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Post Fukushima Flooding Walkdown Report for Callaway Energy Center

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WESTINGHOUSE ELECTRIC COMPANY LLC

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RECORD OF CHANGES

Document Number: PEUS-WR-12-4 **Revision No.:** 1

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CHANGE NUMBER	PARAGRAPH NUMBER	CHANGE DESCRIPTION AND REASON
0		Original Issue.
1		Incorporate Westinghouse Electric Company LLC. Licensing review comments.

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1.0 PURPOSE

This walkdown report is prepared for Callaway Energy Center (Callaway). It documents the results of the external flood verification walkdown of permanent Structures, Systems, and Components (SSCs), portable flood mitigation equipment, as well as the procedures used to monitor and adjust the operation of the plant during an external flood event, and the plant topography as credited in the Current Licensing Basis (CLB) in accordance with the guidance of NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" (Reference 4.1). The walkdown was conducted in response to enclosure 4 of the letter dated March 12, 2012 from the U. S. Nuclear Regulatory Commission (NRC) requesting information pursuant to Title 10 of the Code of Federal Regulations (CFR), Section 50.54(f) (Reference 4.2; herein 10 CFR 50.54(f)), which resulted from recommendation 2.3 of SECY 11-0137, ML11272A111, "Prioritization of Recommended Actions to be taken in Response to Fukushima Lessons Learned" (Reference 4.3) prepared by the Near-Term Task Force (NTTF) review of insights from the Fukushima Dai-ichi accident. Safety-related SSCs and procedures that are credited in the CLB for protecting the plant from external flood have been identified, inspected, either through physical walkdowns or review of prior inspection documentation, and then compared to the documented acceptance criteria identified for the walkdown.

2.0 BACKGROUND

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

In response to the nuclear fuel damage at Fukushima Dai-ichi due to earthquake and subsequent tsunami, the NRC requested information pursuant to 10 CFR 50.54(f), ML12053A340, "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" (Reference 4.2). As part of this request, licensees were required to perform walkdowns to verify that plant features credited in the CLB for protection and mitigation from external flood events are available, functional, and properly maintained.

NEI prepared NEI 12-07 (Reference 4.1), as guidance for performing the external flooding walkdowns and completion of the walkdown report. Subsequently, NEI received endorsement of the document by the NRC. NEI then issued NEI 12-07 (Reference 4.1; herein NEI 12-07), incorporating NRC comments. To aid in the clarification of the guidance after the release of Rev. 0-A, the NEI Fukushima Flooding Task Force (FFTF) developed a Flooding Guidance Inquiry Process. The FFTF responses to each inquiry were evaluated by the Callaway walkdown team and incorporated in the walkdown process, when appropriate.

Section 5.0 provides the direct responses to the NRC requested information items in Reference 4.2 using the guidance in Appendix D of NEI 12-07.

3.0 ACRONYMS

APM	Available Physical Margin
CAP	Corrective Action Program
CAR	Callaway Action Request
CBT	Computer-based Training
CFR	Code of Federal Regulations
CLB	Current Licensing Basis
ESWS	Essential Service Water System
FFTF	Fukushima Flooding Task Force
FSAR	Final Safety Analysis Report
GDC	General Design Criteria
GW	Ground Water
MSL	Mean Sea Level
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
NTTF	Near-Term Task Force
PM	Preventative Maintenance
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
RIS	Regulatory Issue Summary
SA	FSAR - Callaway Site Addendum
SC1	Seismic Category 1
SNUPPS	Standardized Nuclear Unit Power Plant System
SP	FSAR - SNUPPS Standard Plant
SSC	Structures, Systems, and Components
UHS	Ultimate Heat Sink
WdRF	Walkdown Record Form

4.0 REFERENCES

4.1 NEI 12-07, Rev. 0-A, “Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features,” Rev. 0-A, Nuclear Energy Institute, May 2012.

4.2 NRC, “Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident,” U.S. Nuclear Regulatory Commission, March 12, 2012, (ML12053A340) (See Enclosure 4 - Recommendation 2.3: Flooding).

4.3 SECY-11-0137, “Prioritization of Recommended Actions to be taken in Response to Fukushima Lessons Learned,” U.S. Nuclear Regulatory Commission, October 3, 2011 (ML11272A111).

4.4 Regulatory Issues Summary 2005-20, Rev. 1, U.S. Nuclear Regulatory Commission, “Revision to NRC Inspection Manual Part 9900 Technical Guidance, Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety,” (ML073531346).

4.5 NEI letter to Fukushima Points of Contact, “Guidance for Operability Determinations Resulting from Findings during Seismic and Flooding Walkdowns,” July 18, 2012.

4.6 Callaway Plant - Final Safety Analysis Report (FSAR) - Callaway Site Addendum – SA, Rev. OL-19a, July 2012.

4.7 Callaway Plant - Final Safety Analysis Report (FSAR) - SNUPPS Standard Plant – SP, Rev. OL-13, May 2003.

5.0 NRC REQUESTED INFORMATION

Enclosure 4 of the 10 CFR 50.54(f) March 12, 2012 letter on NTTF recommendations from the Fukushima Dai-ichi Accident contains requests for information related to the results of the CLB external flooding walkdowns. This section is organized according to Appendix D of NEI 12-07.

5.1 Item 2.a: "Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress."

Callaway Energy Center Response:

The derivation and basis for flood elevations at the Callaway site are discussed in Section 2.4 of Reference 4.6. The grade elevation of the plant structures is Elevation 840.0 feet Mean Sea Level (MSL) which correlates to a Standardized Nuclear Unit Power Plant System (SNUPPS) Standard Elevation of 1999.5 feet, which is well above the Probable Maximum Flood (PMF) elevation of 548.0 feet MSL on the Missouri River.

The CLB does not document assumed flood duration, but describes a conservative ponding level of 6 inches above grade during a Probable Maximum Precipitation (PMP) event. PMP flood duration of 6 hours is based on Reference 4.6 (Section 2.4). This event produces the PMF at Callaway site.

The following external flooding mechanisms were evaluated and/or screened out in the CLB.

Probable Maximum Precipitation (PMP): The probable maximum precipitation at the greatest rate of intensity is 25.4 inches in 6 hours on an area of 75 acres in the Callaway Energy Center vicinity according to "Callaway Plant - Final Safety Analysis Report (FSAR) - Callaway Site Addendum – SA, Rev. OL-19a" (Reference 4.6, Section 2.4). This is the bounding PMF event at Callaway site.

PMP Key Assumptions:

1. "Callaway Plant - Final Safety Analysis Report (FSAR) - SNUPPS Standard Plant – SP, Rev. OL-13" (Reference 4.7, Section 2.4.2.3.2) assumes that site drainage and plant yard grading are designed to handle the runoff from local winter PMP without endangering safety-related structures. In establishing the required grading and outlets, clogging of inlets and certain size culverts by ice is assumed in the design.

2. Reference 4.6 (Section 2.4.2.3.2) states that for the PMP event, the Unit 2 excavation is conservatively assumed to be completely filled and is, therefore, not credited for storm water runoff retention. Roof-drain design of safety-related structures for locally intense precipitation as severe as that of the PMP is provided so that safety-related facilities would not be affected. It was also conservatively assumed that all runoff due to the PMP would flow over the peripheral roads. Local PMP flows over the peripheral roads were estimated

using a broad-crested weir formula with an assumed coefficient of discharge of 2.5.

3. Reference 4.6 (Section 2.4.2.3.2) states that the maximum runoff coefficient assumed for a recurrence interval of 100 years for the site area under natural drainage conditions is estimated at 0.86, based upon a detailed development of the rational method by M. Barnard in 1938.

4. Reference 4.6 (Section 2.4.2.3.2) states that for evaluating potential local flooding conditions in the plant site area from a local PMP event, the plant area was divided into several drainage areas. Since a reliable recurrence interval cannot be associated with the PMP event, precipitation losses were not estimated and an extremely conservative assumed runoff coefficient value of unity was selected for design purposes.

5. Reference 4.6 (Section 2.4.2.3.3) states that to provide a conservative structural design for the roofs of safety-related buildings, it was assumed that the extreme winter-month snowpack weight is the antecedent condition to the superimposed maximum winter-month PMP with a duration of 48 hours. The weight (no losses assumed) of the 48-hour maximum winter-month PMP is 102.4 pounds per square foot (psf). As the amount of icing in this area is anticipated to be small, it would not contribute significantly to the total snow load considered. This is particularly apparent in comparison with the 48-hour PMP value used, which is extremely conservative. Consideration was also given to assume coincident instantaneous melting of the estimated monthly antecedent snowpack condition.

Flooding in Streams and Rivers: The riverine flooding mechanism was screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Dam Breach and Failures: The dam breach/failure flood mechanism was screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Storm Surge and Seiche Flooding: The storm surge flood and seiche flooding mechanisms were screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Tsunami: The tsunami flood mechanism was screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Ice Induced Flooding: The ice induced flood mechanism was screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Channel Migration or Diversion: The channel migration/diversion flood mechanism was screened out as not a feasible event at Callaway Energy Center as discussed in Reference 4.6 (Section 2.4).

Ground Water Intrusion: The ground water intrusion flood mechanism was evaluated for Callaway Energy Center and resulted in a flood level of 840.00 ft MSL, which represents actual plant grade according to Reference 4.7 (Table 3.4-1), or a reference (SNUPPS) plant grade of elevation 1999.50 ft. Safety-related plant structures are conservatively designed for hydrostatic loads with the design basis Ground Water (GW) at SNUPPS elevation 2000.0 feet.

5.2 Item 2.b: "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."

Callaway Energy Center Response:

Water level (flood) protection and mitigation features considered in the licensing basis evaluation to protect against external ingress of water into the SSCs important to safety are defined in Reference 4.6 (Section 3.4) and Reference 4.7 (Section 3.4). The Callaway flooding licensing basis is applicable for all plant configurations and modes of operation including no mode. The Callaway flooding licensing basis is due to PMP and GW only. Thus, the design basis flood remains constant regardless of configurations or modes of operation.

The following list is a brief summary of walkdown features that were inspected at site.

5.2.1 Incorporated Passive Features:

Incorporated passive features were included within the scope of the flooding walkdown:

Ceilings

Earthen Features

Exterior Walls

Floors

Interior Walls

Penetrations

Roofs

Sumps

Topography

5.2.2 Incorporated Active Features:

Incorporated active features were included within the scope of the flooding walkdown:

Doors

Manhole Covers

5.2.3 Temporary Passive Features:

No temporary passive features are credited for external flood protection.

5.2.4 Temporary Active Features:

No temporary active features are credited for external flood protection.

5.2.5 External Flood Response Procedures:

No operator actions are credited for external flood protection.

5.2.6 Weather Conditions or Flood Levels that Trigger Procedures:

Callaway does not have administrative controls (i.e., procedures) or temporary plant equipment (e.g., portable pumps, sandbags, temporary barriers, etc.) that are credited to protect or mitigate the effects of the external flooding event.

No weather conditions or flood levels trigger procedures or associated actions for providing flood protection and mitigation.

5.2.7 Conditions Assumed Concurrent with Flood Protection Features:

Adverse weather conditions assumed to occur are PMP along with the associated increase in ground water as the only sources of external flooding consideration.

5.2.8 Flood duration assumed in the CLB:

The CLB does not document assumed flood duration, but describes a conservative ponding level of 6 inches above grade during a PMP event. PMP flood duration of 6 hours is based on Reference 4.6 (Section 2.4).

5.3 Item 2.c: "Describe any warning systems to detect the presence of water in rooms important to safety."

Callaway Energy Center Response:

Room water level warning systems are not credited for flood protection in the plant's external flooding licensing basis.

5.4 Item 2.d: "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 as part of Requested Information item 1.h."

Callaway Energy Center Response:

The acceptance criteria for the walkdowns are described in Section 6 of the guideline (NEI 12-07, Reference 4.1). This approach is consistent with requested information item 1.h of the 50.54(f) letter (Reference 4.2). The

flood protection systems and incorporated flood barriers were evaluated using these acceptance criteria as documented in Part B.1, Visual Inspection, Question Q1 of the NEI 12-07, Appendix B, Walkdown Record Forms (WdRFs). Callaway Action Requests (CARs) were generated for potential problems that require further evaluation.

The purpose of the 2.3 Flooding Walkdowns (Reference 4.2, Enclosure 4) is to verify the conformance with the CLB; the adequacy of the CLB will be addressed as part of the 2.1 Flooding Hazard Reevaluations (Reference 4.2, Enclosure 2) if an integrated assessment is required.

According to procedures and methodology written in Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features, NEI 12-07 (Rev. 0-A), May 2012, and 10 CFR 50.54(f) Enclosure 4, NTTF Recommendation 2.3, the walkdown visual inspection has verified that the Callaway site permanent safety-related SSCs are acceptable, not degraded, and capable of performing their design function as credited in the CLB.

Overall, the external flood mitigation features described in the plant's CLB are effective and any discrepancies are noted in CARs as summarized in Table 1.

5.5 Item 2.e: "Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures,) using the documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review."

Callaway Energy Center Response:

Guidance provided in NEI 12-07, Rev. 0-A (Reference 4.1), was followed. There were no exceptions taken to the guidance.

Preventative Maintenance (PM) activities of flood protection features were reviewed to ensure the flood protection function is adequately maintained. However, if the feature was readily accessible, a Walkdown Record Form was also completed.

5.5.1 Walkdown Teams

Callaway Energy Center Response:

The Walkdown Team consisted of seven Westinghouse personnel qualified to perform the walkdowns in accordance with the requirements of NEI 12-07.

Each team member was trained according to a training program designed to meet the requirements of Section 5.3 and Appendix C of NEI 12-07. The training program was composed of computer-based training (CBT), NANTeL training, experience based training (i.e., training matrix), and classroom training.

This qualification program resulted in a walkdown team comprised of individuals who were knowledgeable in the site current licensing basis and experienced and/or trained to perform visual inspections of plant flood protection and mitigation.

The walkdown was executed with two walkdown teams consisting each of one Westinghouse Engineer, two Westinghouse QC Technicians, and one Callaway Engineer. Job oversight consisted of one Westinghouse Walkdown Team Leader.

5.6 Item 2.f: "Results of the walkdown including key findings and identified degraded, nonconforming, 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, Revision 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."

Callaway Energy Center Response:

Walkdown observations were entered into the Corrective Action Program. The observations were reviewed through site processes in accordance with Regulatory Issues Summary 2005-20, Rev. 1 (Reference 4.4). The reviews determined Callaway site flood protection features would be capable of performing their intended flood protection function if subjected to a design basis flooding hazard. No flooding walkdown observations were deemed to be a deficiency per Section 3.8 of NEI 12-07.

Table 1 lists and describes conditions documented in CARs as external flooding mitigation deficiencies.

Table 1: Conditions documented in CARs as external flooding mitigation deficiencies

Feature Description	Building	Elevation	Walkdown Observation Description
Piping Penetration Seal	ESWS Pump House	El. 1993'-0"	Observed absorbent socks installed on perimeter of gap between pipe OD and wall penetration
Cooling Tower Pipe	UHS Cooling Tower	El. 1997'-6"	Ponding Near Drain/Standing water in drain
Cooling Tower Pipe	UHS Cooling Tower	El. 1997'-6"	Ponding on floor and in drain (under grate)
Piping Penetration Seal	Control Building	El. 1987'-6"	Significant staining around penetration with mineral accumulation
Piping Penetration Seal	Control Building	El. 1987'-6"	Significant staining around penetration with mineral accumulation
Piping Penetration Seal	Control Building	El. 1987'-6"	Significant staining around penetration with mineral accumulation
Piping Penetration Seal	Control Building	El. 1987'-6"	Active leakage - water stains
Unit 1 - East Exterior Wall	Auxiliary Building	El. 1974'-0"	Water staining on seam of wall with mineral buildup/accumulation at seam
Piping Penetration Seal	Auxiliary Building	El. 1991'-0"	Observed water & corrosion / leakage around seal penetration
Piping Penetration Seal	Auxiliary Building	El. 1993'-8"	Air movement evident through gap between sleeve and pipe
Piping Penetration Seal	Auxiliary Building	El. 1992'-1"	Rubber 'boot' seal has a tear at the 2 o'clock position - noticeable air movement through tear
Piping Penetration Seal	Auxiliary Building	El. 1993'-7"	Boot type seal around pipe has a tear at the 10 o'clock position about 3/4" long
Piping Penetration Seal	Auxiliary Building	El. 1991'-0"	Significant water stains below penetration

Note: There were no deficiencies that required an operability determination in accordance with Regulatory Issues Summary 2005-20, Rev. 1 (Reference 4.4) and NEI Guidance for Operability Determinations Resulting from Findings during Seismic and Flooding Walkdowns (Reference 4.5).

5.6.1. Flood protection features that could not be inspected

Callaway Energy Center Response:

5.6.1.1. Features affected by restricted access are listed in Table 2:

- Justification for delay -
  Walls / floor of sumps listed in Table 2 due to covers in place.
- Schedule -
  CAR issued to inspect at a future date.
- Any necessary special procedures -
  None.

Table 2: Flood protection features that could not be inspected

Feature Description	Building	Room #	Elevation
Sump	Control Building	3101	El. 1974'-0"
Sump	Control Building	3101	El. 1974'-0"
Sump	Fuel Building	6104	El. 2000'-0"
Sump	Fuel Building	6105	El. 2000'-0"
Sump	Fuel Building	6105	El. 2000'-0"

5.6.1.2. Inaccessible features:

The following is a list of inaccessible features including a 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:

- Waterstops

  Waterstops were designed to be embedded at all construction joints below SNUPPS elevation 2000 feet in the Seismic Category 1 (SC1) buildings according to Structural Design Specification for SC1 structures. The construction drawings, FSAR, and Design Basis Document all indicate that they were installed as designed. During the walkdowns of the rooms that contained walls joints in which waterstops were designed to be installed, there were no indications of in-leakage of water at those locations. Therefore, there is reasonable assurance that the feature is available and will perform its credited function.

5.6.2. Observations not entered into CAP at the time of the report.

Callaway Energy Center Response:

There are no observations relating to the flooding walkdown that had not been entered into the CAP at the time of the report.

5.6.3. Actions that were taken or are planned to address the deficiencies using guidance in Regulatory Issues Summary 2005-20, Rev. 1.

Callaway Energy Center Response:

All observations by the walkdown team were reviewed immediately by qualified plant personnel to determine if the observed condition required initiation of a CAR. Each observation that resulted in a CAR is considered a potential deficiency until a complete review/evaluation of each CAR is performed in accordance with site procedures to justify otherwise. However, as part of the CAR, operability was determined using the guidance of Regulatory Issues Summary 2005-20 (Reference 4.4) and NEI Guidance for Operability Determinations Resulting from Findings during Seismic and Flooding Walkdowns (Reference 4.5).

There is reasonable assurance that the flood protection features are available, functional, and capable of performing their specified functions as set forth in the CLB. The Callaway external flood protection features are effective and able to perform their intended flood protection function when subject to a design basis external flooding hazard. There are no observations relating to the flooding walkdown reported in the CAP that were determined to be a deficiency per Section 3.8 of NEI 12-07.

5.7 Item 2.g: "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."

Callaway Energy Center Response:

As discussed in Section 3.12 of NEI 12-07, the NRC is no longer expecting the Recommendation 2.3: Flooding Walkdowns of the 50.54(f) letter response to include an evaluation of cliff-edge effects.

Available Physical Margins (APMs) have been collected and documented in the Walkdown Record Forms. This information will be used in the Flood Hazard Reevaluations performed in response to Item 2.1: Flooding in the 50.54(f) letter (Enclosure 2 of Reference 4.2).

5.8 Item 2.h: "Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review."

Callaway Energy Center Response:

The walkdown team inspected all external flood protection / mitigation features determined to be credited in the Callaway CLB.

There are no other planned or newly installed flood protection systems or flood mitigation measures to further enhance the external flood protection at Callaway site.

All the Appendix B walkdown record forms (Part A through E) were peer reviewed per the guidance in NEI 12-07. The review was conducted by a member of the flooding walkdown team. The peer reviewer found all walkdown record forms in compliance with the NEI 12-07 guidance. The plant's response to any open issues which are outlined in Table 2 will be evaluated at a future date following the guidance contained in NEI 12-07.