to assure conservatism and also meteorological consistency, the following sequence of events are postulated during the 72-hour rainfall period:

- A stationary north-south frontal system located west of the Connecticut River Valley produces heavy rainfall over the basin.
- The Probable Maximum Hurricane (PMH) moves northward off the eastern seaboard, makes landfall over Long Island and proceeds northward up the Connecticut Valley.
- The PMH strikes the plant site at 0 + 84 hours with maximum east-northeasterly winds consistent with overland modification.
- As the PMH moves north of the site, the precipitation ends with a windshift into the west.

2.2.2 Probable Maximum Flood

In assessing the PMF for the site, several assumptions were made in the analysis and stated in the UFSAR. The major emphasis in the computation of PMF on the Connecticut River Basin above Vernon, Vermont (drainage area of 6,266 square miles) was in the direction of conservatism. The following conservative assumptions were made:

- The maximum persisting 12-hour, 1000-millibar (mb) dew point temperature of record is used as an index of the maximum perceptible water. Furthermore, the 12-hour maximum persisting dew point was used throughout the 72-hour rainfall period.
- The unit of time selected for the unit hydrograph is 6 hours, although for a basin area of 6,266 square miles and a lag time of 75 hours, characteristic of the Connecticut River at Vernon, a more realistic unit of time for the unit hydrograph would be 12 hours.
- An infiltration rate of 0.05 inches per hour is assumed throughout the rainfall period, although the recorded range for this particular basin is 0.05-0.10 inches per hour.

- A base flow of 58,800 cfs, which is about 5.7 times the average discharge and greater than the annual peak discharge recorded in four of the 29-year period of record, and about twice the value which is normally used.

2.3 Methodology

Refer to section 2.1 for discussions on various flood hazard methodology and identification.

2.4 Non Conformance

UFSAR section 2.4.2.3.4 concludes that wave runup effects will be 0.2 feet (without breaking) on flood water surrounding the plant which may have depths varying from 0.25 to 0.5 feet. Therefore, the UFSAR considers the PMF stillwater level of 252.5 feet MSL as the peak of flooding. However, IPEEE section 5.2.1.1 indicates that while the NRC accepts the PMF analysis with a peak stage at the site of 252.5 feet MSL, it concludes that wave effects, including runup, could produce plant flooding at elevations as high as 254 feet MSL. During the course of this walkdown, the conservative value of 254 feet MSL was utilized. VYNPS has initiated actions to update controlled documents as needed to ensure consistency between the documents.

3.0 EXTERNAL FLOOD PROTECTION AND MITIGATION FEATURES

3.1 Flooding Licensing Basis

The equipment required for operation during a probable maximum flood include the RHR pumps and heat exchangers, the RHR service water pumps, a cooling tower cell, and the electrical and piping systems required for operation of these components. If normal electrical power is unavailable, diesel generators and fuel oil pumps are also required. The RHR pumps, the RHR heat exchangers, and RHR service water pumps are located within the Reactor Building. The diesel generators are located within the Turbine Building and the electrical equipment is located within the Turbine and Control Buildings. If normal electrical power is unavailable, diesel generators and fuel oil pumps supplied with fuel oil from the Fuel Oil Storage Tank (FOST) are also required. The fuel oil pumps are located within a structure which forms the tornado protection around the fuel oil tank. Since the entrances to all of these structures are at elevation 252.5 feet MSL, they are at maximum flood stage and thus, are protected against the maximum probable flood. These entrances are protected against wave run up to 254 feet MSL by sandbag and plywood barricades emplaced per the Natural Phenomena procedure.

The curb around the cooling tower basin is at elevation 250.5 feet MSL. The basin will be inundated by the flood, but since no active components are within the basin, there should be no interruption of cooling water flow. All yard valves will have been lined up to permit alternate cooling water system operation by the time the flood stage reaches 237.0 feet MSL, the point at which the station would have to be shut down due to inundation of the circulating water pump motors. Service water pumps would provide for normal reactor cooling. Alternate Cooling Water System would be put into service from within the station to provide for reactor cooling when the river level exceeds 237 feet MSL and the SW pump motors are unavailable. The

PMF stillwater level is essentially above the top of most yard electrical manholes at elevation 252.5 feet MSL. A potential avenue of water intrusion into the Switchgear Room, elevation 248.5 feet MSL exists through underground conduits routed from manholes and handholes to the Switchgear Room floor. Should water enter these manholes, the underground conduits could provide a path for water to enter the Switchgear Room manholes. If the water level gets high enough, flooding in the Switchgear Room and lower levels of the administration and Turbine Building could occur. This flooding could affect the operability of safety class switchgear. To preclude, or reduce, the amount of water entering the Switchgear Room manholes through the underground conduits which extend from the yard manholes, these conduits have been sealed and are inspected each year for any non-conforming degradation per plant procedures. In conjunction with the conduit sealing, sufficient portable pumping capacity is available on-site to remove any water which may enter the Switchgear Room manholes. Additionally, plant procedures direct personnel to pump out this water using staged, inspected and tested equipment as part of the site Natural Phenomena procedures. Another potential avenue of water intrusion into the Switchgear Room is a floor drain located in the East Switchgear Room at elevation 248.5 feet MSL that is connected to a floor drain outside the Administration Building. During PMF, water could backflow through this floor drain into the Switchgear Room. Both of these drains are plugged with pre staged plumbers plugs per the Natural Phenomena procedure.

3.2 Flood Duration

A duration for the PMF of the Connecticut River due to PMF or Dam Failure is not discussed in the plant's current licensing basis. However, per UFSAR table 2.4.9, sixty (60) hours after the peak elevation of 252.5 feet MSL, the elevation of the flood recedes below 237 feet MSL at which point no plant structures would be inundated by the flood.

3.3 Flood Protection Features

The UFSAR notes that entrances to all main plant structures, with the exception of the Intake Structure, are at or above elevation 252.5 feet MSL and therefore, are protected against the PMF. Above a flood elevation of 237.0 feet MSL, the pump motors in the Intake Structure (both service and circulating water) would be inoperable. The ACS is designed to provide necessary design basis cooling water in this case. The curb around the cooling tower basin is at elevation 250.5 feet MSL which is two (2) feet below the maximum PMF level. Even though the basin will be inundated for the PMF, the UFSAR notes that there should be no interruption of cooling water flow.

During the PMF, the Intake Structure floods out and Yard Manholes are below PMF grade. Conduits run from the Intake Structure and Yard Manholes back to manholes in the Switchgear Room. If the conduits are not watertight, flood waters could flow from the Intake Structure back into the Switchgear Room. The water-tightness of these conduits is important since the floor of the Switchgear Room is 4 feet below the PMF stillwater level. All conduits running into the Switchgear Room manholes connected to yard manholes and the Intake Structure are sealed to limit any leakage into the room during site flooding conditions. These flood seals are also inspected periodically to confirm the integrity and soundness of the seal per

plant surveillance procedures. The Natural Phenomena procedure also provides for the monitoring of the manholes in the Switchgear Room during flooding conditions and contains measures to address any minor leakage through the sealed conduits that could reach the Switchgear Room manholes.

The berm around the FOST moat is 4" inch above the grade elevation and therefore 2" below the PMF stillwater level of 252.5 feet MSL. It is likely that some minimal wave action would also occur at this location during the PMF that could reach 254 feet MSL. This could introduce flood waters into the moat area around the tank. In this case the east side of the transfer pump house could be flooded via a louvered door from the pump house into the moat area. To prevent this moat from being subjected to flooding due to a cliff edge effect, a sandbag barricade is erected around the perimeter of the FOST moat adjacent to the berm. Additionally precipitation accumulation in the moat may enter the pump house through the louvered door. To prevent the fuel oil transfer pumps from being flooded, the pump room is segregated by a partition wall with a top elevation of 252.5 feet MSL. All penetrations through this wall are sealed.

3.4 Procedures

3.4.1 Natural Phenomena

The purpose of the Natural Phenomena procedure is to provide guidance in the event that certain natural phenomena are imminent or have occurred. This procedure covers other external events in addition to external flooding. The entry into this procedure for severe weather that may lead to flooding is dictated by prediction of severe weather conditions by the National Weather Service for Windham and surrounding counties. Additionally, the procedure defines that indications that a natural phenomena event or severe weather is imminent or has occurred include:

- Receipt of a warning of impending electrical storm, hurricane, tornado, exceptionally high water, or exceptionally heavy rainfall, from Security, State or Local Emergency Management authorities or ISO New England.

- Report of high river water and high winds combining to produce severe wave action on Vernon Pond.

The procedure notes that the maximum river elevation of the Connecticut River will be 252.5 feet MSL occurring 96 hours after the beginning of the 72 hour probable maximum precipitation. This will cause the site to flood and wave action may cause the PMF level be 254 feet MSL.

The procedure outlines compensatory actions due to external flooding including: constructing sandbag barricades around all plant doors and entrances; a plywood barricade around the FOST moat perimeter; securing TBCCW sump pumps; installing plugs in the 4 kV Switchgear Room floor drain and the floor drain at the north door of the Service Building Addition; monitoring Switchgear Room manholes, monitoring CW and SW pump operation; and ACS startup.

There would be ample warning time before arrival of a PMF to implement the required actions in the procedure. Notification of dam failures is per TransCanada Hydro Northeast Inc. emergency action plan. Therefore, it is concluded that adequate warning time of a PMF or lesser flood capable of impacting any site structures will be available to perform the required actions.

3.5 Adverse Weather

No other adverse weather conditions were assumed concurrent with flood protection features and associated actions as part of the current licensing basis.

4.0 INTERNAL WARNING SYSTEMS

4.1 Room Water Level Warning Systems

No interior water level warning systems or alarms are credited for external flood protection in the plant's current licensing basis. However, Auxiliary Operators (AOs) perform walk downs one per 12 hour shift in the Switchgear and Fuel Oil Pump Building per plant procedures and any water inleakage would be observed and appropriate actions initiated.

5.0 EFFECTIVENESS OF FLOOD PROTECTION SYSTEMS

5.1 Acceptance Criteria

The flood protection features credited in the current licensing basis for VYNPS are incorporated passive, temporary passive, and temporary active features that include pipe and conduit penetration seals through exterior walls, floor drains, sandbag barricade erection, monitoring and pumping of switchgear room manholes, and ACS startup. These flood protection features were visually inspected or reasonably simulated in accordance with the acceptance criteria described in Section 6 of the NEI 12-07 document and as discussed below.

5.2 Discussion

5.2.1 Reactor Building

The Blockouts and pipe penetrations were inspected on the North, South, East, & West Reactor Building walls. A total of ninety-three (93) penetrations were walked down to confirm the presence and integrity of the flood seals.

One (1) penetration seal for pipe 12" CST-4 was found to have a discrepancy in the form of a ½" gap in the grout along the bottom of the pipe. The gap was found on the penetration through the south wall of the Reactor Building leading to the CST trench. This degradation of the seal was entered into the Corrective Actions Program (CAP) and a CR has been initiated. All other penetration seals were found to be in acceptable condition.

5.2.2 Turbine Building

The pipe and conduit penetrations through the floor of Emergency Diesel Generator (EDG) rooms A & B were inspected for flood seal presence and

integrity. Floor drains in the EDG Rooms A & B and the EDG Day Tank Rooms A & B were also walked down to ensure they were sealed around the drain and in good working order. A total of forty-seven (47) features were inspected in the Turbine Building. All penetration seals were found to be acceptable.

The floor drains in located in the both the EDG rooms as well as both the day tank room are cross connected with the floor drains in the boiler room. The egress to this drain system terminates at an always closed valve before exiting to the sewer drains. This valve is only opened after a chemistry reading is performed to ensure there is no contamination in the discharge. Therefore, external flooding cannot backflow into the EDG rooms at elevation 252.5 feet MSL.

If the boiler room were to flood, there exists a possibility that the floor drains could back up until the valve is opened to discharge the water. The drains in the EDG rooms and the Day Tank rooms do not have a check valve to prevent backflow. However, the nominal floor elevation in both the rooms is 252.5 feet MSL, and the site PMF is taken to be 252.5 feet MSL stillwater. As such, the water level in either room would not exceed this level and consequently no SSC's are affected.

5.2.3 Fuel Oil Storage Tank Pump Room

The pipe and conduit penetrations through the North, South, East, & West walls were inspected to confirm the presence and integrity of the flood seals. The separation wall between the east and west fuel oil transfer pump room was also inspected to ensure water could not inundate the west pump room if the fuel oil tank moat were to flood.

A total of sixteen (16) conduit and pipe penetration seals were inspected during the course of the walkdowns. Two (2) conduit penetration seals were found to be inconsistent with the acceptability criteria. The bottom half of the penetration seals around conduits 40270 and 44245-4S were broken off and minor leakage was observed. The conduits remained encased in concrete to create a seal from external ground water ingress into the Fuel Oil Pump Room. These degraded seals were entered into the CAP and a CR has been initiated. All other penetrations were found to be in acceptable condition.

The exterior door to the fuel oil pump room is located at elevation 252.5 feet MSL and is not credited as a flood protection feature. To mitigate any water inleakage through this door, a sandbag barricade is erected around this door per the Natural Phenomena procedure.

The FOST moat could also flood as the still water flood elevation of 252.5 feet MSL is above the 4" berm around the moat. This would allow flood waters to cliff edge into and fill the moat and allow water to propagate through a louvered door on the east side of the fuel oil pump room. This is mitigated by the emplacement of a sandbags/plywood barricade per the Natural Phenomena procedure to prevent still water and wave run up from entering the FOST moat. Additionally, the water level in the FOST moat will fill to the Max Probable Precipitation level. This level of approximately 14.5 inches identified in Table 1 of section 2.1.5 of this report will not

have an adverse impact on the FOST structure even if the FOST level is at suction elevation.

The current flood mitigation actions emplace a sandbag barricade around the Fuel Oil Pump Building door and the Fuel Oil Storage Tank moat. These actions will adequately protect the Fuel Oil Transfer Pumps from any site flooding.

5.2.4 Control Building

The conduit and pipe penetrations and floor cleanouts were walked down to confirm the presence and integrity of the flood seals. A total of forty-three (43) penetrations were inspected in the course of the walkdowns and found to be acceptable. A majority of these penetrations were above the flood elevation of 254 feet MSL and were inspected for Available Physical Margin (APM). No small margins were noted.

The exterior door in the east switchgear room is not credited as a flood protection door. To mitigate any flooding concerns, a sandbag barricade is erected around this door per the Natural Phenomena procedure. The six (6) manholes in the switchgear rooms contain conduits that communicate with the Yard and Intake Structure as well as the Reactor Buildings. The conduits leading to the Yard and Intake Structures are flood sealed at the manholes located outside the Control Building and inspected yearly in order to ensure the integrity of the seals.

During a PMF event, the manholes in the switchgear rooms are monitored for water inleakage and pumped using two gas operated pumps as required (section 5.2.6). The floor drain in the east switchgear room and outside the admin building door in close proximity to the west switchgear room door are also credited for being plugged with plumbers plugs to prevent backflow into the switchgear room. These plugs were inspected and found to be in good working condition.

5.2.5 Alternate Cooling System Startup

The ACS startup is credited in the licensing basis in case of loss of the intake structure. The alignment of the ACS is time credited to be performed in 120 minutes in the licensing basis. The most conservative case of advance warning for the loss of the intake structure as per the Natural Phenomena procedure is 9 hours to peak elevation due to the failure of the Townshend dam.

Reasonable simulation of the ACS start up is credited to a timeline validation performed by plant personal with the resident NRC inspector on 06/09/2011. Additionally, each valve in the ACS system is fully stroked once per cycle per the plant In-service Testing Program (IST) or system valve operability tests. This incorporated active flood protection feature is considered acceptable.

5.2.6 Switchgear Room Manhole Pumping

Per Natural Phenomena procedure, the switchgear room manholes are monitored for water inleakage and two portable pumps are staged with rigid suction hoses to pump water as required. Credit is taken for the 2 year preventative maintenance performed on the Porta-Pumps 1A/1B on date 06/28/11. During this preventative

maintenance, both pumps were successfully staged and operated for 30 minutes. Additionally, the hoses were inspected and found to be in good working condition. It is concluded that this temporary active flood protection feature is considered acceptable.

5.2.7 Sandbag Barricades

The Natural Phenomena procedure instructs that sandbag barricades be erected around the external switchgear room double doors, the fuel oil pump house single door, and any additional critical openings into the Turbine and Administrative Buildings to provide protection from flooding to an elevation of 254 feet MSL. Additionally, the FOST moat is protected from being inundated by flood waters by emplacing a plywood barricade fortified with sandbags around the perimeter of the moat. Per the Natural Phenomena procedure, the sandbags and plywood are pre-staged on pallets and protected by tarps in close proximity to each location where the barricades must be emplaced. Per EN-DC-170, this temporary passive flood protection feature must be simulated to ensure it can be enacted in the time credited and will perform its intended function.

This temporary passive flood protection feature was reasonably simulated by emplacing 300 sandbags to construct a 2 ft high berm (top elevation 254 feet MSL) around the external switchgear room double doors. This action is not considered time critical because during a PMF event that may necessitate the emplacement of these barricades, the warning of the event would be received well in advance. The simulation was successfully performed and this flood protection feature is considered acceptable.

During the simulation, four (4) personnel successfully erected a barricade within a short time period. Using the simulation as a reference, it is postulated that VYNPS possesses adequate pre-staged materials and can perform the actions required in the Natural Phenomena procedure to protect VYNPS from any site flooding up to elevation 254 feet MSL.

Initially, this procedure was identified as deficient as the specific sandbag locations, sandbag construction, and layout details were not identified. Additionally, the location of the sandbags and the sandbag filling machine credited for creating the sandbags for emplacements were not identified in the procedure and were located off-site. During a PMF event, the roads leading to the plant could be washed out and the transportation of the empty sandbags and the sandbag filling machine could be impacted. VYNPS was notified of these shortfalls and the discrepancy was entered into the CAP and a CR was initiated and resolved. A new revision of the Natural Phenomena procedure addresses these shortfalls and led to the successful simulation of this flood protection feature.

5.2.8 Other SSC's & Procedures

Although not credited in the current licensing basis, the Reactor Building and the Fuel Oil Storage Tank Moat are equipped with floor drainage systems. Water entering these structures would flow across sloped floors and enter the floor drainage systems to be collected in sumps at the bottom floor elevations. However, per Section 2.4 of the UFSAR, no credit was taken for the lowering of water levels

by the operation of the floor drainage system. The floor drainage system would assist in the lowering of water levels caused by in-leakage at VYNPS and would prevent water from pooling inside structures. Additionally, site drainage would be assisted by storm drains located around the plant structures, but are not credited in the UFSAR.

6.0 IMPLEMENTATION OF WALKDOWNS

6.1 NEI-12-07 Guidance

The verification walkdowns were performed in accordance with the NRC endorsed guidance of NEI 12-07, Rev. 0A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" dated May 31, 2012, and Entergy Nuclear procedure EN-DC-170 that was developed to provide instructions for implementation of the NRC endorsed guidelines. Additional guidance for implementation was also obtained from the Flooding Walkdown Frequently Asked Questions (FAQs) and NRC responses, which are based on discussions between NEI and the NRC.

The basis for establishing the walkdown scope and the flood protection features included the preparation of a walkdown list in accordance with the guidance provided in Section 4 of NEI 12-07. As part of this preparation, the current licensing basis was reviewed to determine the flood protection features and actions that are necessary to prevent an external flooding event at the site from adversely impacting safety-related SSCs. In addition to the identification of passive and active protection features, existing site and Entergy Corporate procedures were reviewed to determine if any procedures were necessary to ensure existing flood protection features would be functional in the event of a flood at the site.

Walkdown packages were prepared in accordance with the guidance provided in Section 5.2 and walkdown team personnel were selected based on the requirements provided in Section 5.3 of NEI 12-07.

Prior to each walkdown, a pre-job brief was conducted. All walkdown results were documented in accordance with the recommendations of Section 7 of NEI 12-07 on the Flooding Walkdown Record Form provided in Attachment 9.3 of EN-DC-170. The walkdown record form provided in Attachment 9.3 is consistent with the record form template provided in Appendix B of NEI 12-07.

6.2 Team Organization

Consistent with Section 5.3 of NEI 12-07, the walkdown team consisted of two (2) teams of two (2) trained individuals with a complementary set of skills. The walkdown teams consisted of two degreed engineers (or equivalent) with site familiarity. The walkdown teams were supplemented as required by plant maintenance and/or operations personnel.

6.3 Training Approach

Consistent with Section 5.3 of NEI 12-07 and Section 4.1 of EN-DC-170, personnel selected to perform walkdown inspection activities were experienced and knowledgeable of the site current licensing basis. Personnel were also trained to perform the visual

inspections and met the knowledge requirements specified in EN-DC-170 and Appendix C of NEI 12-07. Team members associated with the flooding walkdowns also satisfactorily completed the NANTEL Generic Verification Walkdowns of Plant Flood Protection Features lesson and were knowledgeable of the 50.54(f) letter dated March 12, 2012.

Plant maintenance and/or operations personnel who supplemented the walkdown teams were not required to be qualified to the aforementioned requirements.

7.0 WALKDOWN RESULTS

A total of 220 walkdown packages were associated with the walkdowns completed at VYNPS. Each walkdown feature was broken down into a flood protection type (incorporated passive, temporary passive, incorporated active, and temporary active) as shown in the table below.

Table #2 : Summary – Features Included in the Walkdown Scope

Flood Protection Type	Total Number of Features
Passive – Incorporated	217
Passive – Temporary	1
Active – Incorporated	1
Active – Temporary	1

7.1 Deficiencies

Based on the definition of deficiency provided in Section 3.8 of NEI 12-07, Rev 0A, a deficiency exists when a flood protection feature is unable to perform its intended flood protection function when subject to a design basis flooding hazard.

During the walkdowns at VYNPS multiple observations, as described below, were made which were determined to not meet the acceptance criteria stated in Section 5.1. Based on the CR operability determination in the CAP, no flood protection features were determined to be non-functional and no deficiencies were observed.

7.2 Observations

All observations due to a potential deficiency on the site were input into the corrective action program and an operability determination associated with the observation was completed prior to this report being written. Based on the operability determinations, none of the flooding conditions observed during the walkdowns were determined to pose a risk to the safe operation of the plant and no safety-related or safe-shutdown equipment is adversely impacted by these conditions.

7.3 Corrective Actions

7.3.1 12" CST-4 Pipe Penetration – Reactor Building South Wall

A gap below pipe 12" CST-4 penetrating through the south Reactor Building wall from the CST Trench was observed. Engineering judgment has determined that

the 1/2" concrete spalling below the 12"CST-4 penetration between the CST pipe trench in the CST Court yard, will not create a flood path that has adverse consequences to RB Torus basement flooding. The surface spalling does not go the length of the pipe penetration and negate the credited flood seal within the CST pipe trench. A work order has been generated in order to repair the gap. The pipe and seal have been determined to meet all Design Basis Requirements and the flood protection feature is considered functional.

7.3.2 4" Conduit Penetrations – Fuel Oil Transfer Pump Room

An observation was made that the conduit penetration seals through the Fuel Oil Transfer Pump Room west wall were degraded. A work order has been generated in order to repair the seals. It has been determined that the conduit seals meet all Design Basis Requirements and are considered functional.

7.3.3 Natural Phenomena Procedure

A discrepancy in the Natural Phenomena procedure relating to the erection of sandbag barricades was identified. The Natural Phenomena procedure relating to the erection of sandbag barricades has been enhanced to provide specific detailed guidance to emplace sandbag barriers. This action has been completed and the procedure is issued. A reasonable simulation of the emplacement of sandbags in accordance with the revised procedure has been successfully completed.

7.4 Flood Protection Features not Inspected

No inaccessible or restricted access flood protection features were identified during the walkdowns at VYNPS.

8.0 AVAILABLE PHYSICAL MARGIN

As indicated in Section 3.12 of NEI 12-07, Rev. 0A, the NRC is no longer expecting the Recommendation 2.3: Flooding Walkdowns to include an evaluation of the cliff-edge effects at the site. The available physical margin (APM) has been determined and documented on the walkdown record forms. The APMs provided on the walkdown record forms will allow flood hazard reevaluations performed in response to Recommendation 2.1: Flooding to be completed.

No available physical margins documented in the record forms were considered to be small APM's at VYNPS.

9.0 NEW FLOOD PROTECTION SYSTEMS

At the time of this report, no new flood protection systems are being considered at VYNPS.

10.0 REFERENCES

10.1 NRC Letter to Licensees, dated March 12, 2012, "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 Daiichi Accident."

10.2 Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features (NEI 12-07 [Rev. 0-A]), NEI, dated May 2012.

10.3 EN-DC-170, "Fukushima Near Term Task Force Recommendation 2.3 Flooding Walkdown Procedure"

10.4 Vermont Yankee Nuclear Power Station UFSAR, Rev 25

10.5 Vermont Yankee Individual Plant Examination External Events (IPEEE), Rev 02

11.0 ATTACHMENTS

None