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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/RENEWED LICENSE NO. DPR-23

Subject: Completion of Required Actions for NRC Order EA-12-051 With Regard to Reliable Spent Fuel Pool Level Instrumentation

Ladies and Gentlemen,

On March 28, 2012 the NRC issued EA-12-051, "Order Modifying Licenses With Regard To Reliable Spent Fuel Pool Instrumentation," which required the installation of a reliable indication of the water level in associated spent fuel storage pools capable of supporting 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 operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred. Condition C.3 of the Order required all Licensees to report to the Commission when full compliance with the requirements of the order is achieved.

This letter provides notification that Duke Energy has completed the requirements of EA-12-051 and is in full compliance with the Order for H. B. Robinson Steam Electric Plant, Unit No. 2. The enclosures to this letter provide: 1) a summary of how the compliance requirements were met for H. B. Robinson, 2) the Duke Energy response to SFPLI RAIs and Safety Evaluation Review Item #7 and 3) the design bridge document for H. B. Robinson .

This letter contains no new Regulatory Commitments and no revision to existing Regulatory Commitments.

Should you have any questions regarding this submittal, please contact Mr. Richard Hightower, Manager, Nuclear Regulatory Affairs at (843) 857-1329.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 27, 2015.

Sincerely,

R. Michael Glover

R. Michael Glover
Site Vice President

RMG/shc

Enclosures:
1) Compliance Requirements Summary for NRC Order EA-12-051
2) Response to SFPLI RAIs and Safety Evaluation Review Item #7
3) Design Bridge Document for Spent Fuel Pool Instrumentation

cc: Ms. M. C. Barillas, NRC Project Manager, NRR
Mr. K. M. Ellis, NRC Senior Resident Inspector
Mr. V. M. McCree, NRC Region II Administrator
Mr. J. C. Paige, NRC Mitigation Strategies & SFP Instrumentation Project Manager, NRR/JLD

ENCLOSURE 1

DUKE ENERGY'S

COMPLIANCE REQUIREMENTS SUMMARY FOR

NRC ORDER EA-12-051

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
ORDER EA-12-051 COMPLIANCE REQUIREMENTS SUMMARY

BACKGROUND

H. B. Robinson Steam Electric Plant, Unit No. 2 developed an Overall Integrated Plan (OIP) (Reference 1), documenting how the requirements for reliable spent fuel pool level instrumentation (SFPLI) would be achieved, in response to Order EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," (Reference 2). H. B. Robinson Steam Electric Plant, Unit No. 2 OIP was submitted to the NRC by letter dated February 28, 2013 and was supplemented by Six-Month Status Reports (References 3, 5, 6 and 7), in accordance with Order EA-12-051. By letter dated November 19, 2013, the NRC provided its Interim Staff Evaluation and Request for Additional Information Regarding Order EA-12-051 (Reference 4).

H. B. Robinson's Spent Fuel Pool (SFP) has two independent level measurement channels, that were supplied and qualified by AREVA, and were installed in response to Reference 2. The design features identified in Attachment 2 of Reference 2 are summarized in Section B00 of EC 89580, Revision 5. This document has previously been provided to the NRC and is available for their review.

H. B. Robinson has achieved full compliance with Order EA-12-051, prior to the end of the second refueling outage after submittal of the OIP. Completion of the elements identified below for H. B. Robinson , as well as References 1, 3, 5, 6 and 7 document full compliance with Order EA-12-051 for H. B. Robinson Steam Electric Plant, Unit No. 2.

COMPLIANCE SUMMARY

1. NRC RAI, ISE AND AUDIT ITEMS - STATUS: COMPLETE

During the ongoing audit process, Duke Energy provided responses for the following items for H. B. Robinson:

- Interim Staff Evaluation (ISE) and Request for Additional Information (RAI)
- Safety Evaluation Review Items

In addition, during the H. B. Robinson Steam Electric Plant, Unit No. 2, Audit an additional item was identified related to SFPI. This item was specified as Safety Evaluation Review Item #7. This item was added during the audit and required supplemental information which subsequently addressed the item.

As requested by the NRC, Duke Energy's responses, or references to the source document for the responses, to the SFPLI RAIs and Safety Evaluation Review Item #7 (SE 7) were provided during the onsite audit. It is Duke Energy's position that no further actions related to the SFPLI RAI's or SE #7 are required.

2. MILESTONE SCHEDULE ITEMS - STATUS: COMPLETE

H. B. Robinson Milestone	Completion Date
Submit OIP	February 2013
Commence Engineering and Design	November 2012
Complete Engineering and Design	January 2015
Complete Procurement of SFP Instruments	October 2014
Commence Installation of SFP Instruments	January 2015
Level Measurement System Functional	May 2015

3. IDENTIFICATION OF LEVELS OF REQUIRED MONITORING - COMPLETE

H. B. Robinson has identified the three required levels for monitoring spent fuel pool (SFP) level in compliance with Order EA-12-051. These levels have been integrated into the site processes for monitoring level during events and responding to loss of SFP inventory.

4. INSTRUMENT DESIGNED FEATURES - STATUS: COMPLETE

The design of the SFP level measurement instrumentation system installed at H. B. Robinson complies with the requirements specified in Order EA-12-051 and described in NEI 12-02 "Industry Guidance for Compliance with NRC Order EA-12-051." The instrumentation system has been installed in accordance with the station design control process.

The instruments have been arranged to provide reasonable protection against missiles. The instruments have been mounted to retain design configuration during and following the maximum expected ground motion. The instruments will be reliable during expected environmental and radiological conditions when the SFP is at saturation for extended periods. The instruments are independent of each other and have separate and diverse power supplies. The instruments will maintain their designed accuracy following a power interruption and are designed to allow for routine testing and calibration.

The instrument display is readily accessible during postulated events and allows for SFP level information to be promptly available to decision makers.

5. PROGRAM FEATURES - STATUS: COMPLETE

Training of personnel performing maintenance functions including calibration and surveillance associated with the SFP level instrument channels at H. B. Robinson has been completed in accordance with an accepted training process as recommended in NEI 12-02, Section 4.1.

Operating and maintenance procedures, for the H. B. Robinson SFP level instrument channels have been developed, and integrated with existing procedures. These procedures have been verified and are available for use in accordance with the site procedure control program.

Site processes have been established to ensure the instruments are maintained at their design accuracy.

REFERENCES

The following references support the H. B. Robinson Steam Electric Plant, Unit No. 2 SFPLI Compliance Summary:

1. Carolina Power & Light Company's Overall Integrated Plans 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 (ML13086A096)

2. NRC Order Number EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012 (ML12054A679)

3. H. B. Robinson Steam Electric Plant, Unit No. 2, 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 26, 2013 (ML13242A010)

4. NRC Letter, *H. B. Robinson Steam Electric Plant, Unit 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 NO. MF0793),* Dated November 19, 2013, (ADAMS Accession No. ML13273A481)

5. H. B. Robinson Steam Electric Plant, Unit No. 2, 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 24, 2014 (ML14063A604)

6. H. B. Robinson Steam Electric Plant, Unit No. 2, 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), dated August 26, 2014 (ML14251A013)

7. H. B. Robinson Steam Electric Plant, Unit No. 2, Fourth Six-Month Status Report in Response to March 12, 2012, Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 23, 2015 (ML15065A041)

ENCLOSURE 2

DUKE ENERGY'S RESPONSE TO

SPENT FUEL POOL LEVEL INSTRUMENTATION (SFPLI) REQUEST FOR ADDITIONAL INFORMATION (RAI's) AND SAFETY EVALUATION REVIEW ITEM #7

FOR

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

H. B. ROBINSON RESPONSES TO SFPLI RAIs AND SAFETY EVALUATION REVIEW ITEM #7

By Letter dated November 19, 2013, the NRC issued the H. B. Robinson Unit 2 – Interim Staff Evaluation and Request for Additional Information (RAI) Regarding the Overall Integrated Plan (OIP) for Implementation of Order EA-12-051, Reliable Spent Fuel Pool Instrumentation (TAC NO. MF0793)(ADAMS Accession No. ML1327A481).

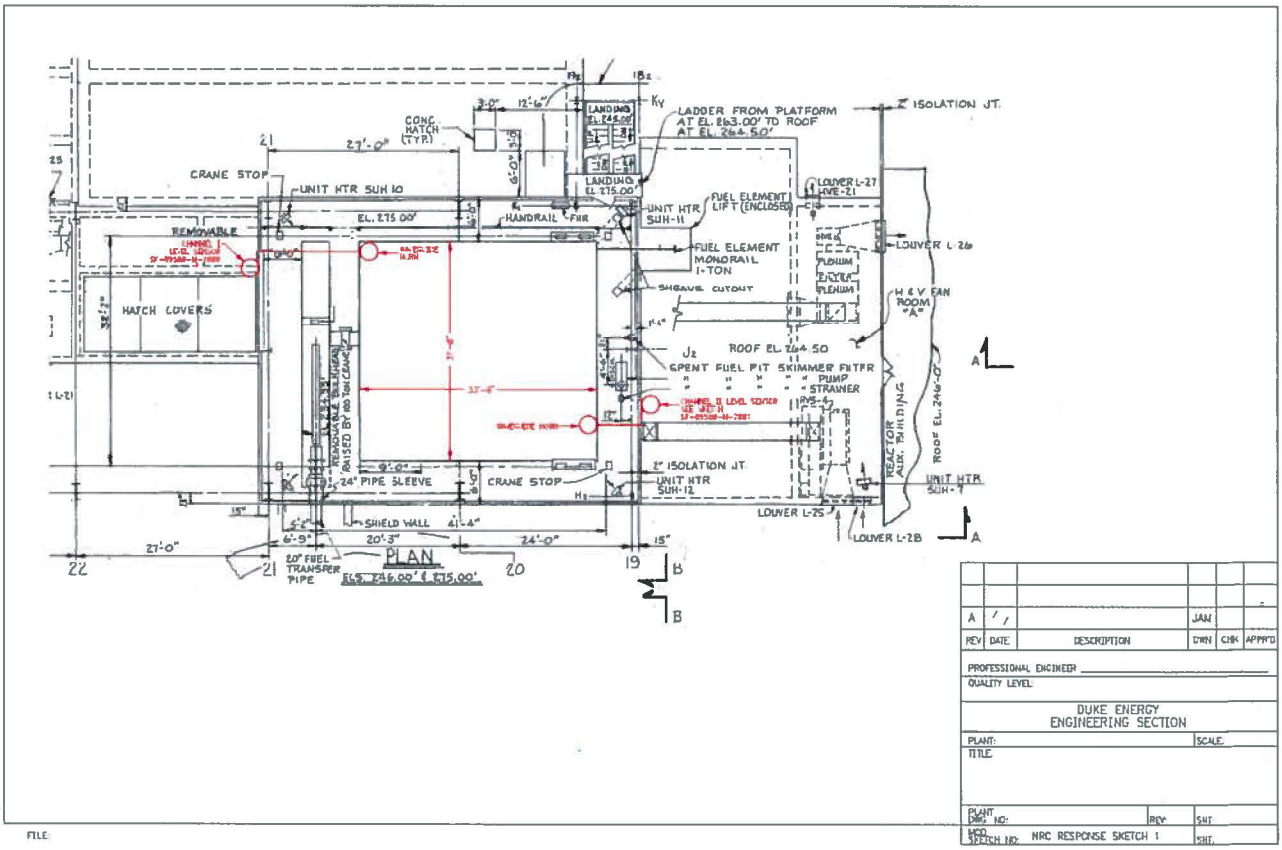
This document provides the H. B. Robinson Unit No. 2 response to the NRC's RAI's regarding the OIP for implementation of Order EA-12-051.

RAI #1

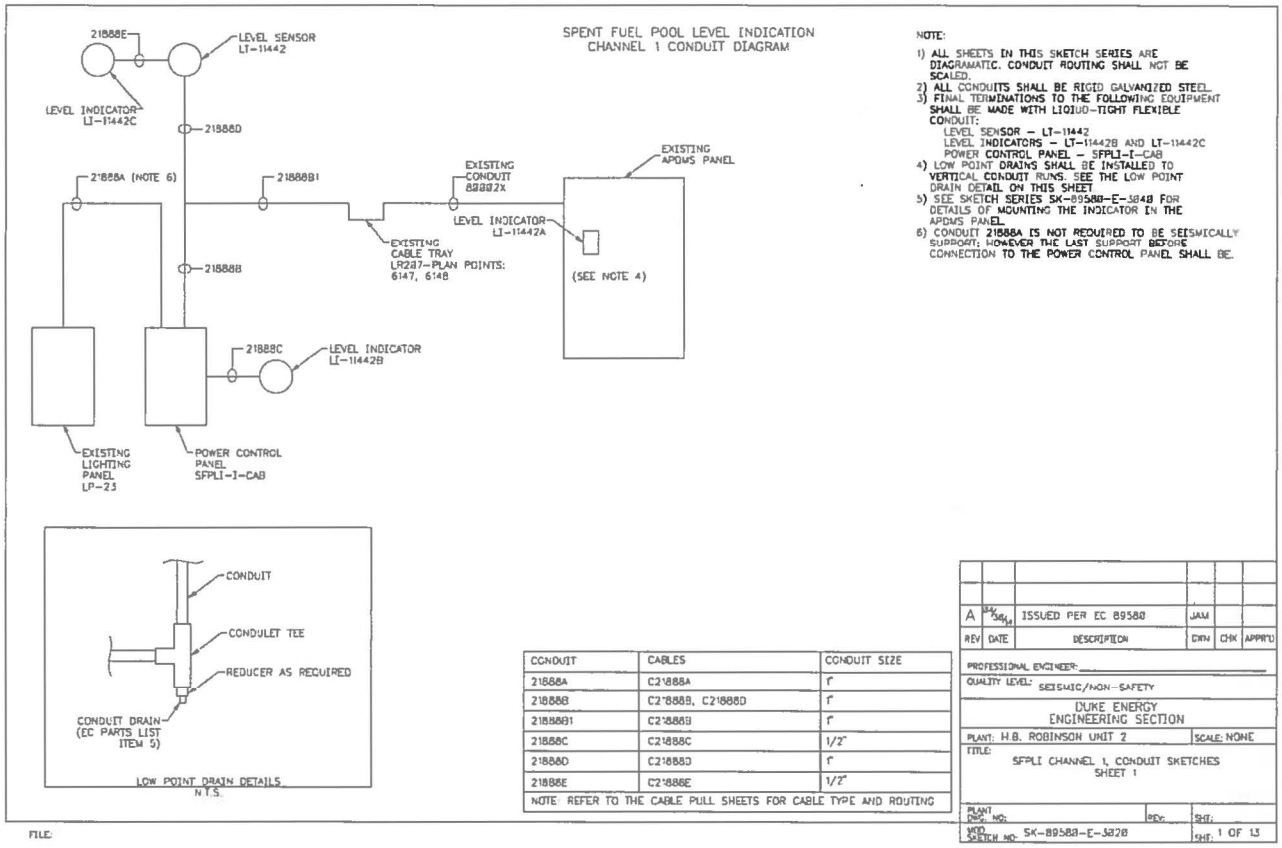
Please provide a clearly labeled sketch or marked-up plant drawing of the plan view of the SFP area, depicting the SFP inside dimensions, the planned locations/placement of the primary and back-up SFP level sensor, and the proposed routing of the cables that will extend from these sensors toward the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

RNP RESPONSE TO RAI #1:

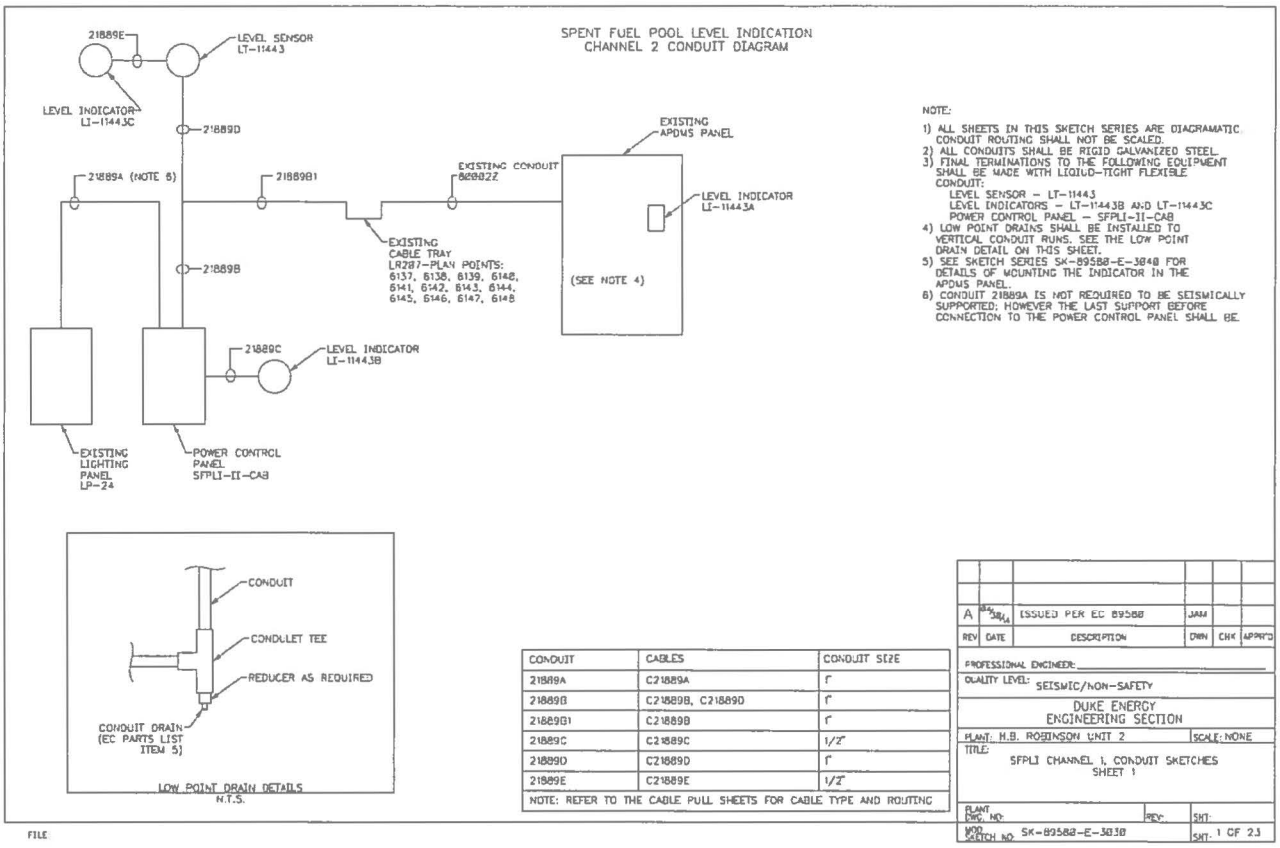
Refer to the Sketch below titled "NRC Response Sketch 1" for locations of the radar, waveguide horn, tubing and sensor locations. As shown on the sketch, both sensors will be located on the outside wall of the spent fuel pool.



Conduit from the sensors to the indicators will be routed as shown on sketch series SK-89580-E-3020 and SK-89580-E-3030 of EC 89580 (As shown below). In general, conduit for one channel of level will be routed across the roof of the Reactor Auxiliary Building to the Control Room. The other channel's conduit will be routed along the outside of the Reactor Auxiliary Building on the north and east walls.



And



RAI #2

Provide the following:

a) The design criteria that will be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology that will be used to estimate the total loading, inclusive of design basis maximum seismic loads and the hydrodynamic loads that could result from pool sloshing or other effects that could accompany such seismic forces.

b) A description of the manner in which the level sensor (and stilling well, if appropriate) will be attached to the refueling floor and/or other support structures for each planned point of attachment of the probe assembly. Indicate in a schematic the portions of the level sensor that will serve as points of attachment for mechanical/mounting or electrical connections.

c) A description of the manner by which the mechanical connections will attach the level instrument to permanent SFP structures so as to support the level sensor assembly.

RNP RESPONSE TO RAI #2:

(a) AREVA developed a calculation (32-9221237-002) to qualify a standard support configuration for the horn assembly for its SFPL monitoring system that is applicable to Duke sites including RNP Unit 2. This calculation documents the design criteria used to estimate the total loading on the mounting device, called Type 'A' support. These criteria include static and dynamic loads imposed by deadweight, seismic and sloshing. Since the instrument is located inside the building, it is not subject to wind loads. AREVA document provides the qualification of the VEGAPULS 62 ER through air radar in accordance with the requirements of USNRC EA-12-051, JLD-ISG-12-03, and NEI 12-02.

Since the support design was to be used at several sites, conservative design inputs and/or maximum dimensions are used in calculating deadweight and other loads.

The Type 'A' support is qualified while also identifying a maximum sloshing load that can be withstood by the horn end assembly and waveguide support configuration.

The waveguide system and supports are considered augmented quality, seismically qualified. Since AREVA used limiting sloshing loads to cover several plants, Robinson hired Numeric Applications Inc. (NAI) to perform plant specific sloshing analysis. NAI analysis confirmed the AREVA sloshing loads.

The NAI site specific sloshing analysis prepared a three dimensional GOTHIC sub-divided model of the SFP and induce the characteristics of a seismic event on the model. A modified version of the GOTHIC 8.0 (QA) code containing adjustable body force terms in the x, y, and z direction momentum conservation equations is used to perform analysis. Artificial time histories developed based on a target response spectrum for the vertical and two horizontal axes are applied simultaneous in the analysis.

The seismic accelerations bound forces applied to the horn, waveguide and electronics supports to above the 2 X SSE Criteria for the BDBEE.

b) There are two level sensing lines (waveguides) added per this modification. One waveguide is installed at the southeast side of the spent fuel pool identified as waveguide sensing line Channel 2 and the second waveguide is installed at the northwest side of the spent fuel pool identified as waveguide sensing line Channel 1.

Sensing Line Channel 1

The routing for this line is shown on Sketch SK-89580-M-2000 and is different from that of sensing line Channel 2. The span inside the fuel handling building is long and needs a support inside the building and is evaluated as discussed below.

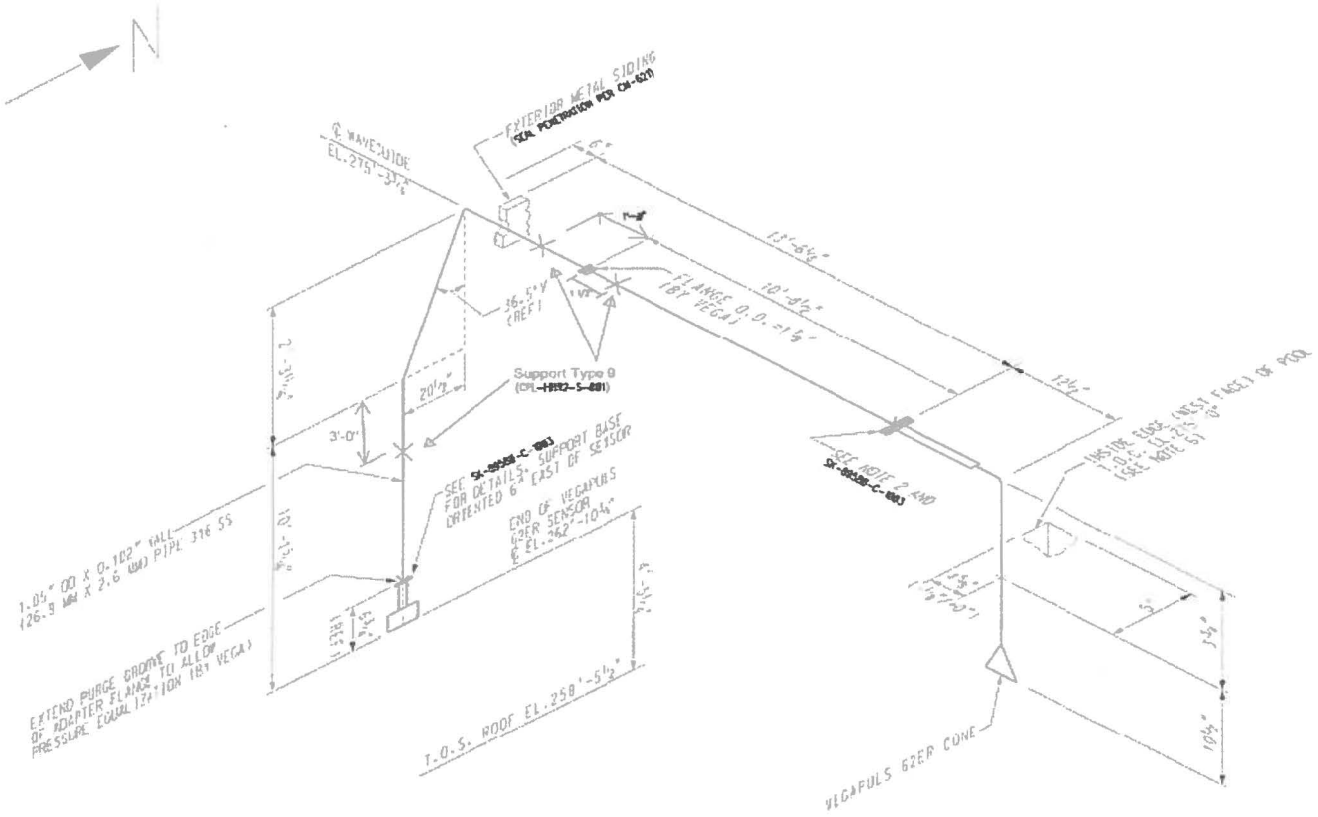
Sensing Line Channel 2

See sketch SK-89580-M-2001 for the piping configuration. Based on the span between the support at the spent fuel pool and the instrument box a new support is required and is located on the outside wall as shown on the isometric drawing.

See isometric drawings for the piping configuration. Based on the span between the support at the spent fuel pool and the wall (Siding) a new supports are required inside fuel handling building on north-south section of the waveguide. This support is not shown on the isometric drawing.

c) Each sensing line consists of stainless piping, 1.059" OD, .102" thick which is equivalent to 3/4", schedule 40 pipe, attached to the antenna horn and an instrument box mounted on the spent fuel pool wall. For sensing line Channel 2 the instrument box is located on the east wall and for sensing line Channel 1 the instrument box is located on the west wall. Installation of waveguide up to the instrument box mounted on the spent fuel pool wall is included in Areva's scope. Waveguide installed at the southeast side of the pool has its instrument box mounted on the east wall of the pool and the waveguide installed at the northwest side has its instrument box mounted on the west wall of the pool. Areva's scope consists of installation of waveguide from the spent fuel pool to the instrument box along with the two supports for each waveguide. Areva has qualified the supports and piping up to the first support. Installation of additional supports as required between the first support and the instrument box is included in RNP's scope.

The revised channel sketches are included on the following two pages.



NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE U.N.O.
2. AREVA TO SUPPLY BLIND FLANGE PER SK-B858R-C-882
   VEGA TO REPLACE BLIND FLANGE FOR
   FINAL CONNECTION (¾ - 14 NPSM).
3. BEND RADIUS IS 3.88" (98MM) (TYP.).
4. GENERAL DIMENSIONAL TOLERANCES ARE +/-½".
5. ADDITIONAL SUPPORT(S) ARE OWNER'S
   RESPONSIBILITY.
6. EL. LISTED IS FOR TOP OF CONCRETE.
7. ELEVATIONS ARE PROVIDED FOR REFERENCE.

A		ISSUED PER EC 88588	JAM		
REV	DATE	DESCRIPTION	DWN	CHK	APPVD

PROFESSIONAL ENGINEER

QUALITY LEVEL: NON-SAFETY RELATED

DUKE ENERGY
ENGINEERING SECTION

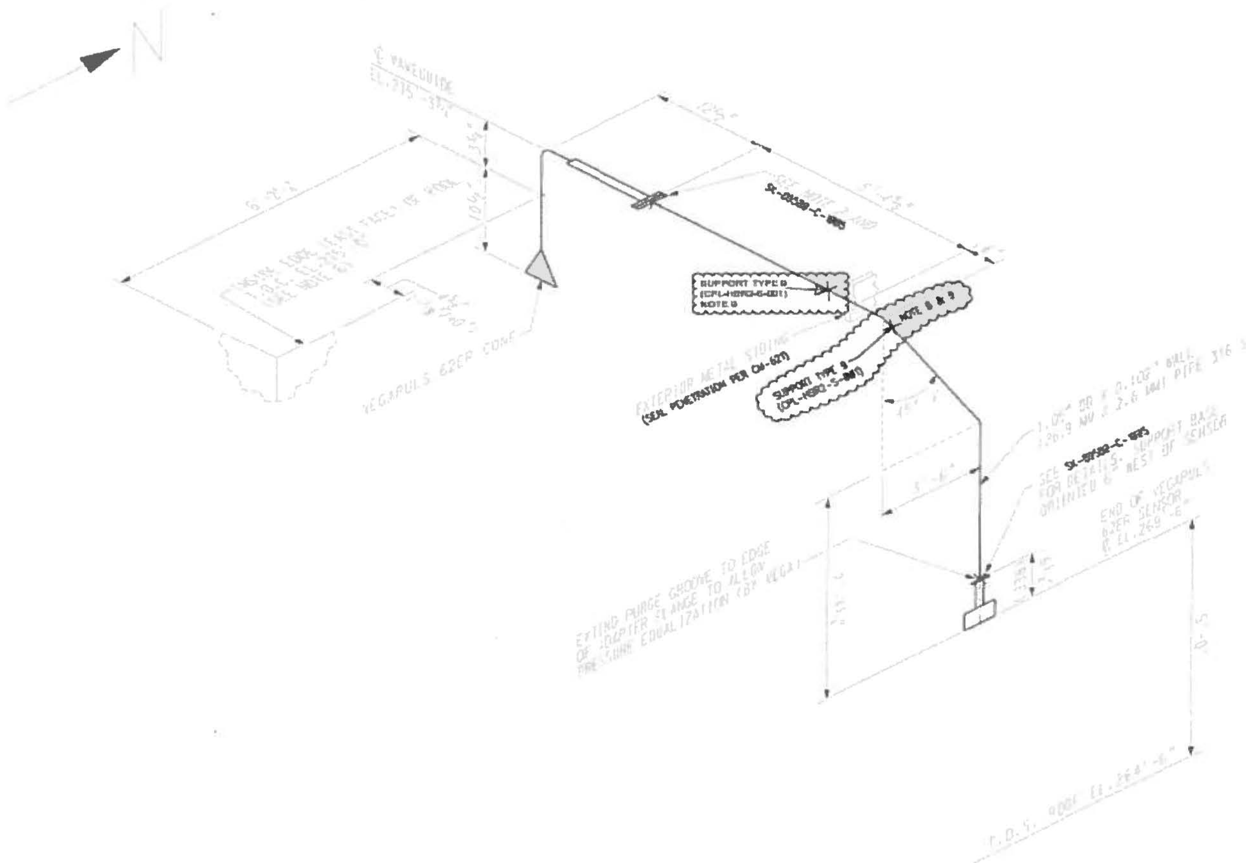
PLANT: ROBINSON NUCLEAR PLANT — NONE

TITLE:

VEGA WAVEGUIDE ISOMETRIC
CHANNEL I

PLANT DWG. NO.:	REV. A	SHT.
DUKE DRAWING NO. SK-B858R-M-2080		SHT.

G01R0 4 | 3 | 2 | 1 Sensing Line CHANNEL I



NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE U.N.O.
2. AREVA TO SUPPLY BLIND FLANGE PER SK-89588-C-1002 VEGA TO REPLACE BLIND FLANGE FOR FINAL CONNECTION 1¾ - 14 NPSM).
3. BEND RADIUS IS 3.88" (98MM) (TYP.).
4. GENERAL DIMENSIONAL TOLERANCES ARE +/- ¼".
5. ADDITIONAL SUPPORT(S) ARE OWNER'S RESPONSIBILITY.
6. EL. LISTED IS FOR TOP OF CONCRETE.
7. [illegible]
8. ROTATE UNISTRUT APPROX. 45 DEGREES ON BASEPLATE TO FIT UP WITH WAVEGUIDE.
9. INSTALL UP TO TWO SUPPORTS TO MEET 6FT MAX. SPAN LENGTH.

REV	DATE	DESCRIPTION	DRN	CHK	APPR
B		ISSUED PER EC 89588	JAM		
A		ISSUED PER EC 89588	JAM		

PROFESSIONAL ENGINEER: ______

QUALITY LEVEL: NON-SAFETY RELATED

DUKE ENERGY
ENGINEERING SECTION

PLANT: ROBINSON NUCLEAR PLANT — SCALE: NONE

TITLE: VEGA WAVEGUIDE ISOMETRIC
CHANNEL II

REV. A

SK-89588-M-2001

G02R0

Sensing Line CHANNEL II

In addition, the NRC staff plans to verify the results of the licensee's seismic testing and analysis when it is completed based on the licensee's response to the following RAI.

RAI #3

For RAI 2(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.

RNP RESPONSE TO RAI #3:

The VEGAPULS 62 ER seismic qualification requirements are specified in detail in the Seismic Qualification Specification. A seismic shake test was performed to the requirements of IEEE 344-2004 for elements of the VEGAPULS 62 ER through air radar to levels anticipated to envelop most if not all plants in the US. The equipment qualified included the VEGAPULS 62 ER sensor, PLICSCOM indicating and adjustment module, VEGADIS 62 display, Power Control Panel, horn waveguide assembly, waveguide piping including standard and repair flanges, and pool end and sensor end mounting brackets. The brackets are considered to be the standard design. Brackets can be provided in shorter cantilever lengths than the tested lengths. The shorter cantilever lengths are inherently more rigid that the tested lengths. Therefore, the seismic test results are considered to be also applicable to brackets with shorter cantilever lengths. Other modifications to the standard design brackets beyond just a shortened cantilever length for specific applications, including longer lengths, will be qualified by analysis. The horn waveguide assembly can be provided in shorter cantilever lengths than the tested assembly. The shorter cantilever lengths are inherently more rigid than the tested lengths. Therefore, the seismic test results are considered to be also applicable to horn waveguide assemblies with shorter cantilever lengths. The tested horn waveguide assembly included a standard flange just above the horn. The supplied horn waveguide assemblies do not include the flange, but are considered to be enveloped by the seismic testing. The supplied horn waveguide assemblies also include a horn cover that was not included in the seismic test. The seismic qualification of the horn cover and seismic effect that the cover impacts to the horn waveguide assembly are covered in AREVA Doc. No. 32-9221237-002, "Qualification for a Waveguide Type "A" Support and Horn End Assembly for AREVA Spent Fuel Pool Level Monitoring Instrumentation" and AREVA Doc. No. 51-9221032-000, "Qualification Analysis for Waveguide Horn Cover". Other modifications to the tested waveguide assembly design including longer cantilever lengths will be qualified by analysis.

As a result of wave formation and sloshing during a seismic event, structures located above the SFP resting surface are subject to hydrodynamic impact and drag loads. The instrument structure will be impacted by a two-phase mixture of air and water. Although rising pool surface is single phase liquid water, the fall back is a two-phase mixture. The Areva Guided Wave instrument, considered rigid for the purpose of load assessment, is expected to be installed with the horn face/cover 5 in. above the resting pool surface.

Hydrodynamic loads on the instrument structure are characterized by an initial impact from a rising flat or oblique pool surface followed by transitional loading as flow establishes around the structure. Impact force has a time varying shape leading to a peak force before flow forms around the impacted structure. For the purpose of evaluating maximum hydrodynamic forces on the instrument, a shape factor is not assigned to characterize the evolution of impact loading since the calculation of interest is for maximum force only.

Following impact loads, the impacted structure is engulfed and flow establishes around the object, leading to static and dynamic drag. A conservative approach combining impact and drag loads

simultaneously is taken although impact and drag forces result from distinct flow regimes occurring sequentially in time. Drag loads are shown to be comparable but less than the initial impact loads although in general this depends upon liquid velocity. The timing of vertical impact loads on the horn cover face will be offset from the timing of loads on the horizontal pipe section that extends over the SFP from the SFP deck. Liquid will impact the horn first followed by a transition to drag loading on the horn. The rising pool surface will then impact the horizontal pipe section. The difference in timing for impact loading on these components is neglected. The maximum impact force on each component is considered to occur at the same time and the forces are simply summed. This is conservative since the sum of forces on each component is greater than the individual forces occurring sequentially.

Drag and impact loads are calculated using liquid velocity, acceleration, and void fraction calculated local to the instrument location. The location for each of the directional velocity components was chosen to provide bounding loads within the tolerance of each installation location. Therefore the calculated loads presented in this report are unique to this location. In other regions of the pool where liquid velocities may be greater, vertical velocity in the pool corners for example, drag and impact loads may be higher.

The NAI site specific sloshing analysis prepared a three dimensional GOTHIC sub-divided model of the SFP and induce the characteristics of a seismic event on the model. A modified version of the GOTHIC 8.0 (QA) code containing adjustable body force terms in the x, y, and z direction momentum conservation equations is used to perform analysis. Artificial time histories developed based on a target response spectrum for the vertical and two horizontal axes are applied simultaneous in the analysis.

The seismic accelerations bound forces applied to the horn, waveguide and electronics supports to above the 2XSSE Criteria for the BDBEE.

RAI #4

For each of the mounting attachments required to attach SFP Level equipment to plant structures, please describe the design inputs, and the methodology that was used to qualify the structural integrity of the affected structures/equipment.

RNP RESPONSE TO RAI #4:

See the responses to RAIs 2 and 3 above.

RAI #5

Please provide the following:

a) **A description of the specific method or combination of methods you intend to apply to demonstrate the reliability of the permanently installed equipment under BDB ambient temperature, humidity, shock, vibration, and radiation conditions.**

b) **A description of the testing and/or analyses that will be conducted to provide assurance that the equipment will perform reliably under the worst-case credible design basis loading at the location where the equipment will be mounted. Include a discussion of this seismic reliability demonstration as it applies to (a) the level sensor mounted in the**

SFP area, and (b) any control boxes, electronics, or read-out and re-transmitting devices that will be employed to convey the level information from the level sensor to the plant operators or emergency responders.

c) A description of the specific method or combination of methods that will be used to confirm the reliability of the permanently installed equipment during and following seismic conditions to maintain its required accuracy.

RNP RESPONSE TO RAI #5:

a) and b)

Engineering Change 89580 Section Z32R0, Attachment AG, "Qualification Analysis of VEGAPULS 62 ER Through Air Radar," states in Section 2.3, 'Temperature and Humidity,' that the postulated temperature and humidity in the spent fuel pool room that results from a boiling pool is 100^{0}C (212^{0}F) with saturated steam. The electronics in the sensor are rated for a maximum continuous duty temperature of 80^{0}C (176^{0}F) on the condition that the process temperature (that which the flange connection is in contact with) is no greater than 130^{0}C (266^{0}F). If a PLICSCOM indicating and adjustment module is mounted on the sensor, the maximum ambient temperature rating is reduced to 70^{0}C (158^{0}F). In either case, the sensor is located away from the spent fuel pool in an area where the temperature is at or below the rated temperature.

The sensor has been tested in accordance with IEC 60068-2-30, "Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12h + 12h cycle)," which varies the temperature from room temperature to elevated temperature at high humidity conditions, to verify that the test item withstands condensation that can occur due to the changing conditions. The sensor has been tested to EN 60529:2000, "Degrees of Protection Provided by Enclosure (IP Code)," to achieve the rating IP66/IP68, which signifies totally dust tight housing, protection against string water jets and waves, and protection against prolonged effects of immersion under 0.2 bar pressure. The VEGADIS 61 indicating and adjustment module and VEGADIS 62 display have housings which are similar to the VEGAPULS 62 ER sensor and are therefore considered to be equally covered by the tests referenced above.

The power control panel internal components are rated for a maximum temperature of at least 70°C (158°F). Allowing for 5°C (9°F) heat rise in the panel, the overall panel maximum ambient temperature for operation is 65°C (149°F). The power control panel enclosure is rated NEMA 4X and provides protection to the internal components from the effects of high humidity environments.

Condensation formation on the inner waveguide pipe walls would require very moist air to enter the pipe at the sensor and travel to a colder area where the air temperature in the pipe would be lowered to the dew point. This is a highly unlikely occurrence given the limited length of waveguide. The horn cover, which blocks airflow through the waveguide pipe, reduces the potential for transfer of warm moist air to a colder area and therefore reduces the potential for condensation forming in the pipe.

In addition, EC 89580 Section Z32R0, Attachment AG, "Qualification Analysis of VEGAPULS 62 ER Through Air Radar," states in Section 2.2, 'Shock and Vibration,' that regarding the VEGAPULS 62 ER Sensor, PLICSCOM, VEGADIS 61 and VEGADIS 62 Displays, that the VEGAPULS 62 ER through air radar sensor is similar in form, fit and function to the VEGAPULS 66 including PLICSCOM indicator that was shock tested in accordance with MIL-S-901D, and vibration tested in accordance with MIL STD 167-1. The test report is contained in

AREVA Doc. 38-9193058-000, "Report of Shock and Vibration Tests on Two (2) 3" Navy Flange Mount Level Indicators and One (1) 3" Triclamp, 1-1/2" Navy Flange Mount Level Indicator for Ohmart/VEGA Corporation Cincinnati, Ohio." Differences in construction are mainly in the smaller size of the VEGAPULS 62 ER. The shape of the housing, its material construction (precision cast stainless steel), the mass and form factor for the electronics modules, the materials and method for mounting the electronics into the sensor housing are the same between the VEGAPULS 66 and the VEGAPULS 62 ER. The end coupling and antennas for VEGAPULS 62 ER are smaller and lighter than for VEGAPULS 66 and therefore less susceptible to shock and vibration. Therefore, the shock and vibration testing is considered to be applicable to the VEGAPULS 62 ER sensor and the PLICSCOM indicator.

The MIL-S-901D test consisted of a total of nine (9) shock blows, three (3) through each of the three (3) principal axes of the sensor, delivered to the anvil plate of the shock machine. The heights of hammer drop for the shock blows in each axis were one (1) foot, three (3) feet and five (5) feet.

The MIL STD 167-1 vibration test procedure applies to equipment found on Navy ships with conventional shafted propeller propulsion. The test frequencies ranged from 4 Hz to 50 Hz with amplitudes ranging from 0.048" at the low frequencies to 0.006" at the higher frequencies. The potential vibration environment around the spent fuel pool and surrounding building structure might contain higher frequencies than were achieved in the testing discussed above. However, in addition to the MIL Standard testing above, the VEGAPULS 62 ER sensor has been shock tested in accordance with EN 60068-2-27 "Basic environmental testing procedures – Part 2:Tests – Test Ea and guidance: Shock", (100g, 6 ms), and vibration tested in accordance with EN 60068-2-6 "Environmental testing - Part 2: Tests - Test Fc: Vibration (sinusoidal)," Method 204 (except 4g, 200 Hz).

The VEGADIS 61 and VEGADIS 62 displays feature housings that are similar in size, materials, and form factor to the VEGAPULS 62 ER sensor, contain a terminal base attached with two screws similar to the electronics module in the VEGAPULS 62 ER, and contain a LCD display module that installs into the housing similar to the PLICSCOM in the VEGAPULS 62 ER. Therefore, these devices are considered to have the same resistance to shock and vibration as the VEGAPULS 62 ER and PLICSCOM.

The power control panel was shock tested per EN 60068-2-27 (10g, 6 ms), and vibration tested per EN 60068-2-6 (2g, 200 Hz). The test results are reported in AREVA Doc. 38-9228047-000, "National Technical System (NTS) Test Report for Spent Fuel Pool Level Instrument (SFPLI) Power Control Panel." The testing included 5 – 200 Hz sweeps in each of three axes, and ten 10g shocks in two directions in each of three axes. Dwell testing was performed at resonant points determined during the frequency sweep. The dwell testing included three 90 minute dwell tests at three frequencies in the x-axis, three 90 minute dwell tests at three resonant frequencies in the y-axis, and four 90 minute dwell tests at four resonant frequencies in the z-axis. The severity of these tests were evidenced by worn insulation of wires in a wiring harness that was located more than a half-inch from the metal object which they vibrated against. This amount of vibration and physical displacement of wiring could not credibly occur in actual installations with the panel rigidly mounted to seismically qualified structures as intended.

Two anomalies occurred during this severe testing. After the last sweep of the Y axis, the batteries had to be removed and reinstalled in the battery holders to obtain the correct voltage output. This is attributed to wear on the battery contact points. In actual installations, battery contact point wear is not credible due to much lower vibration levels that would be encountered

than the tested levels and the requirement placed on the user to replace the batteries at intervals equivalent to once per refueling outage. The second anomaly involved two broken wires to the battery holders that were found at the completion of the vibration test in the final z-axis that required re-soldering. The broken wires occurred as a result of the relative movement of the wiring harness discussed above and the battery holders. This amount of movement could not credibly occur in actual installation when rigidly installed to seismically qualified structures as intended. Based on the above test results and analysis, the power control panel is considered qualified to withstand shock and vibration levels anticipated for SFPLI applications.

Also, EC 89580 Section Z32R0, Attachment AG, states in Section 2.5, Radiation, that the area above and around the pool will be subject to large amounts of radiation in the event that the fuel becomes uncovered. The only parts of the measurement channel in the pool radiation environment are the metallic waveguide, horn, and fused silica glass horn cover which are not susceptible to the expected levels of radiation, and silicone elastomer moisture seal for the horn cover, which has associated radiation test data from the manufacturer. The silicon elastomer seal has been tested for up to 7×10^8 rad, although above 1.6×10^8 rad the elastic modulus began to increase substantially. The silicon elastomer test data demonstrates that the silicon is acceptable for the expected radiation dose for this application.

The electronics are located in an area that is shielded from the direct shine from the fuel, and bounce and scatter effects above the pool. For the purpose of this analysis, the radiation levels in the area do not exceed $1x10^3$ rad.

Table C-1 of USNRC Bulletin 79-01B, "Thermal and Radiation Aging Degradation of Selected Materials," contains a listing of radiation thresholds for various materials. The most susceptible material, and therefore having the lowest threshold, was NMOS electronics with a threshold of $1x10^3$ rad.

For current generation operating reactors, the staff's definition of a mild radiation environment for electronic components, such as semiconductors, or any electronic component containing organic materials as a total integrated dose of less than $1x10^3$ rad.

This is further confirmed in Regulatory Guide 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer – Based Instrumentation and Control Systems in Nuclear Power Plants", which states "ionizing dose radiation hardness levels for MOS IC families range from about 10 gray (Gy) or 1 kilorad (krad) for commercial off-the-shelf (COTS) circuits to about 105 Gy (104 krad) for radiation hardened circuits".

Based on the information in the above references, the electronics in the VEGAPULS 62 ER sensor, displays and power control panel are considered to be qualified for $1x10^3$ rad.

c) EA-12-051 required operating nuclear stations to have reliable indication of the water level in spent fuel pools. The instruments supplying this indication must be qualified to supply the appropriate level fidelity in accident environments, including the effects of shock and vibration due to an earthquake. AREVA NP is qualifying the VEGAPULS 62ER Through Air Radar system as a proposed method for operating stations to meet the above Order requirements. This report documents the test results of qualification test procedure 172-9211123-001 to seismically qualify the VEGAPULS 62ER system.

The test program seismically tested the specimens to levels that enveloped the Required Response Spectra (RRS). The test sequence was as follows:

- Baseline Functional Testing
- Resonance Search

- Seismic Testing (OBEs and SSE)
- Post-Seismic Functional Testing
- Post-Seismic Inspection

The seismic testing and associated qualification documentation were performed in accordance with IEEE 344-2004.

The seismic test input that produced the test response spectra (TRS) enveloped the RRS with exceptions as allowed and noted. The required curves operating basis earthquake (OBE) and safe shutdown earthquake (SSE) tests are shown in the table's displacement limitations.

During testing deviations to the plan were allowed with documented concurrence from the customer. These deviations are reported as anomalies in this report.

Anomalies OBE Testing

Five (5) OBE tests were performed to TRS levels that enveloped the OBE RRS levels. Each test consisted of 30 seconds in duration in the three orthogonal axes. The shaker table motion was in accordance with the RRS/TRS and the defined requirements. During the first attempt at the five OBE sequence, a component failure occurred at TS-13 and TS-14 during OBE 4, near the flange. The VEGAPULS equipment was repaired and an additional stanchion was added approximately 6.25 feet from the foil end stanchion to further support the equipment.

The five OBE tests were performed again to TRS levels that enveloped the OBE RRS. Each test consisted of 30 seconds in duration in the three orthogonal axes. The shaker table motion was in accordance with the RRS/TRS and the defined requirements. Similar to the first sequence, a component failure occurred at TS-4 during OBE 4. The VEGAPULS equipment was repaired (re-welded using a seal weld similar to the original weld).

The five OBE tests were performed again to TRS levels that enveloped the OBE RRS. Each test consisted of 30 seconds in duration in the three orthogonal axes. The shaker table motion was in accordance with the RRS/TRS and the defined requirements. The test specimen passed this test with no component failures.

Anomalies SSE Testing

One (1) SSE test was performed to TRS levels that enveloped the SSE levels. (where the displacement limitations were allowed (IEEE 344-2004 Section 8.6.3) frequencies that fell below the RRS were less than 10% non-adjacent and below the cutoff SSE frequency are acceptable) The test consisted of a 30 second duration shake in the three orthogonal axes. The shaker table motion was in accordance with the RRS/TRS and the defined requirements. The test specimen did not pass the SSE post-test visual inspection as a bolt sheared TS-4.

SUMMARY

The test specimen failed the Post-Seismic visual inspection test following the first and second OBE test sequences prior to passing the third. Subsequently, the test specimen failed the Post-Seismic visual inspection test following the SSE test with a broken bolt head. The bolt did not impair equipment function that was tested in the post seismic functional test.

While the equipment did not pass the post-resonance search and post-seismic testing distance reading acceptance criteria, the equipment performance was within ±3.0 inches. As the acceptance criterion was arbitrarily chosen, the equipment is considered operable for accident conditions; including seismic events.

In addition, the NRC staff plans to verify the results of the licensee's testing and analysis used to demonstrate the qualification and reliability of the installed equipment when it is completed based on the licensee's response to the following RAI.

RAI #6

For RAI #5 above, please provide the results for the selected methods, tests and analyses used to demonstrate the qualification and reliability of the installed equipment in accordance with the Order requirements.

RNP RESPONSE TO RAI #6:

See the response to RAI # 5 above.

RAI #7

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 precluded.**

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 location(s) of the readout devices, and the independence of the displays.**

RNP RESPONSE TO RAI #7:

a) Both channels of level indication will be permanently installed. Normal power to each channel will be from different lighting panels, these lighting panels are supplied from different buses. Additionally, each of these channels is designed with separate battery backup power therefore, independence of electrical power is met.

b) The power supply for the separate channels is discussed above. All conduit and cable of each channel have been arranged to maximize separation to the extent practical and consistent with the separation criteria of safety-related equipment. The power control panels , sensors and local indicators are separated by adequate distance to ensure damage to both channels by a common hazard is minimal. The equipment installed at the Spent Fuel Pool has been designed to be the maximum practical distance apart based on the construction of the pool.

The technologies utilized for both channels is the same; however, the guidance does not require them to be different. Utilization of common equipment provides the ability to cross connect equipment after a beyond design basis event if needed.

RAI #8

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.

RNP RESPONSE TO RAI #8:

Vendor analyses supports the battery capacity (at 20mA continuous discharge) can support ~130 hours and ~230 hours at -22°F and 32°F, respectively.

The calculated battery backup times above demonstrate that the backup battery has sufficient capacity to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies in response to Order EA-12-049.

The required battery back-up capacity duration will further be demonstrated during post-modification testing.

RAI#9

Please provide the following:

a) **An estimate of the expected instrument channel accuracy performance under both (a) normal SFP level conditions (approximately Level 1 or higher) and (b) at the BDB conditions (i.e., radiation, temperature, humidity, 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.**

RNP RESPONSE TO RAI #9:

a) A Factory Acceptance Test was performed by AREVA the accuracy of the system considering overall error due to all effects is ± 3 inches. AREVA document 51-9228351-000 (EC 89580 Attachment AU pages 18-76) contains the completed test report. This test verified the system is capable of performance within the specified accuracy listed in the AREVA Instruction Manual 01-9228622-000 (EC 89580 Attachment AA page 30) under normal operating conditions.

   AREVA Seismic Test Report 174-9213558-006 (EC 89580 Attachment AY) was performed to ensure the system is capable of performance within the specified accuracy following a BDB seismic event. The conclusion of that report was the system performance was within the accuracy listed in the AREVA Instruction Manual 01-9228622-000 (EC 89580 Attachment AA page 30).

b) A channel check will be added to Operations procedure OST-023 to ensure both channels are functional. OST-023 is performed on a monthly frequency.

Based on the wiring and installation sketches each channel may be taken out of service for maintenance and channel check without affecting the other channel. A new channel check procedure is being created for the new Spent Fuel Pool level indication. This maintenance procedure will perform a channel check of the sensors and a calibration check of the instrument loop components.

RAI #10

Please provide the following:

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

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

c) A description of how functional checks will be performed, and the frequency at which they will be conducted. Describe how calibration tests will be performed, and the frequency at which they will be conducted. Provide a discussion 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.

RNP RESPONSE TO RAI #10:

a) The sensing equipment is not in contact with the SFP water. It does not interface with other SSC which would prevent in-situ channel checks. Each channel can be read in the control room or locally. The local instrument provides calibration/setup connections. Each channel will be functionally checked on a periodic bases aligned with the Guidance of NEI 12-02.

b) Operations procedures will direct periodic verification of each level channel with each other and compared to the local level indicator at the pool.

c) Functional checks will be performed on a periodic bases per Operation procedures to verify each channel is reading normal water level correctly. Also, maintenance functional checks will be conducted, which will align with the suggested frequency of NEI 12-02. These procedures are being developed for incorporation into the maintenance procedures program.

d) Battery replacement will occur during functional checks which will be conducted on a frequency aligned with NEI 12-02. Also, Operations will periodically verify correct level readings for each channel.

RAI #11

Please provide the following:

a) The specific location for the primary and backup instrument channel display.

b) For any SFP instrumentation display located outside the main control room, please describe the evaluation used to validate that the display location can be accessed without unreasonable delay following a BDB event. Include the time available for personnel to access the display as credited in the evaluation, as well as the actual time (e.g., based on walk-throughs) that it will take for personnel to access the display. Additionally, please include a description of the radiological and environmental conditions on the paths personnel might take. Describe whether the display location remains habitable for radiological, heat and humidity, and other environmental conditions following a BDB event. Describe whether personnel are continuously stationed at the display or monitor the display periodically.

RNP RESPONSE TO RAI #11:

a) Both channels of Spent Fuel Pool Level will be indicated in the Control Room. Also, both channels will provide indication at the Power Control Panels. Both the Control Room and remote indicators fully meet the requirements of the NEI 12-02 guidance; therefore, neither is considered a backup or alternate. Section 3.9 of NEI 12-02 states if multiple displays are desired they shall not affect the "primary" display. In the case of the installation at RNP, both displays are considered the "primary" display and can fully meet the requirements; therefore, this statement does not apply to RNP.

b) Since an indicator that fully complies with the NEI requirements is located in the Robinson Control Room, this RAI is not applicable.

RAI #12

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

RNP RESPONSE TO RAI #12:

In concert with the engineering change process, the planned station procedures include the following:

- FLEX Support Guideline (FSG) procedures will provide operators with directions on the monitoring of level following a BDB event.

- Operations surveillance procedure will periodically verify proper operation of both channels of SFP level instrumentation. The procedure will perform periodic channel checks or comparisons between available SFP level instrumentation to verify proper operation of the primary and backup SFP level instrumentation. The procedure is intended to provide a means of detection of channel drift and/or malfunction.

- Maintenance procedures will provide periodic checks of both channels of SFP level instrumentation and functional check battery back-up capability. The procedure(s) will verify proper operation of the level instrumentation, and provide instruction for equipment channel check within design accuracy requirements. This procedure will also serve to verify proper channel functionality within 60 days of a planned refueling outage, as required by NEI 12-02. These procedures are being developed for incorporation into the maintenance procedures program.

RAI #13

Please provide the following:

a) Further information describing the maintenance and testing program the licensee will establish and implement to ensure that regular testing and calibration is performed and verified by inspection and audit to demonstrate conformance with design and system readiness requirements. Include a description of your plans for ensuring that necessary channel checks, functional tests, periodic calibration, and maintenance will be conducted for the level measurement system and its supporting equipment.

b) A description of how the guidance in NEI12-02 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 the non-functioning instrument channel cannot be restored to functional status within 90 days.

RNP RESPONSE TO RAI#13:

a) Channel Checks will be performed by Operations Procedure OST-023 on a periodic basis. A Maintenance Procedure is being created for the new instrumentation. This procedure will most likely include replacement of batteries and a functional check of the sensors.

b) and c)

Spent Fuel Pool Level Indication will be included in the Technical Requirements Manual. That procedure will control compensatory actions in regards to non-functional channels of level indication.

SAFETY EVALUATION (SE) REVIEW ITEM #7E

How have EFI/RMI effects on the SFPLI been evaluated?

RNP RESPONSE TO SE REVIEW ITEM #7E

The qualification of EMI/RFI standards has been met per the AREVA Qualification Analysis, AREVA Document 51-9202556-005 and covered in the EC 89580 Design. Excerpts from these documents have been provided in the ePortal in the Supporting Documents Folder.

ENCLOSURE 3

DUKE ENERGY'S

DESIGN BRIDGE FOR SPENT FUEL POOL INSTRUMENTATION

TO SATISFY NRC ORDER EA-12-051

FOR

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

GENERIC DESIGN INFORMATION TEMPLATE FOR RNP

#	Topic	Parameter Summary	Vendor Design Reference Document #	Additional Comments	Test or Analysis Results	Licensee Evaluation
1	Design Specification	Customer technical requirements specification for SFPLI	EC 89580, Attachment D - NCP-Z-0006, Rev. 0 - SFP Wide Range Level Instrumentation Remote Level Sensors.pdf	EA-12-051, NEI-12-02	N/A	The vendor instrumentation design was reviewed and determined to adequately meet the specification requirements.
2	Test Strategy	Qualification is based on a combination of tests and analyses or similarity as described below. Qualification tests and analyses are summarized in qualification analyses report 51-9202556-005.	Qualification analyses Doc. 51-9202556-005 32-9221237-003_Calc_Qualification for a Waveguide Support and Horn End Assembly	EA-12-051, 1.4 NEI-12-02, 3.4	Test and analyses results meet requirements of EA 21-051, JLD-ISG-2012-03, and NEI 12-02 Rev. 1-	The vendor qualification documentation was reviewed and concluded to adequately demonstrate the instrumentation could reliably function in its installed environment(s) during a postulated Beyond Design Bases External Event (BDBEE).
3	Environmental qualification for electronics enclosure with display	Temperature, humidity and dose	Qualification Analyses Doc. 51-9202556-005 Section 2.3	NEI 12-02, 3.4	Temperature rating of Power Control Panel 149°F allowing for 9°F rise above ambient. NEMA 4X enclosure prevents moisture intrusion. Radiation withstand analyzed to $1x10^3$ Rads	The primary channel instrumentation electronics are located outside the SFP area. The vendor instrumentation design temperature, humidity, and dose limits bound the expected environmental conditions during a postulated BDBEE.
4	Environmental testing for level sensor *components* in SFP area – Saturated steam & radiation	Measurement capability through saturated steam and smoke. Testing performed to demonstrate the radar horn cover was effective at preventing moisture intrusion within the horn and wave guide pipe. Radar horn cover (fused silica glass), metal waveguide pipe and horn are not susceptible to radiation degradation. Manufacturer test data supports acceptable radiation degradation resistance for the radar horn cover adhesive.	Qualification Analyses Doc. 51-9202556-005, Section 2.3, 2.4, 2.5, 2.7, Appendix B and supporting references 66-9200846-002 51-9220845-001 51-9221032-000 66-9225632-000	EA-12-051, 1.4 NEI 12-02, 3.4	Initial testing (without horn cover) demonstrated successful measurement capability through steam and smoke. Subsequent testing of the radar horn and cover demonstrated adequate operation during sustained simulated SFP boiling conditions, and that the horn cover was effective in preventing moisture intrusion within the horn and wave guide pipe. The horn cover adhesive is a silicone elastomer manufactured by Down Corning (Sylgard 170). The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to $1.64 x10^8$ Rads.	The radar horn cover qualification testing adequately demonstrated acceptable operation during exposure to simulated SFP boiling conditions. The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time.
5	Environmental testing for level sensor electronics housing – outside SFP	Temperature and humidity testing and analysis of sensor and indication	Qualification Analyses Doc. 51-9202556-005, Sections 2.3, 2.5, Appendix A and supporting references 38-9218218-000, 38-9218214-000, USNRC Bulletin 79-01B Table C-1, Reg. Guide 1.209	NEI 12-02, 3.4	Sensor and indication are demonstrated to withstand the manufacturer ratings 80°C (sensor) and 70°C (indication), 100% RH. Radiation withstand analyzed to $1x10^3$ Rads.	The level sensor electronic housing are located outside the SFP area. The vendor instrumentation design temperature, humidity, and dose limits bound the expected environmental conditions during a postulated BDBEE.

#	Topic	Parameter Summary	Vendor Design Reference Document #	Additional Comments	Test or Analysis Results	Licensee Evaluation
6	Thermal & Radiation Aging – organic components in SFP area	Radar horn cover (fused silica glass), metal waveguide pipe and horn are not susceptible to radiation degradation. Horn cover adhesive manufacturer radiation test data and temperature withstand specifications.	Qualification analyses Doc. 51-9202556-005, Section 2.5 51-9221032-000 66-9225632-000	EA-12-051, 1.4 NEI 12-02, 3.4	Thermal and radiation aging not applicable to metal waveguide in SFP area. The horn cover adhesive is a silicone elastomer manufactured by Down Corning (Sylgard 170). The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to 1.64 x10^8 Rads. The silicone adhesive is rated to withstand temperatures extremes of -45 to 200°C, which adequately bound the postulated temperatures for sustained SFP boiling conditions.	The glass and metallic instrumentation components located within the SFP area are not susceptible to aging due to thermal and/or radiation effects. The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time. The horn cover adhesive temperature ratings are acceptable and readily bound the expected conditions for the postulated beyond design bases event.
7	Basis for Dose Requirement	SFPLI remote transmitter and power control panel qualified to 1x10^3 Rads based on industry operating experience. Based on engineering judgment, the expected total integrated dose for the radar horn cover adhesive would not exceed 1 x10^8 Rads over the required mission time for the instrumentation.	AREVA Document No. 51-9202556-005, Qualification Analysis of VEGAPULS 62 ER Through Air Radar 51-9221032-000 66-9225632-000	NEI 12-02, 3.4	Analyses based on operating experience concludes the electronics are not susceptible to degraded performance up to this dose threshold. The adhesive manufacturer radiation test data adequately demonstrates the adhesive would not experience unacceptable degradation for exposures up to 1.64 x10^8 Rads.	A location specific dose calculation was performed for the remote electronics, which demonstrated the sensor total integrated dose (TID) over its required mission time is enveloped by the vendor instrumentation design limit of 1x10^3 Rads. The horn cover adhesive manufacturer radiation test data adequately demonstrated the adhesive would not experience unacceptable degradation for radiation exposure in excess of that expected for the postulated beyond design bases event over the required mission time.
8	Seismic Qualification	Seismic withstand capability of VEGAPULS 62 ER sensor , indicators, power control panel, mounting brackets, waveguide pipe	Qualification analyses Doc. 51-9202556-005, Section 2.1, Appendix D and supporting references 11-9203036-000, 174-9213558-006	NEI 1-02, 3.4	VEGAPULS 62 ER sensor , indicators, power control panel, mounting brackets, waveguide pipe are seismically qualified to RRS levels from EPRI TR-107330	The vendor instrumentation seismic testing adequately demonstrates the equipment is capable of reliably operating during a seismic event.
9	Sloshing	NRC RAIs indicated a SFP seismic induced sloshing analyses is required. If wave impact is predicted, then the hydrodynamic forces should be included in the mounting design loading combinations.	Allowable seismic combined with hydrodynamic loading that the horn mounting can withstand is analyzed in 32-9221237-003. Predicted loading from impact and drag due to slosh is calculated in Attachment BH - 32-9221237-003_Calc_Qualification for a Waveguide Support and Horn End Assembly. verification and sensitivity study to predict slosh phenomena is evaluated in Attachment AW, NAI-1809-004 Hydraulic Response Calc.	N/A	Seismic induced sloshing analyses concluded that wave impact on the horn end assembly is predicted and the expected combined hydrodynamic and seismic forces are less than the allowable hydrodynamic and seismic forces.	The vendor horn end mounting can withstand the expected seismic and hydrodynamic loading caused by sloshing during a postulated BDBEE.

10	Spent Fuel Pool instrumentation system functionality test procedure	Functionality testing was performed during the factory acceptance test. See #16	AREVA Doc. 51-9228351-000, "Through Air Radar Spent Fuel Pool Level Instrument (SFPLI) Factory Acceptance Test (FAT) Report for H.B. Robinson"	N/A	Testing demonstrated that the SFPLI met the specification functional requirements.	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g. steam exposure). The testing demonstrated the instrumentation met design accuracy and repeatability specifications.
11	Boron Build-Up	Not applicable to Robinson	N/A	N/A	N/A	N/A
12	Pool-side Bracket Seismic Analysis	Test and analyses were performed for the horn cover and adhesive to demonstrate adequate seismic withstand capability. Perform seismic induced sloshing analyses to assess hydrodynamic wave force on the radar horn.	Qualification analyses Doc. 51-9202556-005 and supporting reference 174-9213558-006, Calculations 32-9208751-002, 32-9221237-003 51-9221032-000 66-9225632-000 66-9225469-000 Sloshing analyses was performed by an alternate vendor than the vendor whom supplied the radar level instrumentation Predicted loading from impact and drag due to slosh is calculated in Attachment AW - NAI-1809-004 Hydraulic Response Calc	NEI 12-02, 3.4	Waveguide horns including the mounting are seismically qualified to EPRI TR-107330 or site-specific RRS. Testing and analyses horn cover and adhesive support the components can tolerate horizontal and vertical accelerations up to 100g and SFP sloshing loads up to 3.37 psi. Seismic induced sloshing analyses concluded that wave impact on the horn end assembly is predicted and the expected combined hydrodynamic and seismic forces are less than the allowable hydrodynamic and seismic forces.	The test and analyses of the horn cover and adhesive demonstrate adequate seismic withstand capability. The vendor horn end assembly including the mounting can withstand the expected seismic and hydrodynamic loading caused by sloshing during a postulated BDBEE.
13	Additional Brackets (Sensor Electronics and Electronic Enclosure)	Seismic withstand of sensor brackets and electronic enclosure mounting	Qualification analyses Doc. 51-9202556-005, Section 2.1, Appendix D and supporting references 11-9203036-002, EPRI TR-107330, 174-9213558-006 Calculations 32-9208751-002, 32-9221237-003 32-9221971-000 CPL-HBR2-S-001, Rev. 10, "Specifications for standard supports"	NEI 12-02, 3.4	Sensor brackets and electronic enclosure mounting are seismically qualified to EPRI TR-107330 or site-specific RRS.	Sensor brackets and electronic enclosure are qualified analytically and by seismic testing to adequately demonstrates the equipment is capable of reliably operating after a seismic event.

14	Shock & Vibration	Shock and vibration withstand testing and analyses for sensor, displays, power control panel Test and analyses were performed for the horn cover and adhesive to demonstrate adequate shock withstand. Additional testing was performed for the power control panel assembly.	Qualification Analysis Doc. 51-9202556-005, Sections 2.2 and supporting references MIL-S-901D, MIL-STD-167-1 38-9193058-000, EN 60068-2-27, 38-9218022-000, EN 60068-2-6, 38-9218023-000, 51-9221032-000 66-9225632-000 32-9221237-003 66-9225469-000 38-9228047-000	NEI 12-02, 3.4	Sensor, displays, and power control panel have been tested and/or analyzed for shock and vibration. The test parameter values provided in IEC Standards, IEC 60068-2-6 (vibration) and IEC 60068-2-27 (shock), tables are recommendations and not mandatory testing levels. The test parameter values were selected to be consistent with previous shock and vibration testing performed on the VEGA supplied equipment. The test parameter values specified envelope the expected levels for the equipment installed location, due to the fact that the equipment is mounted to seismic structures within the plant. This approach is consistent with similar technology used in the same application at other installations. The vibration testing deviated from the IEC 60068-2-6 recommended frequency range and displacement magnitude for large power plant equipment (TABLE C.2). In-lieu of the 10-55 Hz and minimum displacement of 0.15 mm recommended in TABLE C.2, the power and control panel vibration testing utilized a narrower frequency band (5-25 Hz) and a more limiting displacement magnitude (1.6 mm). These values were deemed to be acceptable and enveloping for equipment rigidly mounted to a Seismic Category I structure, based on engineering judgment. The shock testing deviated from the IEC 60068-2-27 recommended peak acceleration and duration for land-based permanently installed equipment. In-lieu of the 15 g's peak acceleration and duration of 11 m-sec recommended in TABLE A.1, the power and control panel vibration testing utilized and acceleration of 10g with a 6 m-sec duration. These values were deemed to be acceptable and enveloping for equipment rigidly mounted to a seismic Category I structure, based on engineering judgment. Testing and analyses horn cover and adhesive support the components can tolerate horizontal and vertical accelerations up to 100g and SFP sloshing loads up to 3.37 psi.	The shock and vibration testing performed for the SFP level instrumentation adequately demonstrates the sensor and power control panel will be reliable in the installed design location. Seismic Qualification of the VEGAPULS 62 ER system, including the Power Control Panels and VEGADIS 62 display is summarized in the Seismic Test Report. The system was qualified to an Areva supplied OBE and SSE earthquake which bounds site SSE. A seismic technical review of the vendor qualification report per AD-EG-ALL-1126 Attachment 3 was performed. The report also contains a discussion of environmental qualification of the system in addition to seismic loading. Control Room Indicators are International Instruments which have been used in Control Rooms for years in Safety-Related application.. The post modification testing will demonstrate reliable operation of the instrumentation, which confirms no damage occurred during shipping, handling and installation. Similarly, the performance of monthly channel functional comparisons will serve to confirm proper operation of the instrumentation, or provide a means of early detection of potential instrument degradation. The test and analyses of the horn cover and adhesive demonstrate adequate capability to withstand shock and vibration.

15	Requirements Traceability	Not required by order	N/A	N/A	N/A	N/A
16	Factory Acceptance Test	Inspection of waveguide, test of functionality of power transfer to battery, sensor measurement accuracy and effects of steam and water in waveguide	AREVA Doc. 51-9228351-000, "Through Air Radar Spent Fuel Pool Level Instrument (SFPLI) Factory Acceptance Test (FAT) Report for H.B. Robinson"	N/A	Test demonstrates that specification requirements were met.	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g. steam exposure). The testing demonstrated the instrumentation met design accuracy and repeatability specifications.
17	Channel Accuracy	Normal and accident conditions SFP level measurement accuracy	EC 89580 Attachment AA - 01-9228622-002_Robinson Instruction Manual	EA-12-051, 1.7 NEI 12-02, 3.7	Normal conditions accuracy ±1 inch, error due to all effects including 212°F saturated steam ±3 inches. Accuracy verified during factory acceptance testing.	The vendor factory acceptance test demonstrated reliable operation of the SFP level instrumentation under normal conditions and under various simulated test conditions (e.g. steam exposure). The testing demonstrated the instrumentation met design accuracy and repeatability specifications.
18	Power Consumption	Lifetime of battery backup at full load	Qualification Analysis Doc. 51-9202556-005, Section 2.9, EC 89580 Attachment AA - 01-9228622-002_Robinson Instruction Manual Section 12	EA-12-051, 1.6, NEI 12-02, 3.6	Battery capacity at full load is expected to easily exceed 72 hours.	Based on vendor analyses the battery capacity is deemed sufficient to support reliable instrument channel operation until off-site resources can be deployed by the mitigating strategies in response to Order EA-12-049.
19	Technical Manual	Application-specific information on the installation, operation, and maintenance of the SFPLI	Attachment AA - 01-9228622-002_Robinson Instruction Manual	N/A	N/A	The vendor technical manual has been reviewed, accepted and incorporated in the engineering change package.
20	Calibration	Periodic indication checks, calibration checks, calibration	Attachment AA - 01-9228622-002_Robinson Instruction Manual Sections 7.0 and 9.1	EA-12-051, 1.8 NEI 12-02, 3.8 Based on negligible drift rate of VEGA electronics experienced over large user base, periodic calibration is not needed. Functional verification can be achieved using cross channel checks and functional checks per vendor manual.	N/A	The vendor technical manual has been reviewed, accepted and incorporated in the engineering change package.

21	Failure Modes and Effects Analysis (FMEA)	N/A	N/A	N/A	N/A	The instrumentation is required to function to provide SFP level indication for a beyond design bases event. Performance of a FMEA is not warranted for this type of an application. Reasonable assurance that both channels are not susceptible to a common mode failure is provided by satisfying the NEI 12-02 guidance.
22	EMI Testing	Emissions and susceptibility testing for VEGAPULS 62 ER	Qualification Analysis Doc. 51-9202556-005, Section 2.6 and supporting references 58-9214362-000, 38-9218963-000, 38-9218965-000, 38-9218966-000, 38-9218962-000, 38-9218967-000, 38-9218968-000, 38-9218969-000, 38-9218970-000, 38-9218964-000	N/A	VEGAPULS 62 ER has been tested for emissions to both MIL and IEC standards and for susceptibility to IEC standards	The EMI/RFI susceptibility and emissions testing performed for the waveguide radar transmitter provides adequate assurance the instrumentation will be compatible in the design location. The testing was conservatively performed with unshielded interconnecting wiring. Post-modification testing will further demonstrate acceptable operation in the installed location. During a postulated BDBEE, it is possible that intermittent UHF radio operation could occur in the vicinity of the radar transmitter. Successful long-term SFP monitoring capability during a postulated BDBEE would not be inhibited by potential intermittent radio transmission interference.