~~Security Related Information - Withhold Under 10 CFR 2.390~~

ENERGY NORTHWEST

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July 19, 2013
GO2-13-100

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397
ENERGY NORTHWEST'S RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE OVERALL INTEGRATED PLAN FOR SPENT FUEL POOL INSTRUMENTATION**

References:
1) NRC Order EA-12-051, "Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012

2) Letter, GO2-13-036, dated February 28, 2013, DA Swank (Energy Northwest) to NRC, "Energy Northwest's Response to NRC Order EA-12-051 – Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation"

3) Letter dated June 20, 2013, from LK Gibson (NRC) to ME Reddemann (Energy Northwest), "Columbia Generating Station – Request for Additional Information related to Response to Order EA-12-051 regarding Spent Fuel Pool Instrumentation (TAC NO. MF0797)"

Dear Sir or Madam:

In Reference 1, the Nuclear Regulatory Commission (NRC) issued Order EA-12-051 requiring installation of reliable spent fuel pool level instrumentation. In Reference 2, Energy Northwest submitted the Overall Integrated Plan in response to the Order. Via Reference 3, the NRC requested additional information related to Energy Northwest's submittal. Transmitted herewith in Attachment 1 is the Energy Northwest response to the request for additional information. There are no new commitments identified in this letter.

Energy Northwest believes that this submittal contains some information that should not be made publicly available. Energy Northwest requests that Attachment 1 to this submittal be withheld from public disclosure in accordance with 10 CFR 2.390(d)(1). Transmitted in Attachment 2 is a redacted version of Energy Northwest's response to the request for additional information.

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In Reference 2, Energy Northwest requested that the Overall Integrated Plan be withheld from public disclosure under 10 CFR 2.390(d)(1). Transmitted herewith in Attachment 3 is a redacted version of the plan that can be made publicly available.

If you have any questions or require additional information, please contact Ms. L. L. Williams at (509) 377-8148.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the date of this letter.

Respectfully,

D.A. Swank
Assistant Vice President, Engineering

Attachment 1: Response to Request for Additional Information
Attachment 2: Response to Request for Additional Information (public version)
Attachment 3: Energy Northwest's Response to NRC Order EA-12-051 – Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (public version)

cc: NRC Region IV Administrator
NRC NRR Project Manager
NRC Senior Resident Inspector/988C
AJ Rapacz – BPA/1399 (email)

Response to Request for Additional Information

The NRC staff reviewed the February 28, 2013, response by the licensee and determined that the following request for additional information (RAI) is needed to complete its technical review. If any part of this information is not available within the specified response period for this RAI, please provide the date this information will be submitted.

NRC Request: Levels of Required Monitoring

1. Please provide the following:

   a) 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). Please indicate on this sketch the datum values representing Levels 1, 2, and 3 as well as the top of the fuel. 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 Levels 1, 2, and 3 datum points.

   b) Given the potential for varied dose rates from other materials stored in the SFP, please describe how Level 2 will be adjusted to other than the elevation defined above.

Energy Northwest Response:

a) An elevation view of the Columbia Generating Station (Columbia)spent fuel pool (SFP) showing the Level 1, 2, and 3 datum points and instrument sensitivity is provided on the attached Figure 1. The instrument will be able to measure 0.1 inch water level change, allowing the earliest possible detection of SFP leaks. The final mounting arrangement details (e.g., fixed level sensors and mounting brackets) will be available upon completion of the final design, scheduled for January 2014. The requested information will be finalized and provided in the February 2014 six month Integrated Plan Update.

Columbia Generating Station SFP Elevations

[

]

Figure 1

b) The Level 2 is selected as 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the SFP based on NEI 12-02 guidance. Accordingly, at Columbia, Level 2 is defined at elevation 593 feet 2 inches. The radiation dose rates from irradiated spent fuel and other materials stored in the SFP area will be assessed in a calculation for habitability and equipment qualification purposes. Necessary compensatory measures and actions will be incorporated into station procedures to ensure that there is adequate radiation shielding to maintain personnel radiological dose levels within acceptable limits while performing local operations in the vicinity of the pool when SFP water level is below the normal water level band. Level 2 will remain at 10 feet above the SFP rack because this is the non-changeable value based on SFP rack locations. Conversely, material and the elevations at which it is stored in the pool will vary based on outage work and pool clean-up. Necessary limitation on SFP makeup actions due to temporarily stored materials will be addressed through administrative controls incorporated into the EA-12-051 response related procedures. Any dose from uncovering these materials will be mitigated once water level is restored through diverse and flexible coping strategies (FLEX, procedures) as needed. Additionally, diverse means exist for adding water to the SFP including the use of spray nozzles that do not require access to the immediate vicinity of the SFP.

NRC Request: Instrumentation Design Features – Cable Routing

2. Please provide the following:

a) 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.

b) Please address how other hardware stored in the SFP will not create adverse interaction with the fixed instrument location(s).

Energy Northwest Response:

a) The final design details including SFP dimensions, sensor locations and cable routings will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

b) The final design details will address the impact from other hardware stored in the SFP on the fixed instrument locations and will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

NRC Request: Instrumentation Design Features – Mounting

3. 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. Please 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 roof and/or other support structures for each planned point of attachment of the probe assembly. Please indicate in a drawing the portions of the level sensor that will serve as points of attachment for mechanical/mounting and 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.

Energy Northwest Response:

a) The loading on the probe mount and probe body will include both seismic and hydrodynamic loading using seismic response spectra that bounds the design basis maximum seismic loads applicable to the installation location(s). The static weight load will also be accounted for in the modeling described below but is insignificant in comparison to seismic and hydrodynamic loads. Analytic modeling is being performed by the instrument vendor using Institute of Electrical and Electronic Engineers (IEEE)-344:2004 methodology.

The simple unibody structure of the probe assembly will make it a candidate for analytic modeling and the dimensions of the probe and complex hydrodynamic loading terms in any case preclude meaningful physical testing.

A detailed computational SFP hydrodynamic model has been developed for the instrument vendor by Numerical Applications, Inc., author of the GOTHIC computational fluid dynamics code. The computational model will account for fluid motion, pool sloshing, and loss of water from the pool.

Seismic loading response of the probe and mount will be separately modeled using finite element modeling software. The GOTHIC-derived fluid motion profile in the pool at the installation site and resultant distributed hydrodynamic loading terms will be added to the calculated seismic loading terms in the finite element model to provide a conservative estimate of the combined seismic and hydrodynamic loading terms for the probe and probe mount, specific to the chosen installation location for the probe.

b) The SFP level instrumentation sensors will not be attached to the refueling roof or other support structures. Instead, level instrumentation sensors will be top mounted on the edge of the SFP and will be extended down into the SFP to directly measure the water level without a stilling well. The final mounting details will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

c) The final design details including mechanical connections will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

NRC Request: Instrumentation Design Features – Qualifications

4. 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 Beyond-Design-Basis (BDB) ambient temperature, humidity, shock, vibration, and radiation conditions.

b) A description of the testing and/or analyses that will be conducted to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be mounted. Please include a discussion of this seismic reliability demonstration as it applies to 1) the level sensor mounted in the SFP area, and 2) 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 following seismic conditions to maintain its required accuracy.

Energy Northwest Response:

a) Reliability of the permanently installed equipment under BDB ambient temperature, humidity, shock, vibration, and radiation conditions will be demonstrated by the equipment design parameters and through testing and analysis. The full seismic and environmental qualifications will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

b) The equipment mounts will be seismically configured for the specific conditions and locations determined by the final design. The completion of the final design is scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update. The electronics/processors are currently planned to be located in the main control room, which is a Seismic Category I Structure.

c) The new SFP level instrumentation system will be designed and tested to confirm that the system maintains its design accuracy after a seismic event. Further details of the method used to confirm the reliability of the permanently installed equipment during and following seismic conditions will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

NRC Request: Instrumentation Design Features – Independence

5. 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, independence of signals sent to the location(s) of the readout devices, and the independence of the displays.

Energy Northwest Response:

a) The Columbia SFP proposed level instrumentation will be designed to meet the requirements set forth in EA-12-051, NEI 12-02, and JLD-ISG-2012-03. Each system will provide two completely independent channels of level

instrumentation. The sensors will be located at opposite corners of the SFP and the electronics/processors will be located in the main control room. The location near the opposite corners of the SFP provides the maximum separation between sensors to maximize the protection against missile damage to both channels.

b) The primary and the backup channels will use the same technology but will be redundant and independent. Both channels will be physically separated to the extent practical from each other by having the probes located at opposite corners of the SFP, separate cable routes, and separate electronics/display mounting locations. The power cables and signal cables for both channels will be routed separately and will maintain the Colombia station separation requirements. Both channels will be powered from independent and separate divisions.

NRC Request: Instrumentation Design Features – Power Supplies

6. If the level measurement channels are to be powered through a battery system (either directly or through an uninterruptible power supply (UPS), please provide the design criteria that will be applied to size the battery in a manner that ensures, with margin, that the channel will be available to run reliably and continuously following the onset of the BDB event for the minimum duration needed, consistent with the plant mitigation strategies for beyond-design-basis external events (Order EA-12-049).

Energy Northwest Response:

The battery design criteria to be used to size the battery will be supplied by the vendor per the Columbia procurement specification, and details will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update. Both channels will be powered normally from two separate divisional power sources which are backed by emergency diesel buses. Additionally, the SFP instrumentation will be capable of being restored with FLEX power consistent with the plant mitigation strategies for beyond-design basis external events.

NRC Request: Instrumentation Design Features – Accuracy

7. 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.

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.

Energy Northwest Response:

a) The SFP level instrumentation channel expected absolute accuracy under normal spent fuel pool level conditions (Level 1 or higher) will be within approximately +/- 0.3% of the span. Expected absolute accuracy under beyond design basis conditions will be approximately +/- 0.3% of the span at Level 2 and 3 datum points. Final design accuracy will be determined upon completion of the final design, scheduled for January 2014.

b) The SFP level instrumentation system will perform in-situ auto calibration. In-situ testing capability takes two forms (1) diagnostic evaluation of system electronics, and (2) high-resolution TDR evaluation of the cable, connectors, and probe connected to the instrument. System electronics diagnostics periodically monitor and evaluate pass/fail criteria for all key instrument systems, alerting the operator if a problem is detected. Channel check and calibration tolerances will be developed as part of the detailed design. The final calibration methodology will be determined upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

NRC Request: Instrumentation Design Features – Testing

8. Please provide the following:

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

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

c) A description of how functional checks will be performed, and the frequency at which they will be conducted. Please 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 preventative 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.

Energy Northwest Response:

a, b)The independent calibration methodology and periodic functional testing methodology (including in-situ capability), preventative maintenance tasks and their associated frequency information will be supplied by the vendor per the Columbia procurement specification, and will be determined upon completion of the final design, scheduled for January 2014.

c, d) A technical analyses to demonstrate that the channels will accurately and reliably perform their intended design functions for their intended mission time will be available upon completion of the final design scheduled for January 2014. Tasks that can be performed during normal operations and maximum task intervals will also be considered in the analysis. Surveillances that will verify the channel functionality and calibration will be incorporated into the plant's surveillance program. Energy Northwest will evaluate incorporating SFP instrumentation program related activities into the Columbia plant licensing basis. The requested information will be provided in the February 2014 six month Integrated Plan Update.

NRC Request: Program Features – Procedures

9. 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.

Energy Northwest Response:

Procedures for testing, inspection, maintenance, operation, abnormal response, training, simulator scenarios, and administrative controls associated with the SFP level instrumentation will be developed as appropriate in accordance with the existing Columbia station procedures and processes. These processes ensure standardization of format and terminology and ease of use along with the assurance of a consistent level of quality. There are no portable level channel instruments associated with the new SFP level instrumentation system that will be installed. Consequently, procedures for storage and installation will not be required.

NRC Request: Program Features – Procedures

10. 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. 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.

Energy Northwest Response:

a) The maintenance and testing of the SFP level instrumentation system will be incorporated into the normal station surveillance and work control processes based on vendor recommendations for maintenance and periodic testing. The preventive maintenance, test and calibration procedures will be developed consistent with the vendor's recommendations. This information will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

b) Required compensatory measures and completion times will be provided for instances when one or both of the SFP level instrumentation channels are non-functional. Additionally all non-functional SFP channel events/conditions will be tracked via the Columbia Correction Action Program (CAP). This information will be available upon completion of the final design, scheduled for January 2014. The requested information will be provided in the February 2014 six month Integrated Plan Update.

c) Specific appropriate compensatory measures to address one or both nonfunctional SFP channels will be determined upon completion of the final design. The requested information will be provided in the February 2014 six month Integrated Plan Update.

COLUMBIA GENERATING STATION
RICHLAND, WASHINGTON

Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation

February 2013

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1.0 Introduction

The Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," (Reference 1) on March 12, 2012. The Order requires licensees to have reliable indication of the water level in spent fuel pools. The indication must permit identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool refuel floor, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred. The Order also requires submittal of an overall integrated plan that describes how the requirements of the Order will be achieved.

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'," (Reference 2) provides an approach for complying with the Order. NRC Interim Staff Guidance JLD-ISG-2012-03, Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," (Reference 3) endorses the methodologies and guidance provided in NEI 12-02, Revision 1, and considers them an acceptable method of complying with the Order subject to the clarifications and exceptions related to Section 3.4, Qualifications.

This Overall Integrated Plan describes Columbia Generating Station's (Columbia) approach for complying with Order EA-12-051 using the methods described in NEI 12-02, Revision 1, and NRC JLD-ISG-2012-03, Revision 0.

Consistent with the requirements of Order EA-12-051 and the guidance in NEI 12-02, Revision 1, six-month status reports will describe progress made, any proposed changes in compliance methods, schedule updates, and if needed, requests for relief and the bases. Any differences between the final design and that described in this plan will be discussed in the six-month status report, including the justification for acceptability.

1.1 Applicability

This Overall Integrated Plan applies to the Columbia Generating Station, Docket No. 50-397. This plan is based on current design information and is subject to change as the final design is developed.

1.2 Schedule

The installation of reliable spent fuel pool level instrumentation is scheduled for completion prior to the end of the R22 refueling outage which is scheduled to start on May 1, 2015. This is the end of the second refueling outage following submittal of this Overall Integrated Plan as required by the Order.

The following milestone schedule is provided. The dates are subject to change as the detailed design and the implementation details are developed. Changes to the following target dates will be reflected in subsequent six-month status reports.

Milestones	Date
Commence Engineering Detailed Design	March 2013
Complete Detailed Design	July 2013
Commence Installation	February 2014
Spent Fuel Pool Instrumentation Channels Operational	June 2014

2.0 Spent Fuel Pool Configuration

Columbia's Reactor Building has been configured around a Boiling Water Reactor (BWR) Mark II containment structure. The spent fuel pool is located on the top floor of the Reactor Building (elevation [ ], referred to as the refuel floor, adjacent to the reactor cavity and opposite the dryer separator storage pool. The spent fuel pool, reactor cavity, and dryer separator storage areas are constructed of reinforced-concrete with a stainless steel liner. The spent fuel pool is the only pool used to store irradiated fuel discharged from the reactor vessel.

With the exception of limited time periods for maintenance or refueling operations, station procedures maintain the spent fuel pool opening isolated from the reactor cavity and dryer separator storage area.

The spent fuel pool has a stainless steel liner on top of the concrete. The bottom of the spent fuel pool is located at elevation [ ]. In one corner of the spent fuel pool there is a cask loading pit. The cask loading area is separated by a partial wall that is open at the top and extends up to elevation [ ]. The cask loading pit communicates with the rest of the spent fuel pool via sixteen 1 inch holes (8 on each side of the two internal walls to the spent fuel pool). The fuel rack extends vertically 15 feet ½ inch (nominally) from the bottom of the spent fuel pool with the top of the rack located at elevation [ ]. There are other structures in the pool including hangers for control blades on the south and east walls, a work bench on the west wall and the fuel preparation equipment.

3.0 Identification of Spent Fuel Pool Water Levels

Key spent fuel pool water levels for Columbia will be designated in conformance with the guidance of JLD-ISG-2012-03 and NEI 12-02 and will be identified in station procedures. Each required level is discussed below and may be revised in the final design. Required instrument accuracy levels for the detection of the pool water levels are called out in the guidance and discussed in Section 7.0.

3.1 Level 1 – Normal Operation

The NEI 12-02 guidance indicates that Level 1 is selected to support operation of the normal fuel pool cooling system. Normal fuel pool cooling operation requires reliable indication of suction loss due to the uncovering of the coolant inlet pipes, weirs, or vacuum breakers. At Columbia the level of the spent fuel pool is maintained in a narrow range by the use of overflow weirs that spill into skimmer surge tanks. The minimum level where the skimmer surge tank functions is at elevation [ ]. Level 1 is considered the minimum level where the skimmer surge tank and the spent fuel pool water levels are still coupled.

3.2 Level 2 – Level Adequate to Provide Radiation Shielding

The NEI 12-02 guidance indicates that Level 2 is selected to provide substantial radiation shielding for personnel in the vicinity of the spent fuel pool from the irradiated fuel stored in the spent fuel pool. NEI 12-02 states that Level 2 be specified as 10 feet (+/- 1 foot) above the highest point of any fuel rack seated in the spent fuel pool. Accordingly, at Columbia, Level 2 is defined at elevation [ ], which is 10 feet above the top of the fuel racks ([ ]). In addition to the spent fuel racks, the spent fuel pool is also used to store other materials that could affect the radiation doses in this area. Accordingly, station procedures will be used to maintain a water level to adequately protect personnel from significant dose consequence. The detailed design will determine the basis for the station procedures.

3.3 Level 3 – Level Where Fuel Remains Covered

The NEI 12-02 guidance indicates that Level 3 is set to the top of the fuel racks holding the irradiated fuel to ensure that the top of the fuel remains covered. At Columbia, Level 3 corresponds to an elevation of [ ] which is located at the top of the fuel rack that is 15 feet ½ inch from the bottom of the spent fuel pool. This height is set to alert Operations that actions to implement make-up water addition to the spent fuel pool can no longer be deferred.

4.0 Instruments

The design of the instruments will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02. Specifically, the channels will be designed as discussed below.

The instrument channels will provide a continual display of water level indication over the complete range from the top of the fuel rack at [ ] to the maximum nominal water level at [ ]. The primary and backup (redundant) instrument channels described below will be selected to satisfy the design criteria in Section 3 of NEI 12-02. The quality assurance requirements meet the guidance of NEI 12-02 and JLD-ISG-2012 as described in Section 6.3.

4.1 Primary (fixed) instrument channel

The primary instrument channel level sensing component will consist of the installation of a new permanently mounted guided wave radar device to detect water level in the pool. The device will provide continuous level monitoring over the full span of the probe which will extend from the top of the spent fuel racks (Level 3) to the maximum nominal water level. To measure the water level in the spent fuel pool the electronics will send an electromagnetic signal (pulse) that propagates down the cable through the probe and records the backscatter from the water interface to determine the water level. The probe used to measure the water level will be top mounted on the edge of the spent fuel pool and the probe will extend down into the spent fuel pool to directly measure the water level.

4.2 Backup (fixed) instrument channel

The backup instrument channel will consist of an independent and redundant channel using the same technology. The redundant channel will be routed separately and will utilize a probe mounted on the opposite diagonal corner of the spent fuel pool. The redundant channel will be powered from a separate power source.

5.0 Reliability

Reliability of the primary and backup instrument channels will be assured by conformance with the guidelines of JLD-ISG-2012-03 and NEI 12-02. Reliability is ensured through proper arrangement, mounting, qualification, independence, power supplies, testing, calibration, and training on the spent fuel pool level instrumentation as discussed in sections 6 through 10 below.

6.0 Instrument Channel Design Criteria

The primary and backup instrument channels will be consistent with JLD-ISG-2012-03 and NEI 12-02.

6.1 Arrangement

Probes:
The primary channel level transmitter probe will be located near or in the north-west corner of the pool. The mounting of the level transmitter probe does not require drilling or tapping into the spent fuel pool liner. The final length, location and mounting will be specified in the detailed design.

The backup channel level transmitter probe will be located diagonally across the spent fuel pool from the primary probe in or near the south-east corner of the pool which is in the cask loading area. This location in or near the corner provides protection from the spent fuel transfer cask due to the geometry of the corner and the circular transfer cask. The mounting plate for the level transmitter probe will be anchored to the concrete around the edge of the pool and will not require drilling or tapping into the spent fuel pool liner. The final length, location and mounting will be specified in the detailed design.

Both primary and backup instrumentation sensing components will be in the spent fuel pool directly with no intermediary pool. Monitoring the level of the pool via both probes is assured since there are no internal pool water level communication issues.

The locations near the north-west and south-east corners afford the greatest separation between probes to maximize the protection, through separation, against missile damage to both channels. The minimum distance between the primary and backup channels is the shortest length of the spent fuel pool side (34 feet). Mounting in or near the corner of the spent fuel pool is preferred over other pool locations.

Electronics:
The primary and backup channel electronics cannot be located on the refuel floor because they are sensitive to radiation. The electronics will be located in an area where they are capable of performing their function in the selected environment (humidity, temperature & radiation). The final location will be specified in the detailed design and discussed in the six-month status report.

Cable Routing:
The primary and backup instrument channel cables will be routed separately in rigid conduits and utilize the walls and building structure to provide reasonable protection from missiles that may result from damage to the structure over the spent fuel pool and refuel floor. The maximum distance from the probe to the electronics is limited to 1000 feet of cabling. There are no cables routed external to the Reactor, Radwaste, and Turbine Buildings. The conduit and cable routing will be determined by the detailed design.

6.2 Mounting

Both the primary and backup systems will be installed consistent with the plant Seismic Category I requirements as described in Columbia's Final Safety Analysis Report (FSAR) Section 3.7 Seismic Design (Reference 5).

The basis for the seismic design of the probe mounting in the spent fuel pool will be developed from the plant seismic design basis. The mounting and location of the spent fuel pool instrumentation will be evaluated by the detailed design and will ensure no adverse interactions occur with the fixed instrumentation and other plant equipment.

6.3 Qualification

The primary and backup instrument channels will be classified as Augmented Quality (AQ), similar to those applied to Fire Protection.

Both the primary and the backup channels will be capable of performing their function and maintaining the required accuracy under the required conditions including harsh accident conditions where the equipment is installed.

The probes, connections, and cables will be qualified for expected conditions at the installed location assuming the spent fuel pool has been at saturation for an extended period (7 days). Post event saturation temperatures are with the surface of the spent fuel pool boiling at 212°F. Post event humidity at the probe located above the spent fuel pool

is assumed to be 100% with condensing steam. The probes and cables located in the vicinity of the spent fuel pool will be qualified to withstand peak and total integrated dose radiation levels for their installed location based on a spent fuel pool water level equal to Level 3 for an extended period of time (7 days).

The component vendor will maintain ISO 9001:2008 "Quality Management System – Requirements," (Reference 7) compliant quality management systems with full traceability and 100% inspection of products before shipment.

The instrument channels will be qualified for shock and vibration. Instruments in similar applications have been qualified using the following standards to demonstrate the components have a substantial history of operational reliability in an environment with significant shock and vibration loading.

- MIL-STD-167-1 Mechanical Vibrations of Shipboard Equipment
- MIL-S-901 Shock Testing (high impact) Shipboard Machinery
- MIL-PRF-28800F General Specification for Test Equipment for Use with Electrical and Electronic Equipment

Additionally, the primary and backup channels will meet the Seismic Category I requirement. This does not cover the mounting which is discussed in Section 6.2 above. The instrument channels will be rated by the manufacturer for seismic effects at levels postulated for the design basis event using the methodology in sections 7, 8, 9, and 10 of IEEE Standard 344-2004, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations" (Reference 6). Physical testing is to be performed for the electronics and analytical analysis is to be performed on the probe in accordance with IEEE 344-2004.

6.4 Independence

The primary and the backup channels will be redundant, independent, and use the same technology (Guided Wave Radar). Both channels will be separated to the extent practical from each other by having the probes located at opposite ends of the spent fuel pool, separate cable routes, and separate electronics mounting locations. The instrumentation mounting and routing for the two instrument channels will maintain station separation requirements to prevent impact to other plant equipment. The separation requirements will be complying with Columbia's licensing and design basis requirements.

6.5 Power Supplies

The primary and backup instrument channels will be powered normally from independent divisional power sources such that the loss of one power source does not result in the loss of both channels. Each channel will have a battery power supply that is capable of isolating from the normal supply and supporting the instrument for a minimum of 24 hours. This battery power will be maintained charged through the normal power source.

Both the primary and the backup instrument channels will maintain their design accuracy without recalibration or reconfiguration following a power interruption (including the loss of the redundant battery power) or a change in the power source. The channel electronics

store the device configuration in non-volatile flash memory that upon repowering restores the instrument.

The detailed design will determine the normal power source and the additional FLEX power source that will meet the 7 day requirement for both channels. The detailed design will determine the specific details to meet these requirements.

7.0 Accuracy

The accuracy will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02. The guidance requires a resolution of 1 foot for Level 1 and 3.5 feet for Levels 2 and 3.

The primary and the secondary channels maintain their design accuracy following a power interruption without requiring re-calibration. The loop accuracy of the primary system and the backup system is less than 6 inches for the entire span (above Level 1 through to Level 3) for both channels. The total instrument loop uncertainty will be determined by the detailed design and will meet the accuracy requirements (±1 foot) in NEI 12-02.

8.0 Testing

Testing will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02 and performed in accordance with station procedures. The primary and backup instrument channels will be tested and calibrated. The channels will have the ability to perform in-situ testing. Calibration and testing procedures will be developed in accordance with the station procedures, guidelines and vendor recommendations. Details will be determined in the detailed design.

9.0 Display

Both the primary and backup channel will be continuously displayed in the main control room. Both channels will have an alternate location for viewing level indication at the electronic control cabinet for the guided wave radar. The display supplied in the vendor electronics is a second display location that is designed not to impact the main control room loop indication. The main control room indicator is instrument loop powered. The location for both channels electronics and the displays location inside the main control room are to be determined by the detailed design. The display will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02.

10.0 Instrument Channel Program Criteria

10.1 Training

The Systematic Approach to Training (SAT) will be used to identify the population to be trained and to determine both the initial and continuing elements of the required training. Training will be completed prior to placing the instrumentation in service. Training will be performed in accordance with station procedures, processes, and vendor recommendations. The program criteria will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02.

10.2 Procedures

Procedures will be developed using guidelines and vendor instructions to address maintenance, operation and abnormal response issues associated with the new spent fuel pool instrumentation. The procedures will be in place prior to the instrument being placed into service. Procedures will be prepared in accordance with station procedures, processes, and vendor recommendations. The program criteria will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02.

10.3 Testing & Calibration

Processes will be established and maintained for scheduling and implementing necessary testing and calibration of the primary and secondary instrument channels to maintain the instrument channel at its design accuracy. The calibration will be specific to the mounted instrument and the monitor. Testing and calibration programs will be developed in accordance with station procedures, processes, and vendor recommendations. The program criteria will be consistent with the guidelines of JLD-ISG-2012-03 and NEI 12-02.

11.0 Need for Relief and Basis

Columbia is not requesting relief from the requirements of Order EA-12-051 or the guidance in NRC JLD-ISG-2012-03 at this time.

Consistent with the requirements of Order EA-12-051 and the guidance in NEI 12-02, the six-month reports will delineate progress made, any proposed changes in our compliance methods, updates to the schedule, and if needed, requests for relief and their bases.

12.0 References

1. EA-12-051, Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, March 12, 2012

2. NEI 12-02, Industry Guidance for Compliance with NRC Order EA-12-051, To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, Revision 1, August 2012

3. NRC JLD-ISG-2012-03, Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation, Revision 0, August 2012

4. NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Revision 0, August 2012

5. Columbia Generating Station Final Safety Analysis Report, Amendment 61

6. IEEE Standard 344-2004, IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

7. ISO 9001, Quality Management System – Requirements