George A. Lippard
Vice President, Nuclear Operations
803.345.4810

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A SCANA COMPANY

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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS), UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
RELIEF REQUEST RR-4-13, USE OF A RISK-INFORMED PROCESS AS AN ALTERNATIVE FOR THE SELECTION OF CLASS 1 AND CLASS 2 PIPING WELDS
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

References:
1. Letter from George A. Lippard to NRC Document Control Desk dated October 30, 2017. "RELIEF REQUEST RR-4-13, USE OF A RISK-INFORMED PROCESS AS AN ALTERNATIVE FOR THE SELECTION OF CLASS 1 AND CLASS 2 PIPING WELDS"
ADAMS Accession No. ML 17303B183

2. Letter from Shawn A. Williams to George A. Lippard dated February 15, 2018. "VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1 - REQUEST FOR ADDITIONAL INFORMATION RE: RELIEF REQUEST (RR-4-13), USE OF RISK-INFORMED PROCESS AS AN ALTERNATIVE FOR THE SELECTION OF CLASS 1 AND CLASS 2 PIPING WELDS (EPID NO. L-2017-LLR-0133)" ADAMS Accession No. ML18023B069

South Carolina Electric & Gas Company (SCE&G), acting for itself and as agent for South Carolina Public Service Authority, submitted a Relief Request for the use of a risk-informed process as an alternative for the selection of class 1 and class 2 piping welds (Reference 1). The NRC staff's review of the Relief Request determined additional information was required and a request for additional information (RAI) was issued per Reference 2.

Enclosure I of this letter contains SCE&G's response to these RAIs. Enclosure II of this letter contains the updated relief request. Attachment 1 of this letter contains the updated inspection location selection comparison between the previously approved and revised RI-ISI program by risk category.

If you have any questions or require additional information, please contact Michael Moore at (803) 345-4752.

Very truly yours,

For
George A. Lippard

BAB/GAL/nk

Enclosure I: Response To Request For Additional Information
Enclosure II: Updated Relief Request RR-4-13
Attachment 1: Updated VCSNS – Inspection Location Selection Comparison Between Previously Approved and Revised RI-ISI Program by Risk Category

c:	J.E. Addison	NRC Resident Inspector
	W.K. Kissam	K.M. Sutton
	J. B. Archie	NSRC
	J. H. Hamilton	NSRC
	G. J. Lindamood	RTS (CR-16-01194)
	W. M. Cherry	File (810.19-2)
	C. Haney	PRSF (RC-18-0036)
	S. A. Williams	

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

ENCLOSURE I

Response To Request For Additional Information For Use Of Risk-Informed Process As An Alternative For The Selection Of Class 1 And Class 2 Piping Welds

During the NRC review, the staff identified eight areas where insufficient information was provided in the Relief Request to conduct the detailed review of the Relief Request. These areas are as follows:

RAI No.1

Regarding the risk metrics provided in the RR, please clarify the following:

a. **On page 7 of the RR, the licensee states:**

> **The revised program represents an overall reduction of plant risk of -9.83E-09 for CDF [core damage frequency] and -4.08E-09 for LERF [large early release frequency].**

Please clarify that the negative value of the CDF and LERF risk metrics represent risk reductions and not "negative reductions," in which a reduction of a negative value as provided in the license amendment request (LAR) could imply an increase in risk.

b. **On page 8 of the RR in the table "VCSNS Risk Impact Results", the change in LERF for each system is approximately 40% of the corresponding change in CDF, which is consistent with the overall change in CDF and LERF as provided on page 7 of the LAR. However, the changes in LERF for the Emergency Feedwater (EF) and Feedwater (FW) systems have the same values as their corresponding changes in CDF, which does not appear to be consistent with the rest of the systems, where the change in LERF is always less in magnitude than the corresponding change in CDF, and the overall results. Please clarify why the changes in CDF and LERF for the EF and FW systems are equal and not consistent with the other results.**

SCE&G Response

a. A negative value in the Risk Impact Analysis represents a risk reduction. This has been clarified throughout Enclosure II (Updated Relief Request RR-4-13) as noted by the revision bars.

b. The values for the change in LERF with Probability of Detection (POD) considered for the EF and FW systems were simply transcribed incorrectly from the Risk Impact Analysis results. The value for the EF system should be 2.40E-12 instead of 2.40E-11 and the value for the FW system should be 1.20E-12 instead of 1.20E-11. All other values in the table, including the totals, were verified as being transcribed correctly. This has been updated in the VCSNS Risk Impact Results Table on page 8 of Enclosure II (Updated Relief Request RR-4-13).

RAI No. 2

According to Regulatory Issue Summary 2007-06 (ADAMS Accession No. ML070650428), the NRG staff expects that licensees fully address all scope elements with Revision 2 of Regulatory Guide (RG) 1.200 (ADAMS Accession No. ML090410014) by the end of its implementation period (i.e., one year after the issuance of Revision 2 of RG 1.200). Revision 2 of RG 1.200 endorses, with exceptions and clarifications, the combined American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) Probabilistic Risk Assessment (PRA) standard (ASME/ANS RA-Sa-2009).

On page 3 of Attachment 1 of the LAR, the licensee states:

> **Independent PRA peer reviews were conducted under the auspices of the Pressurized Water Reactor Owners Group (PWROG) following the Industry PRA Peer Review process in 2002 and 2016.**

The licensee further explains a PRA model update was completed in 2016 and a full scope peer review was performed. Please confirm the following items in regard to the 2016 full scope peer review:

a. **Please confirm the full scope peer review was reviewed against the 2009 ASME/ANS PRA standard, as endorsed by RG 1.200, Revision 2. If not, identify any gaps between the peer review and the guidance in RG 1.200, Revision 2.**

b. **For the disposition of SR IE-A5/A6 in Table 1 of the LAR, the licensee states:**

> **The initiating event list in the VCSNS PRA was based on a review of other risk assessments, plant operating history, and plant design. This included a review of support systems."**

The guidance in RG 1.200, Revision 2 specifies the systematic evaluation of each system, including support systems, needs to be performed "down to the subsystem or train level where necessary." Please confirm if the review of the support systems was provided down to this level, and provide justification if it was not

SCE&G Response

a. The VCSNS internal events and flood PRA was peer reviewed against the 2009 ASME/ANS PRA standard as endorsed by RG1.200, Rev 2 for internal events and PRA Standard RA-Sb-2013 for internal flood. The peer review team reviewed the combined (internal and flood) PRA model against RG1.200 Revision 2. A high level review was performed to compare the 2009 ASME/ANS PRA to the 2013 section of the standard for internal floods. The review shows that the 2013 version requires more discussion of uncertainty and assumptions and makes screening slightly more restrictive. No potential gaps were noted.

b. Support systems were reviewed down to the subsystem or train level as necessary for the VCSNS individual plant examination (IPE). The IPE is the basis for the internal events PRA. Support systems in the VCSNS PRA are modeled at a component level. Subsystems and trains are included by modeling of the individual components.

RAI No. 3

In Table 1 of Attachment 1 of the RR, for the disposition of SR IE-C1, the licensee cites performance of a sensitivity study to address the Finding, in which a change in consequence from MEDIUM to HIGH was due to a near factor of four increase in medium loss-of-coolant accident (LOCA) frequency. The disposition further questions the basis for this increase, stating the difference may be based on binning or expert elicitation, and, therefore, concluding that the data used in the current PRA model are "sufficient for medium LOCA." Please explain the reasons for the increase in frequency other than how the data, which may include recent updates, have been processed. Please provide justification for taking exception to the factor of four increase in the medium LOCA frequencies and/or include an evaluation of the effect from the sensitivity study of the factor of four increase in the medium LOCA frequencies on the risk metrics applicable to this application.

SCE&G Response

A sensitivity study has been performed using NUREG/CR-6928 2015 Spreadsheet. Only three consequence keys were affected (CL A, CL B and CL C). These keys went from “medium consequence” to “high consequence” after the sensitivity study. The reason was traced to the medium LOCA frequency in NUREG/CR-6928 2015 Spreadsheet. VC Summer is changing the ranking of consequence keys CL A, CL B and CL C to high consequence based on the sensitivity study.

The change from medium consequence to high consequence for these consequence keys resulted in 17 welds in the SI system moving from Medium Risk (Risk Category 5a) to High Risk (Risk Category 2) and 141 welds in the SI system moving from Low Risk (Risk Category 6a) to Medium Risk (Risk Category 4). As a result, an additional 18 welds were selected for RI-ISI examination. The Risk Impact Analysis was updated to reflect these changes. The Risk Impact was negative (i.e., a decrease in overall risk) whether or not enhanced Probability of Detection (POD) values are considered. Page 8 of Enclosure II (Updated Relief Request RR-4-13) of this submittal provides the updated risk impact results and Attachment 1 of this submittal provides an updated inspection location selection comparison between the previously approved and revised RI-ISI program by risk category.

RAI No. 4

In Table 1 of Attachment 1 of the LAR, for the disposition of SR SY-A4, the licensee states:

> **Walkdowns of recent system modifications have been done in support of Fire PAA human reliability.**

The licensee's National Fire Protection Association (NFPA) 805 "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants" LAR (ADAMS Accession No. ML14287A289) was submitted on November 15, 2011, and the Amendments issued on February 11, 2015 (ADAMS Accession No. ML14287A289). Based on the walkdowns, referenced in Table 1 of the LAR, walkdowns were performed six or more years ago. Please provide justification that these walkdowns are adequate to be representative of the as-built, as-operated status of the plant for the version of the PRA used in this application.

SCE&G Response

PRA personnel routinely participate in validation exercises in the plant simulator. Control room modifications are incorporated into the simulator, so PRA personnel routinely observe how these affect operation of the plant.

Walkdowns for PRA applications have been conducted for Fire, Seismic and Flooding between 2014 and the present. All features that would affect the PRA model used for this application were included.

RAI No. 5

In Table 1 of Attachment 1 of the RR, for the disposition of SR HR-G7, identify the joint Human Error Probability (HEP) floors that were used. Please confirm that none were < 1 E-6 for internal events. If any were <1 E-6 for internal events, please provide the basis and the results of a sensitivity evaluation using 1 E-6, and include any effects on the "small" impact statement under the "Impact" column in Table 1.

SCE&G Response

The sensitivity study performed to evaluate the impact of the peer review Fact and Observation (F&O) for SR HR-G7 on RI-ISI used a dependent human error floor value of 1.0E-05. No combinations were assigned values less than 1.0E-05.

RAI No. 6

In Table 1 of Attachment 1 of the LAR, for the disposition of SR IFEV-A7, the licensee states:

> **Limited on-line maintenance makes human induced flooding less significant and it should not affect the failure probability or consequence for any piping welds.**

Although on-line maintenance is limited, it is not eliminated and, therefore, there may be risk from human induced flooding. Please justify with a bounding quantification the statements that human induced flooding should not affect the risk, and the likely impact on RI-ISI risk is small and will not add significance.

SCE&G Response

EPRI guidelines for internal flooding probabilistic risk assessment (EPRI 1019194 section 5.6) allow qualitative screening if two or more isolation valves are used. Station administrative procedure SAP-0201 states that two valve protection is required for systems or tanks that can cause major flooding of buildings or systems being worked. Based on this, qualitative screening of human induced flooding was appropriate in the VCSNS internal flooding analysis. A further response is provided below.

To assess the possible impact of human-induced internal flooding on RI-ISI, Conditional Core Damage Probability (CCDP) and Large Early Release Probability (LERP) values based on component importance values for internal flooding only were calculated.

Most consequence keys have no basic events in internal flooding cutsets. The consequence keys that have basic events for internal flooding are currently ranked as "medium" or "high" impact based on the baseline PRA. Only one consequence key would be rated greater than "low" based on CCDP for internal flooding alone. This key, for the residual heat removal system, is currently rated "high" based on its impact in the baseline PRA, so flooding impact would not add to the rating. Since internal flooding has been conservatively assessed in the VC Summer PRA, the significance of flooding in the PRA and to RI-ISI will be reduced in the future. Also, human-induced internal flooding is also considered a small component of the consequence keys. Therefore, the likely impact of future assessments for human-induced internal flooding is small and will not significantly add to RI-ISI.

RAI No. 7

In Table 1 of Attachment 1 of the RR, for the disposition of SR QU-D2 / AS-A5, the licensee cites conservatism in the PRA model and that the risk impact is expected to be small. On the basis that conservatism may underestimate the risk increase or overestimate the risk reduction of the application, provide the following information:

a. **When citing conservatism in the PRA model, please confirm that calculation of the differential risk for this application is also conservative (i.e., the risk estimated for the before versus after condition uses the same assumptions, etc., except for the change to any basic event values affected by the application, ensuring that the before value is not overestimated such that subtracting it from the after value could underestimate the risk increase).**

b. **Please provide quantitative justification with a bounding evaluation, crediting the available recovery options, that the expected impact is small, as stated in the "Impact" column.**

SCE&G Response

a. If the before value of CDF (or LERF) is lowered by removing model conservatism, it will not affect the conditional core damage probability CCDP or LERP values associated with RI-ISI consequence keys except to possibly reduce these values and thus reduce the consequence key rank for any consequence keys where the conservatism is removed.

   F&O AS-A5 questioned the PRA success criteria for secondary side breaks and small LOCA and lack of credit for additional systems and recovery actions.

   The success criteria was questioned for small LOCA and secondary breaks. Success criteria that allow more recovery credit would reduce the conditional core damage probability and large early release probability associated with these initiating events. Reducing the conditional core damage probabilities and large early release probabilities of these initiators would not cause RI-ISI consequence keys to be ranked higher. Also, we expect the original success criteria to remain unchanged after review since they are based on thermal hydraulic analysis.

   The peer review suggested the following recoveries should be credited:

   - Closing the block valve for a stuck open power operated relief valve is already in the VCSNS PRA model.

   - Manual recirculation swap is of almost no benefit in the PRA because it relies on much of the same equipment and instrumentation as the much more reliable auto swap.

   - Main feedwater is only useful for a limited number of scenarios where offsite power has not been lost, but all three emergency feedwater pumps and feed and bleed have failed. So the possible credit is very limited.

   - Re-filling the Refueling Water Storage Tank following a small LOCA is of little numerical value based on:

     - Sump recirculation must have failed to use this.
     - The cue to refill occurs when the recirculation swap occurs (18% RWST level) and this limits the time window for success.
     - The possible re-fill rate of the RWST from Reactor Make-Up (120gpm) will not keep up with small LOCA flow.
     - Make-up to the RWST from the spent fuel system is another option. Gravity drain from this source would also be unlikely to keep up with small LOCA flowrates.

   Based on the reasons above, credit for suggested recoveries would be minimal.

b. No CCDP or CLERP values would increase as a result of removing conservatisms from the VCSNS internal events model. No consequence keys would increase in ranking. Also, for reasons described above the overall impact of the conservatism listed in the peer review F&O is small and it would not be beneficial to remove any of the cited conservatisms at this time.

RAI No. 8

VCSNS Unit 1 is currently already in its Fourth 10-Year ISI interval, which started on January 1, 2014, and is scheduled to end on December 31, 2023. The licensee implemented its regular ISI program for ASME Code Class 1 and Class 2 piping welds for the first period of the Fourth 10-Year ISI interval. Relief Request RR-4-13 states that the licensee will use its RI-ISI Program for the balance of the Fourth 10-Year Interval (i.e., second and third periods), and "prorate" for examinations it already performed in the first period.

In its submittal, the licensee did not provide any specific information on the weld examinations already performed for the first period, or how these examinations will be "prorated" for the Fourth 10-Year Interval. Additionally, it is not clear if all risk significant examinations that would have been completed during the first period of a RI-ISI Program at VCSNS Unit 1, were performed.

In its submittal, the licensee provided summary tables that include the total weld population in the scope of the VCSNS Unit 1 proposed RI-ISI Program. Please provide the ASME Code classifications (i.e., ASME Class 1 or 2) of the piping welds in the tables. Additionally, confirm that risk significant examinations that should have been performed during the first period of the RI-ISI program were performed during the first period as part of the regular ASME ISI, or will be performed as part of the RI-ISI Program consistent with the requirements of Table IWB-2411-1.

According to ASME Code Case N-578-1, "Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method B, Paragraph -2420 (a), "Successive Inspections," the sequence of piping examinations established during the first inspection interval using the risk-informed process shall be repeated during each successive inspection. Thus, please confirm that the sequence of the piping examinations for periods 2 and 3 of the Fourth 10-year RI-ISI interval will be consistent with the sequence of examinations for 2 and 3 of the Third 10-year RI-ISI interval.

SCE&G Response

The fourth interval is a seven-outage interval, as opposed to the six-outage third interval. Exams performed during the third interval were scheduled in accordance with Section XI table IWB-2500-1 requirements (with the use of Code Case N-663 per RG 1.147) and per the requirements of Section XI table IWB-2411-1. Understanding that nearly all category B-F welds are now scheduled in accordance with the requirements of Code Case N-770-2 in accordance with 10CFR50.55a(g)(6)(ii) (the exception being the A hot leg DM Weld replaced during RF12 now made of Alloy 690, and thus not covered by Code Case N-770-2), this response is discussing Examination Categories B-J, C-F-1, and C-F-2.

During the first period of the fourth interval, 85 welds were examined for Categories B-J, C-F-1, and C-F-2. Of those 85 exams, only 26 were not part of the weld population selected for examination for the third interval Risk Informed ISI Program. That means that 59 welds were examined during the first period of the fourth interval, which were selected for the third interval

RI-ISI population. The additional 26 examinations were due to ASME Section XI requiring more examinations than the RI-ISI application and therefore are not relevant for the comparison of RI-ISI selections between the Third and Fourth Intervals. The schedule sequence of the third interval was adhered to per the allowable variations which the Code permits, meaning that RF15 exams were performed during RF21 or RF22, RF16 exams were performed during RF22, and RF17 exams were performed during RF23, with the exception of 2 exams in RF21 and 4 exams in RF22.

The percentages are as follows for the first period per the Table IWB-2500-1 selection requirements:

> Examination Category B-J welds: 30% of the required population examined during the first period of the fourth interval.
>
> Examination Category C-F-1 welds: 24% of the required population examined during the first period of the fourth interval.
>
> Examination Category C-F-2 welds: 17% of the required population examined during the first period of the fourth interval.

Updated tables showing the code classes have been provided in Attachment 1 of this submittal.

Due to the fourth interval being a 7-outage interval and the third interval being a 6-outage interval, the exams are scheduled at no more than 7 outages apart (10.5 years), with most being scheduled at 6 outages apart (9 years) or less. The first period of the fourth interval included RF21, RF22 and RF23. All exams for Examination Category B-J, C-F-1 and C-F-2, which were performed during the first period of the third interval, were performed during the first period of the fourth interval. This has been clarified on page 9 of Enclosure II (Updated Relief Request RR-4-13). Additional exams from those Examination Categories were also performed during the first period of the fourth interval in order to meet the Section XI requirements. Some exams from the second period of the third interval were also performed during the first period of the fourth interval. This was again due to the fourth interval being 7-outages as opposed to 6. The sequence of exams for the second and third period selections for the RI-ISI program will be scheduled per the selection scheduling of the third interval as required. The variance will be due to the 7-outage versus 6-outage difference between the intervals.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

ENCLOSURE II

Updated Relief Request RR-4-13

1. Subject

VCSNS Unit 1 is proposing an alternative to the requirements of the inspection and examination requirements of Class 1 and 2 piping welds specified by the ASME Code, Section XI, Tables IWB-2500-1 and IWC-2500-1. The continued use of a risk-informed process as an alternative for the selection of Class 1 and Class 2 piping welds for examination is requested for the Fourth Ten-Year ISI Interval.

2. ASME Code Component(s) Affected

All Code Class 1 and 2 piping welds previously subject to the requirements of ASME Section XI, Table IWB-2500-1, Examination Categories B-F[1] and B-J, and Table IWC-2500-1, Examination Categories C-F-1 and C-F-2.

3. Applicable Code Edition and Addenda

The applicable Code Edition and Addenda for the Fourth Ten-Year Inservice Inspection (ISI) Interval at V.C. Summer Nuclear Station (VCSNS) is the 2007 Edition with 2008 Addenda of ASME Section XI.

The station is in its fourth 10 year interval effective from January 1, 2014, through and including December 31, 2023.

4. Applicable Code Requirement

The selection process for Code Class 1 and Code Class 2 pipe welds to be examined in the Fourth Ten-Year ISI Interval is prescriptively determined in accordance with ASME Section XI Table IWB-2500-1, Examination Categories B-F[1] and B-J, and Table IWC-2500-1, Examination Categories C-F-1 and C-F-2.

[1] Note that although Examination Category B-F welds are included in the RI-ISI program for the consideration of all possible degradation mechanisms, Alloy 600/82/182 examinations in the Third Interval were conducted per Code Cases N-722-1 and N-770-1. In the Fourth Interval, these examinations will be performed in accordance with the versions of the applicable Code Cases that are referenced in the published version of 10CFR50.55a.

5. Reason for Request

The continued use of a risk-informed process as an alternative for the selection of Class 1 and Class 2 piping welds for examination is requested for the Fourth Ten-Year ISI Interval. Use of the risk-informed selection process has been shown to reduce the probable frequency of core damage and large early release when compared to the prescriptive deterministic selection method. The methodology will continue to be based on Electric Power Research Institute (EPRI) Topical Report (TR) 112657, Rev. B-A, with identified differences and additional guidance taken from ASME Code Case N-578-1 and ASME Section XI Nonmandatory Appendix R.

6. Proposed Alternative and Basis for Use

As an alternative to the Code Requirement, a Risk-Informed process will be used for selection of Class 1 and Class 2 piping welds for examination.

Background

In 2002, a risk-informed (RI) methodology for the inservice inspection of Class 1 and 2 piping welds was applied at the V.C. Summer Nuclear Station based on Electric Power Research Institute (EPRI) Topical Report (TR) 112657, Rev. B-A, with identified differences and additional guidance taken from ASME Code Case N-578. The original RI-ISI template, "Risk-Informed Inservice Inspection Program Plan, V.C. Summer Nuclear Station, Rev. 0," was submitted to the NRC for approval as Attachment 2, Relief Request RR-II-07, to letter RC-02-0161, dated September 16, 2002, and supplemented in a letter to the NRC dated January 29, 2003. Based upon the information provided in the RI-ISI template and supplemental submittal described above, the request to implement the RI-ISI methodology on Class 1 and 2 piping welds was approved by the NRC for VCSNS's Second Ten-Year ISI Interval in an NRC SER dated May 12, 2003.

In 2004, the RI-ISI application was evaluated and updated in conjunction with the Third Interval ISI Program Update. This resulted in the generation of Relief Request No. RR-III-02 which addressed continued use of the RI-ISI application during the Third Interval. By letter RC-04-0148 to the NRC on September 8, 2004, South Carolina Electric and Gas submitted Relief Request RR-III-02 for VCSNS requesting relief from the ASME Section XI Code examination requirements of Class 1 and 2 piping weld (Examination Categories B-F, B-J, C-F-1 and C-F-2) inservice inspections by continuing implementation of their RI-ISI Program. Relief Request RR-III-02 was approved by the NRC in a Safety Evaluation Report dated September 6, 2005 (ML052300616).

For the Fourth ISI Interval, which commenced on January 1, 2014, VCSNS intended to resubmit the RI-ISI Program. However, since VCSNS did not submit its RI-ISI Program before or during the first period, conventional Section XI rules were applied to Examination Categories B-F, B-J, C-F-1 and C-F-2 during this period. The first period of the Fourth ISI Interval was completed on June 1, 2017. Upon NRC approval of the RI-ISI Program for the Fourth Interval, VCSNS will prorate examinations in these examination categories accordingly for the remainder of the interval.

RI-ISI Living Program Evaluations and Updates

The original VCSNS RI-ISI Program submittal to the NRC contained the following statement related to the evaluation/update process:

"The RI-ISI program is a living program requiring feedback of new relevant information to ensure the appropriate identification of high safety significant piping locations. As a minimum, piping segments will be reviewed and Risk Ranking adjusted as necessary on an ASME period basis. In addition, significant RI-ISI changes may require more frequent adjustment as directed by NRC Bulletin or Generic Letter requirements, or by industry and plant specific feedback."

The requirement to perform living program evaluations and updates of the RI-ISI Program on a period basis is still applicable. Guidelines for the performance of these living program evaluations and updates are provided in NEI 04-05, "Living Program Guidance To Maintain Risk-Informed Inservice Inspection Programs For Nuclear Plant Piping Systems," published April, 2004. In accordance with NEI 04-05, the following aspects were considered during the periodic reviews for VCSNS:

- Plant Examination Results
- Piping Failures
  - Plant Specific Failures
  - Industry Failures
- PRA Updates
- Plant Design Changes
  - Physical Changes
  - Programmatic Changes
  - Procedural Changes
- Changes in Postulated Conditions
  - Physical Conditions
  - Programmatic Conditions

The updated RI-ISI Program resulting from these periodic evaluations is the subject of this proposed alternative.

During the review after the First Period of the Third Interval, the following changes were identified and incorporated into the RI-ISI Program:

1. The Consequence Evaluation was updated to reflect the latest revision of the PRA.

2. The Risk Ranking Summary, Matrix, and Report were updated to incorporate the change of Risk Categories for 90 segments due to the PRA model update as identified in the RI-ISI Evaluation.

3. The increase in Risk Ranking for 32 Main Steam segments resulted in 143 welds increasing from Low Risk to Medium Risk. A Medium Risk Category requires the

selection of 10% of the population. Therefore, fifteen additional welds were selected for examination.

4. The Risk Impact Analysis was updated to reflect the new Upper Bound Conditional Core Damage Probability (CCDP) and Conditional Large Early Release Probability (CLERP), the revised Risk Categories, and the additional Main Steam elements selected for examination. Risk Impact remained negative (i.e, a decrease in overall risk) with Probability of Detection (POD) considered, and negligible without POD.

5. The Risk Ranking and Risk Impact Analysis were updated to reflect the treatment of Primary Water Stress Corrosion Cracking (PWSCC) in a separate program, similar to the treatment of Flow Accelerated Corrosion (FAC). As a result of this update, there was the potential to reduce the elements selected for examination by 4. However, VCSNS decided that the selections would remain the same until implementation of the SAP-1281 PWSCC Program has been completed and implemented.

As a result of these changes, the number of elements selected for inspection increased from 94 to 109. The increase was due to the change in Consequence Category to 32 Main Steam segments. The potential decrease in examinations due to the treatment of PWSCC in an independent program was deferred until the effectiveness of the independent program could be verified. The total risk (both Core Damage Frequency (CDF) and Large Early Release Frequency (LERF)) continued to be lower than that under the original deterministic Section XI program when POD is considered, and essentially unchanged without consideration of POD.

During the review after the Second Period of the Third Interval, the following change was identified:

1. During the Second Period the PRA model changed from Version 5 to Version 6c. As a result of this change, the Conditional Core Damage Probability (CCDP) of the 32 Main Steam segments that changed as a result of the First Period update decreased sufficiently to change those segments from Risk Category 4 (Medium Risk) back to Risk Category 6a (Low Risk). This resulted in a potential return of the number of Main Steam examinations to what was previously required at the start of the Third Interval. However, VCSNS decided to conservatively keep the RI-ISI examinations as they were until the end of the Third Interval.

During the review after the Third Period of the Third Interval, the following changes were identified and incorporated into the RI-ISI Program:

1. Consideration was given to the selection of welds 1-4100A-26BC and 1-4200A-22BC for RI-ISI examination. This recommendation was the result of Condition Report CR-13-02110 which identified periodic thermal transients in the RCS Cold Leg Safety Injection piping. This piping had already been identified as being subject to thermal transients in the RI-ISI Degradation Mechanism Evaluation and welds 1-4106A-8, 1-4106A-9, 1-4202A-16 and 1-4202A-17 have been selected for examination. Therefore, the criteria of the RI-ISI methodology have been met. In

addition, welds 1-4100A-26BC and 1-4200A-22BC are small bore branch connection welds that are not conducive to examine by ultrasonic examination. However, in order to address Condition Report CR-13-02110, VCSNS opted to schedule owner-elected augmented surface examinations on these welds outside of the RI-ISI Program.

2. During the Third Period the PRA model changed from Version 6c to Version 7. As a result of this change, The Consequence Rank for System/Train Loss identifiers SI B and SI C increased from Low to Medium. As a result, thirty-nine Chemical and Volume Control System (CVCS) segments changed from Risk Category 7a to Risk Category 6a. Since both Risk Category 6 and Risk Category 7 are Risk Rank Low, there is no change in Risk Rank and no additional examinations were required. However, the Consequence Evaluation and Risk Ranking Summary, Matrix and Report were updated to reflect the changes.

3. Per Version 7 of the PRA Model, the Upper Bound CCDP used in the Risk Impact Analysis is 6.25E-05 and the Upper Bound CLERP is 3.00E-08. The Risk Impact Analysis was updated to reflect the new Upper Bound CCDP and CLERP. The Risk Impact remained negative (i.e. a decrease in overall risk) with POD considered, and negligible without POD.

4. During the Third Interval an assessment was performed comparing the ISI drawings to the ISI database and any resulting differences were reconciled. During the Third Period, the Risk Ranking Summary, Matrix and Report and Risk Impact Analysis were updated to reflect the reconciled ISI database information.

5. The Risk Ranking, Element Selection, and Risk Impact Analysis were updated to reflect the application of Code Case N-770-1. The examination of welds due to PWSCC is considered administratively during the RI-ISI application, but the Code Case N-770-1 program takes precedence. Therefore, welds subject to PWSCC are selected for examination per Code Case N-770-1 and examined under that program. Welds for which no other degradation mechanism has been postulated will be examined solely under the Code Case N-770-1 Program and were removed from consideration during the RI-ISI element selection process. Welds for which another degradation mechanism other than PWSCC has been postulated were considered for further examination in the RI-ISI application in the same population as those subject to the additional degradation mechanism. However, the Code Case N-770-1 augmented examination program is not changed by the RI-ISI application and will remain in effect.

6. The Risk Ranking and Risk Impact Analysis were updated to include PWSCC as a potential degradation mechanism for the following welds:

   1-4100A-16(DM)
   1-4100A-32(DM)
   1-4200A-16(DM)
   1-4200A-29(DM)

1-4300A-16(DM)
1-4300A-30(DM)

It was also noted that the following steam generator inlet and outlet dissimilar metal welds were inlayed with Alloy 690 material during steam generator replacement in 1994:

1-4100A-31 (DM)	S/G 2A Inlet
1-4100A-32 (DM)	S/G 2A Outlet
1-4200A-28 (DM)	S/G 2B Inlet
1-4200A-29 (DM)	S/G 2B Outlet
1-4300A-29 (DM)	S/G 2C Inlet
1-4300A-30 (DM)	S/G 2C Outlet

Although these welds were administratively noted as potentially having PWSCC as a degradation mechanism in the RI-ISI Program, the Code Case N-770-1 Program superseded the RI-ISI Program for these welds during the Third Interval. During the Fourth Interval the susceptibility of these welds will be determined and their corresponding examinations will be performed in accordance with the version of Code Case N-770 that is referenced in the published version of 10CFR50.55a as discussed under "Augmented Examination Requirements".

7. The Risk Ranking Summary, Matrix and Report and Risk Impact Analysis were updated to remove welds beneath weld overlays which are subject to a separate examination program.

As a result of incorporating these changes from the Third Period as well as the change identified in the Second Period, the number of elements selected for inspection decreased from 109 to 90. The total risk (both CDF and LERF) remained decreased when compared to that under the original deterministic Section XI program when POD is considered, and essentially unchanged without consideration of POD.

During the review after the First Period of the Fourth Interval, the following changes were identified and incorporated into the RI-ISI Program:

1. In refueling outage RF22, weld 2-2104-6 had limited examination coverage. Weld 2-2204-6 was chosen to supplement the examination of weld 2-2104-6. This additional selection is documented in the Risk Ranking Summary and Report.

2. During the First Period of the Fourth Interval the PRA model changed from Version 7 to Version 8a. As a result of the change in PRA model, the Consequence Ranking changed for 58 Consequence IDs and the associated 82 segments. The Consequence Evaluation, Element Selections, Risk Ranking Summary, Matrix and Report and Risk Impact Analysis were updated to reflect these changes.

3. Per Version 8a of the PRA Model, the Upper Bound CCDP used in the Risk Impact Analysis is 2.63E-03 and the Upper Bound CLERP is 1.10E-03. The Risk Impact Analysis was updated to reflect the new Upper Bound CCDP and CLERP. The

Risk Impact remained negative (i.e., a decrease in overall risk) with POD considered, and negligible without POD.

4. During the RI-ISI Evaluation and Update for the First Period of the Fourth Interval it was determined that ASME Section XI, Nonmandatory Appendix R and Code Case N-578-1 should be referenced for guidance of the RI-ISI Program application.

As a result of incorporating these changes from the First Period of the Fourth Interval, the number of elements selected for inspection increased from 90 to 97. The total risk (both CDF and LERF) continued to be lower than that under the original deterministic Section XI program when POD is considered, and essentially unchanged without consideration of POD.

On October 30, 2017, SCE&G initially submitted Relief Request No. RR-4-13 to the NRC for review and approval. On February 15, 2018, the NRC sent a Request for Additional Information concerning Relief Request RR-4-13. Question RAI No. 3 asked about a potential change in the consequence ranking for a number of locations from Medium to High based on the increase in the medium loss of coolant (LOCA) frequency. The Consequence Keys in the PRA Model impacted by this change are CL A, CL B and CL C. The change from Medium Consequence to High Consequence for these Consequence keys resulted in 17 welds in the SI system moving from Medium Risk (Risk Category 5a) to High Risk (Risk Category 2) and 141 welds in the SI system moving from Low Risk (Risk Category 6a) to Medium Risk (Risk Category 4). As a result, an additional 18 welds were selected for RI-ISI examination. The Risk Impact Analysis was updated to reflect these changes. As discussed below, the Risk Impact was negative (i.e., a decrease in overall risk) whether or not enhanced POD values are considered.

<u>Risk Impact Analysis</u>

All issues identified in the Periodic Reviews have been incorporated into the Risk Ranking, Summary, Matrix and Report. Limits are imposed by the EPRI methodology to ensure that the change in risk of implementing the RI-ISI program meets the requirements of Regulatory Guides 1.174 and 1.178. The EPRI criterion requires that the cumulative change in core damage frequency (CDF) and large early release frequency (LERF) be less than 1E-07 and 1E-08 per year per system, respectively. A new Risk Impact Analysis was performed, and the revised program continues to represent a risk reduction when compared to the last deterministic Section XI inspection program when POD is considered. The revised program represents an overall reduction of plant risk of -1.17E-08 in regards to CDF and -4.86E-09 in regards to LERF. Note that a negative value in the Risk Impact Analysis represents a decrease in risk.

As indicated in the VCSNS Risk Impacts Results table, this evaluation has demonstrated that unacceptable risk impacts will not occur for any system from implementation of the RI-ISI program regardless of whether or not the enhanced POD is credited for the RI-ISI examinations.

VCSNS Risk Impact Results

System	$\Delta Risk_{CDF}$		$\Delta Risk_{LERF}$	
	w/ POD	w/o POD	w/ POD	w/o POD
CS	-3.40E-09	-1.92E-09	-1.42E-09	-7.99E-10
EF	-2.40E-11	0.00E-00	-2.40E-12	0.00E-00
FW	-1.20E-11	0.00E-00	-1.20E-12	0.00E-00
MS	-5.26E-11	-5.26E-11	-2.20E-11	-2.20E-11
RC	-4.72E-09	3.29E-10	-1.97E-09	1.38E-10
RHR	-7.28E-10	-8.89E-11	-2.99E-10	-3.40E-11
SI	-2.74E-09	1.05E-09	-1.14E-09	4.44E-10
SP	-1.32E-11	-1.32E-11	-5.50E-12	-5.50E-12
SW	Negligible	Negligible	Negligible	Negligible
Total	**-1.17E-08**	**-6.98E-10**	**-4.86E-09**	**-2.79E-10**

Augmented Examination Programs

The following augmented inspection programs were considered during the RI-ISI application:

- The augmented examination program for flow accelerated corrosion (FAC) per Generic Letter 89-08 is relied upon to manage this damage mechanism but is not otherwise affected or changed by the RI-ISI program.
- The augmented examinations for thermal fatigue in non-isolable reactor coolant system branch lines are performed in accordance with MRP-146 which is relied upon to manage this damage mechanism but is not otherwise affected or changed by the RI-ISI program.
- The augmented inspection program for the service water intake and piping is addressed in Procedure ES-505, "Service Water System Corrosion Monitoring and Control Program." This procedure is relied upon to manage this damage mechanism (i.e., Microbiologically Influenced Corrosion (MIC) and Pitting (PIT)) but it is not otherwise affected or changed by the RI-ISI program.
- The augmented visual examinations for pressure retaining welds in Class 1 components fabricated with Alloy 600/82/182 materials are performed in accordance with Code Case N-722-1 which is relied upon to manage the damage mechanism of PWSCC but is not otherwise affected or changed by the RI-ISI program.
- The augmented examinations and acceptance standards for Class 1 piping and vessel nozzle butt welds fabricated with UNS N06082 or UNS W86182 weld filler metal were performed during the Third Interval in accordance with Code Case N-770-1 which was relied upon to manage the damage mechanism of PWSCC but was not otherwise affected or changed by the RI-ISI Program. Note that welds selected for examination in

accordance with Code Case N-770-1 were considered as part of the RI-ISI population such that they were evaluated for other potential degradation mechanisms. However, they were excluded from selection under the RI-ISI Program. In the Fourth Interval these examinations will be performed in accordance with the version of Code Case N-770 that is referenced in the published version of 10CFR50.55a. Per the Final Rule for 10CFR50.55a dated August 17, 2017, Code Case N-770-2 is the current applicable version.

Additional Examinations

Whenever RI-ISI examinations reveal flaws or relevant conditions exceeding acceptance standards, additional examinations shall be performed during the current outage using the criteria of ASME Section XI, Nonmandatory Appendix R, Section R-2430.

Proposed ISI Program Plan Change Request

VCSNS requests to submit RI-ISI application in accordance with 10CFR50.55a(z)(1). A comparison between the proposed RI-ISI program and the previously approved RI-ISI Program is provided in Attachment 2.

VCSNS completed the First Period of its Fourth Interval on June 1, 2017. Up until this point, 29.1% of Examination Category B-F, B-J, C-F-1, and C-F-2 weld examinations have been completed in the interval. Beginning in the Second Period of the Fourth Interval, the examinations determined by the RI-ISI process will replace those selected per ASME Section XI criteria. Since 29.1% of the examinations have been completed thus far in the Fourth Interval, 70.9% of the RI-ISI examinations will be performed during the remaining refueling outages in the Fourth Interval. Note that this is the same proration approach that was requested and approved by the NRC in Relief Request RR-II-07. In addition, in order to maintain consistency between examinations in the Third Interval and Fourth Interval, welds selected for examination per ASME Section XI during the First Period of the Fourth Interval corresponded with welds previously selected per the RI-ISI application during the First Period of the Third Interval. Subsequent ISI intervals will implement 100% of the examination locations selected per the RI-ISI program. Examinations shall be performed during the interval such that the period examination percentage requirements of ASME Section XI, paragraphs IWB-2412 and IWC-2412 are met.

The Risk-Informed process continues to provide an adequate level of quality and safety for selection of the Class 1 and Class 2 Piping Welds for examination. Therefore, pursuant to 10CFR50.55a(z)(1) it is requested that the proposed alternative be authorized.

7. PRA Quality

Reference Attachment I Summary Statement of VCSNS Unit 1 PRA Model Capability for use in Risk-Informed Inservice Inspection Program Licensing Actions.

8. Duration of Proposed Alternative:

The alternative will be used at VCSNS until the end of the Fourth Ten-Year ISI Interval, subject to the review and update guidance of NEI 04-05. The Fourth Ten-Year ISI Interval is currently scheduled to end on December 31, 2023.

9. Precedents:

The proposed alternative in this 10CFR50.55a Request was included in a Third Interval Relief Request for VCSNS. This Relief Request was submitted to the NRC for approval per 10CFR50.55a(a)(3)(i) in VCSNS Letter No. RC-04-0148, dated September 8, 2004. Based upon the information provided in the RI-ISI template, the request to implement the RI-ISI methodology on Class 1 and 2 piping welds was approved by the NRC for VCSNS's Third Ten-Year ISI Interval in letter dated September 6, 2005 (TAC No. MC4323) (ML052300616).

10. References:

1. ASME Code Section XI, Division 1, 2007 Edition through 2008 Addenda
2. Electric Power Research Institute (EPRI) Topical Report (TR) 112657 Rev. B-A, Revised Risk Informed Inservice Inspection Procedure.
3. ASME Code Case N-578-1, Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method B Section XI, Division 1.

VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12

ATTACHMENT 1

Updated VCSNS – Inspection Location Selection Comparison Between Previously Approved and Revised RI-ISI Program by Risk Category

System	Risk		Consequence Rank	Failure Potential		Previously Approved (Third Interval)		Updated (Fourth Interval)		Code Class
	Category	Rank		DMs	Rank	Weld Count[1]	RI-ISI[1]	Weld Count[1]	RI-ISI[1]	
01RC	2	High	High	TASCS, TT	Medium	23	8	23	9	1
01RC	2	High	High	TASCS	Medium	2	0	2	0	1
01RC	2	High	High	TT	Medium	36	7	36	7	1
01RC	2	High	High	TT (PWSCC)	Medium	4	2	-	-	1
02RHR	2	High	High	TASCS	Medium	5	2	5	2	1
03SI	2	High	High	TASCS, TT	Medium	7	4	7	4	1
03SI	2	High	High	TASCS	Medium	13	1	13	1	1
03SI	2	High	High	TT	Medium	8	2	18	3	1
03SI	2	High	High	IGSCC	Medium	-	-	3	2	1
03SI	2	High	High	TT, IGSCC	Medium	-	-	4	2	1
04CS	2	High	High	TASCS, TT	Medium	7	1	7	1	1
04CS	2	High	High	TT	Medium	18	6	18	6	1
08EF	2	High	High	TT	Medium	3	1	-	-	2
01RC	4	Medium	High	None	Low	172	18	166	19	1
01RC	4 (2)	Medium (High)	High	None (PWSCC)	Low (Medium)	18	4[2]	16	0[2]	1
02RHR	4	Medium	High	None	Low	3	3	3	3	1
						50	3	50	3	2
03SI	4	Medium	High	None	Low	28	13	169	14	1
						187	9	187	22	2
04CS	4	Medium	High	None	Low	11	2	43	5	1
05SP	4	Medium	High	None	Low	7	1	7	1	2
08EF	4	Medium	High	None	Low	5	1	-	-	2
06MS	4	Medium	High	None	Low	-	-	35	4	2
02RHR	5a	Medium	Medium	TASCS	Medium	6	1	6	1	2
03SI	5a	Medium	Medium	IGSCC	Medium	16	2	13	2	1
03SI	5a	Medium	Medium	TT, IGSCC	Medium	4	1	-	-	1
03SI	5a	Medium	Medium	TT	Medium	10	0	-	-	1
04CS	5a	Medium	Medium	TT	Medium	4	1	2	1	1
07FW	5a	Medium	Medium	TASCS	Medium	7	1	7	1	2
08EF	5a	Medium	Medium	TT	Medium	-	-	3	2[3]	2
01RC	6a	Low	Medium	None	Low	7	0	-	-	1
02RHR	6a	Low	Medium	None	Low	18	0	18	0	1
						219	0	219	0	2
03SI	6a	Low	Medium	None	Low	284	0	143	0	1
						235	0	127	0	2

System	Risk		Consequence Rank	Failure Potential		Previously Approved (Third Interval)		Updated (Fourth Interval)		Code Class
	Category	Rank		DMs	Rank	Weld Count[1]	RI-ISI[1]	Weld Count[1]	RI-ISI[1]	
04CS	6a	Low	Medium	None	Low	96	0	-	-	1
						310	0	35	0	2
05SP	6a	Low	Medium	None	Low	226	0	226	0	2
06MS	6a	Low	Medium	None	Low	143	0	108	0	2
07FW	6a (3)	Low (High)	Medium	None (FAC)	Low (High)	15	0	15	0	2
07FW	6a	Low	Medium	None	Low	52	0	52	0	2
08EF	6a	Low	Medium	None	Low	75	0	80	0	2
09SW	6a (5a)	Low (Medium)	Medium	None (MIC, PIT)	Low (Medium)	35	0	-	-	2
04CS	6b	Low	Low	TT	Medium	-	-	2	0	1
01RC	7a	Low	Low	None	Low	-	-	7	0	1
03SI	7a	Low	Low	None	Low	33	0	141	0	2
04CS	7a	Low	Low	None	Low	-	-	64	0	1
						-	-	270	0	2
05SP	7a	Low	Low	None	Low	14	0	14	0	2
09SW	7a (6b)	Low (Low)	Low	None (MIC, PIT)	Low (Medium)	-	-	35	0	2
Total						**2416**	**94**	**2399**	**115**	

Notes: 1. A dash shown under "Weld Count" or "RI-ISI" indicates that due to changes in Risk Rankings, there were no welds for that particular listing in the given interval.

2. In accordance with 10CFR50.55a(g)(6)(ii)(F), welds subject to PWSCC were selected for examination per Code Case N-770-1 during the Third Interval and examined under that program. Welds for which no other degradation mechanism has been postulated, were examined solely under the Code Case N-770-1 Program and were removed from consideration during the RI-ISI element selection process. During the Fourth Interval this same process will be followed using the version of Code Case N-770 that is referenced in the published version of 10CFR50.55a.

3. A second Class 2 weld in the EF system, Risk Category 5a was selected to supplement a Third Interval selection which had limited coverage.