Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-16-037

February 26, 2016

10 CFR 2.202
10 CFR 50.4

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

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR--52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Completion of Required Action by NRC Order EA-12-051, Reliable Spent Fuel Pool Instrumentation**

References:
1. NRC Order Number EA-12-051, "Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012 (ML12054A679)
2. Browns Ferry Nuclear Plant, Unit 2, "Completion of Required Action by NRC Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," dated June 9, 2015 (ML15160A512)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051, Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Reference 1), to Tennessee Valley Authority (TVA). The requirements of this Order were effective immediately and directed the Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, to install reliable spent fuel pool instrumentation as outlined in Attachment 2 of Reference 1.

This letter, along with its enclosures, provides the notification required by Section IV.C.3 of Reference 1 that full compliance with the requirements described in Attachment 2 of Reference 1 has been achieved for BFN, Units 1, 2, and 3. Previously, Reference 2 provided notification of completion for BFN, Unit 2.

This letter contains no new regulatory commitments. If you have any questions, please contact Jamie Paul at (256) 729-2636.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 26th day of February 2016.

Respectfully,

J. W. Shea

Digitally signed by J. W. Shea
DN: cn=J. W. Shea, o=Tennessee Valley Authority, ou=Nuclear Licensing, email=jwshea@tva.gov, c=US
Date: 2016.02.26 20:57:51 -05'00'

J. W. Shea
Vice President, Nuclear Licensing

Enclosures:

1. Compliance with Order EA-12-051
2. Responses to Requests for Additional Information
3. Answers to Open Audit Items

cc (Enclosures):

NRR Director - NRC Headquarters
NRO Director - NRC Headquarters
NRR JLD Director - NRC Headquarters
NRC Regional Administrator - Region II
NRC Project Manager - Browns Ferry Nuclear Plant
NRC JLD Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

COMPLIANCE WITH ORDER EA-12-051

BACKGROUND

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051, Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Reference 1), to Tennessee Valley Authority (TVA). The requirements of the Order were effective immediately and directed Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3, to install reliable Spent Fuel Pool Instrumentation (SFPI) as outlined in Attachment 2 of the Order. The Order required compliance prior to plant startup from the second refueling outage following submittal of the Overall Integrated Plan (OIP), or by December 31, 2016, whichever comes first.

The compliance date for BFN, Unit 2, was April 10, 2015, and compliance was achieved and reported to the NRC in a letter dated June 9, 2015 (Reference 16). Compliance for BFN, Units 1 and 3, was achieved prior to the plant startup from the second refueling outages and prior to December 31, 2016. Compliance was achieved for BFN, Unit 1, on January 20, 2016, and compliance was achieved for BFN, Unit 3, on January 6, 2016. The NRC staff requested that the compliance report be submitted within 60 days of the compliance date. The information provided herein documents full compliance for BFN, Units 1, 2, and 3, in response to the Order.

COMPLIANCE

BFN is a three unit site with three spent fuel pools (SFPs) and, in response to the Order, two independent full scale level monitors per unit have been installed on BFN, Units 1, 2, and 3, SFPs.

TVA submitted the BFN, Units 1, 2, and 3, OIP by letter dated February 28, 2013 (Reference 5). By letters to TVA dated June 18, 2013 (Reference 6) and November 14, 2013 (Reference 9), the NRC staff sent Requests for Additional Information (RAIs) and provided the Interim Staff Evaluation (ISE). TVA provided the initial and six-month status reports and RAI responses by letters to the NRC dated October 29, 2012 (Reference 4), July 18, 2013 (Reference 7), August 28, 2013 (Reference 8), February 28, 2014 (Reference 10), August 28, 2014 (Reference 12), February 27, 2015 (Reference 14), and August 28, 2015 (Reference 17) .

By letter dated March 26, 2014 (Reference 11), the NRC informed TVA of in-office and onsite audits of open and confirmatory items for the mitigation strategies (FLEX) ISE, RAI responses from the SFPI ISE, the licensee’s integrated plans, and other audit questions. The NRC conducted the onsite audit per the plan dated November 26, 2014 (Reference 13) at BFN from January 5-9, 2015. By letter dated April 6, 2015 (Reference 15), the NRC provided TVA with a summary of the audit activities and an attachment listing all open items under NRC staff review at that time.

BFN, Units, 1, 2, and 3, fully comply with Order EA-12-051. The final compliance information NRC requested (answers to all of the SFPI ISE RAIs, answers to open or pending SFPI items listed in the audit report (Reference 15), and the "Design Bridge" document that compared BFN to vendor's assumptions) are provided in Enclosure 2 of this letter.

Compliance with Order EA-12-051 for BFN, Units 1, 2, and 3, was achieved using the guidance in Nuclear Energy Institute (NEI) document NEI 12-02 (Reference 2), which has been endorsed by the NRC (Reference 3).

REFERENCES

1. NRC Order Number EA-12-051, “Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,” dated March 12, 2012 (ML12054A679)
2. NEI 12-02, “Industry Guidance for Compliance with NRC Order EA-12-051, ‘To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,’” Revision 1, dated August 2012 (ML12240A307)
3. NRC Interim Staff Guidance JLD-ISG-2012-03, “Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” Revision 0, dated August 29, 2012 (ML12221A339)
4. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Initial Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051)," dated October 29, 2012 (ML12307A105)
5. Letter from TVA to NRC, “Tennessee Valley Authority (TVA) - Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant,” dated February 28, 2013 (ML13063A437)
6. Letter from NRC to TVA, “Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Request for Additional Information Regarding Overall Integrated Plan in Response to the Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC Nos. MF0881, MF0882, and MF0883),” dated June 18, 2013 (ML13157A164)
7. Letter from TVA to NRC, “Response to NRC Request for Additional Information Regarding Overall Integrated Plan in Response to the Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC Nos. MF0881, MF0882, and MF0883),” dated July 18, 2013 (ML13206A005)
8. Letter from TVA to NRC, “First Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant,” dated August 28, 2013 (ML13247A290)
9. Letter from NRC to TVA, “Browns Ferry Nuclear Plant, Units 1, 2, and 3 - 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 (TAC Nos. MF0881, MF0882, and MF0883),” dated November 14, 2013 (ML13274A657)
10. Letter from TVA to NRC, “Second Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant (TAC Nos. MF0881, MF0882, and MF0883),” dated February 28, 2014 (ML14174A041)
11. Letter from NRC to TVA, “Nuclear Regulatory Commission Audits of Licensee Responses to Reliable Spent Fuel Pool Instrumentation Order EA-12-051,” dated March 26, 2014 (ML14083A620)
12. Letter from TVA to NRC, “Third Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant (TAC Nos. MF0881, MF0882, and MF0883),” dated August 28, 2014 (ML14247A430)

13. Letter from NRC to TVA, “Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Plan for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0902, MF0903, MF0904, MF0881, MF0882, and MF0883),” dated November 26, 2014 (ML14323A295)

14. Letter from TVA to NRC, “Fourth Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant (TAC Nos. MF0881, MF0882, and MF0883),” dated February 27, 2015 (ML15064A188)

15. Letter from NRC to TVA, “Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0902, MF0903, MF0904, MF0881, MF0882, and MF0883),” dated April 6, 2015 (ML15069A358)

16. Letter from TVA to NRC, “Completion of Required Action by NRC Order EA-12-051, Reliable Spent Fuel Pool Instrumentation,” dated June 9, 2015 (ML15160A512)

17. Letter from TVA to NRC, “Fifth Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) for Browns Ferry Nuclear Plant (TAC Nos. MF0881, MF0882, and MF0883),” dated August 28, 2015 (ML15240A391)

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION

By letters dated June 18, 2013, and November 14, 2013, the NRC issued the Browns Ferry Nuclear Plant (BFN) Requests for Additional Information (RAIs) and an Interim Staff Evaluation, both with regard to requirements for the Reliable Spent Fuel Pool Instrumentation (SFPI) Order EA-12-051 (References 1 and 2). Subsequently, the NRC has conducted a vendor audit of the SFPI supplier for BFN (References 3 and 4).

This enclosure provides a response to these RAIs consistent with the vendor audit results. During the audit, a summary table was developed that includes key topics and parameters from the vendor testing and qualification documentation (Design Bridge) and evaluation of the qualification/test results for a licensee using the Westinghouse level measurement technology.

Enclosure References

1. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - 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 (TAC No. MF0881, MF0882, and MF0883)," dated November 14, 2013 (ML13274A657)
2. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Request for Additional Information Regarding Overall Integrated Plan in Response to the Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC Nos. MF0881, MF0882, and MF0883)," dated June 18, 2013 (ML13157A164)
3. NRC Audit Report, "Watts Bar Nuclear Plant, Units 1 and 2- Report for the Westinghouse Audit in Support of Reliable Spent Fuel Instrumentation Related to Order EA-12-051 (TAC NOS. MF0951 AND MF1178)," dated August 18, 2014 (ML14211A346)
4. NRC Audit Report, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051 (TAC Nos. MF0902, MF0903, MF0904, MF0881, MF0882, and MF0883)," dated April 6, 2015 (ML 15069A358)

RAI #1

Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from the sensors toward the location of the read-out/display device.

(This information was previously requested as RAI-2 in NRC letter dated June 18, 2013 [Reference 2]).

TVA Response

See attached sketches, pages E2-16 - E2-19, for plan view of the SFP area, depicting the requested information.

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 effects that could accompany such seismic forces.

(This information was previously requested as RAI-3 in NRC letter dated June 18, 2013 [Reference 2]).

b) *A description of the manner in which the level probe (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 probe 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 so as to support the level probe assembly.*

TVA Response

a) SFPIS equipment mounting is analyzed to maintain a minimum seismic capacity of high confidence of low probability of failure (HCLPF) equal to or greater than a Review Level Ground Motion (RLGM) of two times (2x) the safe-shutdown earthquake (SSE). To achieve a minimum HCLPF of 2x SSE at BFN, SFPIS SSCs are designed in accordance with plant Seismic Category I design requirements. Applicable TVA design criteria documents are referenced below. The vendor has performed calculations to evaluate the structural integrity of the mounting brackets at the SFP. The model considers load combinations for the dead load, live load and seismic load on the bracket, where seismic loading is two-times the safe shutdown earthquake (SSE). These loads are then compared to the allowable values of the applicable welds, bolts and members to determine the acceptability of the design. See Attachment 1, Items 8 and 12.

Seismic

The seismic loads are obtained from response spectra curves and damping values for the application. The following methodology was used in determining the stresses developed for the model.

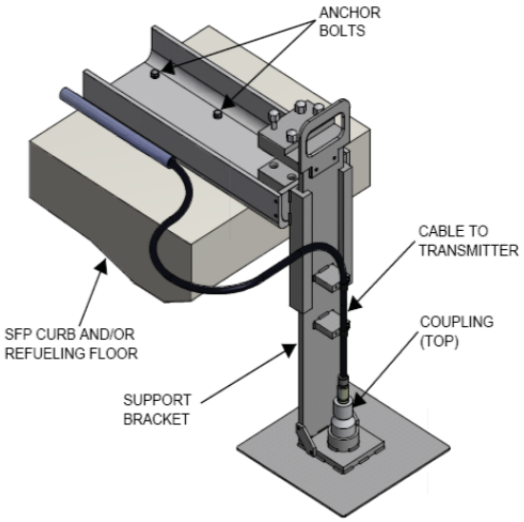
- Frequency analysis is performed to obtain the natural frequencies of the structure in all three directions.
- SSE response spectra analysis is performed to obtain member stresses and support reactions due to the self weight of the bracket and associated components in a seismic event.
- Response spectra analysis results in each direction using SRSS method are then combined. The seismic results in all three directions are combined using SRSS and then combined with the dead load results in absolute values. The combined results are compared with the allowable stress values.

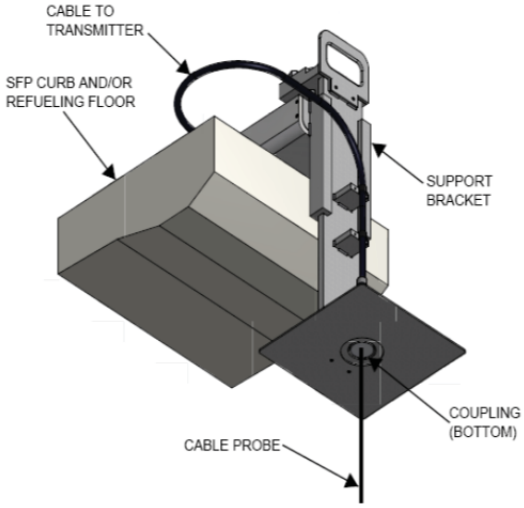
Sloshing

Because of the size and complexity of the spent fuel pool, and practical limitations in preparing a physical scale model suitable for seismic testing, the effects of water sloshing on the SFP level measurement are assessed with analytical methods. As part of work to address NRC Order EA-12-049, calculations to determine plant-specific times for spent fuel pool boiling to begin were re-evaluated. To establish initial post-seismic pool conditions, calculation methods from TID-7204, Nuclear Reactors and Earthquakes, 1963, by the US Atomic Energy Commission, are being used to estimate the amount of water sloshed out of the pool by seismic motion. Using this methodology, bounding results for the sloshing effect are determined and supplemented with alternative analysis methods (e.g. finite-element modeling tools) to make a qualitative assessment of the effects of seismic-induced fluid motion on the cable probe. Because some water can be ejected from a pool, it is necessary to assume that the probe interconnecting cable will become wetted or submerged in water. Reliable operation of the level measurement sensor with a submerged interconnecting cable

are demonstrated by analysis of previous Westinghouse testing of the cable and vendor's cable qualification. See Attachment 1, Item 9. Although a boron build up calculation has been performed for other applications of this system within TVA, BFN does not consider that the boron buildup analysis applies to this installation. See Attachment 1, Item 11.

b) The level sensor cable assembly is suspended from a support bracket, which is secured to the refueling floor and/or spent fuel pool curb using concrete anchor bolts. The level sensor cable suspended in the SFP is attached to a threaded coupling, which is secured to a support bracket. The cable leading to the transmitter is also attached to the threaded coupling. See Attachment 1, Item 12. The generic illustrations below depict these attachments.





c) See response to 2b above and Attachment 1, Item 12.

RAI#2 References:

1. Design Criteria BFN-50-7360, FLEX Mitigation System, Rev. 4
2. Design Criteria BFN-50-C-7106, Equipment Seismic/Structural Qualification, Rev. 4
3. Design Standard DS-C1.7.1, General Anchorage to Concrete, Rev. 11

TVA will make these documents available for review upon request.

RAI #3

For RAI #2(a) above, please provide the results of 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.

TVA Response

Seismic loads resulting from the analyses performed for the cable probe mounting brackets are documented in the referenced Westinghouse calculations. Seismic loads resulting from the analyses performed for mounting of the instrument enclosures and transmitters are documented in the referenced TVA calculations. Seismic loads resulting from the analysis performed for the instrument enclosure and transmitter mounting are documented in the referenced TVA calculation. Results of the seismic testing for the vendor supplied equipment are documented in Section 5.1 of the referenced Westinghouse report. No equipment failures were noted as a

result of the seismic test runs. Per Section 7.2.1 of the referenced Westinghouse test strategy, a preliminary sloshing analysis calculation was conducted by the vendor. Seismic test data has been documented in a seismic test report. See Attachment 1, Items 8, 9, 12, and 13, for qualification testing.

RAI#3 References:

1. Westinghouse calculation CN-PEUS-14-12, Seismic Analysis of the SFP Pool-Side Brackets at Browns Ferry Nuclear Plant, Rev. 2
2. BFN Calculation CDQ0000782014000219, “Seismic Qualification for the Mounting of Spent Fuel Pool Level Instrumentation for BFN”, Rev. 0
3. BFN Calculation CDQ0000782014000252, “Seismic Qualification and Anchorage Design of the BFN Spent Fuel Pool Level Element Support Bracket”, Rev. 3
4. Westinghouse Report EQ-QR-269, Design Verification Testing Summary Report for the Spent Fuel Pool Instrumentation System, Rev. 4
5. Westinghouse document WNA-PT-00188-GEN, SFPIS Standard Product Test Strategy, Rev. 3.

TVA will make these documents available for review upon request.

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 was used to qualify the structural integrity of the affected structures/equipment.

TVA Response

The design input and qualification methodology is consistent with TVA's current safety related seismic design. The design input and qualification methodology used for the mounting attachment of the instrument enclosures and transmitter is documented in the referenced TVA calculation. The design input and qualification methodology used for the mounting attachment of the cable probe mounting brackets is documented in the referenced TVA Civil Calculations.

RAI#4 References:

1. BFN Calculation CDQ0000782014000219, “Seismic Qualification for the Mounting of Spent Fuel Pool Level Instrumentation for BFN”, Rev. 0
2. BFN Calculation CDQ0000782014000252, “Seismic Qualification and Anchorage Design of the BFN Spent Fuel Pool Level Element Support Bracket”, Rev. 3
3. TVA Design Standard DS-C1.7.1, General Anchorage to Concrete, Rev 11

TVA will make these documents available for review upon request.

RAI #5

Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the associated transmitter (electronics package) will be exposed.

TVA Response

The transmitters will be located in the in the reactor building at Elevation 639.0, which is shielded from the fuel in the SFP by concrete. The combined concrete thickness and angle that the radiation would travel through the concrete is expected to significantly limit the dose to the transmitter. BFN calculation NDQ0000782014000216 confirms the total integrated dose to the transmitter during a DBD-EE event is acceptable. See Attachment 1, Item 5.

RAI #6

Please provide information indicating what will be the maximum expected ambient temperature in the room in which the associated transmitter (electronics package) will be located under BDB [Beyond Design Basis] conditions in which there is no AC power available to run Heating Ventilation and Air Conditioning (HVAC) systems.

TVA Response

The transmitters will be located in the in the Reactor Building on Elevation 639.0 on each unit, which is a separate environmental area than the Spent Fuel Pool. The area is a Harsh Environment for design basis events, but this area will be a mild environment for an ELAP [extended loss of alternating current (AC) power]. BFN calculation MDQ0009992014000291, Revision 0, Figures 6.50 through 6.64, provide dry bulb temperatures, wet bulb temperatures and relative humidity profiles for the Reactor Building on Elevation 639.0'. Westinghouse report EQLR-342 Revision 0, Environmental Design Verification Test Report for Spent Fuel Pool Instrumentation System," confirms an acceptable environment for the transmitters. See Attachment 1, Item 5.

RAI#6 References:

1. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051," dated April 6, 2015 (ML15069A358)
2. Westinghouse Report EQLR-342, Revision 0, "Environmental Design Verification Test Report for Spent Fuel Pool Instrumentation System," dated March 2015
3. TVA BFN Calculation MDQ0009992014000291, Revision 0, "Temperature Response of the Reactor Building Following an Extended Loss of AC Power"

These documents were made available to NRC for review on April 1, 2015.

RAI #7

Please provide information indicating the maximum expected relative humidity in the room in which the associated transmitter (electronics package) will be located under BDB conditions, in which there is no AC power available to run HVAC systems, and whether the sensor electronics is capable of continuously performing its required functions under this expected humidity condition.

TVA Response

The transmitter electronics are qualified for a maximum relative humidity of 0-100%. This bounds all environmental humidity conditions that might exist in the area of the transmitter. See Attachment 1, Item 5.

RAI #8

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.*

TVA Response

a) Harsh Environment: The nonmetallic materials of the SFPIS located in the SFP area were evaluated to confirm their behavior with respect to radiation aging mechanisms. Any materials for which radiation degradation effects could not be determined were tested to demonstrate suitable resistance to radiation. Non-metallic components are rated for use in temperatures higher than 212 degrees F, which corresponds to the saturated steam environment of extended boiling in the spent fuel pool. The ability of the SFPIS to function properly at the expected temperature and steam environmental conditions is demonstrated by test. See Attachment 1, Items 4 and 6. The sensor electronics located outside the SFP area were evaluated to be acceptable for the Reactor Building elevation 639' environment. See Attachment 1, Item 5.

Shock and Vibration: Components of both the primary and backup measurement channels are permanently installed and fixed to rigid structural walls or floors of Seismic Category 1 structures, and will not be subject to anticipated shock or vibration inputs. The level sensor electronics are enclosed in a NEMA-4X housing. The electronics panel utilizes a NEMA-4X rated stainless steel housing. These housings are mounted to seismically qualified walls and aid in protecting the internal components from vibration induced damage. No additional vibration and shock testing is required. As provided by the NRC order and the NEI guidance as clarified by the interim staff guidance, the probe, coaxial cable, and the mounting brackets are "inherently resistant to shock and vibration loadings." See Attachment 1, Item 14.

Mild Environment: For equipment located in the mild environment, an assessment of equipment aging-related effects was performed to determine if aging has a significant effect on the ability of the equipment to perform following a plant design basis earthquake. Significant age-sensitive effects will be identified for incorporation into technical manual recommendations for routine preventive maintenance. No beyond design basis conditions have been defined for mild-environment equipment. Environmental testing of the electronics cabinet is in accordance with the following standards:

- IEEE-323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
- Westinghouse Test Procedure, NA 11.2, In-house Environmental Testing, Rev. 1 (Proprietary)

b) The SFPIS seismic adequacy is demonstrated using the methodology defined in IEEE 344-2004 for Seismic Category 1, which allows for a combination of test and analysis. Seismic frequency and acceleration test parameters will reflect an envelope of 2X design basis safe shutdown earthquake test response spectra with 3% critical damping. This equipment shall maintain functionality and physical integrity before and after five operating basis earthquakes and one safe shutdown earthquake. See Attachment 1, Item 8.

The seismic adequacy of the level sensor assembly in the SFP area, transmitter, transmitter bracket, electronics cabinets with indicators, and coaxial cable was demonstrated by vendor testing in accordance with the standards listed below.

The seismic adequacy of the sensor probe supporting bracket within the SFP area was demonstrated by analysis as discussed in the response to RAI 2a.

- IEEE 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Electrical Equipment for Nuclear Power Generating Stations
- IEEE-323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
- USNRC Regulatory Guide 1.100
- Westinghouse Test Procedure, NA 11.1, In-house Seismic Testing , Rev. 1 (Proprietary)

c) The methods described in the response to RAI 8b apply to RAI 8c. The acceptance criteria for these methods states that no degradation or loss of function below a performance level specified by the manufacturer is allowed, and that the system must provide reliable SFP level indication.

RAI #9

For RAI #8 above, please provide the results for the selected methods, tests and analyses utilized to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.

TVA Response

A summary of the test conditions for which the equipment is to be qualified and environmental conditions calculated by TVA are summarized below. Current results of vendor tests and analyses and TVA calculations demonstrate the qualification of the installed equipment. See Attachment 1, Items 3, 4, 5, 6, 7, and 8.

Environmental Conditions for SFPIS Components in the Spent Fuel Pool Area

The coaxial cable and the coupler in the spent fuel pool area are required to operate reliably in the service environmental conditions specified for the environmental conditions in the table below. Since the probe and the pool-side bracket are inherently resistant by design to radiation effects, radiation aging is not required for these components.

Parameter	Normal	BDB
Temperature	60-90°F	212°F
Pressure	Atmospheric	Atmospheric
Humidity	30-80% RH	100% RH (saturated steam)
Radiation TID (above pool)	4.28E+03 Rads γ (10 years)	8.67E+06 Rads γ (7 days)

The equipment qualification Total Integrated Dose is 1E+07 Rads γ.

Environmental Conditions Outside of the Spent Fuel Pool Area

The level sensor electronics, sensor electronics bracket, and the electronics enclosures outside of the spent fuel pool area are required to operate reliably in the service environmental conditions specified for the environmental conditions in the table below.

Parameter	Normal	BDB (Level Sensor Electronics Only)
Temperature	60-90°F	40-150°F
Pressure	Atmospheric	Atmospheric
Humidity	30-80% RH	35-100% RH (90% @ 150°F)
Radiation TID	8.76E+02 Rads γ (10 Years)	4.2E-02 Rads γ (7 days)

The equipment qualification Total Integrated Dose is 1E+03 Rads γ.

The level indicators and electronics located in the shutdown board room (reactor building elev. 621') are considered to be in a mild environment for both normal operation and a beyond-design-basis event.

Thermal Aging

The SFPIS thermal aging process performed on the interconnecting cable and cable coupler inside the spent fuel pool area, followed by successful radiation aging and seismic testing of the components, has demonstrated a 10 year life for the level sensor and still survive a beyond-design-basis event. See Attachment 1, Item 6.

Seismic Cat-1 Testing/Analysis

The SFPIS Cat-1 seismic testing performed by the vendor and manufacturer, together with the technical evaluations performed by the vendor, confirm that the SFPIS is seismically acceptable for plant use and meets the seismic requirements of the vendor's design specification, which states that the SFPIS seismic adequacy shall be demonstrated using the methodology defined in IEEE 344-2004 for Seismic Category I, and that the equipment shall maintain functionality and physical integrity before and after five Operating Basis Earthquakes (OBEs) and one Safe Shutdown Earthquake (SSE). Vendor seismic testing profile exceeds 2x SSE for BFN.

Vibration Justification

Refer to RAI 8a response.

Sloshing Justification

During the SFPIS product development, a sloshing calculation was performed by the vendor to demonstrate that the probe would not be "sloshed" out of the spent fuel pool during a seismic event. This calculation concluded that, regardless of the construction, the probe will not be thrown out of the pool during a seismic event. See Attachment1, Item 9.

RAI #10

Please provide the NRC staff with the final configuration and installation of the level measurement system, consisting of level sensor electronics, cabling, and readout devices. In addition, please provide additional information regarding the selection of independent power sources.

TVA Response

Power to the primary channel is supplied from the 120 volt AC I&C buses, which are powered from the 480V Shutdown Boards. Power to the backup channel is also supplied from 120 volt AC I&C buses and the 480V Shutdown Boards from the opposite train. The 480V Shutdown Boards have the capability of being powered from the 4kV FLEX turbine generators once the 4KV shutdown boards are energized.

Cable and conduit for each channel maintain train separation from the power source to their respective instrument enclosures, which are mounted in separated areas of the plant.

RAI #11

Please provide the design criteria that will be applied to size the battery in a manner that ensures, with margin, that the channel will be available to run reliably and continuously following the onset of the BDB event for the minimum duration needed, function until offsite resource availability is reasonably assured.

TVA Response

The calculation concludes that the backup battery life is at least 4.22 days at full charge after loss of onsite AC power based on maximum power consumption throughout the duration of the battery life. See Attachment 1, Item 18.

RAI #12

Please provide the following:

a) *An estimate of the expected instrument channel accuracy performance under both a) normal SFP level conditions (approximately Level 1 or higher) and b) at the BDB conditions (i.e., radiation, temperature, humidity, and 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 that will be used for determining the maximum allowed deviation from the instrument channel design accuracy that will be employed under normal operating conditions as an acceptance criterion for a calibration procedure to flag to operators that the channel requires adjustment to within the normal condition design accuracy.*

TVA Response

a) Each instrument channel is calculated to be accurate to within ±1% of calibrated span during normal spent fuel pool level conditions. The instrument channels are expected to retain this estimated accuracy after being subjected to BDB conditions. This analysis is based on the vendor's specification documentation and TVA demonstrated accuracy calculation. See Attachment 1, Item 17.

b) Technicians will be required to perform an instrument channel calibration in the event that the instrument channel output lies outside the acceptance band established in the setpoint and scaling documents. The acceptance band or "as-left tolerance" is defined as the acceptable parameter variation limit above or below the desired output for a given input standard associated with the calibration of the instrument channel.

The instrument channel acceptance band, which may or may not be symmetrical, is calculated using the square root of the sum of the squares (SRSS) combination of the as-left tolerance for each component comprising the instrument loop. The as-left tolerance of each component is equal to or greater than the reference accuracy of the device being calibrated, but is not so large that it could prevent or mask detection of instrument degradation or failure. Note that the SRSS method is only used for uncertainty terms that are random, independent, and possess a normal (bell-shaped) distribution; otherwise, the uncertainty term is combined through summation, either within the SRSS (for dependent terms) or outside of the SRSS (for bias and non-normally distributed terms). See Attachment 1, Item 20.

RAI #13

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 how 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. Provide a discussion on the measures that will be taken to detect when the instrumentation is operable but degraded. Provide a discussion as to how these surveillances will be incorporated into the plant surveillance program.*

d) *A description of what preventive maintenance tasks are 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.*

TVA Response

a) The support bracket for the level sensor cable has been designed and manufactured with a sliding section. This sliding section will be raised 12 inches for calibration verification. The manufacturer has documented that the calibration is based on a linear time delay from transmission of the radar pulse to return of reflection on the surface of the water. Manufacturer documentation provides certification that raising the sensor a fixed distance and verifying that the indicator changes by this fixed amount confirms that the transmitter is in calibration. The system is designed to enable the removal of the sensor cable from the transmitter and attach a previously certified sensor cable with an adjustable metal target to allow a detailed multipoint calibration by mounting the target at different points along the cable for troubleshooting, if necessary. Each component in the instrument channel can be replaced (transmitter included) to restore the instrument loop to service in the event a component failure occurs.

   In-situ testing will be performed by loosening the hold down bolts and raising the sensor assembly 12 inches and verifying that the indicator responds with a corresponding 12 inch change (allowed inaccuracy of change will be documented in the scaling analysis). Upon completion of measurement, the technician will lower the mounting bracket and re-torque the slide assembly hold down bolts.

b) Channel Check is not a specified requirement in NEI 12-02. Channel Check is specified in IEEE 338-1987 for Safety Systems. SFP level instrument channels are not safety-related and are not subject to testing requirements of safety-related instrumentation. If the plant staff determined a need to confirm that the two channels are performing as expected, the two channels may be read in the shutdown board room. While the SFP is operating within design basis and at normal level, the indicators may be compared to fixed marks within the SFP by visual observation to confirm indicated level.

c) A description of channel calibration or functional test is shown in the response for RAI 13a. TVA will perform periodic calibration verification using a periodic maintenance procedure. The periodic calibration verification will be performed within 60 days of a refueling outage considering normal testing scheduling allowances (e.g., ±25%). Calibration verification will

not be required to be performed more than once per 12 months. These calibration requirements are consistent with the guidance provided in NEI 12-02 Section 4.3. See Attachment 1, Item 20.

d) Preventive Maintenance procedures will be in place for periodic replacement of the backup batteries based on manufacturer recommendations and for calibration verification as identified in RAI 13c.

RAI #14

a) Please provide the specific location for the backup instrument channel display.

b) Please describe the evaluation used to validate that 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, please 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.

TVA Response

a) The backup channel has an indicator in the 4 KV Shutdown Board Room A (Unit 1), 4 KV Shutdown Board Room C (Unit 2), and Electric Board Room (Unit 3), which is in close proximity to the Backup Control Panel. See attached Sketch 4, page E2-19.

The Spent Fuel Pool Level Indicators and path to the Backup Control Panel (close proximity) from the MCR is a mild environment during ELAP, is promptly accessible (2 minute walk) by main control room personnel and is not subject to the environmental conditions associated with boiling in the SFP. Communication by radio or telephone is available if needed. The route to the Backup Control Panel area from the Main Control Room will be the same route that is utilized during design basis events because the route is within safety-related, seismic structures (Control Building and Reactor Building). The pathway is expected to remain intact following a seismic event. See attached sketch that is an update to the sketch previously provided for access pathway.

b) BFN has three separate SFPs and will have a total of two level instrument channels per SFP. One instrument display per channel will be located in the 4 KV Shutdown Board Room A (Unit 1), 4 KV Shutdown Board Room C (Unit 2), and the Electric Board Room (Unit 3), which is in close proximity to the Backup Control Panel on El 621. The displays will be physically separated utilizing Class 1E train separation criteria to maintain channel independence. The Backup Control Panel and path from MCR to Backup Control Panel is a mild environment during ELAP, is promptly accessible (2 minute walk) by main control room personnel and is not subject to the environmental conditions associated with boiling in the SFP. Communication by radio or telephone is available if needed. The route to the Backup Control Panel from the MCR will be the same route that is utilized during design basis events because the route is within a safety related, seismic structure. The pathway is expected to remain intact following a seismic event. See Sketch 4, page E2-19, for the route from the MCR to the Backup Control Panel

The Backup Control Panel is in a mild environment is promptly accessible (2 minute walk) by main control room personnel. The environment is not affected by the environmental conditions associated with any SFP drain down scenario.

RAI #15

Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the spent SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.

TVA Response

The following list of procedures is provided:

- 1, 2, 3-AOI-57-5A, Abnormal Operating Instruction - Loss of I&C Bus A. This abnormal operating instruction provides symptoms, automatic actions and operator actions for a loss of I&C Bus A. Specific information for the Spent Fuel Pool Wide Range Level Instrumentation power supply is included.
- 1, 2, 3-AOI-57-5B, Abnormal Operating Instruction - Loss of I&C Bus B. This abnormal operating instruction provides symptoms, automatic actions and operator actions for a loss of I&C Bus A. Specific information for the Spent Fuel Pool Wide Range Level Instrumentation power supply is included.
- 0-OI-57C/ATT-3A, Operating Instruction - Electrical Lineup Checklist Unit 1. Includes breakers for Spent Fuel Pool Level Instrumentation.
- 0-OI-57C/ATT-3B, Operating Instruction - Electrical Lineup Checklist Unit 2. Includes breakers for Spent Fuel Pool Level Instrumentation.
- 0-OI-57C/ATT-3C, Operating Instruction - Electrical Lineup Checklist Unit 3. Includes breakers for Spent Fuel Pool Level Instrumentation.
- 1, 2, 3-AOI-78-1, Abnormal Operating Instruction - Fuel Pool Cleanup System Failure. This instruction provides symptoms, automatic actions, and operator actions for a Fuel Pool Cleanup System Failure from loss of cooling or loss of Fuel Pool level.
- 1, 2, 3-OI-78, Operating Instruction - Fuel Pool Cooling and Cleanup System. This instruction provides Precautions and Limitations, Prestartup/Standby Readiness Requirements, and Procedural Steps for the operation of the Fuel Pool Cooling and Cleanup System.
- 1, 2, 3-OI-78/ATT-3A, Operating Instruction - Electrical Lineup Checklist. Includes position requirements of breakers for Spent Fuel Pool Level Instrumentation.
- 1, 2, 3-OI-78/ATT-4A, Operating Instruction - Instrument Inspection Checklist. Instrument inspection - an inspection which is performed to verify all compliance and technical specification instruments, which the instrument section is responsible for maintaining, are in service. Spent Fuel Pool Level Instrumentation is included in this inspection.
- 1, 2, 3-SIMI-78A, System Instrument Maintenance Index - Fuel Pool Cooling and Demineralizer System Index. This contains instruction for performing maintenance and calibration on the Fuel Pool Cooling and Demineralizer System instrumentation and controls. This is the index that is a cross reference to the Calibration Instructions.
- 1, 2, 3-SIMI-78B, System Instrument Maintenance Index - Fuel Pool Cooling and Demineralizer System Scaling and Setpoint Documents. The purpose of this procedure is to provide a controlled document which establishes the scaling/setpoint information for the Fuel Pool and Demineralizer System. This procedure contains a scaling and setpoint document (SSD) for instrumentation in the Fuel Pool Cooling System.

- LCI-1-L-78-042, Loop Calibration Instruction - Unit 1 Spent Fuel Pool Wide Range Level Loop 1 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- LCI-2-L-78-042, Loop Calibration Instruction - Unit 2 Spent Fuel Pool Wide Range Level Loop 1 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- LCI-3-L-78-042, Loop Calibration Instruction - Unit 3 Spent Fuel Pool Wide Range Level Loop 1 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- LCI-1-L-78-043, Loop Calibration Instruction - Unit 1 Spent Fuel Pool Wide Range Level Loop 2 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- LCI-2-L-78-043, Loop Calibration Instruction - Unit 2 Spent Fuel Pool Wide Range Level Loop 2 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- LCI-3-L-78-043, Loop Calibration Instruction - Unit 3 Spent Fuel Pool Wide Range Level Loop 2 Calibration. This instruction is used for calibration and functional testing of Spent Fuel Pool Wide Range Level Loop.
- 0-TPP-ENG-632, Diverse and Flexible Coping Strategies (FLEX) Program. This Technical Program Procedure (TPP) implements the Browns Ferry Nuclear Plant (BFN) site specific requirements for the Diverse and Flexible Coping Strategies (FLEX) Program. This procedure details the structures, systems and components (SSC) as required for the safe operation of BFN. This procedure will ensure BFN requirements associated with FLEX objective are continuously met.
- 0-TPP-ENG-632(Bases), Diverse and Flexible Coping Strategies (FLEX) Program Bases Document. The purpose of this document is to describe the bases of the program for Diverse and Flexible Coping Strategies (FLEX) at Tennessee Valley Authority's (TVA) Browns Ferry Nuclear Plant (BFN).
- 0-GOI-300-1/ATT-11, General Operating Instruction Attachment 11 Control Bay Operator Round Log. Spent Fuel Pool Wide Range Level is recorded each day during operator rounds.

RAI #16

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 your plans for ensuring that necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.*

   (This information was previously requested as RAI-11 in NRC letter dated June 18, 2013, [Reference 2]).

b) *A description of how the guidance in NEI 12-02 section 4.3 regarding compensatory actions for one or both non-functioning channels will be addressed.*

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

TVA Response

a) The maintenance, testing and calibration program has been proceduralized and contains the elements listed below. The procedure(s) controlling maintenance, testing, and calibration of the SPLIS will be available for inspection. (See RAI #15 response for a list of the procedures.)

- Westinghouse has provided instruction manuals and calibration procedures that have been used to develop calibration procedures for the equipment.
- Site Engineering Setpoint and Scaling Documents SE-SSD-1-L-78-42 and 43, SE-SSD-2-L-78-42 and 43, and SE-SSD-3-L-78-42 and 43 included in Design Change Notice (DCN) 71159-A, DCN 71160-A, and DCN 71161-A have been used in the development of the required calibration procedures.
- Instrument loop calibration verification will be performed by a 2 point test, using the adjustable mounting bracket to confirm the transmitter zero point has not drifted and the indicator correctly repeats the elevation change from the adjustable mounting bracket. Required loop accuracy from SE-SSDs will be used in the calibration verification. The SE-SSDs include the BDBEE instrument loop accuracies.
- Westinghouse and K-Tek are also developing an in-situ detailed calibration method which will disconnect the probe cable assemblies and test the transmitter using a test cable probe assembly, if calibration errors are identified during operation or testing.
- The procurement specification contains adequate testing requirements in accordance with EA-12-051 and NEI-12-02, and requires that Westinghouse provide analysis certifying that a 2-point channel check is sufficient to maintain calibration of the full instrument range.
- Calibration to validate the functionality of the installed instrument channels is required within 60 days of a planned refueling outage, considering normal testing scheduling allowances (e.g.+/- 25 percent), provided that the calibration has not been performed within the last 12 months.
- Existing work control processes such as Loop Calibration Instructions (LCI), Preventative Maintenance procedures, and Work Orders, will be utilized to perform testing and maintenance on the instrument channels.
- Allowable channel out of service times and associated actions will be consistent with the guidance provided in NEI 12-02.

b) NEI 12-02, Section 4.3 states "The primary or back-up instrument channel can be out of service for testing, maintenance and/or calibration for up to 90 days provided the other channel is functional. Additionally, compensatory actions must be taken if the instrumentation channel is not expected to be restored or is not restored within 90 days. If both channels become nonfunctioning then initiate actions within 24 hours to restore one of the channels of instrumentation and implement compensatory actions (e.g., use of alternate suitable equipment or supplemental personnel) within 72 hours."

BFN will implement a critical spare parts program for the system, taking into account the lead time and availability of spare parts, to provide assurance that a channel can be restored to service within 90 days. If one or both channels cannot be restored to service within 90 days, or if both channels become non-functioning, as a compensatory measure BFN will utilize 1-AOI-78-1, 2-AOI-78-1, or 3-AOI-78-1, "Fuel Pool Cleanup System Failure" during any loss of spent fuel pool level or cooling event. This instruction requires the dispatch of operators to determine the spent fuel pool level and cooling system status and investigate the cause of leakage and take appropriate actions to restore the spent fuel pool level and cooling.

c) See response to 16b) above.

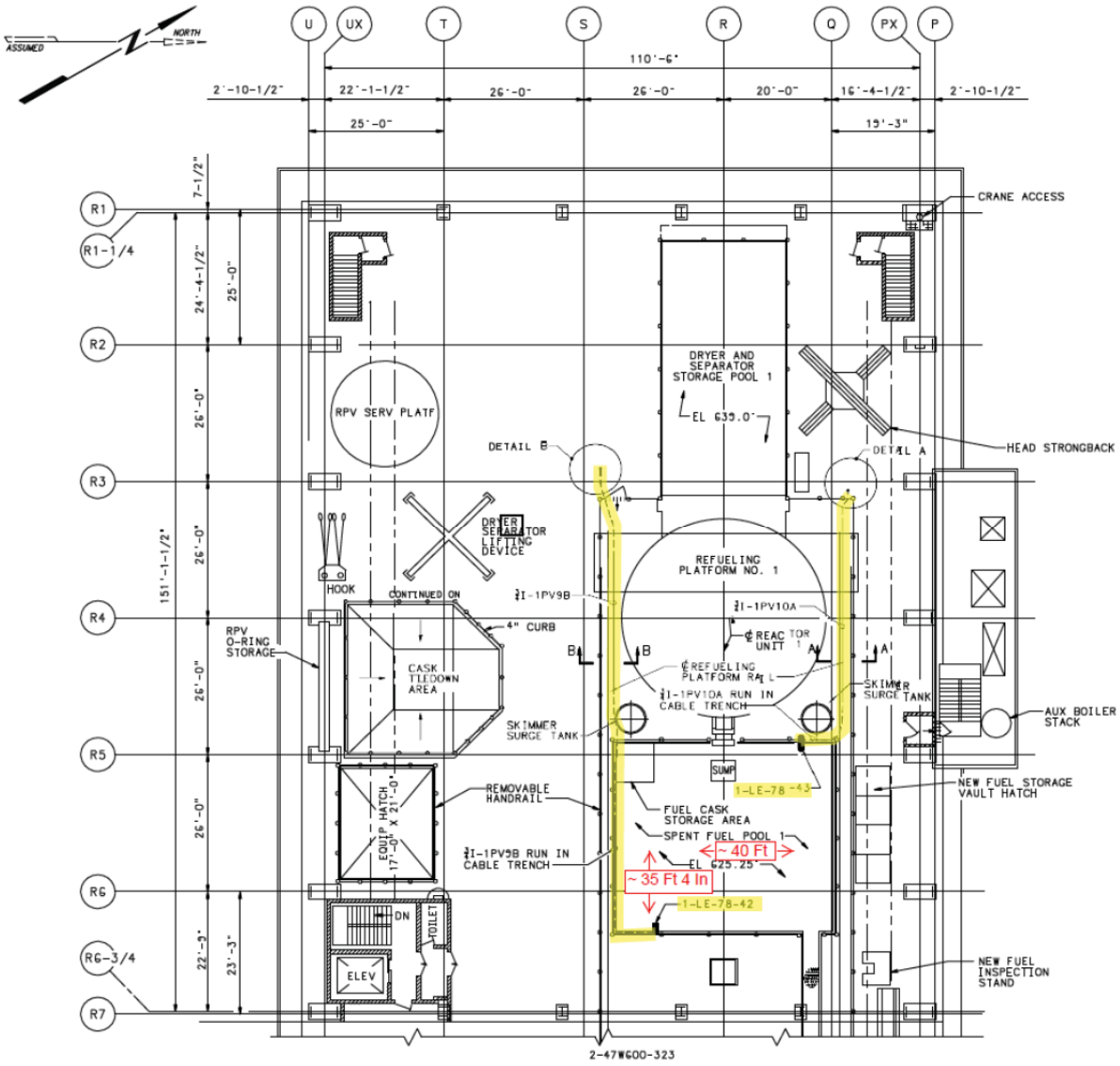
RAI#16 References:

1. DCN 71159, Revision A, “Fukushima Mod. Spent Fuel Pool Level Instrumentation - Unit 1”
2. DCN 71160, Revision A, “Fukushima Mod. Spent Fuel Pool Level Instrumentation - Unit 2”
3. DCN 71161, Revision A, “Fukushima Mod. Spent Fuel Pool Level Instrumentation - Unit 3”

ENCLOSURE 2

SKETCH 1

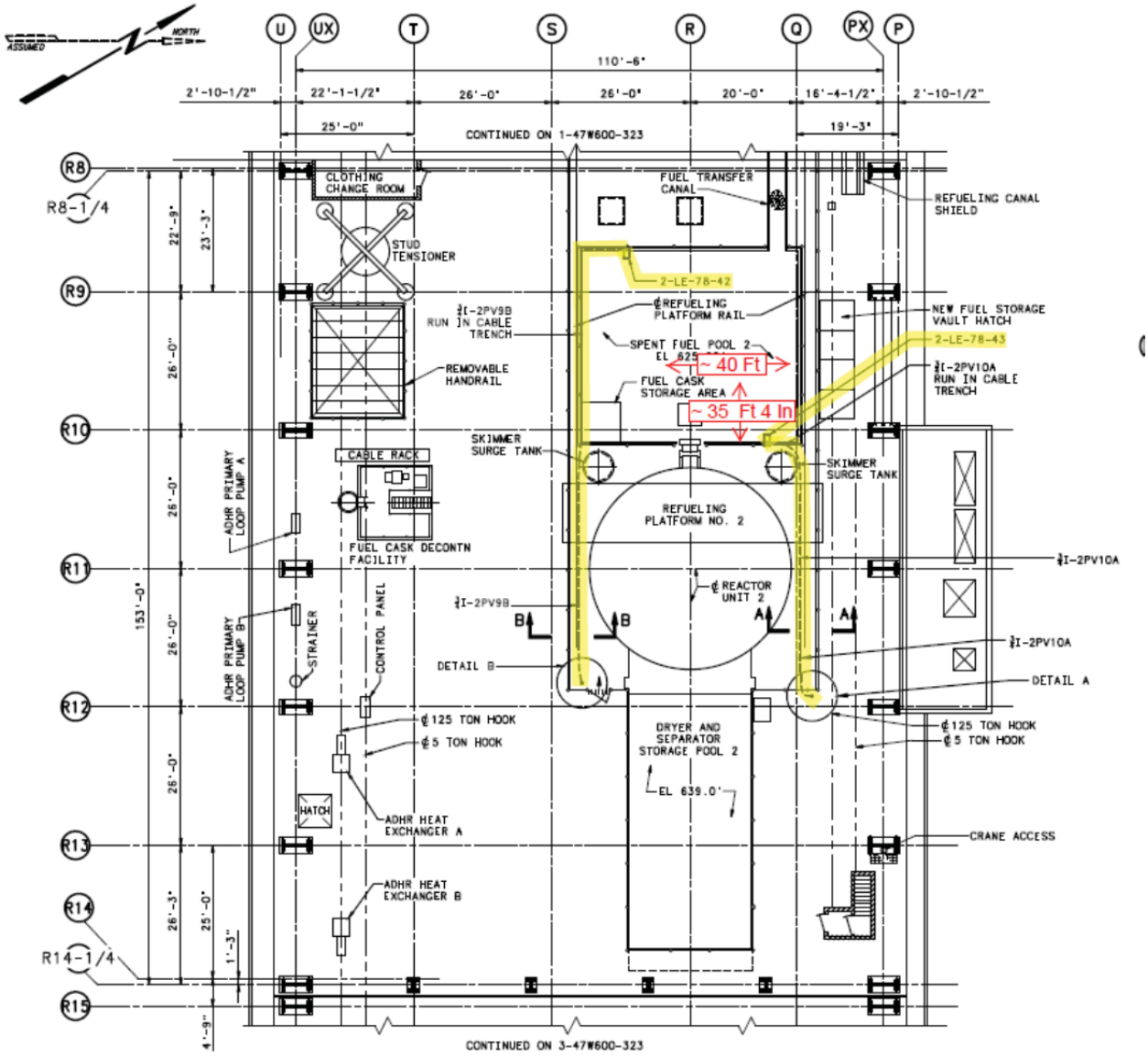
UNIT 1 SPENT FUEL POOL LAYOUT



ENCLOSURE 2

SKETCH 2

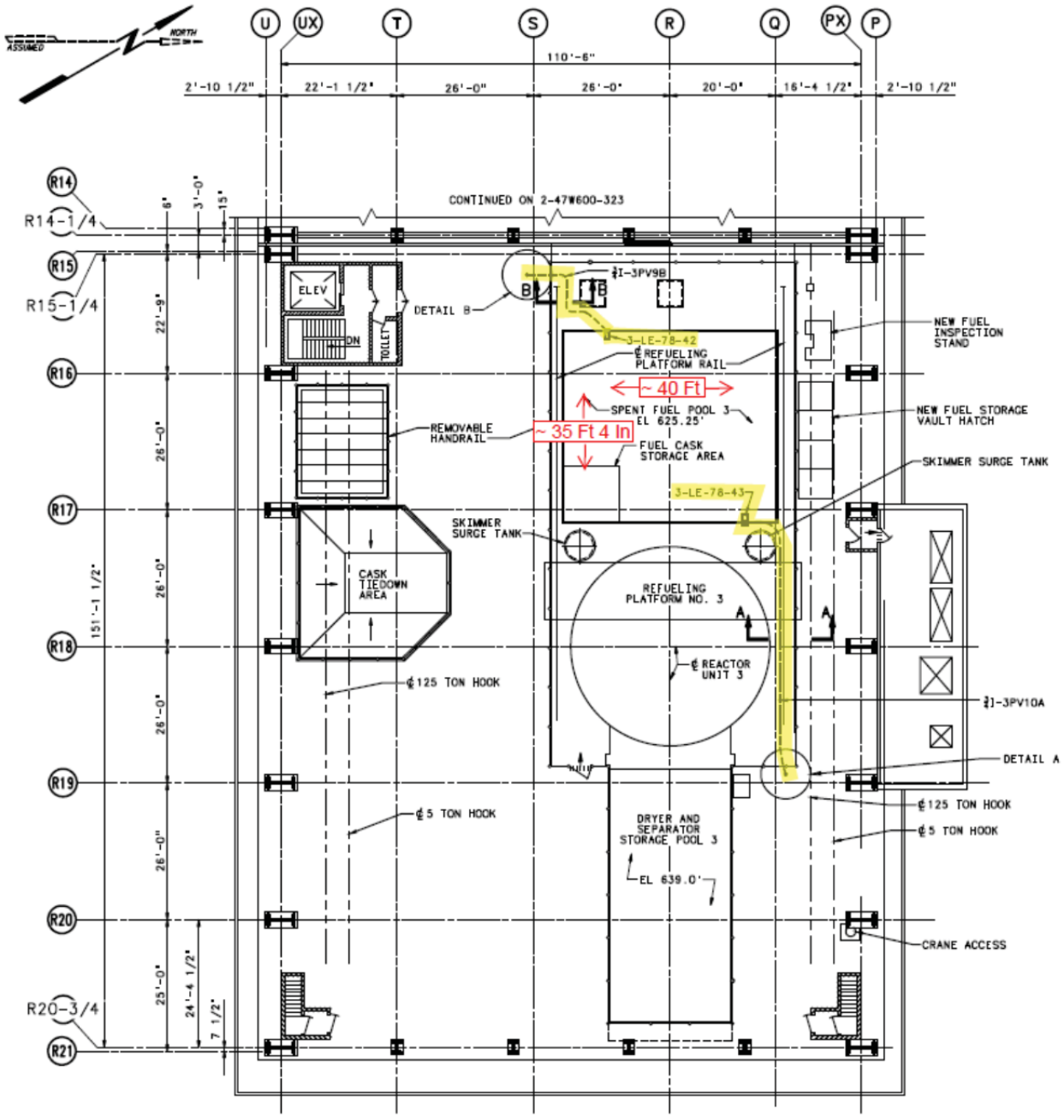
UNIT 2 SPENT FUEL POOL LAYOUT



ENCLOSURE 2

SKETCH 3

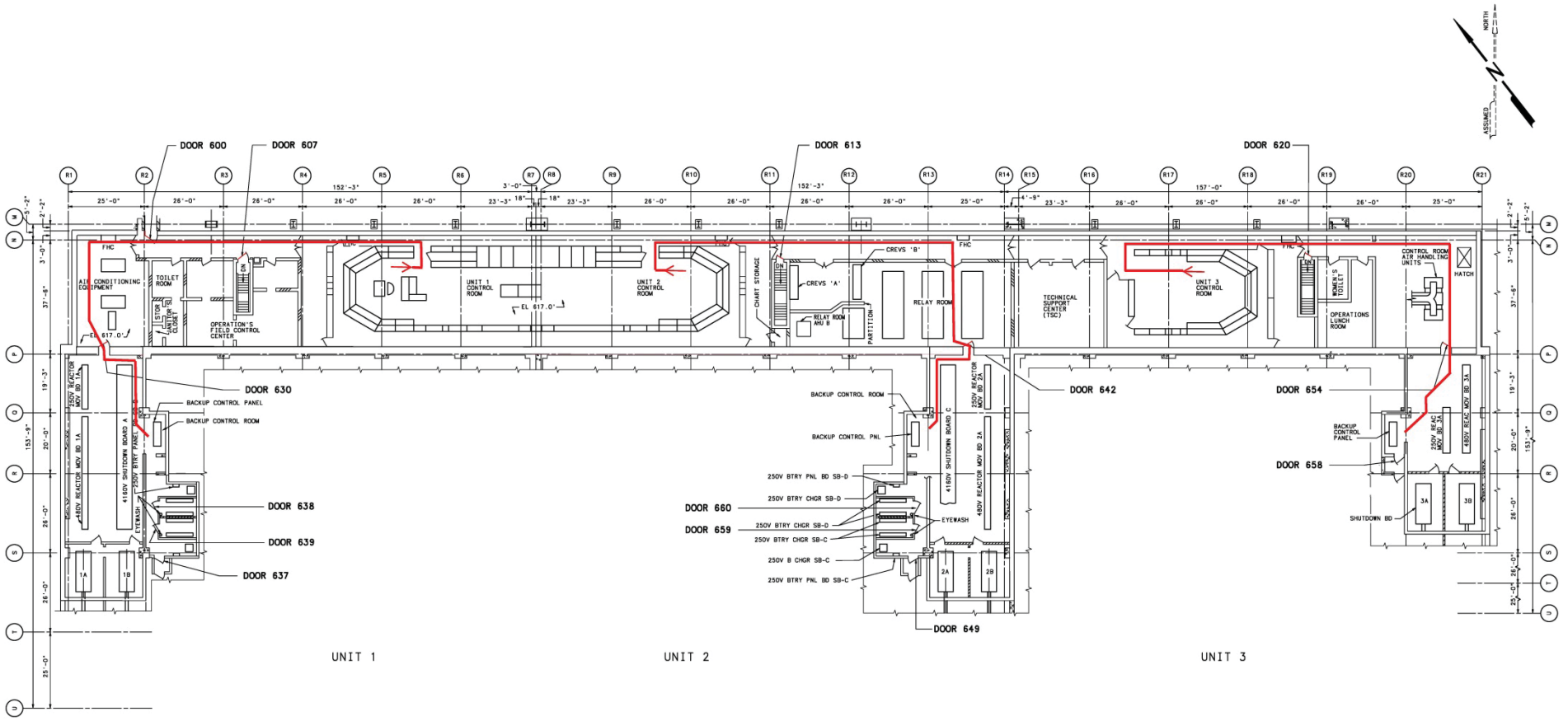
UNIT 3 SPENT FUEL POOL LAYOUT



ENCLOSURE 2

SKETCH 4

Route from Main Control Room to Backup Control Panel
(Unit 2 shown, typical for Units 1 and 3)



ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
1	Design Specification	SFPIS Requirements derived from References 1, 2, & 3	WNA-DS-02957-GEN (Ref. 4)	Contains technical SFPIS requirements based on NRC order, NEI guidance, and the ISG listed above.	N/A	TVA has reviewed WNA-DS-02957-GEN and it bounds BFN requirements from References 1, 2 and 3 as discussed in the following responses, and is therefore acceptable. Refer to RAI #8 and #9 responses.
2	Test Strategy	Per Requirements.	WNA-PT-00188-GEN (Ref. 5)	Strategy for performing the testing and verification of the SFPIS and pool-side bracket.	N/A	TVA has reviewed WNA-PT-00188-GEN and found it to be acceptable for the current design. Refer to RAI #2, #3, #8 and #9 responses.
3	Environmental qualification for electronics enclosure with Display	40^0 F to 140^0 F, 0 to 95% RH TID ≤ 1E03 R γ normal (outside SFP area) TID ≤ 1E03 R γ abnormal (outside SFP area)	EQ-QR-269 (Ref. 6) and WNA-TR-03149-GEN (Ref. 7) for all conditions.	Results are summarized in EQ-QR-269 and WNA-TR-03149-GEN. Radiation Aging verification summarized in Section 5 of WNA-TR-03149-GEN.	Test passed conditions described.	The abnormal temperature and humidity values of 60°F to 112°F and 10 to 90% RH from TVA calculation MDQ0003602014000222 (Ref. 26) are bounded by the values in Section 3.3 of WNA-TR-03149-GEN Rev 2, which is acceptable. Section 3.4 of WNA-TR-03149-GEN states that the service life of electronics enclosure is 10 years. The normal 10 year TID of 8.75E01 R from TVA drawing 0-47W225-1 (Ref. 22) (for 250V Battery Boards [Shutdown Electrical Board Rooms]) is bounded by the justification for aging for TID less than 1E04 rads from Section 4.1.3 of WNA-TR-03149-GEN, and the qualification value of 1E3 rads, which is acceptable. Abnormal dose is not applicable. Refer to RAI #8 and #9 responses.

ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
4	Environmental Testing for Level Sensor components in SFP area – Saturated Steam & Radiation	50^0 F to 212^0 F and 100% humidity	EQ-QR-269 (Ref. 6)	Testing summarized in Section 5.7.	Passed	The temperature and humidity values are documented in BFN calculation MDQ0009992014000291 (Ref. 35), attachments 6.65, 6.66, and 6.67. The values are bounded by the test results from EQ-QR-269 as described in Section 5.2 of WNA-TR-03149-GEN (Ref. 7), which is acceptable. Refer to RAI #8 and #9 responses.
		1E03 R γ normal (SFP area)	WNA-TR-03149-GEN	Thermal Aging & radiation aging verification summarized in Sections 4.1 and 5 (entire system) of WNA-TR-03149-GEN.	4.28E+03 R Based on worst case area harsh environment data for refueling floor.	Section 3.4 of WNA-TR-03149-GEN indicates that the service life of components in the SFP area is indicated as 10 years. The normal 10 year TID of 4.28E+03 R (for Elevation 664.0 Refueling Floor) from TVA drawing 1, 2, 3-47E225-122 (Ref. 37, 38 & 39) and analyzed in TVA calculation NDQ0000782014000216 (Ref. 21) is insignificant in comparison to the BDB dose of 1E+07 R from Section 4.3 of EQ-QR-269, and is assumed to be included in the 10% test margin, and bounded by Section 4.1.2 of WNA-TR-03149-GEN, which is acceptable.
		1E07 R γ BDB (SFP area)	WNA-TR-03149-GEN and EQ-QR-269	Radiation aging summarized in WNA-TR-03149-GEN section 4.1 and EQ-QR-269 section 4.3.	Passed	The BDB radiation value of 8.67E06 rem from TVA calculation NDQ0000782014000216 (Receiver location 2) is bounded by Section 4.1.2 of WNA-TR-03149-GEN (≤1E7 R), which is acceptable. Westinghouse has completed the additional testing to confirm 10 year qualified life for the cable connectors and cable assembly to avoid early replacement activities. (Refer to EQ-QR-269) Refer to RAI #8 and #9 responses.

ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
5	Environmental Testing for Level Sensor Electronics Housing – outside SFP	40^0 F to 150^0 F, 35 to 90% RH	EQLR-342 (Ref. 12)	Testing summarized in Section 8.0.	Passed	The temperature and humidity values are documented in BFN calculation MDQ0009992014000291 (Ref. 35). The values are bounded by Section 8.0, Table 8.-1 of EQLR-342, which is acceptable. The Transient Temperature Analysis calculation MDQ0009992014000291 verifies that 150˚F is not exceeded on Elev. 639.0.
		100% RH	WNA-TR-03149-GEN (Ref. 7)	100% humidity addressed in Section 7.5.	Passed	The humidity values are documented in BFN calculation MDQ0009992014000291. The values are bounded by Sections 5 and 7.5 of WNA-TR-03149-GEN, which is acceptable. Refer to RAI #8 and #9 responses. The transient temperature analysis calculation provides this verification.
		TID ≤ 1E03 R γ normal (outside SFP area) TID ≤ 1E03 R γ abnormal (outside SFP area)	WNA-TR-03149-GEN and WNA-GO-00127-GEN (Ref. 17)	Radiation Aging verification summarized in Section 4 of WNA-TR-03149-GEN. Service life summarized in Section 7.5 of WNA-GO-00127-GEN.	Passed	Section 7.5 of WNA-GO-00127-GEN states that the service life of the level sensor will be 7.1 years. TVA calculation NDQ0000782014000216 (Ref. 21) calculates a 10 year Normal Integrated Dose of 8.76E+02 R plus Beyond Design Basis accident dose of 4.2E-02 R (for 7 days) for a TID of approximately 8.76E+02 R, which is bounded by Section 4.1.3 of WNA-TR-03149-GEN (≤1E3 R), which is acceptable. Abnormal dose is not applicable. Refer to RAI #5, #8 and #9 responses.
6	Thermal & Radiation Aging – organic components in SFP area	1E03 R γ normal (SFP area)	EQ-QR-269 (Ref. 6) and WNA-TR-03149-GEN (Ref. 7)	Thermal Aging & radiation aging verification summarized in Sections 4.1 and 5 (entire system) of WNA-TR-03149-GEN.	Passed	TVA has reviewed EQ-QR-269 and WNA-TR-03149-GEN for this topic and found them acceptable for BFN. See response to Item 4 above.

ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
		1E07 R γ BDB (SFP area)	WNA-TR-03149-GEN and EQ-QR-269	Radiation aging summarized in WNA-TR-03149-GEN sect. 4.1 and EQ-QR-269 sect. 4.3.	Passed	TVA has reviewed the results of the aging program and found them acceptable. See response to Item 4 above.
7	Basis for Dose Requirement	SFP Normal Conditions: 1E03 R γ TID (above pool) 1E09 R γ TID (1' above fuel rack) SFP BDBE Conditions: 1E07 R γ TID (above pool) < 1E07 R γ TID (1' above fuel rack)	LTR-SFPIS-13-35 (Ref. 8) and WNA-DS-02957-GEN (Ref. 4)	Explanation of Basis for Radiation Dose Requirement (includes the clarification of production equivalency of electronics enclosure used for Seismic and EMC Testing)	Passed for all conditions except normal conditions above pool calculated value is 4.28E+03 R and is justified in item 4 above.	For normal and BDB conditions above the pool, see response to Item 4 above. Radiation values 1' above the fuel rack have not been evaluated in TVA calculation NDQ0000782014000216 (Ref. 21), however, Section 4.8.1 of WNA-DS-02957-GEN states that only probe's stainless steel cable and weight are exposed at this location. Therefore, the justification for components that are inherently resistant to radiation effects in Section 4.1.2 of WNA-TR-03149-GEN (Ref. 7) is bounding for BFN, which is acceptable. Refer to RAI #8 and #9 responses.
8	Seismic Qualification	Per Spectra in WNA-DS-02957-GEN (Ref. 4)	EQ-QR-269 (Ref. 6)	EQ-QR-269 summarizes the testing performed by Westinghouse	Passed	TVA has reviewed the seismic qualification testing in EQ-QR-269 and WNA-TR-03149-GEN and finds them to be acceptable. Site-specific response spectra are appended to CN-PEUS-14-11 (Ref. 11) (see Item 12 below). Refer to RAI #2, #3, #4, #8 and #9 responses.
			WNA-TR-03149-GEN (Ref. 7)	WNA-TR-03149-GEN provides high level summary of the pool-side bracket analysis and optional RTD.	Passed	
			EQ-QR-269	Seismic Pull test for new connectors documented in Section 4.4.	Passed	

ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
9	Sloshing	N/A	LTR-SEE-II-13-47 (Ref. 9)	Calculation to demonstrate that probe will not be sloshed out of the SFP.	Passed	TVA has reviewed LTR-SEE-II-13-47 and agrees with the conclusion that sloshing will not throw the instrument out of the pool.
			WNA-TR-03149-GEN (Ref. 7)	Sloshing is also addressed in Section 7.2.	Passed	TVA has reviewed Section 7.2 of WNA-TR-03149-GEN and found it to be acceptable. The BFN spent fuel pool level is sufficiently below the bracket such that sloshing will not impact the bracket. This is acceptable. Refer to RAI #2, #3, & #6 responses. TVA calculation CDQ0000782014000252 (Ref. 24) evaluates impact of the probe on the spent fuel pool liner plate during a seismic event and concludes that it will not have significant impact on the liner plate.
10	Spent Fuel Pool Instrumentation System Functionality Test Procedure	Acceptance Criteria for Performance during EQ testing	WNA-TP-04613-GEN (Proprietary)	Test procedure used to demonstrate that SFPIS meet its operational and accuracy requirements during Equipment Qualification Testing programs.	See applicable EQ test.	WNA-TP-04613-GEN was not provided to TVA. BFN has reviewed WNA-TP-00189-GEN “Integrated Functional Test Plan” (Ref. 13) and found it acceptable, with the exception of EMC qualification to Performance Criteria A, which was independently verified by TVA. Refer to RAI #9 through #13 responses.
11	Boron Build-Up	Per requirement in WNA-DS-02957-GEN (Ref. 4)	WNA-TR-03149-GEN (Ref. 7)	There is no presence of boron through out the Spent Fuel Pool System at BFN.	Passed	BFN has reviewed the justification in Section 7.4 of WNA-TR-03149-GEN and found it does not apply to this installation.
12	Pool-side Bracket Seismic Analysis	N/A	CN-PEUS-14-11 (Ref. 11)	Also includes hydrodynamic forces, as appropriate.	Passed	BFN seismic requirements for 2x SSE HCLPF are bounded by CN-PEUS-14-11, which is acceptable. Refer to RAI #2, #3, #4, #8 and #9 responses.

**Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary**

#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
13	Additional Brackets (Sensor Electronics and Electronics Enclosure)	N/A	WNA-DS-02957-GEN (Ref. 4)	Weights provided to licensees for their own evaluation.	N/A	Instrument panel mounting is qualified by BFN calculation CDQ0000782014000219 (Ref. 23) based on WNA-DS-02957-GEN. TVA evaluates the seismic mounting requirements in accordance with BFN safety related requirements. Refer to RAI #2, #3, #4, #8 and #9 responses.
14	Shock & Vibration	WNA-DS-02957-GEN (Ref. 4)	WNA-TR-03149-GEN (Ref. 7)	Section 7 provides rationale.	N/A	TVA concurs with the Westinghouse evaluation of shock and vibration in Section 7.1 of WNA-TR-03149-GEN. Refer to RAI #8 and #9 responses.
15	Requirements Traceability Matrix	Maps Requirements to documentation / evidence that Requirement is met	WNA-VR-00408-GEN (Ref. 10)	The RTM maps the requirements of the NRC order, NEI guidance, ISG to the applicable technical requirements in the SFPIS design specification and maps the design specification requirements to the documentation demonstrating the requirement is met.	Complete	A copy of WNA-VR-00408-GEN was not provided to TVA, however, TVA has reviewed Revision A of WNA-VR-00408-GEN and concurs with the documents that have been provided.

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Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
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#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
16	Westinghouse Factory Acceptance Test, including testing of dead zones	IFT Functional Requirements from WNA-DS-02957-GEN (Ref. 4)	WNA-TP-04752-GEN (Ref. 14)	The Integrated Functional Test (IFT) demonstrates functionality of the full system for each customer's FAT, which includes calibration of each channel.	Pilot IFT executed/ passed; Watts Bar IFT executed/ passed; BFN IFT executed/ passed	BFN has reviewed WNA-TP-04752-GEN and found it to be acceptable with the exception of any EMI/RFI tests that have been independently verified by TVA. WNA-TR-03544-GBFY1 (Ref. 20) performs the Integrated Functional Check for Browns Ferry. Refer to RAI #12, #13, #15 and #16 responses.
		12" dead-zone at top of probe 4" dead-zone at bottom of probe	WNA-TP-04752-GEN	Dead-zone tests are in Section 9.6.2.	N/A	The BFN instrument scaling from 640' - 10" to 663' - 0" from TVA setpoint and scaling documents 1, 2, 3-L-78-42 and 1, 2, 3-L-78-43 (Ref. 25) is bounded by the unmeasurable zones from Section 9.6.2 of WNA-TP-04752-GEN.
17	Channel Accuracy	+/- 3 inches per WNA-DS-02957-GEN (Ref. 4)	WNA-CN-00301-GEN (Ref. 15)	Channel accuracy from measurement to display.	Passed	TVA has reviewed the channel accuracy in WNA-DS-02957-GEN and WNA-CN-00301-GEN and found them to be acceptable. The BFN channel accuracy, documented in TVA calculation EDQ0000782014000251 (Ref. 36) and setpoint and scaling documents 1, 2, 3-L-78-42 and 1, 2, 3-L-78-43, is considered to be conservative and is bounded by WNA-CN-00301-GEN. Refer to RAI #12 response.

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Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
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#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
18	Power Consumption	3 day battery life (minimum) 0.257 Amps power consumption	WNA-CN-00300-GEN (Ref. 16)	N/A	Passed	TVA has reviewed WNA-CN-00300-GEN and concurs that battery life of 4.22 days from Table 5-7 is adequate for BFN. The 0.257A loading does not challenge the BFN distribution system per TVA calculations EDQ125320020060 (Ref. 34), EDQ199920020070 (Ref. 29), EDQ0030910058 (Ref. 30), EDQ2000870028 (Ref. 27), EDQ2000880086 (Ref. 31), EDQ3999920121 (Ref. 32), and EDQ3253920066 (Ref. 28), which is acceptable. Refer to RAI #11 response.
19	Technical Manual	N/A	WNA-GO-00127-GEN (Ref. 17)	Information and instructions for Operation, Installation, use, etc. are included here.	N/A	BFN has received WNA-GO-00127-GEN and has used it as input for procedure preparation. Refer to RAI #8 and #9 responses.
20	Calibration	Routine Testing/calibration verification and Calibration method	WNA-TP-04709-GEN (Ref. 18)	Also, includes preventative maintenance actions such as those for power supply and UPS functional verifications.	N/A	BFN has received WNA-TP-04709-GEN and has used it as input for procedure preparation. An Acceptable As-Left calibration value listed in SSD 1, 2, 3-L-78-42 and 1, 2, 3-L-78-43 is used in the calibration procedures, which is conservative. Refer to RAI #12, #13, #15 and #16 responses.
21	Failure Modes and Effects Analysis (FMEA)	N/A	WNA-AR-00377-GEN (Ref. 19)	Addresses mitigations for the potential failure modes of the system.	N/A	Not required.

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Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
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#	Topic	Parameter Summary	Westinghouse Reference Document	Additional Comment	Test or Analysis Results	Licensee Evaluation
22	Emissions Testing	RG 1.180 R1 test conditions	EQ-QR-269 (Ref. 6)	Documented in Section 5.6.	Passed	TVA has reviewed the Westinghouse test report and found it meets requirements for radiated emissions limits and criteria B for susceptibility testing. In addition, TVA has conducted additional EMI testing (B43 140513 001) (Ref. 33) and installed the channel such that Level A compliance exists around the transmitter and coax. Level A compliance at the probe cannot be obtained in the VHF frequency band (less than 200 MHZ), however VHF radios will be phased out from all plant organizations other than security. Security will only use VHF as a backup channel if the primary channel is unavailable, so the potential for spurious indication is extremely small and does not exist during BDBEE when low water level (NEI 12-02 level 2) exists in the SFP.

ENCLOSURE 2
ATTACHMENT 1

Browns Ferry Nuclear Plant, Units 1, 2, and 3 -
Spent Fuel Pool Instrumentation Test and Qualification Summary

References:

1. ML12056A044, NRC Order EA-12-051, "ORDER MODIFYING LICENSES WITH REGARD TO RELIABLE SPENT FUEL POOL INSTRUMENTATION," Nuclear Regulatory Commission, March 12, 2012.
2. ML12240A307, NEI 12-02 (Revision 1), "Industry Guidance for Compliance with NRC Order EA-12-051, "To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" August, 2012.
3. ML12221A339, Revision 0, JLD-ISG-2012-03, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation", August 29, 2012, Nuclear Regulatory Commission Japan Lessons-Learned Project Directorate.
4. Westinghouse Proprietary Document, WNA-DS-02957-GEN, "Spent Fuel Pool Instrumentation System (SFPIS) Standard Product System Design Specification," Revision 3 reviewed by NRC in April 2014; current revision is Revision 4.
5. Westinghouse Proprietary Document, WNA-PT-00188-GEN, "Spent Fuel Pool Instrumentation System (SFPIS) Standard Product Test Strategy," Revision 1 reviewed by NRC in February 2014; current revision is Revision 3.
6. Westinghouse Proprietary Document, EQ-QR-269, "Design Verification Testing Summary Report for the Spent Fuel Pool Instrumentation," Revision 1 reviewed by NRC in April 2014; current revision is Revision 4.
7. Westinghouse Proprietary Document, WNA-TR-03149-GEN, "SFPIS Standard Product Final Summary Design Verification Report," Revision 1 reviewed by NRC in April 2014; current revision is Revision 2.
8. Westinghouse Proprietary Document, LTR-SFPIS-13-35, "SFPIS: Basis for Dose Requirement and Clarification of Production Equivalency of Electronics Enclosure Used for Seismic Testing," Revision 0 reviewed by the NRC in February 2014; current revision is Revision 1.
9. Westinghouse Proprietary Document, LTR-SEE-II-13-47, "Determination if the Proposed Spent Fuel Pool Level Instrumentation can be Sloshed out of the Spent Fuel Pool during a Seismic Event," Revision 0 reviewed by the NRC in February 2014; current revision is Revision 0.
10. Westinghouse Proprietary Document, WNA-VR-00408-GEN, Revision A.
11. Westinghouse Proprietary Document, CN-PEUS-14-11, "Seismic Analysis of the SFP Primary-Mounting Bracket at Browns Ferry Nuclear Plant," Revision 1 reviewed by the NRC in February 2014; current revision is Revision 2.
12. Westinghouse Proprietary Document, EQLR-342, "Environmental Design Verification Test Report for the Spent fuel Pool Instrumentation System" current revision is Revision 0.
13. Westinghouse Proprietary Document, WNA-TP-00189-GEN, "Spent Fuel Pool Instrumentation System Standard Product Functional Test Plan," Revision 3.
14. Westinghouse Proprietary Document, WNA-TP-04752-GEN, "Spent Fuel Pool Instrumentation System Standard Product Integrated Functional Test Procedure," Revision 2 reviewed by the NRC in February 2014; current revision is Revision 2.
15. Westinghouse Proprietary Document, WNA-CN-00301-GEN, "Spent Fuel Pool Instrumentation System Channel Accuracy Analysis," Revision 0 reviewed by the NRC in February 2014; current revision is Revision 1.

16. Westinghouse Proprietary Document, WNA-CN-00300-GEN, “Spent Fuel Pool Instrumentation System Power Consumption Calculation,” Revision 0 reviewed by the NRC in February 2014; current revision is Revision 0.
17. Westinghouse Proprietary Document, WNA-GO-00127-GEN, “Spent Fuel Pool Instrumentation System Standard Product Technical Manual,” Revision 2 reviewed by the NRC in April 2014; current revision is Revision 4.
18. Westinghouse Proprietary Document, WNA-TP-04709-GEN, “Spent Fuel Pool Instrumentation System Calibration Procedure,” Revision 3 was reviewed by the NRC in February 2014; current revision is Revision 4.
19. Westinghouse Proprietary Document, WNA-AR-00377-GEN, “Spent Fuel Pool Instrumentation System Failure Modes and Effect Analysis,” Revision 2 was reviewed by the NRC in February 2014; current revision is Revision 3.
20. Westinghouse Proprietary Document, WNA-TR-03544-GBFY1, “Spent Fuel Pool Instrumentation System Integrated Functional Check Report, Browns Ferry Units 1, 2, & 3,” Revision 0.

BFN References:

21. BFN Calculation NDQ0000782014000216, ”Beyond Design Basis Dose Evaluation for Spent Fuel Pool Level Instrumentation” Revision 1.
    a. TID is summarized on cover sheet and shown in Section 7.0.
22. BFN Drawing 0-47W225-1, “Environmental Data Environment - Mild” El 621.25’ Revision 1.
    a. 250V Battery Room (Shutdown Electrical Board Rooms) EL. 621.25’
23. BFN Calculation CDQ0000782014000219, “Seismic Qualification for the Mounting of Spent Fuel Pool Level Instrumentation for BFN”, Revision 0.
24. BFN Calculation CDQ0000782014000252, “Seismic Qualification and Anchorage Design of the BFN Spent Fuel Pool Level Element Support Bracket,” Revision 3.
25. BFN Nuclear Engineering Setpoint and Scaling Documents 1-L-78-42, 2-L-78-42, 3-L78-42,1-L-78-43, 2-L-78-43, 3-L-78-43, Revision 0.
26. BFN Calculation MDQ0003602014000222, “BFN ELAP Transient Temperature Analysis”, Revision 3.
27. BFN Calculation EDQ2000870028, “120V Voltage Drop Calculation,” Revsion 57.
28. BFN Calculation EDQ3253920066“120 VAC Load Flow and Voltage Drop for Instrumentation & Control, Reactor Protection and Unit Preferred Systems”, Revision 41.
29. BFN Calculation EDQ199920020070, “120VAC System, Cable and Bus Protection, and Breaker/Fuse Coordination,” Revision 49.
30. BFN Calculation EDQ0030910058, “Electrical Equipment Heat Losses - Rooms iin Unit 1, 2, and 3,” Revision 36.
31. BFN Calculation EDQ2000880086, “Cable and Bus Protection/Breaker, Fuse Coordination For 120VAC Systems,” Revision 47.
32. BFN Calculation EDQ3999920121, “120 VAC System Cable and Bus Protection/Breaker/Fuse Coordination,” Revision 44.
33. TVA Test Report (B43 140513 001), “TVA NPG EMI Laboratory Spent Fuel Pool Level Testing”, for the Westinghouse-Supplied SFPLIS.

34. BFN Calculation EDQ125320020060, “120 VAC Load Flow and Voltage Drop for Instrumentation and Control, Reactor Protection and Unit Preferred,” Revision 41.
35. BFN Calculation MDQ0009992014000291, “Temperature Response of the Reactor Building Following an Extended Loss of AC Power,” Revision 0.
36. BFN Calculation EDQ0000782014000251, “Demonstrated Accuracy Calculation for Spent Fuel Pool Wide Range Level Channels”, Revision 2.
37. BFN Drawing 1-47E225-122, “Harsh Environmental Data Room No. 15 El 664.0 ft.”, Revision 3.
38. BFN Drawing 2-47E225-122, “Harsh Environmental Data Room No. 15 El 664.0 ft.”, Revision 4.
39. BFN Drawing 3-47E225-122, “Harsh Environmental Data Room No. 15 El 664.0 ft.”, Revision 7.

ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT, UNITS 1, 2, AND 3

ANSWERS TO OPEN AUDIT ITEMS

OPEN AUDIT ITEM

From the audit report (Reference 1), there was one Request for Additional Information (RAI) open item identified, SFPI RAI#6, which required further review.

SFPI RAI#6: Please provide information indicating what will be the maximum expected ambient temperature in the room in which the associated transmitter (electronics package) will be located under BDB [beyond-design-basis] condition in which there is no AC power available to run Heating Ventilation and Air Conditioning (HVAC) systems..

Audit Open Item Tracking Number 6-D: The NRC Staff requests the licensee make available for audit calculation MDQ0009992014000291, "Temperature Response of the Reactor Building Following an Extended Loss of AC Power."

ANSWER

The transmitters are located in the Reactor Building on Elevation 639.0 on each unit, which is a separate environmental area than the Spent Fuel Pool. BFN calculation MDQ0009992014000291, Revision 0 (Reference 3), Figures 6.50 through 6.64, provides dry bulb temperatures, wet bulb temperatures, and relative humidity profiles for the Reactor Building on Elevation 639.0. Westinghouse report EQLR-342 Revision 0 (Reference 2), "Environmental Design Verification Test Report for Spent Fuel Pool Instrumentation System," confirms that this location is an acceptable environment for the transmitter.

These documents were made available to NRC for review on April 1, 2015.

REFERENCES

1. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 - Report for the Onsite Audit Regarding Implementation of Mitigating Strategies and Reliable Spent Fuel Instrumentation Related to Orders EA-12-049 and EA-12-051," dated April 6, 2015 (ML15069A358)
2. Westinghouse Report EQLR-342, Revision 0, "Environmental Design Verification Test Report for Spent Fuel Pool Instrumentation System," dated March 2015
3. TVA BFN Calculation MDQ0009992014000291, Revision 0, "Temperature Response of the Reactor Building Following an Extended Loss of AC Power"