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A SCANA COMPANY

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RC-14-0173

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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
SOUTH CAROLINA ELECTRIC & GAS COMPANY'S RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION – OVERALL INTEGRATED PLAN IN REPONSE TO COMMISSION ORDER MODIFYING LICENSE REQUIREMENTS FOR RELIABLE SPENT FUEL POOL INSTRUMENTATION (Order No. EA-12-051)

References:
1. SCE&G's Overall Integrated Plan in Response to March 12, 2012 Commission Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051), dated February 28, 2013. RC-13-0031

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

3. NRC Request for Additional Information - Overall Integrated Plan in Response to the Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation (Order No. EA-12-051), dated December 5, 2013

In Reference 1, South Carolina Electric & Gas Company (SCE&G) provided the Virgil C. Summer Nuclear Station Unit 1 (VCSNS), Overall Integrated Plan in Response to the March 12, 2012 Commission Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation, pursuant to NRC Order No. EA-12-051 (Reference 2).

The purpose of this letter is to provide the response to the NRC request for additional information (Reference 3) regarding the VCSNS Overall Integrated Plan in (Reference 1).

This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Mr. Bruce L. Thompson at (803) 931-5042.

A001
NRR

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

10/29/14
Executed on

Thomas D. Gatlin

BJD/TDG/ts

Attachments (3):
1. Virgil C. Summer Nuclear Station Unit 1 - Response to Request for Additional Information - Overall Integrated Plan in Response to Commission Order Modifying License Requirements for Reliable Spent Fuel Pool Instrumentation (Order No. EA-12-051)
2. Figure 1 Vega Waveguide Isometric (Northwest) Backup Channel
3. Figure 2 Vega Waveguide Isometric (Southwest) Primary Channel

c: Without attachments unless noted
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VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1

ATTACHMENT I

Virgil C. Summer Nuclear Station Unit 1 - Response to Request for Additional Information - Overall Integrated Plan in Response to Commission Order Modifying License Requirements for Reliable Spent Fuel Pool Instrumentation (Order No. EA-12-051)

1.0 INTRODUCTION

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued Order EA-12-051, "Issuance of Order to Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12054A679), to all power reactor licensees and holders of construction permits in active or deferred status. This Order requires, in part, that all operating reactor sites have a reliable means of remotely monitoring wide-range Spent Fuel Pool (SFP) levels to support effective prioritization of event mitigation and recovery actions in the event of a Beyond-Design-Basis (BDB) external event. The Order required all holders of operating licenses issued under Title 10 of the *Code* of *Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," to submit to the NRC an Overall Integrated Plan (OIP) by February 28, 2013.

By letter dated February 28, 2013 (ADAMS Accession No. ML13063A099), South Carolina Electric & Gas Company (SCE&G) (the licensee) provided the OIP for Virgil C. Summer Nuclear Station (VCSNS) Unit 1, describing how it will achieve compliance with Attachment 2 of Order EA-12-051 by fall, 2015. By letter dated July 29, 2013 (ADAMS Accession No. ML 13203A 180), the NRC staff sent a request for additional information (RAI) to the licensee. The licensee provided supplemental information by letters dated August 28, 2013 (ADAMS Accession No. ML13247A338), August 28, 2013 (ADAMS Accession No. ML13242A272), and August 30, 2013 (ADAMS Accession No. ML13247A339).

The below provides the latest responses to the NRC request for additional information dated December 5, 2013 regarding the VCSNS Overall Integrated Plan.

RAI #1

Please provide additional information describing how the design of shielding for the SFP level instrumentation meets the requirement of the Order to arrange the instruments in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP. Also, describe plans for protecting any equipment mounted outside the buildings from the effects of tornado-driven missiles, freezing, elevated temperature, humidity, flooding, and other BDB conditions.

RAI #1 Response

The primary and backup trains of level instrumentation are mounted in the southwest and northwest corners of the Spent Fuel Pool respectively, providing separation by the distance of the width of the spent fuel pool. The primary channel, horn and waveguide pipe are located and mounted in the southwest corner of the spent fuel pool (463 ft elevation). The primary waveguide pipe is routed due west into the north stairwell of the Auxiliary Building, where the remote transmitter is located. The power control panel, auxiliary battery panel, and display for the primary channel are located due south of the remote transmitter and will be mounted on a column due south of the Auxiliary Building Lift.

Per VCS Technical Report, TR00080-003, the maximum temperature in the north Auxiliary Building stairwell is 150 degrees Fahrenheit. This will provide a 26 degree Fahrenheit margin over its rated temperature for the remote transmitter. Also in VCS Technical Report TR00080-003, the maximum temperature range south of the Auxiliary Building Lift to be between 105-115 degrees Fahrenheit. The minimum rating for any equipment being installed in this area is 158 degrees Fahrenheit (VEGADIS 61 Indication and Adjustment Unit), Areva Document 01-9225772-00, "Through Air Radar Spent Fuel Pool Level Instrument (SFPLI) Instruction Manual for V.C. Summer".

The backup level channel horn and waveguide pipe are mounted in the northwest corner of the spent fuel pool (463 feet elevation). The backup waveguide pipe is routed northwest through the west wall of the Fuel Handling Building. The backup waveguide pipe is routed down along the outside wall of the Fuel Handling Building and the remote transmitter is mounted on the (458 ft - 9 in Elevation). The remote transmitter has been tested in accordance with IEC60068-2-30, Areva Document 51-9202556-004, "Qualification Analysis of VEGAPULS 62 ER Through Air Radar", for temperature and humidity. The backup power control unit, auxiliary battery panel, and display will be mounted roughly 5 feet from the ground elevation of 436 feet, which is above the sites' flood elevation of 437 ft - 8 in (VCS Calculation DC00080-002).

Per VCS Calculation DC00080-002, the maximum design temperature for components located outdoors is 107 degrees Fahrenheit for high temperature and negative 2 degrees Fahrenheit for a low temperature. Per the Vendor Maintenance Manual, the limiting minimum rated maximum temperature for the outside components is 158 degrees Fahrenheit (VEGADIS 61 Indication and Adjustment Unit), Areva Document 01-9225772-00, "Through Air Radar Spent Fuel Pool Level Instrument (SFPLI) Instruction Manual for V.C. Summer". The VEGADIS 61's temperature rating is negative 4 degrees Fahrenheit, which is below our site's minimum temperature requirement. However, the minimum temperature rating is limited by the PLICSCOM which is housed within the unit. The only time the PLICSCOM is needed is when the sensor needs to be configured. The storage temperature rating for the PLISCOM is negative 40 degrees Fahrenheit; therefore it is reasonable to assume that the sensor would function at negative 2 degrees Fahrenheit. It is reasonable to assume that all components mounted outside will be able to survive and function as designed during site-specific freezing conditions.

By utilizing separation and building designs of the Fuel Handling Building and Auxiliary Buildings, per the guidance found in NEI 12-02, Revision 1, Section 3.2, this arrangement meets

the intent to specify reasonable separation and missile protection requirements for permanently installed instrumentation used to meet this order.

The only parts of the primary and backup trains of level instrumentation that will be in the environment of 212 degrees Fahrenheit and 100 percent humidity (Section 3.4 of NEI 12-02, Revision 1) are the waveguide horn and portions of the waveguide pipe. These items are made of stainless steel and will be able to function normally in these environments. All other equipment will be mounted in areas where these conditions do not exist.

RAI #2

Please provide the following:

a) **The design criteria to be used to estimate the total loading on the mounting device(s), including static weight loads and dynamic loads. Describe the methodology to 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 sensing/waveguide assembly. Indicate in a schematic the portions of the level sensor/waveguide 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 wall or floor structures so as to support the waveguide/level sensor assembly.**

RAI #2 Response

a) The potential spent fuel pool sloshing effects due to a postulated seismic event is being evaluated by VCS for the primary and backup channels. Applicable hydrodynamic wave impact forces will be included in the radar horn/pipe qualification and mounting load combinations.

The primary and backup channels consisting of the remote transmitter, horn, and waveguide piping will be mounted seismically. The mounting designs for the remote transmitter support and horn support were qualified considering the total weight of the waveguide piping and its components and the seismic accelerations for the building structure. To meet the design criteria for a Beyond Design Basis (BDB) event, the loading for the mounting supports will be generated considering beyond design basis seismic accelerations.

The remote transmitter mounting support is qualified by a generic calculation using a simple C-channel steel section that is welded centrally on a steel base plate mounted on

the outside west wall of the Fuel Handling Building (primary) and the east wall of the north Auxiliary Building stairwell (backup). The generic sensor mounting support was designed for generic enveloping seismic accelerations of 10g (horizontal) and 6.67g (vertical), which envelope the site seismic response spectra. The calculation further assumed an enveloping sensor cantilevered length.

However, considering this qualification uses conservative generic accelerations compared to the site design basis seismic accelerations, the design seismic accelerations being used are expected to be less than the generic accelerations but greater than the design basis seismic accelerations. A conservative percentage of the generic accelerations will be used for the anchorage of the remote transmitter mounting. It is expected that this reduction will still be greater than the beyond design basis seismic accelerations considered. VCS is currently in the process of developing this final site-specific analysis. When this information becomes available it will be provided in a 6-month status update.

The horn mounting support will be qualified similarly to the remote transmitter support. It will be qualified by a site-specific calculation using a simple C-channel steel section with base plate on the concrete operating deck floor in the spent fuel pool area. The generic design of the horn mounting support conservatively uses generic seismic accelerations of 10g (horizontal) and 6.67g (vertical). A visual representation of the pool edge mounting configuration for the radar horn is shown in the attached, Figure 1 and Figure 2. It also provides the mounting configuration.

All of the mounting supports for the waveguide piping are attached to either the outside west wall of the Fuel Handling Building, the 463 foot elevation of the Fuel Handling Building floor, or the east wall of the north Auxiliary Building stairwell.

The mounting design for the power control panels and auxiliary battery panels are qualified considering the total weight of the panel and its associated components and the seismic accelerations for the building structure. To meet this design criterion for a BDB event, the loading for the panels will be generated considering beyond design basis seismic accelerations.

b) & c) The waveguide piping assembly, horn, and remote transmitter are designed to attach to the spent fuel pool concrete floor, outside west wall of the Fuel Handling Building, and east wall of the north Auxiliary Building stairwell by means of mounting supports. These mounting supports consist of sensor support and horn support. Spacing of the mounting supports complies with site specific specifications and standards and qualification restrictions for the waveguide pipe assembly. Figures 1 and 2 show the designed attachment points for the waveguide piping and horn assembly.

The remote transmitter mounting support is designed using a simple C-channel steel section that is welded centrally on a steel base plate on the east wall of the north Auxiliary Building stairwell (primary) and outside west wall of the Fuel Handling Building (backup). The base plate will be anchored to the wall with four (4) hilti bolts.

The horn mounting support is designed using a simple C-channel steel section that is welded on a base plate and anchored to the Fuel Handling Building concrete floor. The base plate will be anchored to the floor with four (4) hilti bolts.

The power control panel is designed to attach to a column in the Auxiliary Building (primary) and the outside west wall of the Fuel Handling Building (backup). The mounting of the power control panel consist of bolting the power control panel to two (2) sections of unistrut. The unistrut will be anchored to the column and wall using hilti bolts.

RAI #3

Please provide an evaluation verifying the seismic testing of the horn and waveguide assembly and the electronics units, and the analysis of the combined maximum seismic and hydrodynamic forces on the cantilevered portion of the assembly exposed to the potential sloshing effects, demonstrate that the SFP instrument design configuration will be maintained during and following the maximum seismic ground motion considered in the design of the SFP structure.

RAI #3 Response

The potential spent fuel pool sloshing effects due to a postulated seismic event will be evaluated for the primary and backup channels. Applicable hydrodynamic wave impact forces will be included in the radar horn/pipe mounting load combinations.

The Required Response Spectra (RRS) used for seismic testing of the SFP primary and backup level instrumentation and the electronics units envelop the VCS design basis seismic spectra for the locations where the equipment will be installed.

The remote transmitter mounting support is qualified by a generic calculation using a simple C-channel steel section that is welded centrally on a steel base plate on the outside west wall of the Fuel Handling Building (primary) and the east wall of the north Auxiliary Building stairwell (backup). The generic sensor mounting support was designed for generic enveloping seismic accelerations of 10g (horizontal) and 6.67g (vertical), which envelope the site seismic response spectra at the applicable locations and frequencies. The calculation further assumed an enveloping sensor cantilevered length.

The horn mounting support will be qualified similarly to the remote transmitter support. It will be qualified by a site specific calculation using a simple C-channel steel section welded on a base plate on the concrete operating deck floor in the spent fuel pool area. The generic design of the horn mounting support conservatively uses generic seismic accelerations of 10g (horizontal) and 6.67g (vertical). A visual representation of the pool edge mounting configuration for the radar horn is shown in Figure 1 and Figure 2. It also provides the mounting configuration.

Refer to the response to RAI #2 for more information.

RAI #4

For each of the mounting attachments required to fasten SFP level equipment to plant structures, please describe the design inputs, and the methodology that will be used to qualify the structural integrity of the affected structures/equipment.

RAI #4 Response

The SFP level indication equipment is being purchased Quality Related per VCSNS Specification SP-1000. VCSNS Specification SP-1000 requires the SFPL indication equipment to operate at a temperature of 212 degrees Fahrenheit, operate in a boiling water or steam environment at 100% humidity, operate at an elevation of at least 150 meters above sea level, and in radiological conditions for a normal refueling quantity of freshly discarded (100 hours) fuel with the SFP water level 3, as described in NEI 12-02. The instrument channel reliability under seismic conditions will be established using the methodology in NEI 12-02 Revision 1 Section 3 and will meet the intent of interim staff guidance for reliable spent fuel pool instrumentation in NRC JLD-ISG-2012-03, Revision 0. The instrument channel design basis seismic conditions will correspond to the VCSNS Safe Shutdown Earthquake in structure response spectra from SP-702 at the locations of the components of the instrument channel. The adequacy of the seismic design and installation will comply with the site specific requirements for seismic design and installation of seismic equipment as well as applicable guidance in IEEE Standard 344-2004 Sections 7, 8, 9, and 10. The instrumentation will also meet the shock qualifications of NEI 12-02 and MIL-S-901D.

Also refer to the response to RAI #2 for more information.

RAI #5

Please provide analysis of the maximum expected radiological conditions (dose rate and total integrated dose) to which the equipment located within the FH building exterior wall and the auxiliary building stairwell will be exposed. Also, provide documentation indicating how it was determined the electronics for this equipment is capable of withstanding a total integrated dose of $1X10^3$ Rads. Discuss the time period over which the analyzed total integrated dose was applied.

RAI #5 Response

The area above and around the pool will be subject to radiation dose in the event that the fuel becomes uncovered. The only parts of the instrument channels 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 manufacture (see Areva Document No. 51-9202556-004, "Qualification Analysis of VEGAPULS 62 ER Through Air Radar"). The silicon elastomer seal has been tested for up to $7x10^8$ rad, although above $1.6x10^8$ rad the elastic modulus began to increase substantially. Nevertheless, even considering the

conservative scenario above, the silicon elastomer test data demonstrates that the silicon is acceptable for the expected radiation dose for this application.

The electronics will be located in an area that is shielded from the direct shine from the fuel, and bounce and scatter effects above the pool. VCS is currently in the process of developing Dose Calculations for the areas in which the electronics of the systems will be located (Auxiliary Building 463 feet north stairwell, AB 463 feet General Area south of the equipment hatch, and at the Auxiliary Building Column). This calculation will contain does rate and total integrated dose for each area. It is expected that this calculation will show that the dose in these areas is marginal enough for the electronics to withstand. When this information becomes available it will be provided in a 6-month status update.

RAI #6

Please provide information indicating (a) the temperature ratings and whether the temperature ratings for the system electronics are continuous duty ratings; and, (b) the maximum expected ambient temperature in the rooms in which the system electronics will be located under BDB conditions, with no AC power available to run Heating Ventilation and Air Conditioning (HVAC) systems?

RAI #6 Response

a) Per Areva Document 01-9225772-000, "Through Air Radar Spent Fuel Pool Level Instrument (SFPLI) Instruction Manual for V.C. Summer", the maximum continuous duty temperature the system electronics are as follows:

VEGAPULS 62 ER Sensor is -40 to 176°F
VEGADIS 61 Indications and Adjustment Unit -4 to 158°F
Power Control Panel -13 to 160°F
Auxiliary Battery Panel -13 to 160°F

Per the Areva document, the remote transmitter has been tested in accordance with IEC 60068-2-30 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 to achieve the rating IP66/IP68, which signifies totally dust tight housing, protection against water jets and waves, and protection against prolonged effects of immersion under 0.2 bar pressure. The VEGADIS 61 indicating and adjustment module has a housing which is similar to the VEGAPULS 62 ER remote transmitter and are therefore considered equally covered by the test.

The power control panel and auxiliary battery panel is rated for a maximum temperature of at least 158 degrees Fahrenheit. Allowing for 9 degrees Fahrenheit heat rise in the panel, the overall panel maximum ambient temperature for operation is 149 degrees Fahrenheit. The power control panel and auxiliary battery panels enclosures are rated

NEMA 4X and provides protection to the internal components from the effects of high humidity environments.

b) Per VCS Technical Report TR00080-003, the maximum temperature expected in the north stairwell of the Auxiliary Building is 150 degrees Fahrenheit. The only electronic equipment mounted in this area is the primary remote transmitter (VEGAPULS 62 ER Sensor). On the 463 foot elevation of the Auxiliary Building south of the Auxiliary Building Equipment Lift the maximum temperature range is 105-115 degrees Fahrenheit. The electronic equipment mounted in this location is the VEGADIS 61 Indications and Adjustment Unit, the Power Control Panel for the primary channel, and auxiliary battery panel for the primary channel. Per VCS calculation DC00080-002, the maximum outdoor temperature for components located outside is 107 degrees Fahrenheit. The electronic equipment located in this location are the VEGAPULS 62 ER Sensor, VEGADIS 61 Indications and Adjustment Unit, the Power control panel for the secondary channel, and auxiliary battery panels for the primary unit. Per the temperature ranges listed in section a) of this RAI it is reasonable to conclude that the electronics will be located in an area in which they will be able to withstand the maximum expected ambient temperature in the rooms in which the system electronics will be located under BDB conditions.

RAI #7

Please provide information indicating the maximum expected relative humidity in the rooms in which the system electronics will be located under BDB conditions, with no AC power available to run HVAC systems, and whether the sensor electronics are capable of continuously performing required functions under this expected humidity condition.

RAI #7 Response

The maximum humidity postulated for the spent fuel pool area is 100 percent relative humidity, saturated steam. The radar sensor electronics will be located outside of the spent fuel pool room in an area away from the steam atmosphere. The waveguide pipe can tolerate condensation formation on the inner wall surface, provided condensate pooling does not occur within the waveguide pipe. Condensate pooling is prevented by installing a weep hole(s) at the low point(s) in the waveguide pipe. VCSNS is still determining BDB conditions for the Fuel Handling Building exterior wall and the Auxiliary Building stairwell. Additional test information for the equipment will be provided by the vendor per VCS Specification SP-1000. When this information becomes available it will be provided in a 6-month status update.

RAI#8

Please provide information describing the evaluation of the comparative sensor design, the shock test method, test results, and forces applied to the sensor applicable to its successful tests demonstrating the referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of severe shock.

RAI #8 Response

The VEGAPULS 62 ER through air radar sensor is similar in form, fit and function to the VEGAPULS 66 including PLICSOM 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 Document 38-9193058-000, "Report of Shock and Vibration Test on Two (2) 3" Navy Flange Mount Level Indicators and One (1) 3" Triclamp, 1½" 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 incoupling and antennas for VEGAPULS 62 ER are smaller and lighter than for VEGAPULS 66 and therefore less susceptible to shock and vibration. 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 inch at the low frequencies to 0.006 inch at the higher frequencies. This procedure is not applicable to high-speed or surface effect ships that are subject to vibrations for high-speed wave slap, which produce vibration amplitudes and frequencies in excess of the levels on conventional Navy ships. 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 (100g, 6 ms), and vibration tested in accordance with EN 60068-2-6, Method 204 (except 4g, 200Hz).

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.

RAI #9

Please provide information describing the evaluation of the comparative sensor design, the vibration test method, test results, and the forces and their frequency ranges and directions applied to the sensor applicable to its successful tests, demonstrating the

referenced previous testing provides an appropriate means to demonstrate reliability of the sensor under the effects of high vibration.

RAI #9 Response

The test report is contained in AREVA Document 38-9193058-000, "Report of Shock and Vibration Test on Two (2) 3" Navy Flange Mount Level Indicators and One (1) 3" Triclamp, 1½" Navy Flange Mount Level Indicator for Ohmart/VEGA Corporation Cincinnati, Ohio".

The response to this RAI is the same as in RAI #8

RAI #10

Please provide results of the manufacturer's shock and vibration test methods, test results, and the forces and their frequency ranges and directions applied to the display panel associated with its successful tests.

RAI #10 Response

The test report is contained in AREVA Document 38-9193058-000, "Report of Shock and Vibration Test on Two (2) 3" Navy Flange Mount Level Indicators and One (1) 3" Triclamp, 1½" Navy Flange Mount Level Indicator for Ohmart/VEGA Corporation Cincinnati, Ohio".

The response to this RAI is the same as in RAI #8

RAI #11

Please provide an evaluation of the seismic testing results to show that the instrument performance reliability, following exposure to simulated seismic conditions representative of the environment anticipated for the SFP structures at Virgil C. Summer Nuclear Station has been adequately demonstrated. Include information describing the design inputs and methodology used in any analyses of the mounting of electronic equipment onto plant structures, as requested in RAI #4 above.

RAI #11 Response

The sensor, indicator, power control panel, horn end of the waveguide, standard pool end and sensor end mounting brackets, and waveguide piping were successfully seismically tested in accordance with the requirements of IEEE standard 344-2004. The system was monitored for operability before and after the resonance search and seismic tests. The required response spectra used for the five Operating Basis Earthquakes (OBE) and the single Safe Shutdown Earthquake (SSE) in the test were taken from EPRI TR-107330, Figures 4-5. The test response spectra from EPRI TR-107330 Figures 4-5 bound the building required response spectrum at all the locations where equipment will be located.

Intermediate mounting brackets for the waveguide piping as well as mounting for the power control panel and associated equipment will be designed and installed in accordance with site specific standards for seismically mounted equipment and pipe supports.

RAI #12

Please provide the final configuration of the power supply source for each channel so the staff may conclude the two channels are independent from a power supply assignment perspective.

RAI #12 Response

Independence
The primary instrument channel will be redundant to and independent of the backup instrument channel. The power sources for the primary and backup channels will be independent through the utilization of standalone battery power. The channels will be separated by a distance commensurate with the shortest length of a side of the spent fuel pool as defined by NEI 12-02 Section 3.2.

Power Supplies
Both the primary and backup channels will be powered from dual selectable power supplies utilizing dedicated lithium ion batteries with backup batteries available for easy replacement. The minimum expected battery life for each battery supply provides for 7 days of continuous service. The battery systems will include provision for battery replacement should the installed battery be non-functional following the event. Spare batteries will be readily available to maintain power to the system for the entire period of the FLEX response.

The above was previously provided in the original OIP Sections VIII and IX on February 28, 2013 under RC-13-0031.

RAI #13

Please provide the following:

a) **A description of how the spare battery will be maintained to ensure that it will be readily available.**

b) **The results of the calculation depicting the battery backup duty cycle requirements demonstrating that battery capacity is sufficient to maintain the level Indication function.**

RAI #13 Response

a) New Preventative Maintenance (PMs) activities for the SFPLI system spare batteries will be submitted to the VCS PM review group after the vendor manual is received from the

vendor and processed in accordance with VCSNS Procedures SAP-1280 and ES-507. The new PMs will be generated in accordance with VCSNS Procedure SAP-0143 Preventative Maintenance Program, input from the vendor, Maintenance, EPRI, and industry OE. When this information becomes available it will be provided in a 6-month status update.

b) The Power Control Panel and Auxiliary Battery Panel contain eight (8) Tadiran Model TL-5920 C-cell lithium batteries each that provide power. The battery storage life is reported by the manufacturer to be up to 20 years; however, the replacement interval recommended by AREVA is coincident with mandated surveillance of the level instrument. The battery life for worst case condition of 20 mA discharge rate is derived from the manufacturer technical data sheet in Areva Document 51-9202556-004 "Qualification Analysis of VEGAPULS 62 ER Through Air Radar".

Vendor analyses supports the battery capacity (at 20mA continuous discharge) can support approximately 130 hours and approximately 230 hours at negative 22 degrees Fahrenheit and 32 degrees Fahrenheit, respectively. The lifetime increases significantly at lower discharge rates or at higher temperatures. Lifetimes at the temperatures from the Areva Document 51-9202556-004 "Qualification Analysis of VEGAPULS 62 ER Through Air Radar" for a 20 mA discharge rate are summarized in the table below.

Table 2-1: Backup Battery Lifetimes vs. Temperature

Temperature	Ampere-Hours to 2.0 volts	Lifetime to 2.0 volts @ 20 mA (hours)	Lifetime at full voltage @ 20mA (hours)
-30°C (-22°F)	2.7	135	131
0°C (32°F)	4.8	240	233
25°C (77°F)	6.8	340	330
55°C (131°F)	7.2	360	349
75°C (167°F)	4.3	215	209

These calculated battery backup times 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 backup capacity duration will further be demonstrated during post-modification testing.

RAI #14

Please provide analysis verifying the proposed instrument performance is consistent with these estimated accuracy normal and BDB values. Demonstrate the channels will retain these accuracy performance values following a loss of power and subsequent restoration of power.

RAI #14 Response

The sensor, PLICSCOM display, power control panel, horn end of the waveguide, standard pool end and sensor end mounting brackets, and waveguide piping were successfully seismically tested in accordance with the requirements of the IEEE Standard 344-2004. The system was monitored for operability before and after the resonance search and seismic tests.

The factory acceptance testing demonstrated acceptable accuracy and performance capability. The factory acceptance testing was performed utilizing a reflective target for the following conditions:

- normal operating conditions,
- simulated loss of normal AC power and automatic transfer to battery backup power,
- simulated BDB conditions with steam injection into the radar horn,
- simulated BDB conditions water introduction into the radar horn and waveguided pipe.

The requested analysis for verification of instrument performance is still in progress. When this information becomes available it will be provided in a 6-month status update.

RAI# 15

Please provide a description of the in-situ calibration process at the SFP location that will result in the channel calibration being maintained at its design accuracy.

RAI #15 Response

The primary SFP level channel has multi-point testing capability, in that the radar horn antenna can be rotated away from the SFP water surface and aimed at a movable metal target that is positioned at known distances from the horn. This allows checking for correct readings at various points across the instrument measurement range and validates the functionality of the installed system.

The backup SFP level channel design readily supports periodic calibration across its monitoring range. The instrument is to be equipped with a calibration test tee and can be isolated from the process for routine calibrations.

RAI #16

Please describe the evaluation used to validate the display locations 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, 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.

RAI #16 Response

During a postulated event, only periodic personnel monitoring would be required for the backup SFP level gauge. Personnel access to the backup gage during a postulated ELAP event is considered to be readily accessible as defined by NEI 12-02 based on the following considerations:

- Travel path to the primary SFP level display and the display locations is confined within a Seismic Category I structure. The travel path is not exposed to potentially adverse SFP area conditions, and is protected from external events and adverse weather.
- The station is currently analyzing the travel path to the backup SFP level display and the display location do not require entry to a locked high-radiation area, and the associated area dose-rates would not prohibit personnel access.
- Analyses supports room temperatures for the backup level display location will not exceed 107 degrees during the first 7 days without mitigating cooling actions. This is contained in Design Calculation DC00080-002.
- Analyses supports room temperatures along the travel path to the primary level display will not exceed 105-115 degrees per TR00080-003 during the first 7 days without mitigating cooling actions.
- Humidity levels are conservatively assumed to approach 100 percent RH and would not prohibit periodic personnel access.

RAI #17

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

RAI #17 Response

Appropriate quality assurance measures will be selected for the SFP instrumentation as required by Order EA-12-051, consistent with Appendix A-1 of NEI 12-02 and similar to those imposed by Regulatory Guide 1.155. Site procedures will be developed for system inspection, calibration and test, maintenance, repair, operation, and normal and abnormal responses, in accordance with VCSNS procedure controls. The development of the following procedures is still in progress. When this information becomes available it will be provided in a 6-month status update.

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

RAI #18

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 the 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) **Information describing compensatory actions when both channels are out-of-order, and the implementation procedures.**

c) **Additional information describing expedited and compensatory actions in the maintenance procedure to address when one of the instrument channels cannot be restored to functional status within 90 days.**

RAI # 18 Response

(a) The above requested information is still in progress. When this information becomes available it will be provided in a 6-month status update.

(b) As required by NEI 12-02, action(s) to restore at least one channel must be initiated within 24 hours, and compensatory actions must be implemented within 72 hours. The compensatory actions previously outlined are presented again below for the case in which both channels are out of service:

- Increased operator visual surveillance of the SFP level and area,
- Maintain elevated SFP level,
- Reduce SFP temperatures,
- Supplemental operations staffing.

The listed compensatory actions were intended as examples of potential actions which could be considered (one or more), and is not intended to be a comprehensive listing. The corrective action program (CAP) would formally evaluate "functionality" for the SFP level channels and establish appropriate compensatory measures. The CAP would further establish appropriate procedural and process controls to ensure performance of any required compensatory measures.

(c) The maintenance procedures will not explicitly address any expedited or compensatory actions for a channel that is not restored to functional within 90 days.

As required by NEI 12-02, compensatory actions must be implemented if one channel is not expected to be restored to functional within 90 days. The corrective action program will evaluate and establish appropriate compensatory actions for a channel that cannot be restored to functional within 90 days.

Compensatory actions which could be implemented in the event one SFP level channel could not be restored to functional within 90 days. The compensatory actions are presented below for the case in which both channels are out of service:

- Increased surveillance (channel check) to verify functionality of the remaining operable level channel,
- Implement equipment protective measures,
- Increased operator visual surveillance of the SFP level and area,
- Maintain elevated SFP level,
- Reduce SFP temperatures,
- Supplemental operations staffing.

The listed compensatory actions were intended as examples of potential actions which could be considered (one or more), and is not intended to be a comprehensive listing. The corrective action program (CAP) would formally evaluate "functionality" for the SFP level channels and establish appropriate compensatory measures. The CAP would further

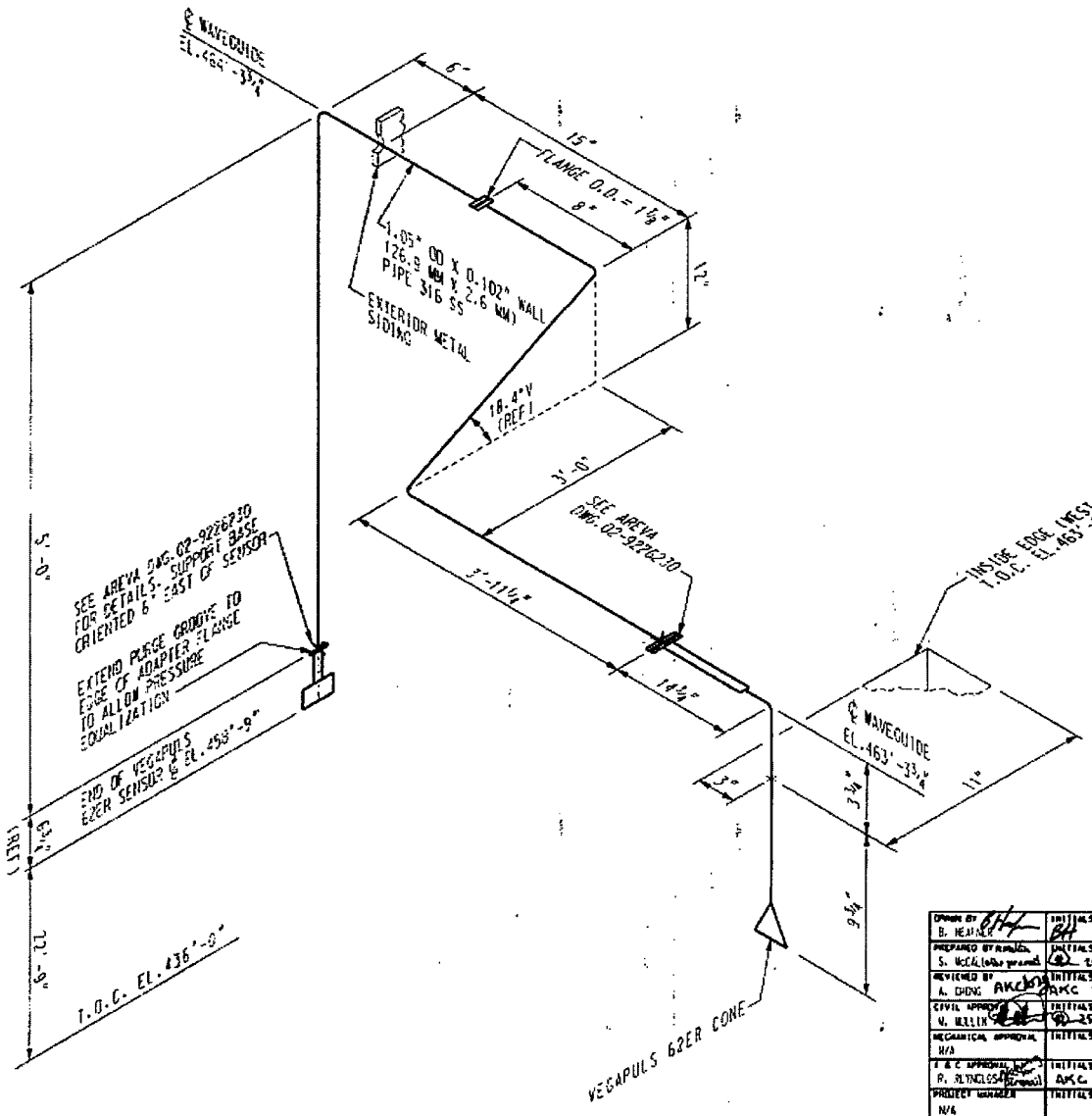
establish appropriate procedural and process controls to ensure performance of any required compensatory measures.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1

ATTACHMENT 2

Figure 1 Vega Waveguide Isometric (Northwest) Backup Channel

REV.	DATE	REVISION DESCRIPTION	DRWN	PRPD	RVWD	CIVIL	I&C



NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE U.N.O.
2. BEND RADIUS IS 3.88" (98MM) (TYP.).
3. GENERAL DIMENSIONAL TOLERANCES ARE +/-¼".
4. ADDITIONAL SUPPORT(S) ARE OWNER'S RESPONSIBILITY.
5. ELEVATIONS ARE PROVIDED FOR REFERENCE.

DRAWN BY B. HEATH	INITIALS/DATE BH 8-25-14
PREPARED BY (PRINT) S. MCCALLA	INITIALS/DATE 8-25-14
REVIEWED BY A. CHONG	INITIALS/DATE AKC 8-15-14
CIVIL APPROVAL W. WELLIN	INITIALS/DATE 8-25-14
MECHANICAL APPROVAL N/A	INITIALS/DATE
I & C APPROVAL R. REYNOLDS	INITIALS/DATE AKC 8-25-14
PROJECT MANAGER N/A	INITIALS/DATE

DO NOT SCALE. USE DIMENSIONS ONLY

AREVA

AREVA INC.
7207 IBM DRIVE, CHARLOTTE, NC 28262

V.C. SUMMER NUCLEAR STATION
VEGA WAVEGUIDE ISOMETRIC (NORTHWEST)

SCALE	DOC. ORIG. SIZE	DOC. ID	DWG. NO.	REV.
NTS	C=22"x17"	02	9226113 C	000

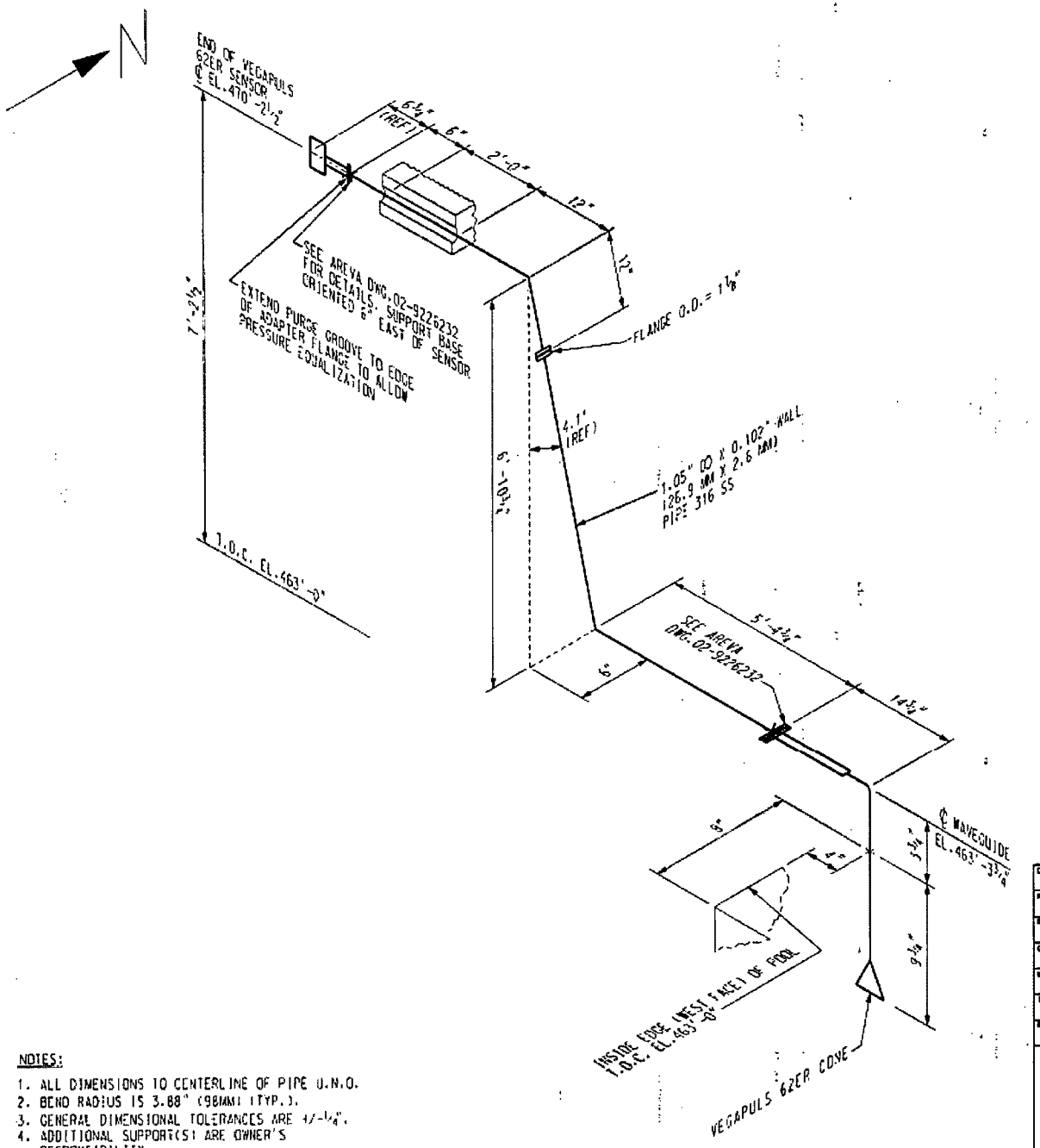
PROJECT DWG. NO.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1

ATTACHMENT 3

Figure 2 Vega Waveguide Isometric (Southwest) Primary Channel

REV.	DATE	REVISION DESCRIPTION	DRWN	PRPD	RVWD	CIVIL	I&C



NOTES:

1. ALL DIMENSIONS TO CENTERLINE OF PIPE U.N.O.
2. BEND RADIUS IS 3.88" (98MM) (TYP.).
3. GENERAL DIMENSIONAL TOLERANCES ARE +/-¼".
4. ADDITIONAL SUPPORT(S) ARE OWNER'S RESPONSIBILITY.
5. ELEVATIONS ARE PROVIDED FOR REFERENCE.

DRAWN BY B. HEAFNER	INITIALS/DATE BH 8-25-14
PREPARED BY S. MCCALL	INITIALS/DATE 25 Aug 14
REVIEWED BY J. CHONG AKChong	INITIALS/DATE AKC 8-25-14
CIVIL APPROVAL M. MILLIN	INITIALS/DATE 25 Aug 14
MECHANICAL APPROVAL N/A	INITIALS/DATE
I & C APPROVAL R. REYNOLDS	INITIALS/DATE AKC 8-25-14
PROJECT MANAGER N/A	INITIALS/DATE

DO NOT SCALE. USE DIMENSIONS ONLY

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7207 IBM DRIVE, CHARLOTTE, NC 28262

V.C. SUMMER NUCLEAR STATION
VEGA WAVEGUIDE ISOMETRIC (SOUTHWEST)

SCALE	DOC. ORG. SIZE	DOC. ID	DWG. NO.	REV.
NTS	C=22"x17"	02	9226114 C	000

PROJECT DWG. NO.