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February 27, 2015
RC-15-0031



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 (SCE&G) FOURTH
6-MONTH STATUS REPORT OF ORDER EA-12-051, ORDER MODIFYING
LICENSES WITH REGARD TO REQUIREMENTS FOR RELIABLE SPENT
FUEL POOL INSTRUMENTATION

- References:
1. NRC Order Number EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012 [ML12054A682]
 2. 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 [ML13063A099]

On March 12, 2012, the Nuclear Regulatory Commission issued an order (Reference 1) to South Carolina Electric & Gas Company (SCE&G). Reference 1 was immediately effective and directs SCE&G to have a reliable indication of the water level in associated spent fuel storage pools.

Reference 1 requires submission of a 6-month status report following the submittal of the Overall Integrated Plan (Reference 2). The purpose of this letter is to provide the fourth 6-month status report pursuant to Section IV, Condition C.2, of Reference 1. SCE&G developed an Overall Integrated Plan (Reference 2), documenting the requirements to install reliable spent fuel pool level instrumentation, in response to Reference 1. Attachment I provides the fourth 6-month status report of milestone accomplishments since the submittal of the Overall Integrated Plan. This update includes any changes to the compliance method, schedule, or need for relief/relaxation and the basis.

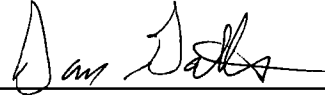
This letter contains no new regulatory commitments. If you have any questions regarding this report, please contact Bruce L. Thompson at (803) 931-5042.

A001
NRR

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

2-27-2015

Executed on



Thomas D. Gatlin

TS/TDG/rp

Attachment:

South Carolina Electric & Gas (SCE&G) Company Fourth 6-Month Status Report of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation

- c: K. B. Marsh
- S. A. Byrne
- J. B. Archie
- N. S. Carns
- J. H. Hamilton
- J. W. Williams
- W. M. Cherry
- W. M. Dean
- V. M. McCree (w/attachment)
- S. A. Williams (w/attachment)
- M. A. Brown (w/attachment)
- NRC Resident Inspector
- K. M. Sutton
- NSRC
- RTS (CR-12-01070)
- File (815.07)
- PRSF (RC-15-0031)

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1

ATTACHMENT

**SOUTH CAROLINA ELECTRIC & GAS COMPANY (SCE&G) FOURTH 6-MONTH STATUS
REPORT OF ORDER EA-12-051, ORDER MODIFYING LICENSES WITH REGARD TO
REQUIREMENTS FOR RELIABLE SPENT FUEL POOL INSTRUMENTATION**

1. Introduction

SCE&G developed an Overall Integrated Plan (Reference 2) and first six-month status report (Reference 4), documenting the requirements to install reliable spent fuel pool level instrumentation (SFPLI), in response to Reference 1. This attachment provides an update of milestone accomplishments since submittal of the Overall Integrated Plan, including any changes to the compliance method, schedule, or need for relief/relaxation and the basis.

2. Milestone Accomplishments

The following milestone(s) in section 3 have been completed since the development of the Overall Integrated Plan (Reference 2), and are current as of February 18, 2015.

VCSNS submitted a modification development, and an Engineering Change Request was completed in December 2014.

3. Milestone Schedule Status

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

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

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Submit 60 Day Status Report	Oct 2012	Complete	
Submit Overall Integrated Plan	Feb 2013	Complete	
Submit Response to RAIs on Overall Integrated Plan	Aug 2013	Complete	

Milestone	Target Completion Date	Activity Status	Revised Target Completion Date
Submit Response to RAIs on Overall Integrated Plan	Oct 2014	Complete	
Submit 6 Month Updates:			
Update 1	Aug 2013	Complete	
Update 2	Feb 2014	Complete	
Update 3	Aug 2014	Complete	
Update 4	Feb 2015	Complete	
Update 5	Aug 2015	Not Started	
Update 6	Feb 2016	Not Started	
Modifications:			
Modification Development	Jan 2014	Complete	January 2015
Complete Procurement of Instrumentation Package	Jun 2013	Completed	
Complete Engineering and Design	Jul 2014	Complete	January 2015
Commence Implementation	Oct 2014	In Progress	April 2015
Unit 1 Implementation Outage	Oct 2015	Not Started	
Procedures:			
Complete Procedures Development	Feb 2015	In Progress	May 2015
Training:			
Develop Training Plan	Feb 2015	In Progress	June 2015
Training Complete	Aug 2015	Not Started	

4. Changes to Compliance Method

As noted in previous updates (References 4, 5, and 12), there was one change to the compliance method as documented in the Overall Integrated Plan (Reference 2). The backup

channel of the spent fuel pool level monitoring system will be a permanently installed channel instead of the portable channel described in Reference 2. The details of this change were provided in the station response to the Request for Additional Information (References 3 and 6).

There are no other changes to the compliance method to report in this update.

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

SCE&G expects to comply with the order implementation date and no relief/relaxation is required at this time.

6. Open Items from Overall Integrated Plan and Draft Safety Evaluation

Public meetings were held on November 26, 2013 and February 6, 2014 to discuss reliable spent fuel pool level instrumentation RAIs based on binning (References 8, 9, and 10). The two bins are: generic RAIs to be answered by the vendor and plant specific.

VCSNS provided a response to all RAIs October 29, 2014 (Reference 13). Below is an update on plant specific RAIs 2, 5, 7, 13a, and 14 (as indicated by revision marks) which are listed in Reference 7. VCSNS will provide follow-up information for RAI 17 as it becomes available in a 6-month status update.

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 Safe Shutdown Earthquake 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.

VCS has decided to treat the waveguide pipe as Quality Related (QR) piping. This means the piping will meet ASME Sec III Class 2, but using non-code material, making it Seismic Category 1. The seismic spectra used were taken from both the Operating Basis Earthquake and Safe Shutdown Earthquake specific for VCS Unit 1 at the spent fuel pool and adjacent building (composite spectra). Differential building movement was taken into account (SAM – seismic anchor movement), along with the pool sloshing loads. The reactions at the support locations (from the analysis above) were reviewed to ensure they were bounded by the loads used in the vendor supplied calculations.

The horn mounting support will be qualified similarly to the remote transmitter support. It will be qualified by a generic calculation which has been verified to bound site specific geometry and seismic loadings. 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 #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 1×10^3 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 7×10^8 rad, although above 1.6×10^8 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. VCS Calculation DC00030-057 is being revised to address radiological conditions in these areas. When this calculation is completed and this information becomes available, it will be provided in a 6-month status update.

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. The system electronics for the system are contained in the Power Control Panel. Since the power control panel is a NEMA 4X enclosure, it is designed for indoor or outdoor use to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water). Since the Power Control Panel will be able to withstand direct ingress of water, it is logical to assume that it would be able to withstand an environment of 0 to 100 percent humidity.

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 (PM) activities for the SFPLI system spare batteries were submitted to the VCS PM review group for approval after the vendor manual was received from the vendor and processed in accordance with VCSNS Procedures SAP-1280 and ES-507. The new PM task was generated in accordance with VCSNS

Procedure SAP-0143 Preventative Maintenance Program, input from AREVA, VCS Maintenance Department, EPRI templates, and industry OE.

The requested PM activities will verify spent fuel pool level indication function, verify battery capability, and replace Lithium C-cell batteries periodically per the vendor manual. Upon approval, the following PM guidance will be implemented to ensure continued proper functioning of the VEGAPULS 62 ER Through Air Radar spent fuel pool level instrument:

1. Periodic checks should be made to compare the level indication and measurements certainty of the signal to the baseline values for the same water surface conditions, including distance from horn and water stillness. Verifying correct function of the sensor will involve the following three steps:
 - a. Verify that the indication and current output (if used) is within the expected calibration tolerance for the loop, including the readout device, as compared to the actual level.
 - b. The measurement reliability of the target echo is not less than 6 decibels (dB) below the baseline measurement reliability. The measurement reliability is accessed in the Diagnostics/Meas. reliability menu of the PLICSCOM. Alternatively, using PACTware, the target echo amplitude is not more than 6 dB below the baseline.
 - c. Place a target at a different distance than the water level and verify the indication changes in the correct direction.
 2. Periodic checks should be made to verify proper operation of the battery backup capability. The backup power supply batteries should be replaced every surveillance period to ensure full battery capacity.
 3. There are four (4) battery holders in the power control panel each holding two (2) Lithium C-cell batteries. When replacing batteries, it is recommended to apply a piece of electrical tape along the side of the batteries to connect the two cells together to simplify subsequent removal of the rearmost cell.
- 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. Post modification testing will be performed to validate the accuracies tested during the factory acceptance testing. When this information becomes available it will be provided in a 6-month status update.

7. Potential Draft Safety Evaluation Impacts

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

8. References

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

1. NRC Order Number EA-12-051, " Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation, " dated March 12, 2012
2. 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)
3. Robert E. Martin to Thomas D. Gatlin Letter : Virgil C. Summer Nuclear Station, Unit 1- Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC NO. MF1173) dated July 29, 2013
4. SCE&G's 6-Month Status Report of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation, dated August 28, 2013 (RC-13-0117)
5. SCE&G's Second 6-Month Status Report of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation, dated February 27, 2014 (RC-14-0031)
6. Virgil C. Summer Nuclear Station, Unit 1 Response to Request for Additional Information Regarding Overall Integrated Plan for Reliable Spent Fuel Pool Instrumentation (Order Number EA-12-051) (TAC NO. MF1173), dated August 28, 2013 (RC-13-0119)
7. Shawn Williams to Thomas D. Gatlin Letter : Virgil C. Summer Nuclear Station, Unit 1- 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. MF1173), dated December 5, 2013
8. NRC (Nuclear Regulatory Commission 2013) *Public Meeting on Reliable Spent Fuel Pool Instrumentation—Staff Evaluations of Licensee Plans for Addressing Order EA-12-051, November 26, 2013* Rockville, MD: NRC
9. NEI (Nuclear Energy Institute 2013) *Spent Fuel Pool Instrumentation Order (EA-12-051) RAIs Binning Nov. 26, 2013* Washington, DC: NEI

10. NRC (Nuclear Regulatory Commission 2013) *Public Meeting on Reliable Spent Fuel Pool Instrumentation—Staff Evaluations of Licensee Plans for Addressing Order EA-12-051, February 6, 2014* Rockville, MD: NRC
11. SCE&G's Virgil C. Summer Nuclear Station (VCSNS) Unit 1 Specification for Fukushima (FLEX) SFP Level Instrumentation System SP-1000, Revision 1, dated February 4, 2014
12. SCE&G's Third 6-Month Status Report of Order EA-12-051, Order Modifying Licenses with Regard to Requirements for Reliable Spent Fuel Pool Instrumentation, dated August 28, 2014 (RC-14-0141)
13. SCE&G's Response to Request for Additional Information – Overall Integrated Plan in Response to Commission Order Modifying License Requirements for Reliable Spent Fuel Pool Instrumentation (Order No. EA-12-051), dated October 29, 2014 (RC-14-0173)