NEXTera ENERGY
DUANE ARNOLD

December 8, 2016

NG-16-0228
10 CFR 2.202

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Duane Arnold Energy Center
Docket No. 50-331
Renewed Op. License No. DPR-49

NextEra Energy Duane Arnold, LLC's Final Compliance with EA-12-051 Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation

References:
1) Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" dated March 12, 2012 (ML12054A682)
2) Letter, R. Anderson (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold, LLC's Overall Integrated Plan in Response to March 12, 2012 Commission Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," NG-13-0086 dated February 28, 2013 (ML13063A014)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1, an Order to all licensees including NextEra Energy Duane Arnold, LLC (hereafter NextEra Energy Duane Arnold). This Order was effective immediately and directed NextEra Energy Duane Arnold to have a reliable indication of the water level in the spent fuel storage pool for the Duane Arnold Energy Center (DAEC) as outlined in Attachment 2 of the Order. In Reference 2, NextEra Energy Duane Arnold submitted an Overall Integrated Plan for the implementation of this Order.

Condition C.3 of the Order requires all licensees to report to the Commission when full compliance with the requirements of the Order is achieved. This letter, along with its enclosure, provides the notification required by Section IV.C.3 of the Order that full compliance with the requirements described in Attachment 2 of the Order has been achieved for the DAEC.

A001
NRR

This letter contains no new regulatory commitments. If you have any questions or require additional information, contact Michael Davis at 319-851-7032.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on December 8, 2016.

T. A. Vehec
Vice President, Duane Arnold Energy Center
NextEra Energy Duane Arnold, LLC

Enclosure

cc: Regional Administrator, USNRC, Region III
Resident Inspector, USNRC, Duane Arnold Energy Center
Project Manager, USNRC, Duane Arnold Energy Center

Enclosure to NG-16-0228

NextEra Energy Duane Arnold, LLC's Final Compliance with EA-12-051 Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation

32 pages follow

NextEra Energy Duane Arnold, LLC
Duane Arnold Energy Center

Order EA-12-051 Compliance Requirements Summary

Background

NextEra Energy Duane Arnold, LLC (hereafter, NextEra Energy Duane Arnold) has installed SFP level monitors for the DAEC Spent Fuel Pool (SFP) in response to Order EA-12-051, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events." The information provided herein documents full compliance for the DAEC with the Order.

The DAEC SFPLI was supplied and qualified by Westinghouse LLC. The DAEC OIP was submitted to the NRC on February 28, 2013 and was supplemented by six-month status reports (References 4, 7, and 8), in accordance with Order EA-12-051. By letter dated November 26, 2013, the NRC provided its Interim Staff Evaluation and Request for Additional Information Regarding Order EA-12-051.

During the audit process, NextEra Duane Arnold, LLC provided responses for the RAIs. The NRC audit report (Reference 9) delineated the items reviewed during the DAEC onsite audit. The audit report identified no open audit items related to SFPLI.

The elements identified below, as well as the DAEC response submittal (Reference 1), the six-month status reports and the response to requests for additional information (enclosed), demonstrate the DAEC's compliance with Order EA-12-051 (Reference 2).

Milestone Schedule Items - Status: Complete

Milestone	Activity Status
Commence Engineering and Design	Complete
Complete Design	Complete
Complete Procurement of SFP Instruments	Complete
Complete Installation of SFP Instruments	Complete
Instruments Operational and Training Complete	Complete

Identification of Levels of Required Monitoring - Status: Complete

The DAEC has identified the three required levels for monitoring spent fuel pool (SFP) level in compliance with Order EA-12-051. These levels have been integrated into the site processes for monitoring SFP level during beyond design basis external events and responding to loss of SFP inventory.

Instrument Designed Features - Status: Complete

The design of the SFP level measurement instrumentation system installed at the DAEC complies with the requirements specified in Order EA-12-051 and described in NEI 12-02 "Industry Guidance for Compliance with NRC Order EA-12-051." The instrumentation system has been installed in accordance with the station design control process.

The instruments have been arranged to provide reasonable protection against missiles. The instruments have been mounted to retain design configuration during and following the maximum expected ground motion. The instruments will be reliable during expected environmental and radiological conditions when the SFP is at saturation for extended periods.

The instruments are independent of each other and have separate and diverse power supplies. The instruments will maintain their designed accuracy following a power interruption and are designed to allow for routine testing and calibration. The instrument display is readily accessible during postulated events and allows for SFP level information to be promptly available to decision makers.

Program Features - Status: Complete

The Systematic Approach to Training was utilized to develop and implement training. Training has been provided for applicable personnel in the use of, and provision of alternate power to, primary and backup instrument channels.

Operating and maintenance procedures for the DAEC SFP level instrument channels have been developed, and integrated with existing procedures. These procedures have been verified and are available for use in accordance with the site procedure control program.

Site processes have been established to ensure the instruments are maintained at their design accuracy.

REFERENCES

The following references support the DAEC SFPLI Compliance Summary:

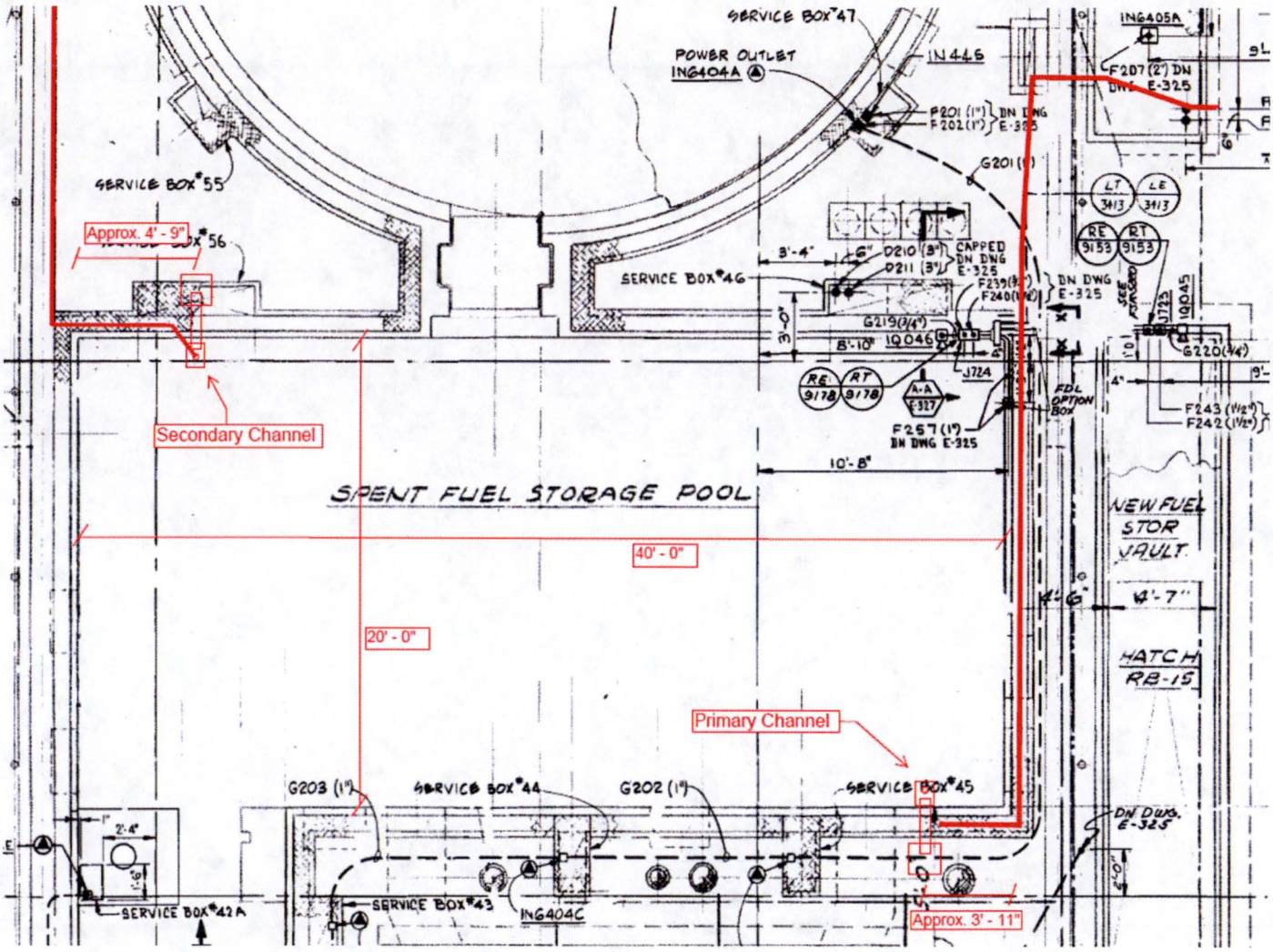
1) Letter, R. Anderson (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold, LLC's Overall Integrated Plan in Response to March 12, 2012 Commission Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," NG-13-0086 dated February 28, 2013 (ML13063A014)
2) Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" dated March 12, 2012 (ML12054A682)
3) Letter, R. Anderson (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "Response To Request For Additional Information Regarding Overall Integrated Plan In Response To Order EA-12-051," NG-13-0389 dated October 10, 2013 (ML13284A122)
4) Letter, T.A. Vehec (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold Energy Center, LLC's Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," NG-15-0280 dated August 27, 2015 (ML15243A033)
5) NRC Letter, "Duane Arnold Energy Center-Interim Staff Evaluation and Request For Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," dated November 26, 2013 (ML13323B443)
6) NRC Letter, "Correction Letter-Duane Arnold Energy Center Regarding Interim Staff Evaluation and Request for Additional Information for Reliable Spent Fuel Pool Instrumentation (Order EA-12-051)," dated January 17, 2014 (ML14007A215)
7) Letter, T.A. Vehec (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold Energy Center, LLC's Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," NG-16-0047 dated February, 2016 (ML16064A022)
8) Letter, T.A. Vehec (NextEra Energy Duane Arnold, LLC) to U.S. NRC, "NextEra Energy Duane Arnold Energy Center, LLC's Six-Month Status Report in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," NG-16-0168 dated August 31, 2016 (ML16246A006)
9) NRC letter, Duane Arnold Energy Center – Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Pool Instrumentation Related to Orders EA-12-049 and EA-12-051 (ML 16217A157)

DAEC RAI 1

Please modify the marked-up plant drawing of the plan view (in Section XVIII, Page 10 of 10) of the SFP area, to depict the SFP inside dimensions, the planned locations/ placement of the primary and back-up SFP level sensors, and the proposed routing of the cables that will extend from the sensors toward the location of the local electronics cabinets and read-out/display devices in the main control room or alternate accessible location.

Response

See the attached marked up drawing of BECH-E327 depicting inside dimensions of the Spent Fuel Pool (SFP), the locations of the Primary and Secondary SFP Level sensors, and the independent routes of the cables on the refueling floor. SFP level sensors have been located in opposite corners of the pool and cable routes have been kept independent and separated by at least the shortest length of the pool (20'-0") per the NEI 12-02 guidance.


SERVICE BOX*47
POWER OUTLET ING404A
IN446
ING405A
F207 (2") DN
E-325
P201 (1")
P202 (1")
DN DWG E-325
G201 (1")
SERVICE BOX*55
Approx. 4' - 9"
SERVICE BOX*56
SERVICE BOX*46
3'-4"
6"
D210 (3")
D211 (3")
CAPPED DN DWG E-325
F239(1")
F240(1")
DN DWG E-325
G219(3/4")
3'-0"
8'-10"
10046
J724
RE 9178
RT 9178
A-A E-327
F257 (1")
DN DWG E-325
FDL OPTION BOX
F243 (1 1/2")
F242 (1 1/2")
10'-8"
SPENT FUEL STORAGE POOL
40' - 0"
20' - 0"
Secondary Channel
NEW FUEL STOR VAULT
14'-7"
HATCH RB-15
Primary Channel
G203 (1")
SERVICE BOX*44
G202 (1")
SERVICE BOX*45
DN DWG. E-325
SERVICE BOX*42A
SERVICE BOX*43
ING404C
Approx. 3' - 11"

DAEC RAI 2

Please provide the following:

a) The design criteria that will be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology that will be used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

b) A description of the manner in which the level sensor (and stilling well, if appropriate) will be attached to the refueling floor and/or other support structures for each planned point of attachment of the probe assembly. Indicate in a schematic the portions of the level sensor that will serve as points of attachment for mechanical/mounting or electrical connections.

c) A description of the manner by which the mechanical connections will attach the level instrument to permanent SFP structures, to support the level sensor assembly.

Response

a) The SFPLI system is designed in accordance with requirements that envelope the DAEC DBE.

The vendor, Westinghouse, has evaluated the structural integrity of the pool-side mounting brackets in calculation CN-PEUS-15-09. Other brackets were subjected to testing. The GTSTRUDL model, used by Westinghouse to calculate the stresses in the bracket assembly, considers load combinations for the dead load, live load and seismic load on the bracket. The reactionary forces calculated from these loads become the design inputs to design the mounting bracket anchorage to the refuel floor.

Seismic

The OBE loads are obtained from DAEC Plant's response spectra and multiplied by a 2.4 factor to obtain the DBE loads in accordance with the plant design basis requirements. The following methodology was used in determining the stresses on the bracket assembly:

- Frequency analysis of the structure is performed to obtain the natural frequencies of the structure for all modes of excitation.
- SSE response spectra analysis is performed to obtain member stresses and support reactions.
- Modal responses are combined using the Ten Percent Method per U.S. NRC Regulatory Guide 1.92, Revision 1, "Combining Modal Responses and Spatial Components in Seismic Response Analysis". This method is endorsed by the Updated FSAR for DAEC.

- The seismic loads for each of the three directions are combined using the absolute sum method as required in Chapter 3.7 of DAEC UFSAR.
- Sloshing analysis is performed to obtain water pressure resulting from a DBE event and its impact on bracket design.
- The stresses resulting from seismic loads are combined with those from the dead load and the hydrodynamic loads in absolute sum. These combined stresses for each component of the structure are compared with the allowable stress values from DAEC applicable code of record.

Sloshing

Sloshing forces were obtained by analysis. The TID-7024, Nuclear Reactors and Earthquakes, 1963, by the US Atomic Energy Commission, approach has been used to estimate the wave height and water natural frequency. Horizontal and vertical sloshing force on the bracket components resulting from the water waves was calculated using the wave height and natural frequency. Using this methodology, sloshing forces have been calculated and added to the total reactionary forces that would be applicable for bracket anchorage design. Reliable operation of the level measurement sensor with a submerged interconnecting cable has been demonstrated by analysis of previous Westinghouse testing of the cable, and the vendor's cable qualification.

The following Westinghouse documents provide information with respect to the design criteria used, and a description of the methodology used to estimate the total loading on the device.

a. CN-PEUS-15-09 – Pool-side Bracket Seismic Analysis
b. WNA-TR-03149-GEN – Sloshing Analysis
c. EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 – Seismic Qualification of other components of SFPI

Duane Arnold Energy Center specific calculation CAL-C15-004 – "Evaluation of SFPIS Mounting Bracket Anchorage" provides the qualification for the anchorage of the SFPIS equipment. The design criteria used in this calculation meets the requirements specified in CN-PEUS-15-09 and will meet the Duane Arnold installation requirements of GMP-CNST-01.

b) The level sensor, which is one long probe, will be suspended from the launch plate via coupler/connector assembly plus a transmitter located outside of the SFP area. The launch plate is a subcomponent of the bracket assembly, which is mounted to the refuel floor via anchors.

c) The bracket assembly that supports the sensor probe and launch plate will be mechanically connected to the SFP structure. The mechanical connection consists of four concrete undercut anchors that will bolt the bracket assembly to the SFP structure via the base plate. The concrete undercut anchors will be designed to withstand the loads resulting from the bracket assembly and will meet DAEC seismic installation requirements. The qualification details of the bracket are provided in Westinghouse's Pool-side bracket Seismic Analysis CN-PEUS-15-09 and the qualification of the

anchorage to the floor is provided in Duane Arnold specific calculation CAL-C15-004 – "Evaluation of SFPIS Mounting Bracket Anchorage".

DAEC RAI 3

For RAI 2(a) above, please provide the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

Response

The following Westinghouse documents provide the analyses used to verify the design criteria and describe the methodology for seismic testing of the SFP instrumentation and electronics units, inclusive of design basis maximum seismic loads and hydrodynamic loads that could result from pool sloshing and other effects that could accompany such seismic forces:

a. CN-PEUS-15-09 – Pool-side Bracket Seismic Analysis

b. WNA-TR-03149-GEN – Sloshing Analysis

c. EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 – Seismic Qualification of other components of SFPI

No equipment failures were noted as a result of seismic test runs. Seismic test data has been documented in the seismic test reports, referenced above.

Per EC 283472, all components associated with the SFPLI are required to be seismically mounted. Installation of the conduit and conduit supports is per GMP-ELEC-25 and SPEC-E503, which meets the seismic requirements.

Duane Arnold specific calculation CAL-C15-004 – "Evaluation of SFPIS Mounting Bracket Anchorage," addresses the seismic qualification of the installation attachment to the Reactor Building at the Spent Fuel Pool. The design criteria used in this calculation satisfies the requirements specified in CN-PEUS-15-09 and will meet the Duane Arnold installation requirements of GMP-CNST-01. The loading on the probe body and the probe mounting bracket includes both seismic and hydrodynamic loading using seismic response spectra that bound the DAEC design basis maximum seismic loads applicable to the installation locations.

DAEC RAI 4

For each of the mounting attachments required to attach SFP level equipment to plant structures, please describe the design inputs, and the methodology that will be used to qualify the structural integrity of the affected structures/equipment.

Response

RAI-2 provides the design criteria and methodology used by Westinghouse for the mounting bracket design loads. The Westinghouse documents provide the analyses used to verify the design criteria and describe the methodology for seismic testing of the SFP instrumentation, inclusive of design basis maximum seismic loads and hydrodynamic loads that could result from pool sloshing and other effects that could accompany such seismic forces. Westinghouse report EQ-QR-269 (Design Verification Testing Summary Report for the Spent Fuel Pool Instrumentation System) documents the seismic testing performed on the SFP level instrumentation components.

The SFPLIS equipment (including enclosure panels, boxes, conduits and instruments) is mounted to the Reactor Building and Control Building. Both of these buildings are classified as Seismic Category 1.

Duane Arnold Energy Center specific calculation CAL-C15-004 (Evaluation of SFPIS Mounting Bracket Anchorage) addresses the seismic qualification of the SFPIS equipment mounting to the Reactor Building at the Spent Fuel Pool. The design input uses loads taken from CN-PEUS-15-09 (Seismic Analysis of the SFP Primary and Backup Mounting Bracket at Duane Arnold Energy Center) with an additional amplification factor for conservatism. Plate stresses, anchor forces, and welded stud forces are determined using APLAN for comparison to code allowables.

New electronics enclosure panels are installed in the control room. Five panels are mounted to a labyrinth wall near the southwest entrance to the control room and one is mounted to the south masonry wall. The loads imposed on the 2' thick concrete wall by the enclosure weights (approximately 460 pounds total) are insignificant compared to the capacity of the wall. The south masonry is evaluated in a revision to Calculation CAL-239-664-006 (Re-Evaluation of Wall C-665-6 A-E). Plant seismic spectra are applied to the dead weight of the enclosure panel to determine the added loading to the wall. Existing load is considered and checked against the capacity of the wall to determine adequacy.

DAEC RAI 5

Please provide the following:

a) A description of the specific method or combination of methods you intend to apply to demonstrate the reliability of the permanently installed equipment under BDB ambient temperature, humidity, shock, vibration, and radiation conditions.

b) A description of the testing and/or analyses that will be conducted to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be mounted. Include a discussion of this seismic reliability demonstration as it applies to a) the level sensor mounted in the SFP area, and b) any control boxes, electronics, or read-out and re-transmitting devices that will be employed to convey the level information from the level sensor to the plant operators or emergency responders.

c) A description of the specific method or combination of methods that will be used to confirm the reliability of the permanently installed equipment such that following a seismic event the instrument will maintain its required accuracy.

Response

a) Beyond Design Basis Environment – Westinghouse qualified the components (probe, connector, cable) of the SFPIS located in the SFP area to the beyond design basis environment. Components of the system were subjected to beyond design basis conditions of heat and humidity, thermal and radiation aging mechanisms. This testing confirmed functionality of these system components under these beyond design basis environmental conditions. Westinghouse performed testing to ensure aging of the components in the SFP area will not have a significant effect on the ability of the equipment to perform following a plant design basis earthquake. Reports with the test results document compliance to the Order. Reference Westinghouse documents EQ-TP-351, WNA-TR-03149-GEN, and EQ-TP-354 for description of specific qualification methods.

Mild Environment – Westinghouse qualified the system components (display panel, sensor) that reside in the mild environment conditions to determine that the components can satisfactorily perform to those conditions. Westinghouse has determined that aging does not have a significant effect on the ability of the equipment to perform following a plant design basis earthquake. Reports with the test results document compliance to the Order. Reference Westinghouse documents EQ-QR-269, WNA-TR-03149-GEN for description of specific methods.

Shock and Vibration – SFPIS pool side brackets were analyzed for seismic design requirements per NRC order EA-12-051 and NEI 12-02 guidance. As provided by the NRC Order EA-12-051, the NEI 12-02 guidance and as clarified by the NRC interim

staff guidance, the probe, coaxial cable, and the mounting brackets are "inherently resistant to shock and vibration loadings." As a result, no additional shock and vibration testing is required for these components. SFPIS pool side brackets for both the primary and backup Westinghouse SFP measurement channels will be permanently installed and fixed to rigid refuel floors, which are Seismic Category 1 structures. The SFPI system components, such as level sensor and its bracket, display enclosure and its bracket, were subjected to seismic testing. Results were consistent with the anticipated shock and vibration expected to be seen by permanently mounted equipment. The level sensor electronics are enclosed in a NEMA-4X housing. The display electronics panel utilizes a NEMA-4X rated stainless steel housing as well. These housings will be mounted to a seismically qualified wall and will contain the active electronics, and aid in protecting the internal components from vibration induced damage. Reference Westinghouse reports WNA-DS-02957, WNA-TR-03149-GEN for shock and vibration.

b) The seismic adequacy of the SFPIS (all components) is demonstrated by analysis and vendor testing in accordance with below listed standards:

- IEEE 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Electrical Equipment for Nuclear Power Generating Stations
- IEEE-323-2003, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
- CAL-C15-004 - Evaluation of SFPLIS Mounting Bracket Anchorage

c) Westinghouse has seismically qualified the SFPI instrument and its components. CN-PEUS-15-09 describes Pool-side Bracket Seismic Analysis, EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 describe remaining seismic qualifications of the instrument components. With the instrument being seismically qualified and installed as described in RAI 2b response, the instrument is assured to maintain reliable and accurate indication when required. Westinghouse report WNA-CN-00301-GEN provides the channel accuracy from measurement to display.

DAEC RAI 6

For RAI #5 above, please provide the results for the selected methods, tests and analyses used to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.

Response

The SFPIS has been qualified to the requirements from the Order and results are documented in CN-PEUS-15-09, EQ-QR-269, and WNA-TR-03149-GEN. These reports document the seismic, environmental and EMC testing that was performed to ensure reliability of the system under normal and BDBEE conditions. In summary the equipment is capable of withstanding the following conditions:

Environmental Conditions in Spent Fuel Pool Area (Post Event)

SFP Area Environmental Conditions (Post Event)	
Description	Beyond Design Basis (Post Event)
Temperature	212 °F
Humidity	100% Relative Humidity Boiling Water and/or Steam Environment
Radiological	1E9 R for stainless steel probe and weight 1E7 R for all other components
Chemistry	9000 ppm Boron

The components installed inside the Spent Fuel Pool area furnished by Westinghouse are qualified to operate reliably per the service environmental conditions described below for a harsh environment per WNA-PT-00188-GEN and WNA-DS-02957-GEN Table 4.8-1. The probe is qualified for 9000 ppm boron as indicated in Section 7.4 of WNA-TR-03149-GEN. The components located inside the SFP area are the coaxial cable, the coupler, the pool side bracket and the probe.

WEC Specified Component EQ Limits (Inside SFP)			DAEC R.B., el. 855', Refuel Floor Environmental Conditions (QUAL-SC101 Rev.16) – unless otherwise noted)	
Description	Normal	Beyond Design Basis (Post Event)	Normal	Accident (Max.)
Temperature	50-140°F	212°F	68/110 °F	112 °F
Pressure	Atmospheric	Atmospheric	0 psig	0.3 psig
Humidity	0-95% RH	100% Saturated Steam	20/90 %	100 %
Radiation TID (above pool)	1E03 R γ	1E07 R γ (after 7 days)	3.2E03 R γ	6.4E04 R γ (after 30 days)
Radiation TID (SFP water at Level 3)	$\leq$ 1E09 R γ (only probes stainless steel cable and weight are exposed for the period)	1E07 R γ (only probe's stainless steel cable and weight are exposed for 7 days)	N/A	1.60E06 Rγ (after 7 days) Per S&L Report SL-012387, Rev 0)
Chemistry (in SFP)	2000 – 4000 ppm B	9000 ppm B	N/A	N/A

In summary, the Westinghouse testing demonstrated that the probe, coaxial cable, straight connector, 90 degree connector and stainless steel coupler were able to perform in these conditions for 185 hours. This exceeds the seven day requirement of the NRC order. The components exposed to water are stainless steel components and have no adverse effects on water chemistry.

Vendor data, the system vendor steam test report, and the two testing summary reports demonstrated that the level sensor electronics with the coupler and the coaxial cable attached performed accurately when the probe, coupler and coaxial cable were exposed to a temperature range 50°F to 212°F and 100% humidity. This meets the harsh environment requirements inside the SFP.

Environmental Conditions Outside of the Spent Fuel Pool Area (Post Event)

Requirements for WEC Equipment Limits, Outside SFP Area Environment	
Description	Beyond Design Basis (Post Event)
Temperature	0°F to 125°F
Humidity	0% to 95% Relative Humidity (non-condensing)
Radiological	<1E3 R

The components installed outside of the Spent Fuel Pool area furnished by Westinghouse are qualified to operate reliably per the service environmental conditions specified for a non-harsh environment. These components are the level sensor electronics, the sensor electronics enclosures and enclosure mounting brackets.

WEC Specified Component EQ Limits (Outside SFP)			DAEC C.B., el. 786', Control Room Environmental Conditions (QUAL-SC101 Rev.16)	
Description	Normal	Beyond Design Basis (Post Event)	Normal	Accident (Max.)
Temperature	50-120°F	140°F	75 °F	75 °F
Pressure	Atmospheric	Atmospheric	0 psig	0 psig
Humidity	0-95% RH	0-100% (non-condensing) 0-95% (non-condensing) for Sensor Electronics Note 1	50 %	50 %
Radiation TID	≤ 1E03 R γ	≤ 1E03 R γ (after 7 days)	2.7E02 R γ	8.2E00 R γ (after 30 days)

Note 1. During the test program, it was determined that the existing design specification for 100% humidity (non-condensing) and 170°F for the level sensor electronics housing was not physically possible. Therefore, the design specification for abnormal environmental conditions was formally changed to a humidity range of 95% and a maximum temperature of 140°F for the level sensor electronics.

As shown in the table above, the environmental temperatures, humidity levels and TID are enveloped by the equipment qualification.

The results of the testing verify that the system electronics operate acceptably when exposed to the normal and beyond design basis conditions.

The aggregate of the environmental qualification activities for the SFPIS demonstrates that the SFPIS operates reliably per the service environment requirements specified for the harsh environment inside the SFP as well as those for outside the SFP area.

Thermal and Radiation Aging – organic components in SFP area

Westinghouse documents EQ-QR-269, EQ-TP-354, WNA-TR-03149-GEN provide thermal and radiation aging program details for the SFPI components. Westinghouse completed their thermal and radiation aging testing programs to qualify the SFPI components to 10 years. (Initial aging program was 1.25 years). These are documented in WNA-TR-03149-GEN and EQ-QR-269.

Seismic Category I Testing, Vibration and Sloshing

Seismic qualification testing performed by Westinghouse, along with technical evaluations, confirm that the SFPIS meets seismic requirements. As provided by the NRC Order EA-12-051, the NEI 12-02 guidance and as clarified by the NRC interim staff guidance, the probe, coaxial cable, and the mounting brackets are "inherently resistant to shock and vibration loadings." As a result, no additional shock and vibration testing is required for these components. SFPIS pool side brackets for both the primary and backup Westinghouse SFP measurement channels will be permanently installed and fixed to rigid refuel floors, which are Seismic Category 1 structures. The SFPI system components, such as level sensor and its bracket, display enclosure and its bracket, were subjected to seismic testing. Results were consistent with the anticipated shock and vibration expected to be seen by permanently mounted equipment. Reference Westinghouse reports WNA-DS-02957, WNA-TR-04757-GEN.

DAEC RAI 7

Please provide the following:

a) A description of the manner in which the proposed level measurement system meets the independence requirement, to minimize, to the extent practicable, the potential for a common cause event to adversely affect both channels.

b) Further information describing how each level measurement system, consisting of level sensor electronics, cabling, and readout devices will be designed and installed to address independence through the application and selection of independent power sources, the use of physical and spatial separation, independence of signals sent to the location(s) of the readout devices, and the independence of the displays.

Response

The Westinghouse level measurement system consists of two independent fixed instrument channels mounted seismically in the Spent Fuel Pool (SFP). The primary and secondary instrument channels are mounted in opposite corners of the SFP to provide reasonable protection against missiles within the refuel floor area. Similarly, signal cables are routed independently and a distance of at least the shortest length of the SFP (20'-0") is maintained between signal channels within the Reactor Building.

Independent instrument transmitters, level indicators and electronic enclosures for the two channels are mounted seismically in the Control Room behind the control panels. The two channels are completely independent and the transmitter and electronic enclosures are physically and spatially separated. Signal cables for each channel are routed in separate conduits and separation of these conduits is maintained.

Two independent power sources will be used for powering the new SFP instrumentation system. Existing branch circuit 24 in panel 1Y11 and branch circuit 23 in panel 1Y21 will be used to power the level instruments. Panels 1Y11 and 1Y21 are alternate divisions of the Instrument AC power supply and the loss of one of these distribution panels will not result in the loss of both channels. During a BDBEE, each channel has an independent battery system which will supply the level instrument channel with at least three (3) days of power. Repowering of 1Y11 and 1Y21 via portable diesel generators will be included in the FLEX coping strategies.

DAEC RAI 8

Please provide the following:

a) A description of the electrical AC power sources and capacities for the primary and backup channels.

b) The results of the calculation depicting battery backup duty cycle requirements, demonstrating battery capacity is sufficient to maintain the level indication function until offsite resource availability is reasonably assured.

Response

Two independent power sources will be used for powering and charging the batteries of the new SFP instrumentation system. Existing branch circuit 24 in panel 1Y11 and branch circuit 23 in panel 1Y21 will be used to power the level instruments. Panels 1Y11 and 1Y21 are alternate divisions of the Instrument AC power supply system and the loss of one of these distribution panels will not result in the loss of both channels. During a BDBEE, each channel has an independent 26-Amp-Hr battery system which will supply the level instrument channel with at least three (3) days of power. Repowering of 1Y11 and 1Y21 via portable diesel generators will be included in the FLEX coping strategies.

The Westinghouse Report, WNA-CN-00300-GEN, (Spent Fuel Pool Instrumentation System Power Consumption Calculation) provides the results of the calculation depicting the battery backup duty cycle. This calculation demonstrates that level indication for both channels is maintained for approximately 4.22 days after AC power to the instruments is lost. The results of the calculation demonstrate battery capacity is sufficient to maintain level indication function until offsite resources are available.

DAEC RAI 9

Please provide the following:

a) An estimate of the expected instrument channel accuracy performance under both (a) normal SFP level conditions (approximately Leve1·1 or higher) and (b) at the BDB (i.e., radiation, temperature, humidity, post-seismic and post-shock conditions) that would be present if the SFP level were at the Level 2 and Level 3 datum points. ·

b) A description of the methodology to be used for determining the maximum allowed deviation from the instrument channel design accuracy under normal operating conditions.

Response

a) The Westinghouse documents WNA-CN-00301 and WNA-DS-02957-GEN describe the channel accuracy under both (a) normal SFP level conditions and (b) at the Beyond Design Basis (BDB) conditions that would be present if SFP level were at Level 2 and Level 3. Each instrument channel will be accurate to within ±3″during normal spent fuel pool level conditions. The instrument channels will retain this accuracy after BDB conditions, in accordance with the above Westinghouse documents. This value is within the channel accuracy requirements of the Order (±1 foot).

b) The Westinghouse document WNA-TP-04709-GEN describes the methodology for routine testing/calibration verification and calibration methodology. This document also specifies the required accuracy criteria under normal operating conditions. DAEC calibration and channel verification procedures follow the guidance and criteria provided in this document.

DAEC RAI 10

Please provide the following:

a) A description of the capability and provisions the proposed level sensing equipment will have to enable periodic testing and calibration, including how this capability enables the equipment to be tested in-situ.

b) A description of the way such testing and calibration will enable the conduct of regular channel checks of each independent channel against the other, and against any other permanently-installed SFP level instrumentation.

c) A description of how functional checks will be performed, and the frequency at which they will be conducted. Describe how calibration tests will be performed, and the frequency at which they will be conducted. Discuss how these surveillances will be incorporated into the plant surveillance program.

d) A description of the preventive maintenance tasks required to be performed during normal operation, and the planned maximum surveillance interval that is necessary to ensure that the channels are fully conditioned to accurately and reliably perform their functions when needed.

Response

a) Westinghouse calibration procedure WNA-TP-04709-GEN and functional test procedure WNA-TP-04752-GEN, factory acceptance procedure WNA-TP-05246-GEN describe the capabilities and provisions of SFPI periodic testing and calibration, including in-situ testing. DAEC will utilize the Westinghouse calibration procedure for the functional check at the pool side bracket.

b) The level displayed by the channels will be verified per the DAEC Surveillance Test Procedure (STP) 3.0.0-1 "Instrument Checks", as recommended by Westinghouse vendor technical manual WNA-GO-00127-GEN. If the level is not within the required accuracy per Westinghouse recommended tolerance in WNA-TP-04709-GEN, channel calibration will be performed.

c) Functional checks will be performed per Westinghouse calibration procedure WNA-TP-04709-GEN and DAEC procedure I.LI-W120-001 at the Westinghouse recommended frequency. Calibration tests will be performed per Westinghouse calibration procedure WNA-TP-04709-GEN at the Westinghouse recommended frequency.

d) Duane Arnold has developed preventive maintenance tasks for the SFPI per Westinghouse recommendation identified in the technical manual WNA-GO-00127-GEN to assure that the channels are fully conditioned to accurately and reliably perform their functions when needed. DAEC procedure I.LI-W120-001, FLEX - Fuel Pool Level Instrument Loop Calibration, provides instructions, steps, and data necessary to

perform a calibration verification. This procedure is normally performed within 60 days of a planned refueling outage, but it is NOT required to be performed more than once in a 12 Month period. The procedure also provides guidance on battery replacement activities. The battery replacement interval is every 36 months or 3 years.

DAEC RAI 11

Please provide the following:

a) The specific location for each of the primary and backup instrument channel displays.

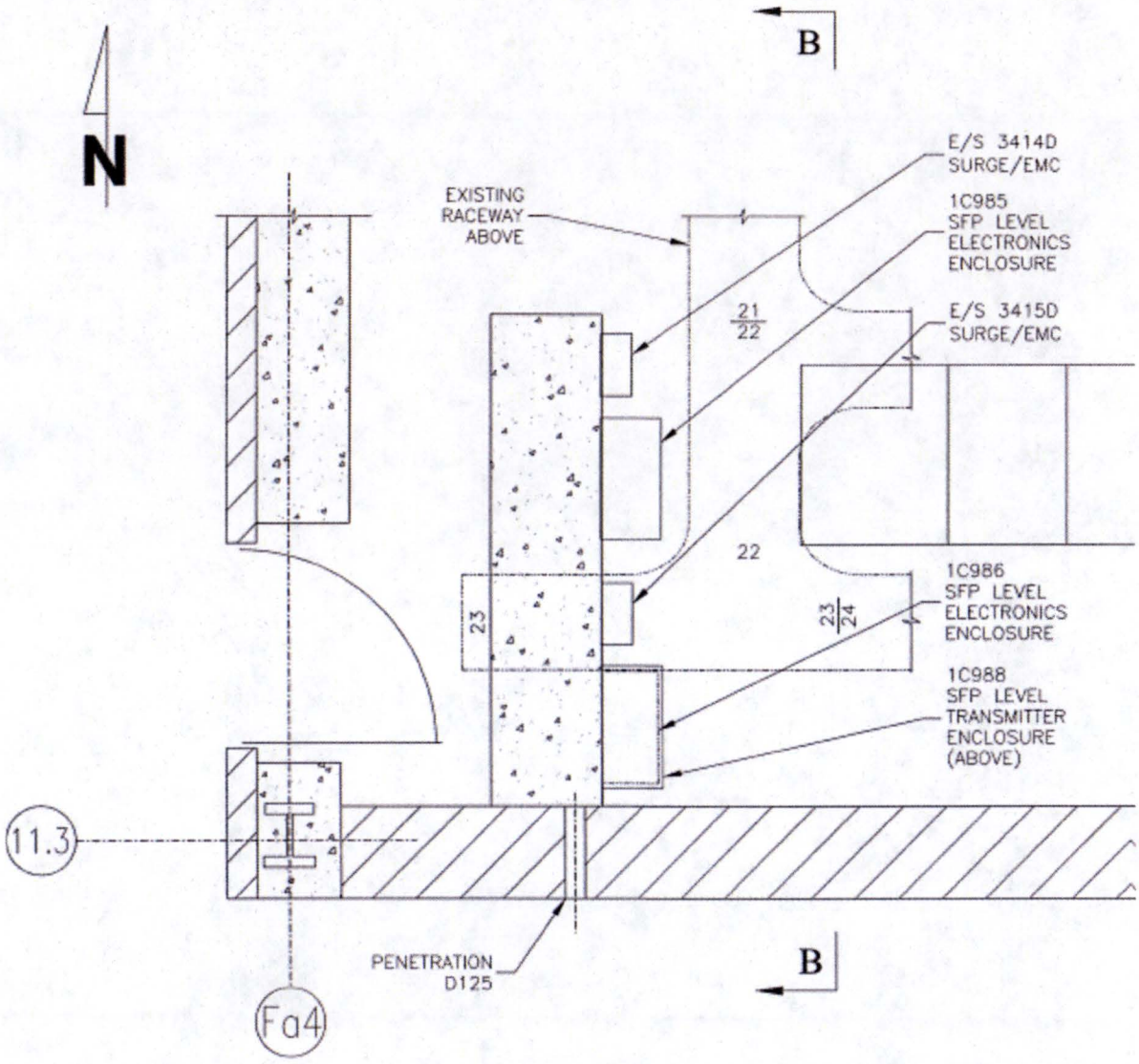
b) For any displays located outside the MCR, describe the evaluation used to validate the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as well as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.

Response

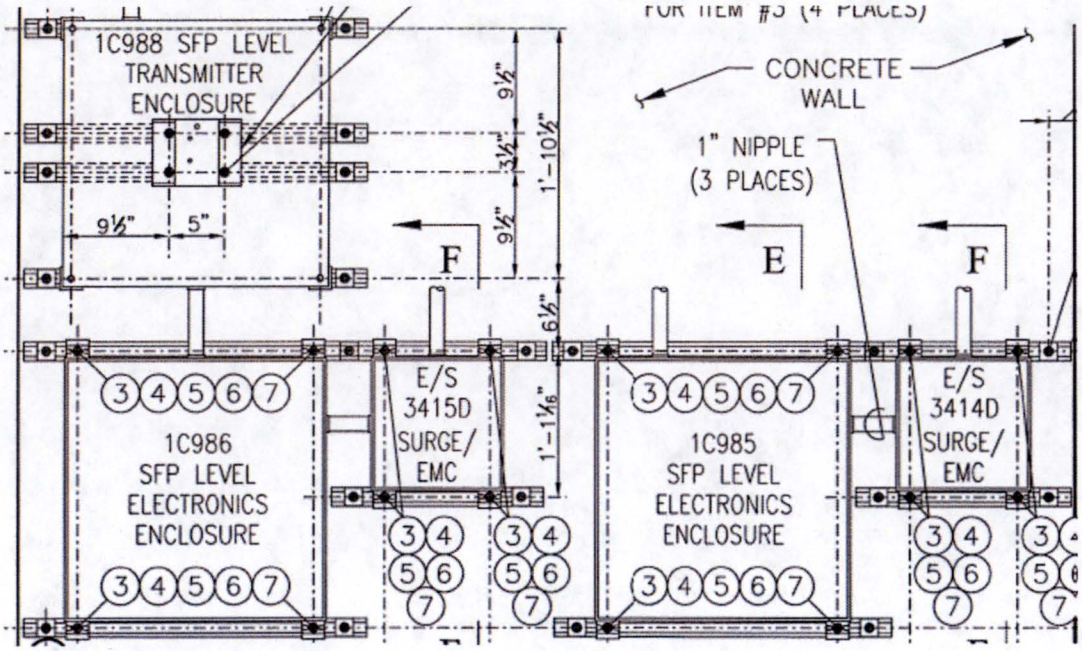
Primary and backup level instrument displays are located in the Southwest corner of the Control Room behind the control board panels. The indicators are located on the 1C985 and 1C986 electronics enclosures in the Control Room. Personnel will be stationed in the Control Room during a BDBEE such that the displays are in a habitable environment, will be readily accessible and will be monitored periodically.

See the attached drawings showing exact locations:

Control Room



Section B-B


FOR ITEM #3 (4 PLACES)
CONCRETE WALL
1" NIPPLE (3 PLACES)
1C988 SFP LEVEL TRANSMITTER ENCLOSURE
9½"
5"
9½"
3½"
9½"
1'-10½"
6½"
1'-1⅛"
F
E
F
3 4 5 6 7
1C986 SFP LEVEL ELECTRONICS ENCLOSURE
E/S 3415D SURGE/ EMC
1C985 SFP LEVEL ELECTRONICS ENCLOSURE
E/S 3414D SURGE/ EMC

DAEC RAI 12

a) Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection that will be developed for use of the SFP instrumentation.

b) Please provide a brief description of the specific technical objectives to be achieved within each procedure.

Response

Letter NG-14-0068 dated February 24, 2014 (EA-12-051 Six-month status update report) provided a response to RAI 12. That response has been revised to reflect additional information developed during the SFP level instrumentation modification process. The following is the revised response.

The modification review process was used to ensure all necessary procedures were developed for maintaining and operating the installed spent fuel level instruments. These procedures were developed in accordance with the NextEra procedural control process.

The objectives of each procedural area are described below:

Inspection, Calibration, and Testing - Guidance on the performance of periodic inspections, as well as calibration and testing, to ensure that each SFP channel is operating and indicating level within its design accuracy.

Preventative Maintenance - Guidance on scheduling of, and performing, appropriate preventative maintenance activities necessary to maintain the instruments in a reliable condition.

Maintenance - To specify troubleshooting and repair activities necessary to address system malfunctions.

Programmatic controls - Guidance on actions to be taken if one or more channels is out of service.

System Operations - To provide instructions for operation and use of the system by plant staff.

Response to inadequate levels - Action to be taken on observations of levels below normal level have been addressed in site Off Normal procedures and /or FLEX Support Guidelines.

Procedure #	Procedure Title	Comments
OI 317.1	120 VAC Instrument Control Power System	Normal operating procedure for the SFPLI power supply
STP 3.0.0-01	Instrument Checks	Includes SFPLI channel check
I.LI-W120-001	FLEX - Fuel Pool Level Instrument Loop Calibration	Includes calibration verification and battery replacement activities
AOP 317	Loss of 120 VAC Instrument Control Power	Abnormal operating procedure for the SFPLI power supply
SAMP 722	FLEX Repowering Battery Chargers from FLEX 480 VAC DG	Repowering the battery chargers will allow the Instrument AC panels to be repowered
SAMP 723	FLEX Repowering MCC 1B32 from a FLEX 480 VAC Portable Diesel Generator	Repowering 1B32 allows Instrument AC panel 1Y11 to be repowered (for one of the SFPLI channels)
SAMP 725	FLEX Alternate Power to Instrument AC	Repowers Instrument AC panels

DAEC RAI 13 (Note that NRC's Correction Letter changed RAI #15 to #13.)

Please provide the following:

a) Further information describing the maintenance and testing program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Include a description of plans to ensure necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.

b) A description of the NextEra/DAEC procedure/process to implement the guidance in NEI 12-02 section 4.3 regarding compensatory actions for one or both nonfunctioning channels.

c) A description of the compensatory actions planned in the event that one of the instrument channels cannot be restored to functional status within 90 days.

Response

Letter NG-14-0068 dated February 24, 2014 (EA-12-051 Six-month status update report) provided a response to RAI 13. That response has been revised to reflect additional information developed during the SFP level instrumentation modification process. The following is the revised response.

a) SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness were established in accordance with NextEra's processes and procedures. The design modification process considered the vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance are performed.

Once the maintenance and testing program requirements for the SFPI were determined, the requirements were documented in Maintenance program documents.

Performance checks, described in the Vendor Operator's Manual, and the applicable information are contained in plant procedures. Operator performance tests will be performed periodically as recommended by the vendor.

Channel functional tests with limits established in consideration of vendor equipment specifications are performed at appropriate frequencies.

Channel calibration tests per maintenance procedures with limits established in consideration of vendor equipment specifications are planned to be performed at frequencies established in consideration of vendor recommendations.

b) Both primary and backup SFPI channels incorporate permanent installation (with no reliance on portable, post-event installation) of relatively simple and robust augmented quality equipment. Permanent installation coupled with stocking of adequate spare parts reasonably diminishes the likelihood that a single channel (and greatly diminishes the likelihood that both channels) is (are) out-of-service for an extended period of time.

Attachment 1 to fleet procedure EN-AA-110 "Diverse and Flexible Coping Strategies (FLEX) Program" includes a table of compensatory actions in the event that SFPLI instrumentation is out-of-service. These compensatory measures are implemented per site administrative control procedure FLEX-AB-100-1000 "Guidance for FLEX Equipment When it is Unavailable." The nomenclature in the fleet procedure's table is modified in the site-specific procedure to be consistent with DAEC terminology (i.e., functional vs available).

The following Table is contained in Appendix C of FLEX-AB-100-1000

ACTIONS:

---------- **NOTE** ----------

1. Separate condition entry is allowed for each Fuel Pool Level Channel
2. Initiate an evaluation in accordance with the Corrective Action Program. The evaluation shall determine compensatory actions if a second channel becomes Unavailable. The evaluation shall include a planned schedule for restoring the instrument channel(s) to Available status.
3. Initiate compensatory actions for monitoring wide-range Spent Fuel Pool level within 24 hours. Initiate an evaluation in accordance with the Corrective Action Program. The evaluation shall document compensatory actions taken or planned to be taken to implement an alternate method of monitoring and schedule required actions for restoring the instrumentation channel(s) to Available status.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A One Spent Fuel Level instrument Unavailable	A1	Initiate actions to restore channel to an Available status	90 days
	A2	AND Implement actions in accordance with Note 2	Immediately
B Both Spent Fuel Level instruments Unavailable	B1	Initiate action to restore at least one channel to an Available status	24 hours
	B2	AND Implement actions in accordance with Note 3	Immediately

c) See RAI-13b response above.

DAEC RAI 14 (Note that NRC's Correction Letter changed RAI #16 to #14.)

Please provide a description of the in-situ calibration process at the SFP location that will result in the channel calibration being maintained at its design accuracy.

Response

Westinghouse calibration procedure WNA-TP-04709-GEN, the functional test procedure WNA-TP-04752-GEN, and the factory acceptance procedure WNA-TP-05246-GEN describe the capabilities and provisions of SFPI periodic testing and calibration, including in-situ testing. Duane Arnold will utilize the Westinghouse calibration procedure for the functional check at the pool side bracket. The level displayed by the channels will be verified per Duane Arnold administrative and operating procedures, as recommended by Westinghouse vendor technical manual WNA-GO-00127-GEN. If the level is not within the required accuracy per Westinghouse recommended tolerance in WNA-TP-04709-GEN, channel calibration will be performed.

Maintenance Procedure I.LI-W120-001, FLEX – Fuel Pool Level Instrument Loop Calibration, provides instructions, steps, and data necessary to perform a calibration verification of Spent Fuel Pool Level Instrumentation.

SE Tracker 15-D

Equipment Reliability: EMC Compliance
Please make available for staff review an assessment of potential susceptibilities of EMI/RFI in the areas where the SFP instruments are located and how to mitigate those susceptibilities (eq. exclusion zones, procedures, etc.)

Response

The electromagnetic compatibility (EMC) qualification for the SFPLIS was demonstrated by an EMC test performed by Westinghouse and documented per Test Report EQ-QR-269 with the appropriate EMC Test Standards governed by NRC Regulatory Guide 1.180 Rev.1. Test results demonstrated compliance to Performance Criterion B standards (as a minimum).

In addition, the SFPLI electronics enclosure panels are located in the Control Room, a location where the enclosures are not subject to the use of hand held radios, thereby eliminating the potential for radio interference.

There are therefore no EMI/RFI concerns.

SE Tracker 16-D

Please make available for staff audit the following:

- Final configuration of Duane Arnold SFPI cable connectors (straight or 90 Deg.)
- Modification (if any) to the connectors as resulted from Westinghouse's recent life-upgrade tests for the connectors.

Response

The 90° connector is at the probe end (pool side) and straight connector is at the transmitter end (Control Room back panel area).

The 90° connector is qualified (without any Raychem) per LTR-SFPIS-15-34 and the Control Room back panel area is not subject to a steam environment, thus connector modifications were not required.

See Section 2.4.2 of the EC Description and drawing BECH-E123<26> from EC283472.