Exelon Generation®

Order No. EA-12-051

RS-14-203

August 28, 2014

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

Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: 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)

References:

1. NRC Order Number EA-12-051, " Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012
2. NRC Interim Staff Guidance JLD-ISG-2012-03, "Compliance with Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," Revision 0, dated August 29, 2012
3. 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
4. Exelon Generation Company, LLC'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 25, 2012
5. Exelon Generation Company, LLC Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 28, 2013 (RS-13-035)
6. Exelon Generation Company, LLC 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), dated August 28, 2013 (RS-13-128)
7. Exelon Generation Company, LLC 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), dated February 28, 2014 (RS-14-025)
8. NRC letter to Exelon Generation Company, LLC, Quad Cities Nuclear Power Station, Units 1 and 2 – Interim Staff Evaluation and Request for Additional Information Regarding the Overall Integrated Plan for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC Nos. MF1052 and MF1053), dated October 9, 2013

On March 12, 2012, the Nuclear Regulatory Commission ("NRC" or "Commission") issued an order (Reference 1) to Exelon Generation Company, LLC (EGC). Reference 1 was immediately effective and directs EGC to install reliable spent fuel pool level instrumentation. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an overall integrated plan pursuant to Section IV, Condition C. Reference 2 endorses industry guidance document NEI 12-02, Revision 1 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the EGC initial status report regarding reliable spent fuel pool instrumentation. Reference 5 provided the Quad Cities Nuclear Power Station, Units 1 and 2 overall integrated plan.

Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan. Reference 3 provides direction regarding the content of the status reports. References 6 and 7 provided the first and second six-month status reports, respectively, pursuant to Section IV, Condition C.2, of Reference 1 for Quad Cities Nuclear Power Station. The purpose of this letter is to provide the third six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1. The enclosed report provides an update of milestone accomplishments since the last status report, including any changes to the compliance method, schedule, or need for relief and the basis, if any. The enclosed report also addresses the NRC Interim Staff Evaluation Request for Additional Information Items contained in Reference 8.

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact David P. Helker at 610-765-5525.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of August 2014.

Respectfully submitted,

Glen T. Kaegi
Director - Licensing & Regulatory Affairs
Exelon Generation Company, LLC

Enclosure:

1. Quad Cities Nuclear Power Station, Units 1 and 2 Third Six-Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation

cc: Director, Office of Nuclear Reactor Regulation
NRC Regional Administrator - Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station, Units 1 and 2
NRC Project Manager, NRR – Quad Cities Nuclear Power Station, Units 1 and 2
Ms. Jessica A. Kratchman, NRR/JLD/PMB, NRC
Mr. Stephen R. Monarque, NRR/JLD/JPMB, NRC
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Mr. Blake Purnell, NRR/DORL/LPL3-2, NRC
Illinois Emergency Management Agency - Division of Nuclear Safety

Enclosure

Quad Cities Nuclear Power Station, Units 1 and 2

Third Six-Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation

(24 pages)

Quad Cities Nuclear Power Station, Units 1 and 2

Third Six-Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation

1 Introduction

Quad Cities Nuclear Power Station, Units 1 and 2, developed an Overall Integrated Plan (Reference 1 in Section 8), documenting the requirements to install reliable Spent Fuel Pool Level Instrumentation (SFPLI), in response to Reference 2. This enclosure provides an update of milestone accomplishments since submittal of the Second six month status report including any changes to the compliance method, schedule, or need for relief/relaxation and the basis, if any.

2 Milestone Accomplishments

The following milestones have been completed since the development of the Second six month status report (Reference 8), and are current as of the issuance of this report.

- Complete and Issue SFPI Modification Package for Quad Cities Nuclear Power Station
- Begin SFPLI Installation, July 2014

3 Milestone Schedule Status

The following provides an update to the milestone schedule to support the Overall Integrated Plan. This section provides the activity status of each item, and the expected completion date noting any change. The dates are planning dates subject to change as design and implementation details are developed.

The revised milestone target completion dates do not impact the order implementation date.

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Submit 60 Day Status Report	October 25, 2012	Complete	
Submit Overall Integrated Plan	February 28, 2013	Complete	
Submit Responses to RAIs	July 3, 2013	Complete	
Submit 6 Month Updates:			
Update 1	August 28, 2013	Complete	
Update 2	February 28, 2014	Complete	
Update 3	August 28, 2014	Complete with this submittal	

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Update 4	February 28, 2015	Not Started	
Provide Final Safety Evaluation (SE) Info	September 30, 2014	Complete	
Modifications:			
Conceptual Design	3Q2012	Complete	
Issue Exelon Fleet contract to procure SFPI Equipment	2Q2013	Complete	
Begin (Site Specific) Detailed Engineering Design	4Q2013	Complete	
Complete and Issue SFPI Modification Package	2Q2014	Complete	
Begin Installation	4Q2014	Complete	
Complete SFPI Installation and Put Into Service	1Q2015	Not Started	

4 Changes to Compliance Method

There are no changes to the compliance method as documented in the Overall Integrated Plan (Reference 1).

5 Need for Relief/Relaxation and Basis for the Relief/Relaxation

Quad Cities Nuclear Power Station, Units 1 and 2 expects to comply with the order implementation date and no relief/relaxation is required at this time.

6 Open Items from Overall Integrated Plan and Draft Safety Evaluation

The following tables provide a summary of the open items documented in the Overall Integrated Plan(Ref. 1) or the Draft Safety Evaluation (SE)(Ref. 5) and the status of each item. All incomplete RAI questions from the Draft Safety Evaluation are included as Open Items in the Tables below.

Overall Integrated Plan Open Items(OI)		
OI#	**Description**	**Status**
1 (Ref.1)	Open Item: **Continuous level indication will be provided by a guided wave radar system, submersible pressure transducer, or other appropriate level sensing technology that will be determined during the detailed engineering phase of the project.**	Complete. (Addressed in Reference 7)
2 (RAI-2, Ref.4)	RAI Question: **Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from the sensors toward the location of the read-out/display device.**	Complete. See enclosed RAI-2 Sketch.
3 (RAI-3, Ref.4)	RAI Question: **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**	Complete a) All SFPLI system equipment will be designed in accordance with the Quad Cities Station Safe Shutdown Earthquake (SSE) design requirements. The vendor, Westinghouse, has evaluated the structural integrity of the mounting brackets in calculation CN-PEUS-14-5. The GTSTRUDL model, used by Westinghouse to calculate the stresses in the bracket assembly, considers load combinations for the dead load, live load and seismic load on the bracket. The reactionary forces calculated from these loads become the design inputs to design the mounting bracket anchorage to

	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.**	the refuel floor to withstand a Safe Shutdown Earthquake (SSE). **Seismic** The seismic loads are obtained from Quad Cities Station's response spectra curves (Reference Updated FSAR Chapter 3.7 Figures for Quad Cities Nuclear Generating Station). The following methodology was used in determining the stresses on the bracket assembly: • Frequency analysis, taking into account the dead weight and the hydrodynamic mass of the structure, is performed to obtain the natural frequencies of the structure in all three directions. • SSE (Safe Shutdown Earthquake) response spectra analysis is performed to obtain member stresses and support reactions. • Modal responses are combined using the Ten Percent Method per U.S. NRC Regulatory Guide 1.92, Revision 1, "Combining Modal Responses and Spatial Components in Seismic Response Analysis. The seismic loads for each of the three directions are combined by the Square Root of the Sum of Squares (SRSS) Method. • Sloshing analysis is performed to obtain liquid pressure and its impact on bracket design.(see below for more details) • The seismic results are combined with the dead load results and the hydrodynamic pressure results in absolute sum. These combined results are compared with the allowable stress values. **Sloshing** Sloshing forces were obtained by analysis. The TID-7024, Nuclear Reactors and Earthquakes, 1963, by the US Atomic Energy Commission, approach has been used to estimate the wave height and natural frequency. Horizontal and vertical impact force on the bracket components was calculated using the wave height and natural frequency obtained using TID-7024 approach. Using this methodology, sloshing forces have been calculated and added to the total reactionary forces that would be applicable for bracket anchorage

		design. The analysis also determined that the level probe can withstand a credible design basis seismic event. During the design basis event, the SFP water level is expected to rise and parts of the level sensor probe are assumed to become submerged in borated water. The load impact due to the rising water and submergence of the bracket components has also been considered for the overall sloshing impact. Reliable operation of the level measurement sensor with a submerged interconnecting cable has been demonstrated by analysis of previous Westinghouse testing of the cable, and the vendor's cable qualification. Boron build up on the probe has been analyzed to determine the potential effects on the sensor; this is however not applicable to Quad Cities pool. The following Westinghouse documents provide information with respect to the design criteria used, and a description of the methodology used to estimate the total loading on the device. a. CN-PEUS-14-5 – Pool-side Bracket Seismic Analysis b. LTR-SEE-II-13-47, WNA-TR-03149-GEN – Sloshing Analysis c. EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 – Seismic Qualification of other components of SFPI Quad Cities Station specific calculations QDC-1900-S-2108 – Evaluation of SFPI Sensor Mounting Detail Anchorage and QDC-1900-S-2109 were performed. The design criteria used in this calculation meets the requirements to withstand a SSE and will meet the Quad Cities Station safety related installation requirements. The methods used in the calculation follow IEEE Standard 344-2004 and IEEE Standard 323-2003 for seismic qualification of the instrument. b) The level sensor, which is one long probe, will be suspended from the launch plate via coupler/connector assembly. The launch plate is a subcomponent of the bracket assembly, which is mounted to the refuel floor via anchors. Enlosed Sketch RAI 3 shows a schematic of the level sensor with mechanical attachment points.

		c) The bracket assembly that supports the sensor probe and launch plate will be mechanically connected to the SFP structure. The mechanical connection consists of four concrete expansion anchors that will bolt the bracket assembly to the SFP structure via the base plate. The concrete expansion anchors will be designed to withstand SSE and will meet the Quad Cities Station safety related installation requirements. The qualification details of the bracket are provided in Westinghouse's Pool-side bracket Seismic Analysis CN-PEUS-14-5 and the qualification of the anchorage to the floor is provided in Quad Cities Station specific calculation QDC-1900-S-2108 – Evaluation of SFPI Sensor Mounting Detail Anchorage.
4 (RAI-4, Ref.4)	RAI Question: **Please provide the following:** **a) A description of the specific method or combination of methods you intend to apply to demonstrate the reliability of the permanently installed equipment under 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**	Complete a) Beyond Design Basis Environment – Westinghouse qualified the components (probe, connector, cable) of the SFPLI located in the SFP area to the beyond design basis environment. Components of the system were subjected to beyond design basis conditions of heat and humidity, thermal and radiation aging mechanisms. This testing confirmed functionality of these system components under these beyond design basis environmental conditions. Westinghouse performed testing to ensure aging of the components in the SFP area will not have a significant effect on the ability of the equipment to perform following a plant design basis earthquake. Exelon has reviewed the documents and found acceptable. Reference Westinghouse documents EQ-TP-351, WNA-TR-03149-GEN, and EQ-TP-354 for description of specific qualification methods. Mild Environment – Westinghouse qualified the system components (display panel, sensor) that reside in the mild environment conditions to determine that the components can satisfactorily perform to those conditions. Westinghouse has determined that aging does not have a significant effect on the ability of the equipment to perform following a plant design basis earthquake. Exelon has reviewed the documents and found acceptable.

	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.**	Reference Westinghouse documents EQ-QR-269, WNA-TR-03149-GEN for description of specific methods. Shock and Vibration – SFPIS pool side brackets were analyzed for Safe Shutdown Earthquake design requirements per NRC order EA-12-051 and NEI 12-02 guidance. As provided by the NRC Order EA-12-051, the NEI 12-02 guidance and as clarified by the NRC interim staff guidance, the probe, coaxial cable, and the mounting brackets are "inherently resistant to shock and vibration loadings." As a result, no additional shock and vibration testing is required for these components. SFPIS pool side brackets for both the primary and backup Westinghouse SFP measurement channels will be permanently installed and fixed to rigid refuel floors, which are Seismic Category 1 structures. The SFPI system components, such as level sensor and its bracket, display enclosure and its bracket, were subjected to seismic testing, including shock and vibration test requirements. The results for shock and vibration tests were consistent with the anticipated shock and vibration expected to be seen by mounted equipment. The level sensor electronics and the display electronics will be mounted to a seismically qualified wall. Reference Westinghouse reports WNA-DS-02957, WNA-TR-03149-GEN for shock and vibration. b)The seismic adequacy of the SFPLI (all components) is demonstrated by vendor testing and analysis in accordance with below listed standards: • IEEE 344-2004, IEEE Recommended Practice for Seismic Qualification of Class 1E Electrical Equipment for Nuclear Power Generating Stations • IEEE-323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations • USNRC Regulatory Guide 1.100, Rev. 3 • USNRC Regulatory Guide 1.92, Rev. 1 • Calculation QDC-1900-S-2109, Seismic Qualification of Instrument Enclosure and Level Transmitter Boxes Seismic adequacy of the level sensor probe

		supporting bracket within the SFP area was demonstrated by analysis as discussed in response to RAI-3. c) Westinghouse has seismically qualified the SFPI instrument and its components. CN-PEUS-14-5 describes Pool-side Bracket Seismic Analysis, EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 describe remaining seismic qualifications of the instrument components. With the instrument being seismically qualified and installed as described in RAI 4b response, the instrument is assured to maintain reliable and accurate indication when required. Westinghouse report WNA-CN-00301-GEN and Quad Cities Engineering Change 393703 provide the channel accuracy from measurement to display.
5 (RAI-5, Ref.4)	<u>RAI Question</u>: **Please provide the following:** **a) A description of how the two channels of the proposed level measurement system meet this requirement so that the potential for a common cause event to adversely affect both channels is minimized to the extent practicable.** **b) Further information on how each level measurement system, consisting of level sensor electronics, cabling, and readout devices will be designed and installed to address independence through the application and selection of independent power sources, the use of physical and spatial separation, independence of . signals sent to the**	Complete a) The level probes will be mounted on the east side of the SFP and will be separated by a distance greater than the span of the shortest side of the pool. This meets the NEI 12-02 revision 1 guidance for channel separation. The two installed systems will function as completely independent channels to ensure that a single power source failure will not disable both primary and backup indications. b) To ensure adequate channel separation, the level sensor for the primary channel will be mounted in the northeast corner of the Unit 1 SFP on an existing abandoned jib crane plate. The level sensor for the backup channel will be mounted in the southeast corner of the Unit 2 SFP on an existing abandoned jib crane plate. The level transmitter and level indicating display for the primary and backup channels will be installed in Unit 1 and Unit 2 Turbine Buildings, respectively. The 120 VAC power for the primary and backup level indicating displays will be provided from Unit 1 and Unit 2 instrument buses. The power and instrument cables will be routed on the Unit 1 side for primary channel and on the Unit 2 side for the backup channel. The display locations are greater than 50 ft apart and the raceway systems are separated completely routing in opposite directions. Therefore, adequate separation is maintained between the primary and

	location(s) of the readout devices, and the independence of the displays.	backup channels.
6 (RAI-6, Ref.4)	RAI Question: **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.**	Complete a) The 120 VAC power for the primary and backup level indicating displays will be provided from Unit 1 and Unit 2 instrument buses. These buses are reliable sources of power fed from Diesel Generator backed MCC 18-2/28-2 busses respectively. Upon loss of normal AC power, individual batteries installed in each channel's electronics/ UPS enclosure will automatically maintain continuous channel operation for at least three (3) days. These ESF MCCs have also been identified as part of the FLEX strategy to ensure that the SFPLI will have ac power restored if a Beyond Design Basis External Event would occur. Additionally, a receptacle and a selector switch are installed in each channel electronics/ UPS enclosure to directly connect emergency power to the SFPLI. b) The Westinghouse Report, WNA-CN-00300-GEN, provides the results of the calculation depicting the battery backup duty cycle. This calculation demonstrates that battery capacity is 4.22 days to maintain the level indicating function to the display. Therefore, the Quad Cities Station readout display of level indication will be available for greater than 72 hours of operation. The results of the calculation meet the NEI 12-02 requirements.
7 (RAI-7, Ref.4)	RAI Question: **Please provide the following:** **a) An estimate of the expected instrument channel accuracy performance under both (a) normal SFP level conditions (approximately Level 1 or higher) and (b) at the – 16 beyond design-basis conditions (i.e.,**	Complete a) The Westinghouse documents WNA-CN-00301and WNA-DS-02957-GEN describe the channel accuracy under both (a) normal SFP level conditions and (b) at the Beyond Design Basis (BDB) conditions that would be present if SFP level were at Level 2 and Level 3 datum points. Each instrument channel will be accurate to within ±3"during normal spent fuel pool level conditions. The instrument channels will retain this accuracy after BDB conditions, in accordance with the above Westinghouse documents.

	radiation, temperature, humidity, postseismic and post- shock conditions) that would be present if the SFP level were at the Level 2 and Level 3 datum points. **b) A description of the methodology that will be used for determining the maximum allowed deviation from the instrument channel design accuracy that will be employed under normal operating conditions as an acceptance criterion for a calibration procedure to flag to operators and to technicians that the channel requires adjustment to within the normal condition design accuracy.**	b) The Westinghouse document WNA-TP-04709-GEN describes the methodology for routine testing/calibration verification and calibration methodology. This document also specifies the required accuracy criteria under normal operating conditions. Quad Cities Station calibration and channel verification procedures will follow the guidance and criteria provided in this document. Instrument channel calibration will be performed if the level indication reflects a value that is outside the acceptance band established in the Quad Cities Station calibration and channel verification procedures. Calibration will be performed once per refueling cycle for Quad Cities Station. Per Westinghouse document WNA-TP-04709-GEN calibration on a SFP level channel is to be completed within 60 days of a planned refueling outage considering normal testing scheduling allowances (e.g. 25%). An equivalent time period and periodicity may be used not tied to the refueling outage. This is in compliance with the NEI 12-02 guidance for Spent Fuel Pool Instrumentation.
8 (RAI-8, Ref.4)	RAI Question: **Please provide the following:** **a) A description of the capability and provisions the proposed level sensing equipment will have to enable periodic testing and calibration, including how this capability enables the equipment to be tested in-situ.** **b) A description of how such testing and calibration will enable the conduct of regular channel checks of each independent channel**	Started a) Westinghouse calibration procedure WNA-TP-04709-GEN and functional test procedure WNA-TP-04613-GEN describe the capabilities and provisions of SFPI periodic testing and calibration, including in-situ testing. b) The level displayed by the channels will be verified per the Quad Cities Station administrative and operating procedures, as recommended by Westinghouse vendor technical manual WNA-GO-00127-GEN. If the level is not within the required accuracy per Westinghouse recommended tolerance in WNA-TP-04709-GEN, channel calibration will be performed. c) Functional checks will be performed per Westinghouse functionality test procedure WNA-TP-04613-GEN at the Westinghouse recommended frequency. Calibration tests will be performed per

	against the other, and against any other permanently-installed SFP level instrumentation. **c) A description of how functional checks will be performed, and the frequency at which they will be conducted. Describe how calibration tests will be performed, and the frequency at which they will be conducted. Provide a discussion as to how these surveillances will be incorporated into the plant surveillance program.** **d) A description of what preventive maintenance tasks are required to be performed during normal operation, and the planned maximum surveillance interval that is necessary to ensure that the channels are fully conditioned to accurately and reliably perform their functions when needed.**	Westinghouse calibration procedure WNA-TP-04709-GEN at the Westinghouse recommended frequency. In accordance with Quad Cities Station modification process, maintenance and operating surveillances will be developed for calibration, functional test, channel verification procedures per Westinghouse recommendations to ensure reliable, accurate and continuous SFPI functionality by March 1, 2015. d) Quad Cities Station will develop preventive maintenance tasks for the SFPI per Westinghouse recommendation identified in the technical manual WNA-GO-00127-GEN to assure that the channels are fully conditioned to accurately and reliably perform their functions when needed by March 1, 2015.
9 (RAI-9, Ref.4)	RAI Question: **Please provide the following:** **a) The specific location for each of the primary and backup instrument channel displays.** **b) If the primary and backup display location is other than the main control room, provide justification for prompt accessibility to displays including primary and**	Replaced by Interim SE RAI #12 (Ref. 5).

	alternate route evaluation, habitability at display location(s), continual resource availability for personnel responsible to promptly read displays, and provisions for communications with decision makers for the various SFP drain down scenarios and external events. **c) The reasons justifying why the locations selected enable the information from these instruments to be considered "promptly accessible" to various drain-down scenarios and external events.**	
10 (RAI-10, Ref.4)	RAI Question: **Please provide a description of the standards, guidelines and/or criteria that will be utilized to develop procedures for inspection, maintenance, repair, operation, abnormal response, and administrative controls associated with the SFP level instrumentation, as well as storage and installation of portable instruments.**	Replaced by Interim SE RAI #13 (Ref. 5).
11 (RAI-11, Ref.4)	RAI Question: **Please provide the following:** **a) Further information describing the maintenance and testing program the licensee will establish and implement to**	Complete Response for a): Performance tests (functional checks) and Operator performance checks will be described in detail in the vendor operator's manual, and the applicable information is planned to be contained in plant operating procedures. Operator performance tests are planned to be

	ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Please 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 how the guidance in NEI 12-02 section 4.3 regarding compensatory actions for one or both non-functioning channels will be addressed.** **c) A description of what compensatory actions are planned in the event that one of the instrument channels cannot be restored to functional status within 90 days.**	performed periodically as recommended by the equipment vendor. Channel functional tests per operations procedures with limits established in consideration of vendor equipment specifications are planned to be performed at appropriate frequencies established equivalent to or more frequently than existing SFPI. Manual calibration and operator performance checks are planned to be performed in a periodic scheduled fashion with additional maintenance on an as-needed basis when flagged by the system's automated diagnostic testing features. 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. SFPI channel/equipment maintenance/preventative maintenance and testing program requirements to ensure design and system readiness are planned to be established in accordance with Exelon's processes and procedures and in consideration of vendor recommendations to ensure that appropriate regular testing, channel checks, functional tests, periodic calibration, and maintenance is performed (and available for inspection and audit). Subject maintenance and testing program requirements are planned to be developed during the SFPI modification design process. Response for b, c: Both primary and backup SFPI channels incorporate permanent installation (with no reliance on portable, post-event installation) of relatively simple and robust augmented quality equipment. Permanent installation coupled with stocking of adequate spare parts reasonably diminishes the likelihood that a single channel (and greatly diminishes the likelihood that both channels) is (are) out-of-service for an extended period of time. Planned compensatory actions for unlikely extended out-of-service events are summarized as follows:

<table>
<tr><td></td><td></td><td>
<table>
<tr><th># Channel(s) Out-of-Service</th><th>Required Restoration Action</th><th>Compensatory Action if Required Restoration Action not completed within Specified Time</th></tr>
<tr><td>1</td><td>Restore channel to functional status within 90 days (or if channel restoration not expected within 90 days, then proceed to Compensatory Action)</td><td>Immediately initiate action in accordance with Note below</td></tr>
<tr><td>2</td><td>Initiate action within 24 hours to restore one channel to functional status and restore one channel to functional status within 72 hours</td><td>Immediately initiate action in accordance with Note below</td></tr>
</table>
Note: Present a report to the on-site Plant Operations Review Committee (PORC) 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.</td></tr>
<tr><td>12

(RAI-1, Ref. 4)</td><td><u>RAI Question:</u>

Please provide the following:
a) For level L1, specify how the identified location represents the higher of</td><td>Complete

(Addressed in Reference 4)</td></tr>
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	the two points described in the NEI 12-02 guidance for this level. **b) A clearly labeled sketch depicting the elevation view of the proposed typical mounting arrangement for the portions of 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 L1, L2, and L3 as well as the top of the fuel. Indicate on this sketch the portion of the level sensormeasurement range that is sensitive to measurement of the fuel pool level, with respect to the L1, L2, and L3 datum points.**	

Draft Safety Evaluation Open Items (Ref. 5 & 6)		
OI#	**Description**	**Status**
1 (RAI-1, Ref. 5, 6)	RAI Question: **Please provide the following:** **a) Describe the impact of the installation of the gates between the SFPs and transfer canal on the reliability of the SFP level instrumentation for each SFP. Describe the compensatory measures that would be taken to ensure reliable indication in each SFP when the gates are installed.** **b) Describe the**	Complete (Adressed in Reference 8)

	elevation for the bottom of the gate opening or highest elevation of the bottom of the transfer canal to demonstrate that both the primary and backup SFP level instrument channels can measure the same Level 3 elevation in both SFPs.	
2 (RAI-4, Ref. 5)	RAI Question: **For RAI3(a) above, please provide the analyses used to verify the design criteria and methodology for seismic testing of the SFP instrumentation and the electronics units, including design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.**	Started The following Westinghouse documents provide the analyses used to verify the design criteria and describe the methodology for seismic testing of the SFP instrumentation and electronics units, inclusive of design basis maximum seismic loads and hydrodynamic loads that could result from pool sloshing and other effects that could accompany such seismic forces: a. CN-PEUS-14-5 – Pool-side Bracket Seismic Analysis b. LTR-SEE-II-13-47, WNA-TR-03149-GEN – Sloshing Analysis c. EQ-QR-269, WNA-TR-03149-GEN, EQ-TP-353 – Seismic Qualification of other components of SFPI No equipment failures were noted as a result of seismic test runs. Seismic test data has been documented in the seismic test reports, referenced above. Quad Cities Station specific calculation QDC-1900-S-2109 – Seismic Qualification of SFPI Transmitter and Display boxes will address the seismic qualification of the display panel indicators. This analysis will be finalized by December 2014.
3 (RAI-5, Ref.5)	RAI Question: **For each of the mounting attachments required to attach SFP level equipment to plant structures, please describe the design inputs and methodology used to qualify the structural integrity of the affected structures and equipment.**	Started Quad Cities Station specific calculations QDC-1900-S-2108 – Evaluation of SFPI Sensor Mounting Detail Anchorage and QDC-1900-S-2109 were performed. The design criteria used in this calculation meets the requirements to withstand a SSE and will meet the Quad Cities Station safety related installation requirements. The methods used in the calculation follow IEEE Standard 344-2004 and IEEE Standard 323-2003 for seismic qualification of the instrument. This analysis will be finalized by December 2014.
4 (RAI-7,	RAI Question: **For RAI #6 above,**	Started Below is a summary of the test conditions used by

<table>
<tr>
<td>Ref. 5)</td>
<td>please provide the results for the selected methods, tests and analyses utilized to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.</td>
<td>Westinghouse to qualify the SFPIS. Environmental Conditions for SFPIS Components installed in the Spent Fuel Pool Area at Quad Cities Station are bounded by below test conditions, except for radiation Total Integrated Dose (TID) 12” above top of fuel rack for beyond design basis conditions (BDB). The BDB radiation TID, 12” above top of fuel rack for Quad Cities is 4.E07 R γ, per calculation BYR13-051 – NEI 12-02 Spent Fuel Pool Doses. The BDB radiation value to which the Westinghouse equipment is qualified to is 1.E07 R γ, per Section 5.1.1 of WNA-TR-03149-GEN. The radiation value of 4.E07 R γ is higher than 1.E07 R γ to which Westinghouse qualified the instrument. However, this value of 4.E07 R γ is applicable only when the water is at Level 3. At Level 2 the TID reduces to 2.E07 R γ and it further reduces to 8.E06 at Level 1 and above. With SFP water level at Level 3 the only components of SFPI that are exposed to high radiation are the stainless steel probe and the stainless steel anchor. The materials with which the probe and the anchor are manufactured are resistant to radiation effects. The stainless steel anchor and stainless steel probe can withstand 40 year dose. Westinghouse updated the design specification (WNA-DS-02957-GEN) and LTR-SFPIS-13-35, Revision 1 documentation to include the above technical justification.

Environmental Conditions for SFPIS Components in the Spent Fuel Pool Area

Level sensor probe, coax coupler and connector assembly, launch plate and pool side bracket assembly, coax cable are designed and qualified to operate reliably in the below specified environmental conditions.

<table>
<tr><th>Parameter</th><th>Normal
for Exelon Plants</th><th>BDB</th></tr>
<tr><td>Temperature</td><td>50-140°F</td><td>212°F</td></tr>
<tr><td>Pressure</td><td>Atmospheric</td><td>Atmospheric</td></tr>
<tr><td>Humidity</td><td>0-95% RH</td><td>100% (saturated steam)</td></tr>
<tr><td>Radiation TID γ
(above pool)</td><td>1E03 Rads</td><td>1E07 Rads</td></tr>
</table>
</td>
</tr>
</table>

Radiation TID γ (12" above top of fuel rack)	1E09 Rads (probe and weight only)	1E07 Rads

Environmental Conditions Outside of the Spent Fuel Pool Area

The level sensor transmitter and bracket, electronics display enclosure and bracket are designed and qualified to operate reliably in the below specified environmental conditions.

Parameter	Normal	BDB	BDB (Level Sensor Electronics Only)
Temperature	50-120°F	140°F	140°F
Pressure	Atmos-pheric	Atmos-pheric	Atmospheric
Humidity	0-95% RH	0-95% (non-condensing)	0-95% (non-condensing)
Duration	3 days	3 days	3 days
Radiation TID γ	≤ 1E03 R γ	≤ 1E03 R γ	≤ 1E03 R γ

Thermal and Radiation Aging – organic components in SFP area

Westinghouse documents EQ-QR-269, EQ-TP-354, WNA-TR-03149-GEN provide thermal and radiation aging program details for the SFPI components. Westinghouse completed their thermal and radiation aging testing programs to qualify the SFPI components to 1.25 years. Exelon has reviewed the documents and found acceptable. Additionally, Westinghouse is continuing their aging tests to age the system components to 10 years. These tests are

		projected to be completed towards the end of Summer 2014. Final test reports are scheduled to be provided to Exelon by September 4, 2014. Exelon will complete the test report reviews by September 30, 2014.
5 (RAI-12, Ref. 5)	RAI Question: **Please provide the following:** **a) The specific location for each of the primary and backup instrument channel displays.** **b) If a display will be located somewhere other than the control room or alternate shutdown panel, please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as we as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, please include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display**	Complete a) Quad Cities' primary and backup instrument channel displays are located in the Main Turbine Building on the Main Turbine floor along the Reactor Building wall. The primary channel is in the Unit 1 portion of the building and the backup is in the Unit 2 portion. b) Quad Cities' primary and backup instrument channel displays are located outside of the control room. As described above, they are located on the Main Turbine floor. This location was selected due to the milder environment and display location proximity to the main control room. Radiological habitability at the display location has been evaluated against estimated dose rates from SFP drain down to Level 3 conditions (EC #393703). For primary channel electronics enclosure and transmitter enclosure(worst case) on the Unit 1 side of the plant, the straight line distance from the pool to the electronics panel mounted in the Turbine Building at EL. 639'-0" is 80'. For conservatism, using a distance of 70', and treating all walls and floors as a combined 3' in straight thickness, an overall dose rate for the area can be obtained. Based on Design Analysis BYR13-187 calculated dose rates as a function of distance and wall thickness scaling factors, the dose rate is 8.30E+01 rem/hr x 2.151E-10 = 1.8E-08 rem/hr at the primary channel enclosures during a BDBEE when the water in the SFP is the top of the fuel assemblies. Radiation exposure to personnel monitoring SFP levels would remain considerably less than exposure limits allowable for emergency responders, per Plant Emergency Plan procedure EP-AA-113. Heat and humidity from a SFP boil down conditions have been determined to be of minimal concern as the display locations are outside the secondary containment such that heat and humidity from a boiling SFP would not compromise habitability concerns for accessing these displays. The expected Turbine Building temperatures with loss of ventilation max for all conditions is 120 F and humidity can reach 90%NC (non-condensing) and at 100% NC for LOCA Both primary and backup instrument channel displays are located to reduce likelihood of missile damage. The display

	periodically.	locations are mounted on seismic category I structure wall adjacent to safety related 4 kV switchgear. Per section 3.2 and 3.8 the Turbine Building location selected "assures a degree of safety against structural failure afforded as to Class I equipment located within the Class I reactor building." Spent fuel pool level control and level display monitoring will be the responsibility of an Equipment Operator position, who will normally be observing pool level at the location of the primary display once dispatched from the Control Room. Travel time from the Control Room to the primary display is approximately 2 to 5 minutes based on traveling trials on various paths available. Travel time from the Control Room to the secondary display location is approximately 3 to 6 minute based on trial runs along various travel paths. Radiological habitability for the transit routes to both displays has been evaluated for estimated dose rates from SFP drain down to Level 3 conditions (EC #393703). Exposure to personnel monitoring SFP levels would remain considerably less than exposure limits allowable for emergency responders to perform this action, per the Plant Emergency Plan procedure EP-AA-113. Heat and humidity from a SFP boil down conditions have been determined to be of minimal concern as the travel paths are outside the secondary containment such that heat and humidity from a boiling SFP would not compromise habitability concerns for accessing these displays. Diverse communications are accessible at both display locations. The operators would first employ radio communications or the telephone communication. If the radio communications or telephone systems are non-functional, the sound powered phone system is assumed available because no power is required.. Sound powered phone jacks units are located near both display locations and can be setup as needed. For severe accidents scenarios involving core damage and increased radiological exposure levels, access to these SFP level displays for short term can be achieved (see UFSAR chapter 12, Reference 12.3.6-1). Exposure duration to personnel monitoring SFP levels would be limited to remain within exposure allowable for emergency responders to perform this action, per the Plant Emergency Plan procedure EP-AA-113. The SFP electronics and displays are not expected to take radiation dose higher than the qualified TID 1.0E03 rads. This is because the location is outside secondary containment and not near any piping systems that could contain fission products. (see UFSAR chapter 12, Reference 12.3.6-1). Heat and humidity from

		Post Accident conditions have been determined to be of minimal concern as some travel paths are outside the secondary containment and heat and humidity conditions are the same as for BDE scenarios. The diverse travel paths provide alternate access to the displays addressing concerns of potential missiles impacts.
6 (RAI-13, Ref. 5)	RAI Question: **Please provide a list of the procedures addressing operation (both normal and abnormal response), calibration, test, maintenance, and inspection procedures that will be developed for use of the spent SFP instrumentation. Please provide a brief description of the specific technical objectives to be achieved within each procedure.**	Complete 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 Exelon's procedural control process. The objectives of each procedural area are described below: • System Inspection To verify that system components are in place, complete, and in the correct configuration, and that the sensor probe is clean. • Calibration and Test To verify that the system is within the specified accuracy, is functioning as designed, and is appropriately indicating SFP water level. • Maintenance To establish and define scheduled and preventive maintenance requirements and activities necessary to minimize the possibility of system interruption. • Operation To provide sufficient instructions for operation and use of the system by plant operation staff. To specify troubleshooting/diagnostics information to help identify component repair and replacement activities in the event of system malfunction, as appropriate. • 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.

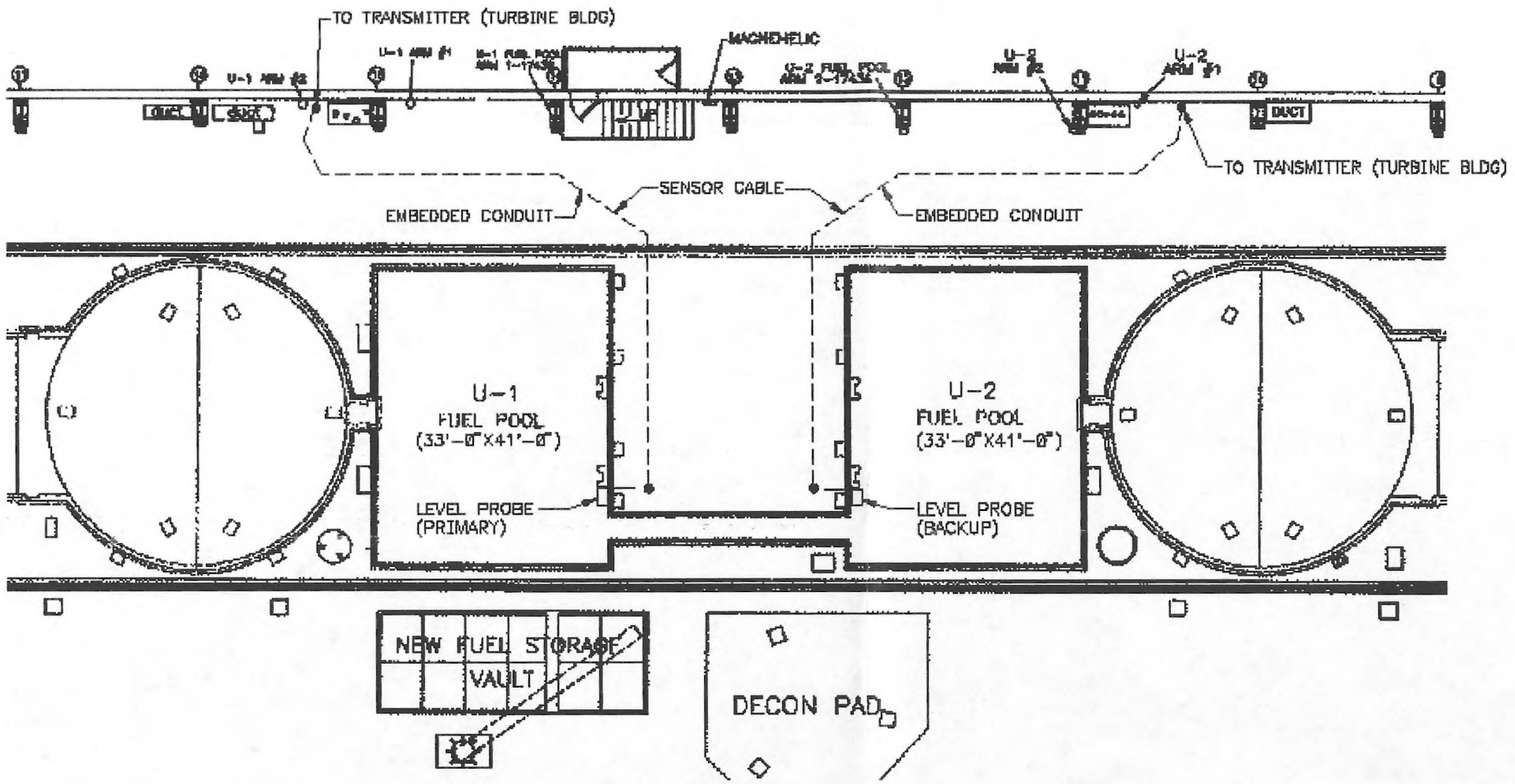
7 Potential Draft Safety Evaluation Impacts(Ref. 5)

There are no potential impacts to the Draft Safety Evaluation identified at this time.

8 References

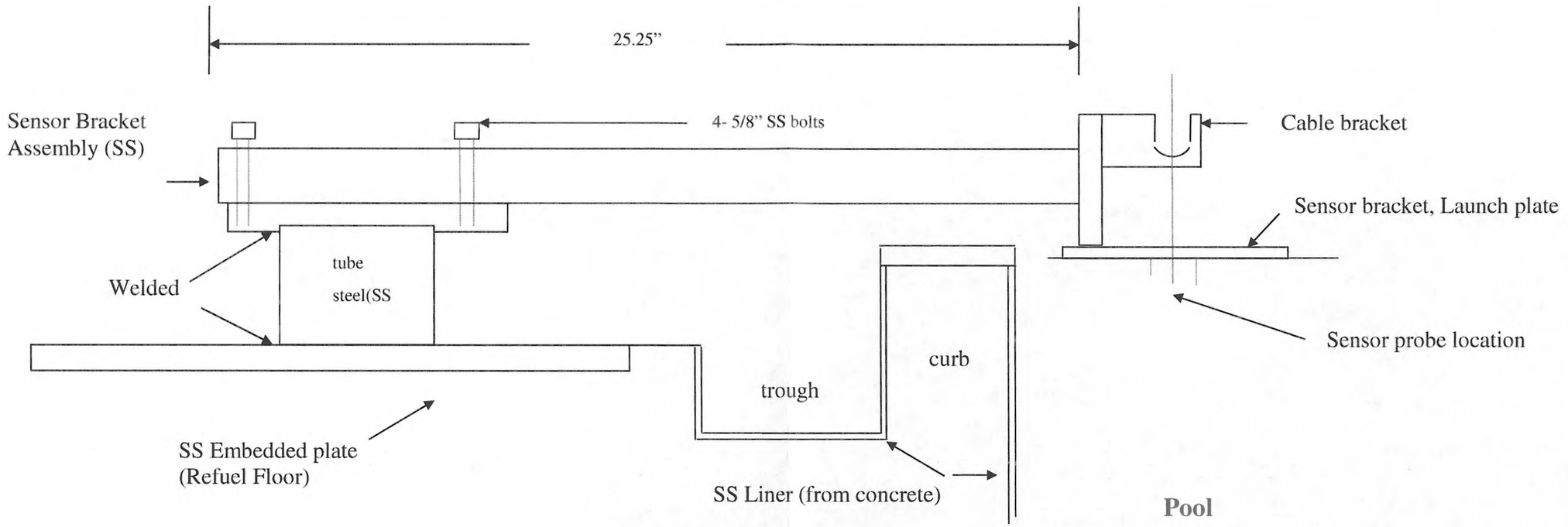
The following references support the updates to the Overall Integrated Plan described in this enclosure.

1. Exelon Generation Company, LLC, letter to USNRC, "Overall Integrated Plan 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 February 28, 2013 (RS-13- 035)
2. NRC Order Number EA-12-051, "Issuance of Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012.
3. USNRC letter to Exelon Generation Company, LLC, Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation, dated June 7, 2013.
4. Exelon Generation Company, LLC, letter to USNRC, "Response to Request for Additional Information – Overall Integrated Plan in response to Commission Order Modifying License Requirements for Reliable Spent Fuel pool Instrumentation (Order No. EA-12-051)", dated July 3, 2013 (RS-13-159).
5. USNRC letter to Exelon Generation Company, LLC, "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 October 9, 2013.
6. USNRC letter to Exelon Generation Company, LLC, Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation, dated November 26, 2013.
7. First Six-Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated August 28, 2013 (RS-13-128).
8. Second Six-Month Status Report for the Implementation of Order EA-12-051, Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, dated February 28, 2014 (RS-14-025).
9. Attachments
   - RAI 2 Sketch
   - RAI 3 Sketch



QUAD CITIES SPENT FUEL LEVEL INSTRUMENTATION LAYOUT
(PORTION OF THE REFUEL FLOOR ELEV. 690'-6")

RAI 2 SKETCH



RAI 3 Sketch, Level Sensor Assembly w/Mechanical Attachment Points