

NRR-PMDAPEm Resource

From: Distel, David J:(GenCo-Nuc) <David.Distel@exeloncorp.com>
Sent: Wednesday, February 15, 2017 8:47 AM
To: Hughey, John
Cc: Mokkapati, Sailaja:(GenCo-Nuc); Seo, Timothy P:(GenCo-Nuc)
Subject: [External_Sender] Response to Additional NRC Questions on Braidwood SFP Instrumentation
Attachments: Braidwood SFPI SE RAIs.docx

John – Attached are the Braidwood SFPI responses to the NRC’s follow up questions.

Please let us know if any additional information is needed.

Thanks.
Dave Distel

From: Distel, David J:(GenCo-Nuc)
Sent: Friday, January 27, 2017 11:24 AM
To: 'Hughey, John'
Cc: Mokkapati, Sailaja:(GenCo-Nuc)
Subject: RE: RE: Additional NRC Questions on Braidwood SFP Instrumentation

John – Will do.

Dave Distel

From: Hughey, John [<mailto:John.Hughey@nrc.gov>]
Sent: Friday, January 27, 2017 11:22 AM
To: Distel, David J:(GenCo-Nuc)
Cc: Mokkapati, Sailaja:(GenCo-Nuc)
Subject: RE: RE: Additional NRC Questions on Braidwood SFP Instrumentation

Dave,

The SFPI reviewer has identified another additional question as described below. Please include a response to this question in your Braidwood SFPI responses.

In its OIP, the licensee identified the SFP levels of monitoring as follows:

- Level 1 corresponds to the 418 ft., 1¾ in. plant elevation
- Level 2 corresponds to the 410 ft., 1¾ in. plant elevation
- Level 3 corresponds to the 400 ft., 1¾ in. plant elevation

In its letter dated August 28, 2014, the licensee revised the Level 1 from 418 ft. 1 ¾ in. to 422 ft. 0 in. It is not clear whether this is the only change to the SFP levels of monitoring. Please provide the Braidwood final configuration of the SFP levels of monitoring for both units. Also, please provide an updated sketch depicting the elevation view of the final Level 1, 2, and 3 datum points and the instrument’s measurement range.

Thanks and please let me know if you have any questions,
John

John Hughey

Mitigation Strategies & SFP Instrumentation
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From: Distel, David J:(GenCo-Nuc) [<mailto:David.Distel@exeloncorp.com>]
Sent: Friday, January 27, 2017 10:58 AM
To: Hughey, John <John.Hughey@nrc.gov>
Cc: Mokkapati, Sailaja:(GenCo-Nuc) <Sailaja.Mokkapati@exeloncorp.com>
Subject: [External_Sender] RE: Additional NRC Questions on Braidwood SFP Instrumentation

John – Braidwood is targeting 2/10/17 for the SFPI responses but may need an additional week as the site lead has 1 week of scheduled training in early February.

Thanks.
Dave Distel

From: Hughey, John [<mailto:John.Hughey@nrc.gov>]
Sent: Thursday, January 26, 2017 8:44 AM
To: Distel, David J:(GenCo-Nuc)
Subject: [EXTERNAL] Additional NRC Questions on Braidwood SFP Instrumentation
Importance: High

Dave,
Attached is a file with 4 follow-up questions (related to questions we previously asked) on the Braidwood SFP instrumentation for Order EA-12-051. We would appreciate a prompt reply via email. If you reference plant analyses, please place a copy on the eportal so we can read them. Thanks.

John Hughey

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From: Distel, David J:(GenCo-Nuc)

Created By: David.Distel@exeloncorp.com

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Tracking Status: None

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Tracking Status: None

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Tracking Status: None

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BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

The NRC staff has reviewed Exelon's June 9, 2015, Spent Fuel Pool Instrumentation (SFPI) Order compliance report (ADAMS Accession No. ML15160A351) for Braidwood and has determined that additional information is needed in order for the NRC staff to complete its review. Please provide a response by email to the following questions. Request for Information (RAI) numbers 7 and 13 are follow-up questions to those questions in the Interim Staff Evaluation (ISE), ADAMS Accession No. ML13280A566. RAI numbers 15 and 16 are follow-up questions to questions asked during the onsite audit. The NRC's safety evaluation tracker file for Braidwood may contain amplifying information.

ISE RAI No. 7

Order EA-12-051, Attachment 2, "Requirements for Reliable Spent Fuel Pool Level Instrumentation at Operating Reactor Sites and Construction Permit Holders," states, in part, that

The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period.

NEI 12-02 states, in part, that

The temperature, humidity and radiation levels consistent with conditions in the vicinity of the [SFP] and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until offsite resources can be deployed by the mitigating strategies resulting from Order EA-12-049 should be considered. Examples of post-event (beyond-design basis) conditions to be considered are:

- radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water level 3 as described in this Order,
- temperatures of 212 degrees F and 100% relative humidity environment,
- boiling water and/or steam environment, and
- a concentrated borated water environment.

Related to the environmental and radiological conditions outside of the SFP area, in its letter dated August 28, 2014 (ADAMS Accession No. ML14248A208), the licensee stated that

The level sensor transmitter and bracket, electronics display enclosure and bracket, which are located outside of the SFP area, are designed and qualified to operate reliably in the below specified environmental conditions.

Parameter	Normal	BDB
Temperature	50-120°F	140°F
Pressure	Atmospheric	Atmospheric
Humidity	0-95% RH	0-95% (non-condensing)
Duration	3 days	3 days
Radiation TID γ	$\leq 1\text{E}03 \text{ R } \gamma$	$\leq 1\text{E}03 \text{ R}$

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

It is not clear whether the listed BDB temperature has analyzed for the maximum temperature during an ELAP event. It is also not clear whether the BDB radiological condition analyzed for the radiation total integrated dose (TID) 12 inches above the fuel rack, which could be 1E09 R y at the SFP area.

The NRC staff requests additional information for the following:

- a. Maximum temperature of the Electrical Penetration Area including temperature during an ELAP event, when HVAC is not available and how the SFP level instrument equipment installed in that area maintains its design function under that condition.
- b. Radiological condition of the Electrical Penetration Area when the SFP water level reach Level 3 and how the SFP level instrument equipment installed in that area maintains its design function under that condition.

Response:

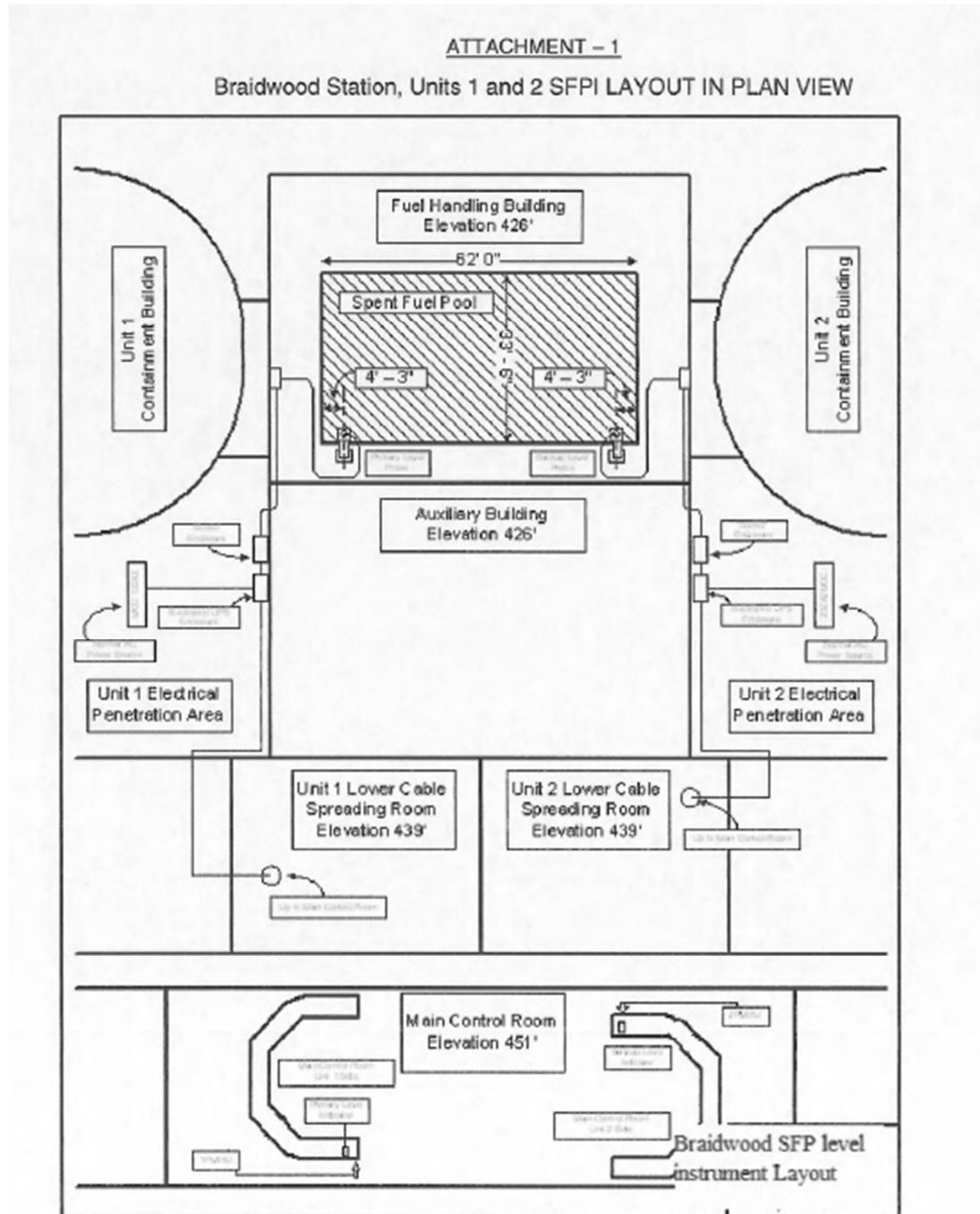
a. Spent Fuel Pool Level instrument components are located in EQ Zone A11. Per calculation BRW-01-0153-E, Revision 2 (Environmental Parameters of EQ Zones), EQ Zone A11 is a Mild Zone with maximum normal temperature of 133 Degrees F. EQ Zone A11 does not have a temperature for accident conditions, however, Note 14 of the calculation addresses conditions of LOCA and LOOP as follows": Under conditions of LOCA and LOOP, maximum temperature will increase during 2-hour period due to HVAC systems operation using available electrical power sources and with consideration of equipment heat loads for event mitigation. Maximum temperatures during this condition are: 140 Degrees F for Zone A11." The bounding value of 140 Degrees F is determined in calculation VA-102, Revision 4 (Aux Bldg. Energy Load Calcs for EI. 330' 346', 364', 383' 401' & 426' in Abnormal Condition), which determines temperatures for multiple locations within EQ Zone A11, as follows:

EQ Zone A11 Locations

Unit 1 and Unit 2 Electrical Penetration Area (EI 426')	Calculated Temperature = <u>127.1 F</u>
Unit 1 and Unit 2 Electrical Penetration Area (EI 414')	Calculated Temperature = <u>125.3 F</u>
Unit 1 and Unit 2 Electrical Equipment Room (EI 414')	Calculated Temperature = <u>138.2 F</u>
Unit 1 and Unit 2 Motor Driven AF Pump Rooms	Calculated Temperature = <u>135.8 F</u>
Unit 1 and Unit 2 Diesel Driven AF Pump Rooms	Calculated Temperature = <u>133.0 F</u>

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

SFP Level electronics are located as follows: REF: RS-14-195 attachment 1



Primary SFP Level Loop: Unit 1 Auxiliary Building 426' Electrical Penetration Area, plant coordinates U-15 (Test Report 0FC-001, Rev 1 and Drawing 20E-1-3352, Rev CJ)

Secondary SFP Level Loop: Unit 2 Auxiliary Building 426' Electrical Penetration Area, plant coordinates U-21 (Test Report 0FC-002, Rev 1 and Drawing 20E-2-3352, Rev CU)

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

With the Primary and Secondary SFP Level electronics located in Unit 1 and Unit 2 Electrical Penetration Areas, El 426', the calculated temperature of this location is 127.1 F during conditions of LOCA and LOOP for a 2-hour period, which is below the stated 140 F maximum temperature for Zone A11 (140 F bounds all locations above in EQ Zone A11).

The LOCA and LOOP conditions described above include heat loads from electrical equipment and liquid systems that will not exist during an Extended Loss of Power Event (ELAP). During an ELAP event, there will be no heat loads from electrical equipment or liquid systems in the area. The heat generated from the Spent Fuel Pool has to conduct to 426' Electrical Penetration Areas, which includes a 3' concrete wall. There is a significant heat sink in the 426' Electrical Penetration areas from the containment wall and surrounding Auxiliary Building walls. There is also a significant heat sink from the Fuel Handling Building walls and ceiling. Due to the lack of heat sources in the area of the instruments, barriers between the Fuel Handling Building and instrument areas, and the large heat sink that will dissipate heat, the 140 F rating of the SFP Level instrumentation is adequate.

b. REF: BYR13-051, BYR13-187, BYR14-056

For the primary channel electronics enclosure and transmitter enclosure on the Unit 1 side of the plant, the straight line distance from the pool to the panels is 63' and the enclosures are directly adjacent to a 3' thick concrete wall. For conservatism, using a distance of 60', neglecting other walls or materials along the path, and using the straight thickness of the wall instead of the slant thickness, an overall dose rate for the area can be obtained. Based on BYR13-187 Table 7.4-1 (which lists calculated dose rates as a function of distance) and Table 7.3-4 (which lists wall thickness scaling factors), the dose rate is $9.92\text{E}+01 \text{ rem/hr}$ (function of distance from spent multiplier) $\times 2.151\text{E}-10$ (wall thickness scaling multiplier) = $2.1\text{E}-08 \text{ rem/hr}$ at the primary channel enclosures during a BDBEE when the water in the SFP is at the top of the fuel assemblies.

For the backup channel electronics enclosure and transmitter enclosure on the Unit 2 side of the plant, the straight line distance from the pool to the panels is 59' and directly adjacent to a 3' thick concrete wall but is near the 1'-6" section. For conservatism, using a distance of 55' and a 1' wall for these values, an overall dose rate for the area can be obtained. Based on BYR13-187 Table 7.4-1 and Table 7.3-4, the dose rate is $1.10\text{E}+02 \text{ rem/hr}$ (function of distance from spent multiplier) $\times 7.505\text{E}-05$ (wall thickness scaling multiplier) = $8.3\text{E}-03 \text{ rem/hr}$ at the primary channel enclosures during a BDBEE when the water in the SFP is at the top of the fuel assemblies.

NRC Order EA-12-051 requires that 7 days (168 hours) with the water level at the top of the fuel rack in the SFP be considered to establish Total Integrated Dose (TID). Using the dose rate of of primary channel $2.1\text{E}-08 \text{ Rem/hr}$ and backup channel $8.3\text{E}-03 \text{ Rem/hr}$, and duration of 168 hours, the 7 day TID can be calculated as $3.5\text{E}-06 \text{ Rem}$ for primary channel and 1.4 Rads for backup channel. The dose these instruments will be subject to is within the qualified radiation level for the instrument, 1E03R, and will not impact the operation of the SFP equipment, located outside the SFP area.

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

ISE RAI No. 13

Order EA-12-051, Attachment 2, "Requirements for Reliable Spent Fuel Pool Level Instrumentation at Operating Reactor Sites and Construction Permit Holders," states, in part, that

Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.

By letter dated August 28, 2014 (ADAMS Accession No. ML14248A208), Exelon Generation provided the following response to RAI No. 13:

Appropriate quality measures will be selected for the SFPIS required by Order EA-12-051, consistent with Appendix A of NEI 12-02. Site procedures will be developed for system inspection, calibration and test, maintenance, repair, operation and normal and abnormal responses, in accordance with Exelon's procedure control process. Technical objectives to be achieved in each of respective procedures are described below:

Procedure Objectives to be achieved

1. System Inspection: To verify that the system components are in place, complete, and in the correct configuration, and that the sensor probe is free of significant deposits of crystallized boric acid.
2. Calibration and Test: To verify that the system is within the specified accuracy is functioning as designed, and is appropriately indicating SFP water level.
3. Maintenance: To establish and define scheduled and preventive maintenance requirements and activities necessary to minimize the possibility of system interruption.
4. Repair: To specify troubleshooting steps and component repair and replacement activities in the event of system malfunction.
5. Operation: To provide sufficient instructions for operation and use of the system by plant operation staff.
6. Responses: To define the actions to be taken upon observation of system level indications, including actions to be taken at the levels defined in NEI 12-02.

It is not clear whether Braidwood's procedures addressed the above objectives. The NRC staff requests the full list of procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the SFP level instrumentation. For each procedure, please provide a brief description of the specific objectives to be achieved.

Response:

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

The following – procedures/checklists provide full list of procedures addressing operation, calibration, testing, maintenance, inspection of the SFPI equipment:

1. Bwip 2500-181, (Calibration and Test) calibration of guided wave radar spent fuel level instruments , (provide instructions to calibrate the spent fuel pool level instrumentation system(sfplis), loops 0l-fc001 and 0l-fc002)
2. TRP 0fc-001, (Calibration and Test) calibration test report – primary channel, local indicator cal check (page 5 of trp) and calibration of main control board indicator (page 6 of trp).
3. TRP 0fc-002, (Calibration and Test) calibration test report – backup channel, local indicator cal check (page 5 of trp) and calibration of main control board indicator (page 6 of trp).
4. 0bwos fx-2a, (System Inspection) AAR spent fuel pool (SFP) level instrumentation (The procedure provides a tracking mechanism for unavailability of the Spent Fuel Pool level instrumentation).
5. 0bwos fx-3, (Calibration and Test) spent fuel pool level instrumentation channel check (This procedure outlines the steps necessary to verify the availability of the Spent Fuel Pool Level Instrumentation by performing a Channel Check of the required instruments and indications and verifying the required number of channels are available. This procedure shall be performed once per 31 days and is applicable in all modes).
6. Bwop fx-e3, (System Inspection) electrical lineup - unit 0 operating(Provides normal operating positions for SFPI power supply breakers)
7. 1bwos xcb-r1, (System Inspection) u0 and u1 MCR and rsdp meter color banding(This procedure outlines the steps necessary to perform a check for proper Main Control Room and Remote Shutdown Panel meter color banding after each refueling cycle).
8. 2bwos xcb-r1, (System Inspection) u2 MCR and rsdp meter color banding(This procedure outlines the steps necessary to perform a check for proper Main Control Room and Remote Shutdown Panel meter color banding after each refueling cycle).
9. 1BwFSG-5, (Operation/Response) Initial Assessment and FLEX Equipment Staging(This guideline provides actions for the initial assessment of plant equipment and system status, and for staging FLEX equipment in preparation for use in plant recovery).
10. 0bwosr 0.1-0, (System Inspection) unit common all modes/at all times shiftly and daily operating surveillance(This procedure outlines the steps necessary to perform the required Tech Spec and Administrative verifications of shiftly and daily parameters and is applicable in all MODES/at all times).
11. Bwop ap-60, (Operation) bus 142 outage while in mode 6 or defueled(This procedure outlines the steps necessary to de-energize and restore Bus 142 while Unit 1 is in Mode 6 or Defueled).

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

12. Bwop ap-60t1, (Operation) bus 142 outage checklist(Checklist for actions to be completed during Bus 142 bus outage)
13. Bwop ap-64, bus 242 outage while in mode 6 or defueled(This procedure outlines the steps necessary to de-energize and restore Bus 242 while Unit 2 is in Mode 6 or Defueled).
14. Bwop ap-64t1, bus 242 outage checklist(Checklist for actions to be completed during Bus 242 bus outage)
15. Per eSOMs Power source is verification is performed every 4 days by operators.

PM Tasks (Pre-Defines) (Maintenance/Repair) created at Braidwood:

Equip ment	Service Request	PMID	Description	Freq
SFPI				
	87915	00193396-01, 00193397-01	SFPI BATTERY REPLACEMENT	3 Y
	87916	00193901-01	Channel Check- SPENT FUEL POOL LEVEL INDICATION MONTHLY	1 M
	87917	00193877-01, 00193878-01	Electronic Component replacement SPENT FUEL POOL LEVEL INDIC. COMP. PM	28 Y
	87918	00193882-01, 00193883-01	SPENT FUEL POOL LEVEL INDIC. CALIBRATION	18 M
		Operator Rounds Point number 863 and 842	VERIFY POWER SOURCE WALKDOWN	4D
	87919	00193882-02, 00193883-02	Probe Replacement SPENT FUEL POOL LEVEL INDIC. PROBE PM	40 Y
	PMC-17- 000392		Transmitter Replacement SPENT FUEL POOL LEVEL INDIC. COMP. PM	7Y

Documents have been added to ePortal.

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

RAI No. 15

The NRC staff audited Westinghouse's SFP level instrumentation design verification analyses and performance. The staff reviewed the vendor's SFP level instrumentation system design specifications, calculations and analyses, test plans, and test reports. The staff issued an audit report on August 18, 2014 (ADAMS Accession No. ML14211A346). Regarding the Electromagnetic Compatibility (EMC) review, the audit report states that

As a result of the NRC staff's evaluation of the EMC testing results, the staff identified a generic open item applicable to all licensees using this technology to identify any additional measures, site-specific installation instructions or position taken to address the potential effect of an EMC event on the SFPI equipment.

The NRC staff requests additional information or an assessment of potential susceptibilities of Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) in the areas where the SFP level instrument located and how to mitigate those susceptibilities.

Response:

Braidwood has painted "No-radio" zones around the electronics boxes and transmitters to mitigate any potential EMC susceptibilities. The following testing provided in the EC package CC-AA-107 for testing susceptibilities in the areas has been completed: operate a radio near perimeter of no-radio zone around electronics boxes and transmitters and verify that no noticeable interference is introduced (i.e. verify that no sporadic behavior of the level signal is present at the level displays). If interference is detected, the no-radio zone needs to be expanded to the perimeter where there is no interference detected.

Ref: IR 2480052 and 2487167

EC: 394935

WO: 1678537-02

Documents have been updated to e-Portal.

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

RAI No. 16

Order EA-12-051, Attachment 2, "Requirements for Reliable Spent Fuel Pool Level Instrumentation at Operating Reactor Sites and Construction Permit Holders," states, in part, that

The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period.

NEI 12-02 states, in part, that

The temperature, humidity and radiation levels consistent with conditions in the vicinity of the [SFP] and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until offsite resources can be deployed by the mitigating strategies resulting from Order EA-12-049 should be considered. Examples of post-event (beyond-design basis) conditions to be considered are:

- radiological conditions for a normal refueling quantity of freshly discharged (100 hours) fuel with the SFP water level 3 as described in this Order,
- temperatures of 212 degrees F and 100% relative humidity environment,
- boiling water and/or steam environment, and
- a concentrated borated water environment.

Westinghouse performed the life-upgrade tests for the SFP level instrument including the steam test for both straight and 90-degree cable connectors. The straight connector did not pass the steam test and therefore is not suitable for the SFP's BDB environment. It is not clear what cable connector utilized at Braidwood's SFP.

The NRC staff requests additional information for the following:

- a. Final configuration of Braidwood SFP level instrument cable connectors (straight or 90 Degree)
- b. Modification (if any) to the connectors as a result of Westinghouse's tests for the connectors

Response:

- a. Final configuration of Braidwood SFP level instrument cable connectors are the 90 degree configuration. Ref Third Six-Month Status Report (RS-14-195). REF: Drawing 20E-0-3356D09
- b. Not applicable due to the configuration used at Braidwood Station is the 90 degree configuration.

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS

Additional request:

In its OIP, the licensee identified the SFP levels of monitoring as follows:

- Level 1 corresponds to the 418 ft., 1 $\frac{3}{4}$ in. plant elevation
- Level 2 corresponds to the 410 ft., 1 $\frac{3}{4}$ in. plant elevation
- Level 3 corresponds to the 400 ft., 1 $\frac{3}{4}$ in. plant elevation

In its letter dated August 28, 2014, the licensee revised the Level 1 from 418 ft. 1 $\frac{3}{4}$ in. to 422 ft. 0 in. It is not clear whether this is the only change to the SFP levels of monitoring. Please provide the Braidwood final configuration of the SFP levels of monitoring for both units. Also, please provide an updated sketch depicting the elevation view of the final Level 1, 2, and 3 datum points and the instrument's measurement range.

Response: REF EC 394935 rev 1 sec. 4.1.19 pg 17, SACRG-1 rev 7 Sec. 3.F.

With the finalization of calculation NED-M-MSD-041 rev 2. Level 1 is 421'6" not 422'0" as previously reported in RS-14-195 update. Procedure SACRG-1 rev 7 is utilizing elevation 421' 6" as level 1. Level 2 has changed to 410' 2" and level 3 is 400' 2" with the completion of the calculation.

Calculation NED-M-MSD-041 has been posted on ePortal.

Documents are provided in e-Portal.

See following sketch depicting the elevation view of the final Level 1, 2, and 3 datum points.

BRAIDWOOD FOLLOW-UP SFPI RAI QUESTIONS