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June 24, 2016
L-16-122

10 CFR 2.202

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-001

SUBJECT:
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
Completion of Required Action by NRC Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (CAC No. MF0960)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, to FirstEnergy Nuclear Operating Company (FENOC). This Order was effective immediately and directed FENOC to have a reliable indication of the water level in associated spent fuel storage pools for the Davis-Besse Nuclear Power Station (DBNPS) as outlined in Attachment 2 of the Order. This letter, along with its attachments, 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 DBNPS.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 24, 2016.

Respectfully submitted,

Brian D. Boles

Attachments:
1. Compliance with Order EA-12-051
2. NRC Requests for Information

cc: Director, Office of Nuclear Reactor Regulation (NRR)
NRC Region III Administrator
NRC Resident Inspector
NRC Project Manager
Ms. Lisa M. Regner, NRR/JLD/PMB, NRC
Mr. Blake A. Purnell, NRR/JLD/PMB, NRC
Utility Radiological Safety Board (without Attachments)

BACKGROUND

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Reference 1), to FirstEnergy Nuclear Operating Company (FENOC). This Order was effective immediately and directed FENOC to have a reliable indication of the water level in associated spent fuel storage pools for the Davis-Besse Nuclear Power Station (DBNPS) 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 DBNPS was May 7, 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 DBNPS in response to the Order.

COMPLIANCE

FENOC has installed two independent full scale level monitors on the spent fuel pool (SFP) at DBNPS in response to Reference 1. This SFP instrumentation was supplied and qualified by Westinghouse, LLC (Westinghouse). DBNPS discharges irradiated fuel to a single spent fuel storage pool. With the exception of limited time periods for maintenance or non-refueling operations, administrative controls maintain gates in the open position between the following pools: SFP, fuel transfer canal, and cask loading pit. Thus, these pools are normally inter-connected and at the same water level when the water level in the SFP is greater than 1 foot above the top of stored fuel seated in the storage racks. These pools are treated as one SFP with regard to Reference 1.

FENOC submitted the DBNPS OIP by letter dated February 27, 2013 (Reference 2). By letter dated December 11, 2013 (Reference 3), the NRC provided its interim staff evaluation and requested additional information necessary for completion of the review. The information requested by the NRC is included in Attachment 2 of this submittal.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance and status reports at six-month intervals following submittal of the OIP. FENOC provided the initial status report for DBNPS by letter dated October 26, 2012 (Reference 4). The first, second, third, fourth, fifth, and sixth six-month status reports for DBNPS were provided by letters dated August 26, 2013, February 27, 2014, August 28, 2014, February 26, 2015, August 18, 2015, and February 9, 2016, respectively (References 5, 6, 7, 8, 9, and 10.)

Compliance with Order EA-12-051 was achieved using the guidance in Nuclear Energy Institute (NEI) document NEI 12-02, Revision 1 (Reference 11), which has been endorsed by the NRC (Reference 12) with exceptions and clarifications. A summary of the compliance elements is provided below.

Identification of Levels of Required Monitoring

FENOC has identified the three required levels for monitoring SFP level in compliance with Reference 1. These levels have been integrated into the site processes for monitoring SFP level during beyond-design-basis external events (BDBEEs) and responding to loss of SFP inventory.

Instrumentation Design Features

FENOC has installed SFP instrumentation consisting of permanently mounted, fixed primary and backup instrument channels at DBNPS. This SFP instrumentation was supplied and qualified by Westinghouse. The design of the SFP instrumentation system complies with the requirements specified in Reference 1 and Reference 11. The SFP instrumentation has been installed in accordance with the site design control process.

The instruments have been arranged to provide reasonable protection against missiles (airborne objects). Each channel consists of a level sensor, an electronics unit, and an indicator. The sensors are mounted on the opposite ends of the SFP as far apart as practical within the constraints of the existing pool geometry and equipment and as close to the adjacent corners as possible to minimize the possibility of a single event or missile damaging both channels. The sensor arrangement also limits interference with existing equipment in or around the SFP. This design does not pose a potential hazard to personnel working around the pool or on the SFP level instrumentation itself.

The instruments have been mounted to retain design configuration during and following the maximum expected ground motion considered in the design of the SFP structure. 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 BDBEEs and allows for SFP level information to be promptly available.

Program Features

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.

Procedures for the testing, calibration, and use of the primary and backup SFP instrument channels have been established and integrated with existing procedures.

Preventive maintenance tasks have also been established and scheduled to ensure the instruments are maintained at their design accuracy.

REFERENCES

1. Nuclear Regulatory Commission (NRC) Order Number EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated March 12, 2012.

2. FirstEnergy Nuclear Operating Company's (FENOC's) Overall Integrated Plan in Response to March 12, 2012 Commission Order Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 27, 2013.

3. NRC Letter, Davis-Besse Nuclear Power Plant Unit No. 1 - 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 December 11, 2013.

4. FirstEnergy Nuclear Operating Company's (FENOC's) Initial Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated October 26, 2012.

5. FirstEnergy Nuclear Operating Company's (FENOC's) First 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) (TAC Nos. MF0799, MF0800, MF0960, and MF0802), dated August 26, 2013.

6. FirstEnergy Nuclear Operating Company's (FENOC's) Second 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) (TAC Nos. MF0799, MF0800, MF0960, and MF0802), dated February 27, 2014.

7. FirstEnergy Nuclear Operating Company's (FENOC's) Third 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) (TAC Nos. MF0799, MF0800, MF0960, and MF0802), dated August 28, 2014.

8. FirstEnergy Nuclear Operating Company's (FENOC's) Fourth 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) (TAC Nos. MF0799, MF0800, MF0960, and MF0802), dated February 26, 2015.

9. FirstEnergy Nuclear Operating Company's (FENOC's) Fifth 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) (TAC Nos. MF0800 and MF0960), dated August 18, 2015.

10. FirstEnergy Nuclear Operating Company's (FENOC's) Sixth 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) (TAC No. MF0960), dated February 9, 2016.

11. NEI Document, 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.

12. NRC Japan Lessons-Learned Project Directorate Interim Staff Guidance, JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, dated August 29, 2012.

By letter dated December 11, 2013, the Nuclear Regulatory Commission (NRC) issued an interim staff evaluation (ISE) and request for additional information (RAI) regarding the Davis-Besse Nuclear Power Station (DBNPS) overall integrated plan for implementation of NRC Order EA-12-051, Reliable Spent Fuel Pool Instrumentation. Subsequently, by letter dated March 26, 2014, the NRC staff transitioned to an audit-based review process that allowed the use of the licensee's ePortal to provide responses to the RAIs to support the staff's review process. FirstEnergy Nuclear Operating Company (FENOC) utilized the ePortal to provide the majority of RAI responses for DBNPS. The responses to the following RAIs were previously provided to the NRC via the FENOC ePortal: RAI-4(b) schematic, RAI-5, RAI-7, RAI-8, RAI-10(b), RAI-11, RAI-12, RAI-13, RAI-14, and RAI-15. The previously docketed RAI responses to RAI-2, RAI-3, and RAI-4(c), have been amended. RAI responses to RAI-5, RAI-7, RAI-8, RAI-11(a), RAI-12(b), and RAI-13 have been amended on the ePortal. The responses are provided in the tense that was applicable when presented on the ePortal, and therefore may not reflect the final completed status. The NRC staff question is presented in bold type, followed by the FENOC response. Following the RAI responses is a copy of the bridging document that was previously provided to the NRC via the FENOC ePortal.

RAI-1:

Please specify for Level 1 how the identified location represents the higher of the two points described in the NEI [Nuclear Energy Institute] 12-02 guidance for this level.

Response:

The response to this RAI was provided by FENOC letter dated February 27, 2014.

RAI-2:

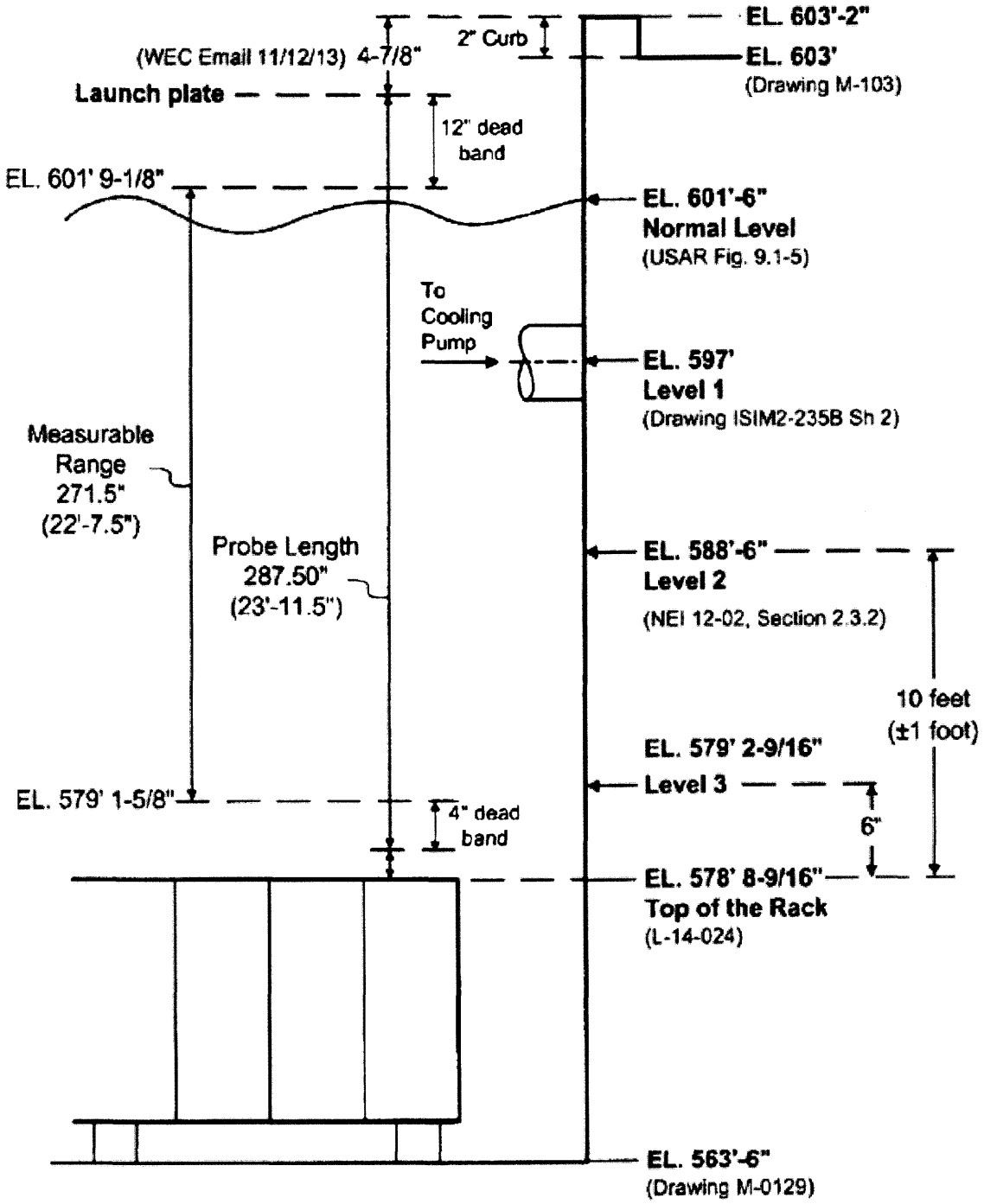
Please provide a clearly labeled sketch depicting the elevation view of the proposed typical mounting arrangement for the portions of the instrument channel consisting of permanent measurement channel equipment (e.g., fixed level sensors and/or stilling wells, and mounting brackets). Indicate on this sketch the datum values representing Level 1, Level 2, and Level 3, as well as the top of the fuel racks. Indicate on this sketch the portion of the level sensor measurement range that is sensitive to measurement of the fuel pool level, with respect to the Level 1, Level 2, and Level 3, datum points.

(This information was previously requested as RAI-1b in the NRC letter dated July 17, 2013.)

Response:

The response to this RAI was provided by FENOC letter dated February 27, 2014. Subsequently, more refined measurements were obtained for the top of fuel rack and bottom of measurement range. An updated sketch is provided below.

DBNPS Critical Level Elevations and Measurement Range



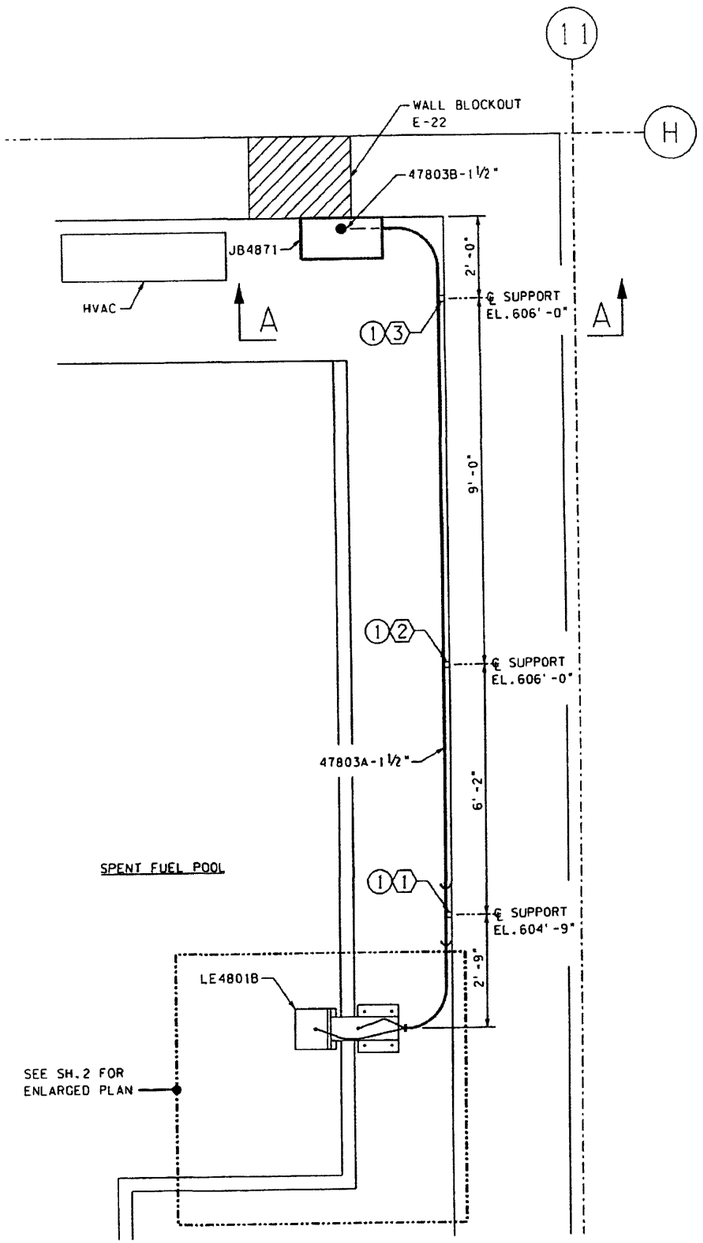
RAI-3:

Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the SFP [spent fuel pool] 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 these sensors toward the location of the read-out/display device.

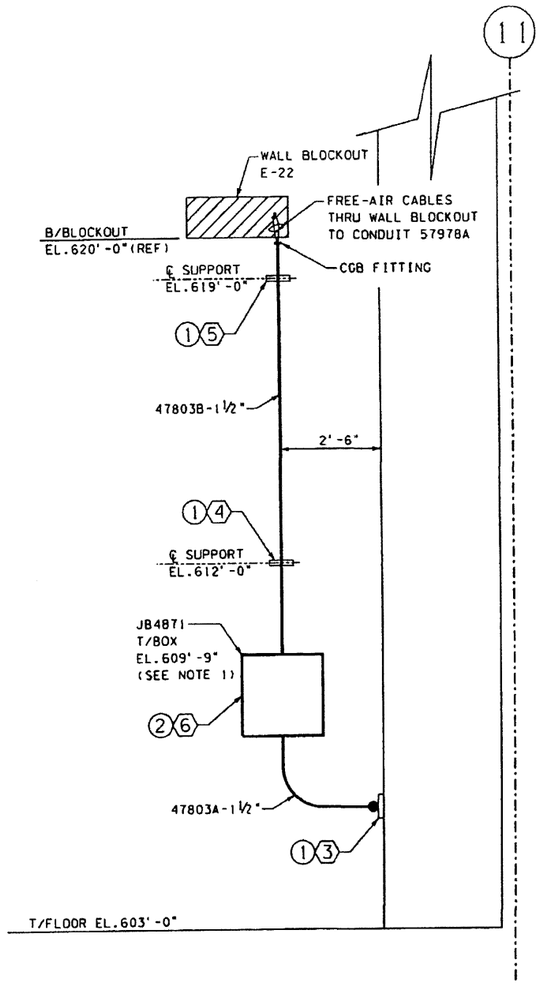
(This information was previously requested as RAI-2 in the NRC letter dated July 17, 2013.)

Response:

The response to this RAI was provided by FENOC letter dated February 27, 2014. The location of the backup level sensor, DB-LE4801B, was indicated to be on the south deck of the southeast corner of the SFP. The final location of the backup level sensor is on the south deck of the southwest corner of the SFP. Updated sketches for the location of DB-LE4801B are provided below, depicting general configuration.



PLAN VIEW
EL. 603'-0"



SECTION A-A

SUPPORT NUMBER:

1. 21979-224-SE
2. 21980-224-SE
3. 21981-224-SE
4. 21982-224-SE
5. 21983-224-SE
6. 21984-224-SE

SUPPORT SCHEDULE:

1. E302A SH.159A
2. E302A SH.1194

NOTES:

1. BOX TO BE USED TO COIL EXCESS CABLE.

NO.	DATE	REVISIONS	BY	CH'K	ENGR.	ENGR. SUPV.
0	11-25-14	ISSUED FOR ECP 13-0596, DUN 13-0596-001-014 PG. 2 OF 2	JTB 11-25-14	JTB 11/25/14		

SCALE NONE	DESIGNED	DRAWN	DATE

DAVIS-BESSE NUCLEAR POWER STATION
UNIT NO. 1

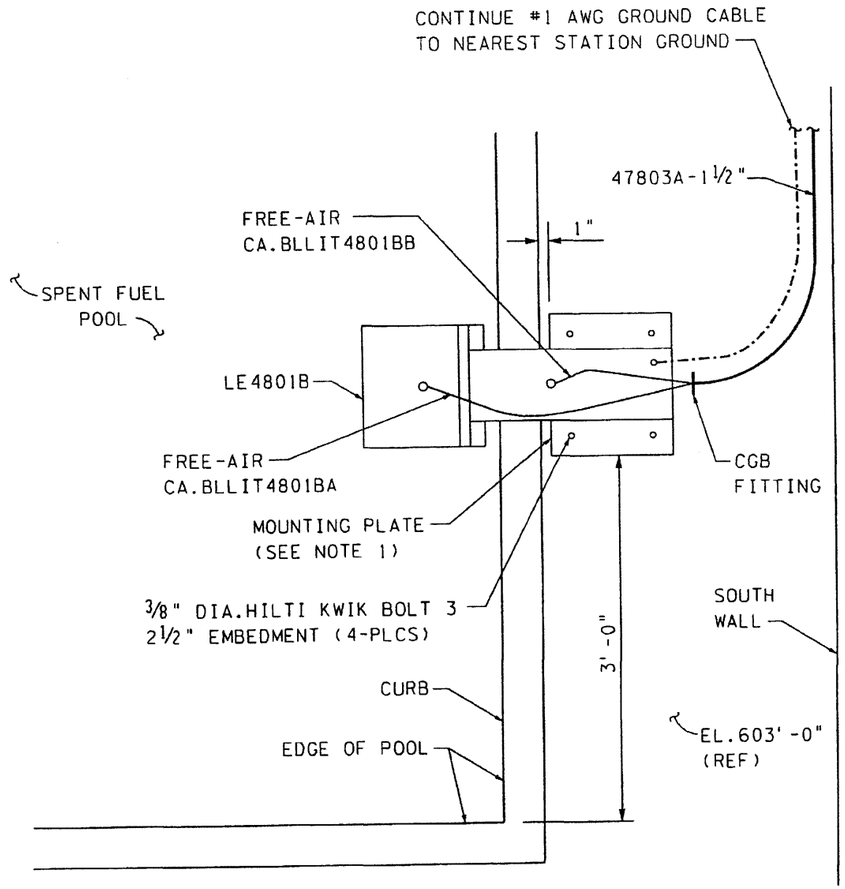
CONDUIT ROUTING
FOR ECP 13-0596-001

FENOC	DRAWING NO.	SHEET NO.	REV.
	FSK-E-0205	1	0

DB DFN=/ / .

NOTES:

1. SEE WESTINGHOUSE DWG.1006693 FOR LEVEL SENSOR MOUNTING BRACKET.



ENLARGED PLAN
EL. 603'-0"

NO.	DATE	REVISIONS
0	1/28/2015	ISSUED FOR ECP 13-0596, DUN 13-0596-001-015 PG. 2 OF 2

BY	CH'K	ENGR.	ENGR. SUPV.
JB 1/27/15	AKF 1/28/15	Hafner 1/28/2015	

SCALE NONE	DESIGNED	DRAWN	DATE

DAVIS-BESSE NUCLEAR POWER STATION
UNIT NO. 1

CONDUIT ROUTING
FOR ECP 13-0596-001

FENOC	DRAWING NO.	SHEET NO.	REV.
	FSK-E-0205	2	0

DB DFN=/ / .

RAI-4:

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 so as to support the level sensor assembly.

(This information was previously requested as RAI-3 in NRC letter dated July 17, 2013.)

Response:

The response to part (a) of this RAI was provided by FENOC letter dated February 27, 2014.

With the exception of providing a schematic, a response to part (b) of this RAI was provided by FENOC letter dated February 27, 2014. The requested schematic contains vendor proprietary information. Westinghouse, LLC (Westinghouse) drawing 1006693, Revision 1, provides details of the mechanical and electrical connections for the mounting of the level sensor in the fuel handling area of the Auxiliary Building. The drawing was made available to the NRC staff for review.

The response to part (c) of this RAI was provided by FENOC letter dated February 27, 2014. Part (c) has subsequently been amended as follows:

(c) The attachment of the seismically qualified bracket to the pool deck will be through permanently installed anchors. With permanently installed anchors, the bracket pedestal will be secured to the poolside deck with adequate washers and bolts.

The following results of the response spectra analysis are contained in Westinghouse calculation CN-PEUS-13-25, Revision 1, Seismic Analysis of the SFP Mounting Bracket at Davis-Besse and Beaver Valley Nuclear Stations. The GTSTRUDL model and output considers self-weight, dead load of the instrumentation, hydrodynamic loads due to

seismic effects, and seismic load on the bracket. All members passed code check with interaction ratios below the allowable limit using the applicable requirements per American Institute of Steel Construction (AISC) 7th Edition. Considering all of the loads and load combinations, all members of the bracket are acceptable. All welds and bolts are acceptable when compared to their applicable allowable values. This calculation, which contains vendor proprietary information, was made available for NRC review.

RAI-5:

For RAI 4(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.

Response:

The parameters used and analytical results are contained in Westinghouse calculation CN-PEUS-13-25, Revision 1, Seismic Analysis of the SFP Mounting Bracket at Davis-Besse and Beaver Valley Nuclear Stations. The results are obtained from the GTSTRUDL model and are in accordance with site design requirements and AISC 7th Edition. Considering all of the applicable loads and load combinations, all members of the bracket are acceptable. All welds and bolts are acceptable when compared to their applicable allowable values. The results of the analysis represent all the applied loads and load combinations that were applied. The GTSTRUDL model and output considers self-weight, dead load of the instrumentation, hydrodynamic effects of the SFP water, and seismic load on the bracket. All members passed code check with interaction ratios below the allowable limit using the applicable requirements per AISC 7th Edition. Considering all of the loads and load combinations, all members of the bracket are acceptable. All welds and bolts are acceptable when compared to their applicable values.

Calculations are C-CSS-070.01-007, SFPLI Enclosure and Transmitter Mounting, and C-CSS-070.01-008, SFPLI Sensor Mounting. The vendor technical manual is M-024-00030, Davis-Besse Spent Fuel Pool Level Instrumentation. These documents demonstrate that the design for the mounting of electronic components and conduits was completed in accordance with the endorsed guidance in Institute of Electrical and Electronics Engineers, Inc. (IEEE) Standard 344-2004, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

Because Beaver Valley Power Station and Davis-Besse Nuclear Power Station (DBNPS) share a bracket design and because DBNPS has a larger pool, the sloshing analysis performed in CN-PEUS-13-25 is bounded by DBNPS. The site specific seismic analysis of the DBNPS pool-side bracket documented in CN-PEUS-13-25, Section 4.8, shows that the height of the wave due to sloshing is 2.65 feet maximum, which is lower than the 5 feet considered in the generic analysis performed by

Westinghouse (LTR-SEE-II-13-47). Therefore, the evaluation performed in LTR-SEE-II-13-47 remains bounding. The DBNPS specific distance from the nominal water level to the bracket is approximately 15.125 inches, which is greater than the 12 inches used in LTR-SEE-II-13-47. However, the freeboard assumed in the analysis for CN-PEUS-13-25 was approximately 15 inches. In Engineering Evaluation Request 601009784, FENOC engineering personnel have assessed the DBNPS specific parameters by estimating the change in postulated hydrodynamic load on the level sensor combined with the design loads resulting in an estimated maximum anchor tension of 531 pounds. Review of the postulated load has confirmed that it remains within the allowable limits for the 3/8 inch anchors, affirming the general conclusions of LTR-SEE-II-13-047 that the resulting loads on the level sensor probe will not result in probe ejection or potential impact of the instrument on the side walls.

The following documents were made available for NRC review:

- Engineering Evaluation Request 601009784, SFP Level Bracket Design
- Calculation C-CSS-070.01-007, SFPLI Enclosure and Transmitter Mounting
- Calculation C-CSS-070.01-008, SFPLI Sensor Mounting
- Vendor Manual M-024-00030, Davis-Besse Spent Fuel Pool Level Instrumentation

RAI-6:

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.

Response:

The response to this RAI was provided by FENOC letter dated February 27, 2014.

RAI-7:

Please provide the following:

(a) A description of the specific method or combination of methods that will be applied to demonstrate the reliability of the permanently installed equipment under BDB [beyond-design-basis] 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.

(This information was previously requested as RAI-4 in the NRC letter dated July 17, 2013.)

Response:

The NRC staff audited Westinghouse SFP instrumentation design verification analyses and performance test results in support of its review of Tennessee Valley Authority's (TVA's) overall integrated plan for the Watts Bar Nuclear Plant (WBN) facility (ADAMS Accession No. ML14211A346) for compliance to EA-12-051. The NRC staff found the SFP instrumentation design and qualification process reasonable.

Westinghouse methodologies for demonstrating the reliability of the installed SFP level instrumentation system are described in Westinghouse report EQ-QR-269, Revision 1, Design Verification Testing Summary Report for the Spent Fuel Pool Instrumentation System and Westinghouse report EQ-QR-264, Revision 0, Equipment Qualification Abbreviated Summary Report for the Spent Fuel Pool Instrumentation System. These reports, which contain vendor proprietary information, were made available for NRC review.

(a) Environmental qualification testing was performed in accordance with Institute of Electrical and Electronics Engineers, Inc. (IEEE) Std. 323-2003, and electromagnetic compatibility (EMC) qualification testing was performed in accordance with the technical requirements of Regulatory Guide 1.180.

Temperature and Humidity – Thermal aging and steam testing were performed on the coaxial cables and couplers using a thermal aging oven at a temperature of 212°F for the calculated age duration of 311 hours plus 10 percent margin, or 343 hours and at 219°F for 206.5 hours plus a 10 percent margin, or 228 hours. The coaxial cables and couplers were coiled and set on separate racks in the thermal oven. The coupler was required to be threaded into the non-preconditioned end of the cable and aged as one assembly. Steam testing was performed in accordance with IEEE Std. 323-2003. The test specimen was exposed to 212°F (+/- 1.8°F), 100 percent saturated (+0, -2 percent) for a duration including 10 percent margin of 185 hours. In addition, the connectors were splash tested to determine the appropriate torque level and sealing.

Thermal aging was performed within the required temperature parameters and for the required duration and a post-thermal aging functional test was successfully performed. During steam testing, functional tests were performed, which verified that the test equipment was functioning within the required accuracy, as well as

confirmed that the enclosure display correctly identified the simulated pool level. Acceptable functional test results were obtained during functional testing. Post-test baseline testing was conducted upon completion of environmental testing with successful functional results.

Westinghouse concluded that the probe, coaxial cable, 90 degree and straight connector, and stainless steel coupler are able to perform in abnormal conditions in the SFP area for up to seven days. In addition, Westinghouse tests demonstrated that the level sensor electronics with the coupler and the coaxial cable attached performs accurately when the probe, coupler, and coaxial cable are exposed to a temperature range of 10 to 100°C (50 to 212°F) and up to 100 percent relative humidity.

Regarding components outside the SFP area, Westinghouse concluded the aggregate of the environmental verification activities for the SFPI demonstrate that the instrumentation operates reliably in accordance with the service environmental requirements specified for both the harsh and outside SFP area conditions. The level sensor electronics housing was also verified to meet IP67 rating per EPSILON 08 TEST 2373, which will prevent water ingress and withstand 100 percent humidity.

In addition, Westinghouse completed their 10-year aging test. The purpose of the testing was to extend the existing qualified life from 15 months to 10 years. The system with the 90 degree connector passed the test and is now qualified to a 10-year life. The DBNPS design uses the 90 degree connector.

The expected temperature of the SFP area in beyond-design-basis external event (BDBEE) conditions is 212°F. The expected humidity is 100 percent. This matches the design humidity of 100 percent.

The components outside of the SFP area are required to operate reliably per "mild environment conditions," which occur during normal plant operation, including an abnormal operating occurrence. An abnormal operating occurrence would be a loss of heating, ventilating, and air conditioning (HVAC) in the installed equipment location. For equipment located in a mild environment, seismic is the only postulated consequential event. No BDBEE conditions were defined for mild environment equipment.

The transmitter is located in the control room. The temperature and humidity levels in this area will remain mild during both normal and BDBEE conditions. The results are that it is below the design temperature of 140°F and within the design range of 0-95 percent humidity.

It is required that the operators be able to access the electronics enclosures located in the control room in the event of the BDBEE. The temperature and humidity levels in this area will remain mild during the BDBEE. Therefore, the area conditions are considered habitable by the operator.

Radiation – The coaxial cable and coupler underwent radiation aging in accordance with IEEE Std. 323-2003 for service in post-accident radiation conditions. Test specimens were required to be exposed to a minimum of 11 Mrad of Co^{60} gamma rays at a dose rate minimum of 0.2 – 0.5 Mrad/hour.

The bounding dose for location of the transmitters and electronic enclosures TID $\leq$ 1E3 rads with a 1,000 rad design limit. The bounding dose for the level sensors was determined to be less than 11Mrad with an 11 Mrad design limit. The bounding dose for the location of the electronics enclosures was determined to be 1.1 rad (control room), which is well within the design limits for the transmitter and enclosure. Per C-NSA-070.01-005, Spent Fuel Pool Instrumentation Dose Calculation, radiation to the probe is <.06 Mrad/hr. This corresponds to 10.08 Mrad over the seven-day period, which is less than the bounded value of 11 Mrad.

EMC – Susceptibility, emissions and harmonics testing was performed and the guidance and limits provided in Regulatory Guide 1.180 were used. Continuous monitoring was performed to monitor the performance during the application of EMC susceptibility testing. Performance criterion for this system is determined to be Criterion B.

The transmitter and electronics enclosure locations are already established exclusion zones. There are no motors in the vicinity of the equipment that could interfere with the operation of the equipment. A radio exclusion zone was established around the equipment in the SFP.

(b) Seismic testing consisted of five successful operating basis earthquake (OBE) tests, two successful safe shutdown earthquake (SSE) tests, and one successful hard rock high frequency (HRHF) test. During the second successful SSE level test, AC power was cut off to the SFP instrumentation system to ensure that the uninterruptible power supply would reliably switch during a seismic event. No equipment failures were noted as a result of the seismic test runs. Westinghouse performed functional testing of the equipment before and after each SSE and HRHF runs, and the equipment maintained its functionality. In addition, Westinghouse inspected the equipment after the seismic testing, and no damage was found. Westinghouse concluded that the system met all requirements, maintained structural integrity during and after all OBEs, SSEs, and HRHF tests.

Seismic qualification testing was performed in accordance with IEEE Std. 344-2004, which is endorsed by NRC Regulatory Guide 1.100, Revision 3, and IEEE Std. 323-2003. The electronics enclosure was mounted to the test fixture with four 3/8-inch Grade 5 bolts, lock washers, flat washers, and nuts torqued snug tight. The sensor head unit mounting bracket was mounted to the fixture with four 3/8-inch Grade 5 bolts, lock washers, and flat washers torqued snug tight. The sensor head unit was mounted to the sensor head unit mounting bracket with two 1/4 inch-20 bolts and lock washers torqued to 75 inch-pounds. The coaxial coupler was torqued hand tight. The launch plate was mounted to the fixture with four 5/16-inch Grade 5 bolts and lock washers torqued snug tight. The sensor head unit mounting bracket

was mounted to the coupler using the integral threads in the probe and a lock washer to snug tight. Terminal block attachments within the rear of the sensor head unit were torqued to 8 inch-pounds.

Seismic testing was performed on a 4x4-foot independent triaxial test table using random, multi-frequency acceleration time history inputs. Accelerometers were mounted on the test table and equipment under test. The table drive signal was applied separately and simultaneously in both the horizontal and vertical directions for a duration of 30 seconds with a minimum of 20 seconds of strong motion. The response from the table and the response accelerometers were analyzed at 5 percent critical dampening for each OBE and SSE test and were plotted at one-twelfth octave intervals over the frequency range of 1 to 100 Hz.

Seismic testing of the instrumentation was performed in accordance with IEEE 344-2004. The required response spectra (RRS) included a 10 percent margin recommended by IEEE 323-2003. Seismic testing was performed to the defined SSE and HRHF spectra. The OBE RRS at 5 percent critical damping was at least 70 percent of the respective SSE seismic level. At a minimum, five successful OBE level tests were required, followed by two successful SSE level tests and one successful HRHF level test. In addition, static pull tests were performed on the radial connectors (straight and 90 degree) to address seismic qualification of the connectors.

(c) The equipment under test (EUT) was powered on during OBE seismic test runs but was not electrically monitored during the test runs. Functional testing was performed before and after the five successful OBE test runs. The system maintained accuracy after five successful OBE level tests, and no loss of power was noted during the test runs. The EUT was powered on during all SSE and HRHF seismic test runs, but was not electrically monitored during the test runs. Functional testing was also performed before and after each successful SSE and HRHF test run. The system maintained accuracy after all SSE and HRHF level tests, and no loss of power was noted during the test runs.

During the SSE 2, the alternating current (AC) power was removed from the system approximately 15 seconds into the run. This operation was performed to ensure that the uninterruptible power supply (UPS) was able to switch from line power to battery power during a seismic event. The system performed without issue. The EUT met all of the required performance and acceptance criteria and maintained structural integrity during all acceptable OBE test runs, acceptable SSE test runs, and the acceptable HRHF test run to the RRS. Acceptable functionality of the EUT was confirmed upon completion of seismic testing. The post-test inspection performed upon completion of all seismic tests revealed no major structural issues or damage to the EUT.

RAI-8:

For RAI 7 above, please provide the results from 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 NRC staff audited the Westinghouse SFP instrumentation design verification analyses and performance test results in support of its review of TVA's overall integrated plan for the WBN facility (ADAMS Accession No. ML14211A346) for compliance to EA-12-051. The NRC staff found the SFP instrumentation design and qualification process reasonable.

Westinghouse test results for the SFP level instrumentation system are described in Westinghouse report EQ-QR-269, Revision 1, Design Verification Testing Summary Report for the Spent Fuel Pool Instrumentation System and Westinghouse report EQ-QR-264, Revision 0, Equipment Qualification Abbreviated Summary Report for the Spent Fuel Pool Instrumentation System. These reports, which contain vendor proprietary information, were made available for NRC review.

Temperature and Humidity – Thermal aging was performed within the required temperature parameters and for the required duration and a post-thermal aging functional test was successfully performed. During steam testing, functional tests were performed, which verified that the test equipment was functioning within the required accuracy, as well as confirmed that the enclosure display correctly identified the simulated pool level. Acceptable functional test results were obtained during functional testing. Post-test baseline testing was conducted upon completion of environmental testing with successful functional results.

Westinghouse concluded that the probe, coaxial cable, 90 degree and straight connector, and stainless steel coupler are able to perform in abnormal conditions in the SFP area for up to seven days. In addition, Westinghouse tests demonstrated that the level sensor electronics with the coupler and the coaxial cable attached performs accurately when the probe, coupler, and coaxial cable are exposed to a temperature range of 10 to 100°C (50-212°F) and up to 100 percent relative humidity (RH).

Regarding components outside the SFP area, Westinghouse concluded the aggregate of the environmental verification activities for the SFP instrumentation demonstrate that the instrumentation operates reliably in accordance with the service environmental requirements specified for both the harsh and outside SFP area conditions. The level sensor electronics housing was also verified to meet IP67 rating per EPSILON 08 TEST 2373, which will prevent water ingress and withstand 100 percent humidity.

In addition, Westinghouse completed their 10-year aging test. The purpose of the testing was to extend the existing qualified life from 15 months to 10 years. The system

with the 90 degree connector passed the test and is now qualified to a 10-year life. The DBNPS design uses the 90 degree connector.

Shock and Vibration – Seismic testing consisted of five successful OBE tests, two successful SSE tests, and one successful HRHF test. During the second successful SSE level test, AC power was cut off to the SFP instrumentation system to ensure that the UPS would reliably switch during a seismic event. No equipment failures were noted as a result of the seismic test runs. Westinghouse performed functional testing of the equipment before and after each SSE and HRHF runs, and the equipment maintained its functionality. In addition, Westinghouse inspected the equipment after the seismic testing, and no damage was found. Westinghouse concluded that the system met all requirements, maintaining structural integrity during and after all OBEs, SSEs and HRHF tests.

Radiation – The coaxial signal cable and coupler were subjected to thermal and radiation aging prior to seismic testing. Two sets of identical specimens were aged, and the components performed to the limits of 2.5 years for thermal aging and 10 MRad + 10 percent margin for radiation aging. The coaxial cable and coupler were visually inspected after radiation resting. It was identified that a lock washer was missing from the probe attachment point of the coupler. Westinghouse noted that the absence of this lock washer had no effect on the thermal or radiation aging performed, and that the inspection did not reveal any noticeable degradation. A baseline functional test was performed and did not show any change in performance as a result of the radiation aging performed. Per C-NSA-070.01-005, Spent Fuel Pool Instrumentation Dose Calculation, radiation to the probe is <.06 Mrad/hr. This corresponds to 10.08 Mrad over the seven day period, which is less than the bounded value of 11 Mrad.

EMC – The system met all of the identified performance requirements before, during and after each EMC susceptibility test and demonstrated compliant emission levels. No modifications or deviations were required to achieve compliance during EMC testing.

The installation has a trace wire in the conduit attached to the connectors, which minimizes the susceptibility, emissions, and harmonics associated with EMC.

RAI-9:

Please provide the following:

(a) A description of the manner the two channels of the proposed level measurement system meet 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 the design and installation of each level measurement system, consisting of level sensor electronics, cabling, and readout devices. Please address how independence of these components of the primary

and back-up channels is achieved through the application of independent power sources, physical and spatial separation, independence of signals sent to the location(s) of the readout devices, and the independence of the displays.

(This information was previously requested as RAI-5 in NRC letter dated July 17, 2013.)

Response:

The response to this RAI was provided by FENOC letter dated February 27, 2014.

RAI-10:

Please provide the following:

(a) A description of the electrical ac power sources and capabilities for the primary and backup channels.

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

(This information was previously requested as RAI-6 in NRC letter dated July 17, 2013. However, based on feedback from the licensees, it was revised as above.)

Response:

The response to part (a) of this RAI was provided by FENOC letter dated February 27, 2014.

(b) The back-up battery is designed to last a minimum of 72 hours. The vendor's calculation has determined that the battery should last from a full charge for greater than 100 hours per Section 5.2.1 of Westinghouse calculation WNA-CN-00300-GEN, Revision 0, Spent Fuel Pool Instrumentation System Power Consumption.

RAI-11:

Please provide the following:

(a) An estimate of the expected instrument channel accuracy performance (e.g., in percent of span) under both (a) normal SFP level conditions (approximately Level 1 or higher) and (b) at the BDB conditions (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.

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 and to technicians that the channel requires adjustment to within the normal condition design accuracy.

(This information was previously requested as RAI-7 in NRC letter dated July 17, 2013.)

Response:

(a) The design accuracy is 3 inches or less for both normal and BDB conditions. Westinghouse calculation WNA-CN-00301-GEN provides the channel accuracy of a wired system with a standard measurement span of 296 inches. The calculated accuracy of the standard system is 0.54 percent of span or 1.60 inches. The cable probe length for DBNPS is 287.5 inches, which is less than the assumed value in WNA-CN-00301-GEN; therefore, the calculated accuracy of 0.54 percent of span or 1.60 inches is bounding for DBNPS and within the design range.

(b) A periodic calibration verification will be performed within 60 days of a refueling outage considering normal testing scheduling allowances (for example, 25 percent). 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 Nuclear Energy Institute (NEI) 12-02, Section 4.3. Per Westinghouse procedures, should the calibration verification indicate that the instrument is out of tolerance by more than the designed 3-inch tolerance, a recalibration will be performed.

RAI-12:

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 testing and calibration necessary to 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 the calibration tests and functional checks processes to be performed, and their frequency. Discuss the steps to be taken to ensure these surveillances will be incorporated into the plant surveillance program.

(d) A description of the preventive maintenance tasks that are required to be performed during normal operation, and the planned maximum surveillance

interval necessary to ensure that the channels are fully conditioned to accurately and reliably perform their functions when needed.

(This information was previously requested as RAI-8 in NRC letter dated July 17, 2013.)

Response:

(a) A periodic calibration verification will be performed in-situ to verify that the transmitter is in calibration using a calibration verification tool provided by the manufacturer and in accordance with the plant procedures and manufacturer's recommendations (Reference RAI 15 response for more detail). Should the calibration verification indicate that the transmitter is out of calibration, a full-range calibration adjustment will be completed using a calibration test kit. The portable test kit is composed of a replicate probe, coupler and launch plate equivalent to those installed, a replicate coaxial cable of the same electrical length as installed in the pool, a bracket to hold the weight end of the probe cable, simulated pool liner, and a moveable metal target. To perform the calibration, the installed SFP instrumentation system coaxial cable is disconnected from the sensor and the replicate test kit coaxial cable is connected. A metal target is used to measure several points along the length of the probe to perform the full-range calibration. The readings displayed on the output display at each point along the probe will be compared to the physical distance measured along the length of the probe cable to determine calibration acceptance. 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.

(b) DBNPS procedure DB-MI-05340, Calibration of Fuel Pool Level Transmitter Model ABB/K-TEK MT5000, was made effective. The SFP level indication is located in the main control room. To aid in early detection of any "off normal" readings, which could indicate that channel adjustment may be required, a daily channel check using this indication of SFP level will be added to Operator Rounds and entered in the Shift Operations Management System (eSOMS) based on NORM-OP-0104, eSOMS Operator Rounds Module. The channel check confirms that the two SFP level instruments are reading within 6 inches of each other to conform to the system design accuracy of ±3 inches per channel. The channel check periodicity and acceptance criteria are controlled within DBNPS operating procedures and periodic maintenance programs and may change based on equipment operating experience. Testing to validate instrument functionality per NEI 12-02, Section 4.3, is based on the instrument calibration periodicity as noted in response to RAI-12(c).

(c) FENOC will perform periodic calibration verifications using periodic maintenance procedures and manufacturer's guidelines. The periodic calibration verification will be performed within 60 days of a refueling outage, considering normal testing scheduling allowances (for example, 25 percent). 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.

(d) Preventive Maintenance (PM) procedures will be in place for periodic replacement of the backup batteries based on manufacturer recommendations and for calibration verification.

RAI-13:

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 SFP instrumentation. The licensee is requested to include a brief description of the specific technical objectives to be achieved within each procedure.

Response:

The modification review process will be used to ensure all necessary procedures are developed for maintaining and operating the spent fuel level instruments upon installation. These procedures will be developed in accordance with the FENOC procedural control process.

The objectives of each procedural area are described below:

Inspection, Calibration, and Testing – Guidance on the performance of periodic visual 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 will be addressed in site off normal procedures and/or FLEX [Diverse and Flexible Coping Strategies] Support Guidelines (FSGs).

The following procedures have been identified:

- DB-MI-05340, Calibration of Fuel Pool Level Transmitter Model ABB/K-TEK MT5000
- DB-OP-02547, Spent Fuel Pool Cooling Malfunctions
- DB-OP-02600, Operational Contingency Response Action Plan
- DB-OP-06021, Spent Fuel Pool Operating Procedure

New PMs are based on NORM-ER-3733, FENOC FLEX Spent Fuel Pool Level Monitor. The following PMs support installation of the SFP instrumentation system:

Equipment	PM Type	Interval	Owner
Primary and Secondary Level Sensor Transmitter	Calibration	1/Cycle	Maintenance
Primary and Secondary Level Sensor Transmitter	Cleansing / Inspection	1/Cycle	Maintenance
Primary and Secondary Level Sensor Transmitter	Coax Cable Resistance Check	1/Cycle	Maintenance
Primary and Secondary Battery	Replacement	3 Years	Maintenance
Primary and Secondary Level Sensor Transmitter	Replacement	6 Years	Maintenance
Level Sensor Probe	Replacement	7 Years	Maintenance
Primary and Secondary Coaxial Cable, Coupler, and Coax Connector	Replacement	10 Years	Maintenance
Primary and Secondary Electronics Enclosure Components	Replacement	10 Years	Maintenance

RAI-14:

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.

(b) A description of the approach and process to be used by the licensee to follow guidance in NEI 12-02 Section 4.3, regarding compensatory actions for one or both non-functioning channels.

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

(This information was previously requested as RAI-11 in NRC letter dated July 17, 2013.)

Response:

(a) SFP instrumentation channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness will be established in accordance with FENOC's processes and procedures. The design modification process will take into consideration the vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance is performed (and available for inspection and audit).

Once the maintenance and testing program requirements for the SFP are determined, the requirements will be documented in maintenance program documents.

Performance checks, described in the vendor operator's manual, and the applicable information will be 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 will be 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 SFP instrumentation 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. Planned compensatory actions for unlikely extended out-of-service events are summarized as follows:

# Channel(s) Out-of-Service	Required Restoration Action	Compensatory Action if Required Restoration Action not completed within Specified Time
1	Restore channel to functional status within 90 days (or if channel restoration not expected within 90 days, then proceed to Compensatory Action)	Immediately initiate action in accordance with Note below
2	Initiate action within 24 hours to restore one channel to functional status and restore one channel to functional status within 72 hours	Immediately initiate action in accordance with Note below

Notes:
1. Present a report to the on-site safety review committee within the following 14 days. The report shall outline the planned alternate method of monitoring, the cause of the non-functionality, and the plans and schedule for restoring the instrumentation channel(s) to functional status.

(c) A condition report will be initiated and addressed through FENOC's Corrective Action Program. Provisions associated with out of service (OOS) or non-functional equipment, including allowed outage times and compensatory actions, will be consistent with the guidance provided in Section 4.3 of NEI 12-02. If one OOS channel cannot be restored to service within 90 days, appropriate compensatory actions, including the use of alternate suitable equipment, will be taken. If both channels become OOS, actions would be initiated within 24 hours to restore one of the channels to operable status and to implement appropriate compensatory actions, including the use of alternate suitable equipment and/or supplemental personnel, within 72 hours.

RAI-15:

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:

The calibration verification involves attaching a sliding plate to the flat surface above the launch plate of the fixed bracket and placing a metal target against the probe cable above the water level. To complete this method, the water level must be a sufficient distance below the 100 percent level mark, which is nominally 12 inches below the launch plate. The differences in distances imparted by this standard can be physically determined and compared to the distance difference observed on the level display of the sensor electronics. The second portion of this calibration verification is a visual waveform check to verify proper signal operation. If the calibration verification check falls within the required calibration tolerance (±3 inches) and the waveform check meets the criteria outlined, the calibration verification is successful and the equipment may be returned to the normal operating setup. If an anomaly with the calibration is observed during this calibration verification, the electronic verification or calibration adjustment is to be followed for further investigation. This verification shall be performed on both channels (primary and backup) of the SFP instrumentation system independently.

#	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	Contains technical SFPIS requirements based on NRC order, NEI guidance, and the ISG listed above.	N/A	Acceptable. FENOC provided a supplemental Technical Requirements Document in the Equipment Purchase Order
2	Test Strategy	Per Requirements.	WNA-PT-00188-GEN	Strategy for performing the testing and verification of the SFPIS and pool-side bracket.	N/A	Acceptable
3	Environmental qualification for electronics enclosure with Display	50° F to 140° F, 0 to 95% RH TID ≤ 1E03 R γ normal (outside SFP area) TID ≤ 1E03 R γ abnormal (outside SFP area)	EQ-QR-269 and WNA-TR-03149-GEN 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.	Acceptable
4	Environmental Testing for Level Sensor components in SFP area – Saturated Steam & Radiation	50 ° F to 212° F and 100% humidity	EQ-QR-269, Rev. 1	Testing summarized in Section 5.7.	Passed	Acceptable
		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.	Passed	Acceptable
		1E07 R γ BDB (SFP area)	EQ-TP-354 (procedure) Actual test report is in progress.	Additional thermal & radiation aging programs being conducted under test procedure EQ-TP-354.	Additional aging program is in progress to achieve longer life.	Acceptable
5	Environmental Testing for Level Sensor Electronics Housing –	50° F to 140° F, 0 to 95% RH	EQ-QR-269, Rev. 1	Testing summarized in Section 5.5.	Passed	Acceptable

#	Topic	Parameter Summary	Westinghouse Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
	outside SFP	100% RH	WNA-TR-03149-GEN	100% humidity addressed in Section 7.5.	Passed	
		TID ≤ 1E03 R γ normal (outside SFP area) TID ≤ 1E03 R γ abnormal (outside SFP area)	WNA-TR-03149-GEN	Radiation Aging verification summarized in Section 5.	Passed	
6	Thermal & Radiation Aging – organic components in SFP area	1E03 R γ normal (SFP area)	EQ-QR-269, Rev. 1 and WNA-TR-03149-GEN	Thermal Aging & radiation aging verification summarized in Sections 4.1 and 5 (entire system) of WNA-TR-03149-GEN.	Passed	Acceptable with the exception of the 10-year aging test failure documented per Westinghouse Letter LTR-EQ-14-149, steam test failure using the straight connector (affects Perry)
		1E07 R γ BDB (SFP area)	EQ-TP-354 (procedure) Actual test report is in progress.	Additional thermal & radiation aging programs being conducted under test procedure EQ-TP-354.	Additional aging program is in progress to achieve longer life.	
7	Basis for Dose Requirement	<u>SFP Normal Conditions:</u> 1E03 R γ TID (above pool) 1E09 R γ TID (1' above fuel rack) <u>SFP BDBE Conditions:</u> 1E07 R γ TID (above pool) < 1E07 R γ TID (1' above fuel rack)	LTR-SFPIS-13-35 and WNA-DS-02957-GEN	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	Acceptable

#	Topic	Parameter Summary	Westinghouse Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
8	Seismic Qualification	Per Spectra in WNA-DS-02957-GEN	EQ-QR-269, Rev. 1	EQ-QR-269, Rev. 1 summarizes the testing performed by Westinghouse.	Passed	Acceptable
			WNA-TR-03149-GEN	WNA-TR-03149-GEN provides high level summary of the pool-side bracket analysis and optional RTD.	Passed	
			EQ-QR-269, Rev. 1	Seismic Pull test for new connectors documented in Section 4.4.	Passed	
9	Sloshing	N/A	LTR-SEE-II-13-47	Calculation to demonstrate that probe will not be sloshed out of the SFP.	Passed	Acceptable
			WNA-TR-03149-GEN	Sloshing is also addressed in Section 7.2.	Passed	
10	Spent Fuel Pool Instrumentation System Functionality Test Procedure	Acceptance Criteria for Performance during EQ testing	WNA-TP-04613-GEN	Test procedure used to demonstrate that SFPIS meet its operational and accuracy requirements during Equipment Qualification Testing programs.	See applicable EQ test.	Acceptable
11	Boron Build-Up	Per requirement in WNA-DS-02957-GEN	WNA-TR-03149-GEN	Boron build up demonstrated through Integrated Functional Test (IFT).	Passed	Acceptable
12	Pool-side Bracket Seismic Analysis	N/A	CN-PEUS-13-25, Rev. 1 (Davis Besse and Beaver Valley) CN-PEUS-13-27, Rev. 2 (Perry)	Also includes hydrodynamic forces, as appropriate.	Passed	Acceptable
13	Additional Brackets (Sensor Electronics and Electronics Enclosure)	N/A	WNA-DS-02957-GEN	Weights provided to licensees for their own evaluation.	N/A	Acceptable

#	Topic	Parameter Summary	Westinghouse Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
14	Shock & Vibration	WNA-DS-02957-GEN	WNA-TR-03149-GEN	Section 7 provides rationale and summary of RTD.	N/A	
15	Requirements Traceability Matrix	Maps Requirements to documentation / evidence that Requirement is met	WNA-VR-00408-GEN	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	Acceptable
16	Westinghouse Factory Acceptance Test, including testing of dead-zones	IFT Functional Requirements from WNA-DS-02957-GEN	WNA-TP-04752-GEN	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 Beaver Valley IFT executed/passed Davis Besse IFT executed/passed Perry IFT executed/passed	Acceptable
		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	
17	Channel Accuracy	+/- 3 inches per WNA-DS-02957-GEN	WNA-CN-00301-GEN	Channel accuracy from measurement to display.	Passed	Acceptable
18	Power Consumption	3 day battery life (minimum) 0.257 Amps power consumption	WNA-CN-00300-GEN	N/A	Passed	Acceptable

#	Topic	Parameter Summary	Westinghouse Reference Document #	Additional Comment	Test or Analysis Results	Licensee Evaluation
19	Technical Manual	N/A	WNA-GO-00127-GEN	Information and instructions for Operation, Installation, use, etc. are included here.	N/A	Acceptable
20	Calibration	Routine Testing/calibration verification and Calibration method	WNA-TP-04709-GEN	Also, includes preventative maintenance actions such as those for Boron buildup and cable probe inspection.	N/A	Acceptable
21	Failure Modes and Effects Analysis (FMEA)	N/A	WNA-AR-00377-GEN	Addresses mitigations for the potential failure modes of the system.	N/A	Acceptable
22	Emissions Testing	RG 1.180 R1 test conditions	EQ-QR-269, Rev. 1	Documented in Section 5.6.	Passed	Acceptable

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 4 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; NRC did not review in April; current revision is Revision 2.

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 1.

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 1.

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; NRC did not review in April; 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; NRC did not review in April; current revision is Revision 0.

10) Westinghouse Proprietary Document, WNA-TP-04613-GEN, "Spent Fuel Pool Instrumentation System Functionality Test Procedure," Revision 5 reviewed by the NRC in February 2014; NRC did not review in April; current revision is Revision 5.

11) Westinghouse Proprietary Document, CN-PEUS-13-25, "Seismic Analysis of the SFP Mounting Bracket at Davis Besse and Beaver Valley Nuclear Stations," Revision 1; never reviewed by the NRC.

12) Westinghouse Proprietary Document, CN-PEUS-13-27, "Seismic Analysis of the SFP Mounting Bracket at Perry Nuclear Power Plant," Revision 2; never reviewed by the NRC.

13) Westinghouse Proprietary Document, WNA-VR-00408-GEN, "Spent Fuel Pool Instrumentation System Requirement Traceability Matrix," Revision 0 reviewed by the NRC in April 2014; current revision is Revision 1.

14) Westinghouse Proprietary Document, WNA-TP-04752-GEN, "Spent Fuel Pool Instrumentation System Standard Product Integrated Functional Test Procedure," Revision 1 reviewed by the NRC in February 2014; NRC did not review in April; current revision is Revision 1.

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; NRC did not review in April; 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; NRC did not review in April; current revision is Revision 1.

17) Westinghouse Proprietary Document, WNA-GO-00127-GEN, "Spent Fuel Pool Instrumentation System Standard Product Technical Manual," Revision 1 reviewed by the NRC in April 2014; current revision is Revision 1.

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; NRC did not review in April; 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; NRC did not review in April; current revision is Revision 3.