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Wolf Creek Nuclear Operating Corporation Post Fukushima Flooding Walkdown Report

(17 pages)

Westinghouse Non-Proprietary Class 3

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**Wolf Creek Nuclear Operating
Corporation
Post Fukushima Flooding
Walkdown Report**



Westinghouse Non-Proprietary Class 3
WESTINGHOUSE ELECTRIC COMPANY LLC

Walkdown Plan Number PEUS-WR-12-5	Revision 1	Page 1
Project Post Fukushima Flooding Walkdown Report for Wolf Creek Nuclear Operating Corporation		Total No. Pages 16

**Title: Post Fukushima Flooding Walkdown Report for
Wolf Creek Nuclear Operating Corporation**

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CHANGE NUMBER	PARAGRAPH NUMBER	CHANGE DESCRIPTION AND REASON
A		Draft Issue
0		Original Issue
1		Licensing Review Comments



TABLE OF CONTENTS

1.0 PURPOSE.....4

2.0 BACKGROUND.....4

3.0 ACRONYMS.....5

4.0 REFERENCES.....6

5.0 NRC REQUESTED INFORMATION.....7

5.1 Item 2.a: "Describe the design basis flood hazard level(s) for all flood causing mechanisms, including ground water ingress"7

5.2 Item 2.b: "Describe protection and mitigation features that are considered in licensing basis evaluation to protect against external ingress of water into the SSCs important to safety"9

5.3 Item 2.c: "Describe any warning systems to detect the presence of water in rooms important to safety."11

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 a part of Requested information 1.h.11

5.5 Item 2.e: "Present information related to the implementation of the walkdown process. (e.g., details of the selection of the walkdown team and procedures,) using the documentation template discussed in Requested Information 1.j, including actions taken in response to the peer review."12

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."13

5.7 Item 2.g: "Document any cliff-edge effects identified in the associated basis. Indicate those that were entered into the CAP system. Also include a detailed description of the actions taken or planned to address these effects."15

5.8 Item 2.h: "Describe any planned or newly installed flood protection system or flood mitigation measures including flood barriers that further enhance the flood protection. Identify the results and any subsequent actions taken in response to the peer review."16



1.0 PURPOSE

This walkdown report is prepared for Wolf Creek Nuclear Operating Corporation (WCNOC) and documents the results of the external flood verification walkdown of permanent structures, systems, and components (SSCs), portable flood mitigation equipment, the procedures needed to install and/or operate them during an external flood, and the plant topography as credited in the current licensing basis (CLB) in accordance with the guidance of Nuclear Energy Institute (NEI) 12-07, Rev. 0-A (Reference 4.1), "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features." 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 CFR 50.54(f) (Reference 4.2), which resulted from recommendation 2.3 of SECY 11-0137 (Reference 4.3) presented by the Near-Term Task Force 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 and 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, tsunamis, and seiches without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to 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 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) (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, Rev. 0 (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, Rev. 0-A (Reference 4.1), 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 WCNOC 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
CBT	Computer-Based Training
CFR	Code of Federal Regulations
CLB	Current Licensing Basis
CR	Condition Report
ESW	Essential Service Water
FFTF	Fukushima Flooding Task Force
GDC	General Design Criteria
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
QC	Quality Control
RWST	Refueling Water Storage Tank
SNUPPS	Standardized Nuclear Unit Power Plant System
SPF	Standard Project Flood
SSC	Structures, Systems, and Components
UHS	Ultimate Heat Sink
USAR	Updated Safety Analysis Report
WCNOC	Wolf Creek Nuclear Operating Corporation
WCGS	Wolf Creek Generating Station
WEC	Westinghouse Electric Company



4.0 REFERENCES

- 4.1 NEI 12-07, Nuclear Energy Institute, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," Rev. 0-A, May 2012.
- 4.2 U.S. Nuclear Regulatory Commission, "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," March 12, 2012 (ML12053A340) (See Enclosure 4 - Recommendation 2.3: Flooding).
- 4.3 SECY-11-0137, U.S. Nuclear Regulatory Commission, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," 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 NUMARC 93-01, Nuclear Energy Institute, "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," Rev. 4A.
- 4.7 USAR – Wolf Creek Updated Safety Analysis Report. Revision 25 – March 2012.



5.0 NRC REQUESTED INFORMATION

Enclosure 4 of the March 12, 2012 50.54(f) letter on Near Term Task Force recommendations from the Fukushima Dai-ichi Accident contains requests for information related to the results of the flooding design basis 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 ground water ingress"

Wolf Creek Nuclear Operating Corporation Response:

The following flood mechanisms were evaluated and / or screened out in the current licensing basis. Wolf Creek Generating Station (WCGS) is a dry site (Probable Maximum Flood (PMF) below site grade) and safety-related SSCs are not affected by flooding. The design basis flood hazards and methodology are defined in Reference 4.7, Section 2.4. Flood duration is defined in Reference 4.7, Section 2.4.2.3.1. Two elevation datums are used in the WCGS USAR and design documents. Some elevations are in MSL (1929 Datum) and some elevations are in the SNUPPS datum. There is a 900.0 ft difference between them. All elevations listed in this report and attachments reference the SNUPPS datum. Subtract 900.0 from values given to obtain MSL equivalent.

The maximum calculated water level due to PMP near safety related plant buildings is less than elevation 2000.0 ft. which is the grade elevation of the powerblock seismic Category I structures. (Reference 4.7)

Probable Maximum Precipitation (PMP): The Plant Area at Wolf Creek is divided primarily into two Zones; Zone A and Zone B, based on the drainage characteristics of the site during PMP. The Maximum calculated water levels for Zones A and B are 1999.86 ft and 1999.68 ft respectively. Therefore, the safety related facilities at Wolf Creek Station are not affected by the local PMP per reference 4.7.

PMP Key Assumptions:

1. The site drainage system is assumed not functioning at the time of the PMP.
2. The rainfall on the roofs of the buildings is assumed to contribute to runoff without any retention.
3. No credit is taken for the roof drains in the local PMP analysis.
4. The local PMP runoff will flow away from the plant buildings by overflowing peripheral roads and railroad tracks.
5. The maximum water level near the safety related power block buildings is obtained by a backwater calculation starting from the water level upstream of the peripheral road or railroad calculated by assuming the peak runoff flows over the road or railroad as broad crested weir.
6. A standard project flood (SPF) has preceded the PMF, and due to this, initial loss (i.e., rainfall absorbed into the ground) for PMP was not considered.
7. A maximum 6 hr. rainfall of 28 inches and a maximum 1 hr. rainfall of 10.6 inches is assumed for PMP calculations.
8. The storage due to temporary ponding within the site is not considered.



Flooding in Streams and Rivers: The Flow of the Neosho River is controlled by three reservoirs above the site. Flooding on the Neosho River may back up the Wolf Creek Valley and reach the downstream toe of the non-safety cooling lake dam. However, flooding on the Neosho River is separated from any site facilities by a topographic ridge between the Neosho River Valley and the Wolf Creek Valley. In the Wolf Creek Valley the maximum flood design elevation of 1997.5 ft., resulting from the probable maximum flood routed through the cooling lake with coincident wave activity, is below the plant site grade of 1999.5 ft. per reference 4.7.

Dam Breach and Failures: The dam breach/failure flood mechanism was screened out as not a feasible event as discussed in Reference 4.7, Section 2.4.4.

Storm Surge and Seiche Flooding: The storm surge flood and seiche flooding mechanisms were screened out as not a feasible event as discussed in Reference 4.7, Section 2.4.5.

Tsunami: The tsunami flood mechanism was screened out as not a feasible event as discussed in Reference 4.7, Section 2.4.6.

Ice Induced Flooding: The ice induced flood mechanism was screened out as not a feasible event as discussed in Reference 4.7, Section 2.4.7.

Channel Migration or Diversion: Cooling water channels and reservoirs are defined in Reference 4.7, Section 2.4.8. Channel diversion is defined in Reference 4.7, Section 2.4.9.

Ground Water Intrusion: The ground water intrusion flood mechanism was evaluated for WCGS and resulted in a flood level of 1099.5 ft, which represents actual plant grade in mean sea level 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 at SNUPPS elevation 2000.0 feet.



5.2 Item 2.b: **“Describe protection and mitigation features that are considered in licensing basis evaluation to protect against external ingress of water into the SSCs important to safety”**

Wolf Creek Nuclear Operating Corporation 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 4.7, Section 3.4. The WCGS flooding licensing basis is applicable for all plant configurations and modes of operation including no mode.

All seismic Category I structures and the systems they house are designed to withstand the effects of natural phenomena, such as flooding and groundwater level (GDC-2). Flood elevations, including the probable maximum flood (PMF) and the maximum groundwater elevations used in the design of powerblock seismic Category I structures for buoyancy and hydrostatic pressure, are shown in Tables 1.2-1 and 3.4-1 of Reference 4.7 and are discussed in Section 2.4 of Reference 4.7.

5.2.1 Incorporated Passive Features:

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

- Topography
- Structures
- Floors
- Walls
- Penetrations
- Vaults
- Forebay

5.2.2 Incorporated Active Features:

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

- Doors
- Sump Pumps
- Sump Pump Motors



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

Wolf Creek does not have any 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

The following adverse weather conditions were assumed to occur coincident with the PMF.

Wind speed of 40 mph. See Reference 4.7, Section 2.4.3.6.



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

Wolf Creek Nuclear Operating Corporation 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 a part of Requested information 1.h.**

Wolf Creek Nuclear Operating Corporation Response:

The acceptance criteria for the walkdowns are consistent with Section 6 of the guideline (NEI 12-07). This approach is consistent with requested information item 1.h of the 50.54(f) letter. 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. WCGS Condition Reports were generated for potential observations that require further evaluation.

The walkdown visual inspection has verified that there is reasonable assurance the flood protection features are available, functional, and capable of performing their specified functions as set forth in the CLB. The Wolf Creek external flood protection features are effective and able to perform their intended flood protection function when subject to a design basis external flooding hazard.

The purpose of the 2.3 walkdowns is to verify the conformance with the CLB; the adequacy of the CLB will be addressed as part of the 2.1 flood reevaluations if an integrated assessment is required.



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

Wolf Creek Nuclear Operating Corporation Response:

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

PM activities of flood protection features were reviewed in accordance with NEI 12-07 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

Wolf Creek Nuclear Operating Corporation 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 or trained to perform visual inspections of plant flood protection and mitigation.

The walkdown was executed with two walkdown teams consisting of one Westinghouse Engineer, two Westinghouse QC Technicians, one WCGS engineer, and one WCGS assistant operator at a minimum.



- 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.”**

Wolf Creek Nuclear Operating Corporation 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 WCGS 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.

- 5.6.1 Flood protection features that could not be inspected, including

Wolf Creek Nuclear Operating Corporation Response:

5.6.1.1 Features affected by restricted access:

- The UHS Dam, Reservoir, ESW Pumphouse Forebay and Discharge Structure are considered restricted access and cannot be visually inspected during a physical walkdown. These features are normally under water and are inspected by divers as a SSC scheduled in the PM program. NRC Reg. Guide 1.127 states the frequency (performance to performance) for these inspections. These PMs meet those requirements.
- Licensing basis flood control features of ESW electrical manholes MHE1A, 2A, 3A, 4A, 5A, 1B, 2B, 3B, 4B, and 5B consist of interior waterstops at joints and an exterior seal at the manhole cover. A 6200lb concrete cover limits access to the interior of each manhole. Further, entry into the manhole requires de-energization of medium voltage cables for personnel safety. Therefore, a crane and an ESW train outage are required to inspect the internal walls of these manholes. Credit will be taken for existing inspections in lieu of a Fukushima flood inspection of the manhole interior.

The waterstop seals on the cover rely on caulking at the cover joint. This caulking must be reapplied each time the cover is lifted. There have been instances wherein the cover has not been properly resealed, and as a result, rainwater entered the manhole. The cover seals are observable without opening the manhole. Therefore, these seals were checked during Fukushima flooding walkdowns.



5.6.1.2 Inaccessible features:

- Room 1319 - Demineralizer Compartments South Wall

Room 1319 at 2000'-0" is considered inaccessible and cannot be visually inspected during a physical walkdown. Only the lower portion of the south wall is within scope. This room is entombed by the concrete wall and a line of 4'-0" Concrete Masonry Unit (CMU) shielding preventing personnel access. This room has remote cameras in it to support Health Physics monitoring. No evidence of external flood leakage has been seen from these cameras. The room slab is at grade 2000'-0" with the Hot Machine Shop on the adjoining wall. There is no evidence of damage to the walls made of similar construction in rooms adjacent to Room 1319 south wall. Therefore, there is reasonable assurance that the feature is available and will perform the external flood protection function for the full duration of the flood condition.

- Waterstops

Although not serving a safety-related function, waterstops and waterproofing materials were within the scope of the flooding walkdown review. Waterstops are considered inaccessible for walkdown being within building foundations as shown in Reference 4.7, Figure 3.4-1. Evidence of leakage in these areas would be an indication of ineffective or nonexistent waterstops. Walls and floors sealed by waterstops were included within the scope of the flooding walkdown. Waterstops were identified on drawings as expected.

- Sump Pumps

Credited sump pumps were inspected in accordance with the acceptance criteria. Disassembly of the motor and cover plate over the sump would have been required to inspect the pumps; therefore, the flow rating requirements were determined using documentation and name plate rating. Additionally, PMs were reviewed to ensure that the pumps are being maintained.



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

Wolf Creek Nuclear Operating Corporation 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.

Wolf Creek Nuclear Operating Corporation Response:

All observations by the walkdown team were reviewed immediately by qualified plant personnel to determine if the observed condition required initiation of a CR. Each observation that resulted in a CR is considered a potential deficiency until a complete review/evaluation of each CR is performed in accordance with site procedures to justify otherwise. As part of the CAP, 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 Wolf Creek 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 in the associated basis. Indicate those that were entered into the CAP system. Also include a detailed description of the actions taken or planned to address these effects.**

Wolf Creek Nuclear Operating Corporation 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 planned or newly installed flood protection system or flood mitigation measures including flood barriers that further enhance the flood protection. Identify the results and any subsequent actions taken in response to the peer review.”**

Wolf Creek Nuclear Operating Corporation Response:

A CAP plan is in progress to update existing external flood calculations. The results of the reanalysis will increase design margins to CLB limits.

A CAP plan is in progress to implement a modification that will relieve groundwater pressure from Power Block structures. Penetrations with a history of leakage will then be reworked or repaired.

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.