VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

PROPRIETARY INFORMATION – WITHHOLD UNDER 10CFR2.390

February 14, 2012

10CFR50.90

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.	12-028
SPS/LIC-CGL	R1
Docket Nos.	50-280/281
License Nos.	DPR-32/37

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
RELATED TO LICENSE AMENDMENT REQUEST FOR
PERMANENT ALTERNATE REPAIR CRITERIA
FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

By letter dated July 28, 2011 (Serial No. 11-403), Dominion requested a license amendment request in the form of a change to the Technical Specifications (TS) to Facility Operating License Numbers DPR-32 and DPR-37, for Surry Power Station Units 1 and 2, respectively. This amendment request proposes to permanently revise TS 6.4.Q, "Steam Generator (SG) Program," to exclude portions of the SG tube below the top of the SG tubesheet from periodic inspections and to revise TS 6.6.A.3, "Steam Generator Tube Inspection Report," to provide reporting requirements specific to the permanent alternate repair criteria.

An NRC letter, dated January 18, 2012 [ADAMS Accession No. ML12006A001], provided a request for additional information (RAI) regarding the permanent alternate repair criteria amendment request for Surry. The response to the RAI is contained in this letter. Attachment 1 provides the proprietary version of the RAI responses to Questions 1, 3, 4, 5, 7, 8, 9, and 14 prepared by Westinghouse. Attachment 2 provides the non-proprietary version of the RAI responses to Questions 1, 3, 4, 5, 7, 8, 9, and 14 prepared by Westinghouse. Attachment 3 is Westinghouse letter CAW-12-3370, "Application for Withholding Proprietary Information from Public Disclosure," with accompanying affidavit. Attachment 4 provides the Dominion responses to Questions 12 and 15. Related to Question 15, marked-up and proposed TS pages reflecting the revised primary to secondary leakage limit of 83 gallons per day are provided in Attachments 5 and 6, respectively. Note that question numbers 2, 6, 10, 11, and 13 were not used in the Surry RAI to preserve consistency with the recently issued RAI for Catawba Unit 2; those questions for Catawba are not applicable to Surry.

ATTACHMENT 1 CONTAINS PROPRIETARY INFORMATION THAT IS BEING WITHHELD FROM PUBLIC DISCLOSURE UNDER 10CFR2.390. UPON SEPARATION OF ATTACHMENT 1, THIS PAGE IS DECONTROLLED.

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Attachment 1 contains information proprietary to Westinghouse Electric Company LLC, and it is supported by the affidavit in Attachment 3 signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10CFR2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information, which is proprietary to Westinghouse, be withheld from public disclosure in accordance with 10CFR2.390. Correspondence with respect to the copyright or proprietary aspects of Attachment 1 or the supporting Westinghouse affidavit should reference letter CAW-12-3370 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, PA 16066.

The RAI response provided by this letter does not affect the significant hazards consideration determination or the environmental consideration that was previously provided in support of the permanent alternate repair criteria amendment request.

As stated in our July 28, 2011 letter, approval of this amendment request for the Units 1 and 2 permanent alternate repair criteria is requested by April 2, 2012 with a 30-day implementation period to support the Surry Unit 1 Refueling Outage 24 (Spring 2012), since the Unit 1 existing one-time alternate repair criteria approved by Unit 1 Amendment 267 expires at the end of the current operating cycle. This amendment will be implemented prior to the 200 degree F mode change during startup following the Unit 1 Refueling Outage 24.

If you have any questions or require additional information, please contact Mr. Gary Miller at (804) 273-2771.

Sincerely,

J. Alan Price
Vice President – Nuclear Engineering

VICKI L. HULL
Notary Public
Commonwealth of Virginia
140542
My Commission Expires May 31, 2014

COMMONWEALTH OF VIRGINIA)

COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by J. Alan Price who is Vice President – Nuclear Engineering, of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 14TH day of February, 2012.

My Commission Expires: May 31, 2014.

Vicki L. Hull
Notary Public

Attachments:
1. Proprietary Version of the RAI Responses to Questions 1, 3, 4, 5, 7, 8, 9, and 14 (Westinghouse Letter LTR-SGMMP-11-29 Rev. 1 P- Attachment)
2. Non-proprietary Version of the RAI Responses to Questions 1, 3, 4, 5, 7, 8, 9, and 14 (Westinghouse Letter LTR-SGMMP-11-29 Rev. 1 NP- Attachment)
3. Westinghouse Electric Company LLC Letter CAW-12-3370, "Application for Withholding Proprietary Information from Public Disclosure"
4. RAI Responses to Questions 12 and 15
5. Marked-up Technical Specifications Pages
6. Proposed Technical Specifications Pages

Commitments made in this letter:
1. The SG tube inspection program/CMOA for both units includes the commitment for continuing tube slippage monitoring.
2. An administrative operational leakage limit associated with the PARC and the 1.80 leakage factor will be established in the CMOA starting with the Unit 1 Spring 2012 RFO and the Unit 2 Fall 2012 RFO.

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ATTACHMENT 2

NON-PROPRIETARY VERSION OF THE RAI RESPONSES TO QUESTIONS 1, 3, 4, 5, 7, 8, 9, AND 14 (WESTINGHOUSE LETTER LTR-SGMMP-11-29 REV. 1 NP- ATTACHMENT)

RELATED TO LICENSE AMENDMENT REQUEST FOR PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2

Response to USNRC Request for Additional Information Regarding the Surry Units 1 & 2 License Amendment Request for Permanent Application of the Alternate Repair Criterion, H*

Westinghouse Electric Company LLC
1000 Westinghouse Drive
Cranberry Township, PA 16066, USA

References:

1. Dominion Letter, 11-403, "Surry Power Station Units 1 and 2 – License Amendment Request – Permanent Alternate Repair Criteria for Steam Generator Tube Inspection and Repair," July 28, 2011, ADAMS Accession No. ML112150144.
2. USNRC Letter, "Surry Power Station Units 1 and 2-Request for Additional Information Regarding the Steam Generator License Amendment Request to Revise Technical Specifications for Permanent Alternate Repair Criteria (TAC Nos. ME6803 and ME6804)," January 18, 2012.
3. Duke Energy Letter, "Duke Energy Carolina (Duke Energy) Catawba Nuclear Station, Units 1 and 2 Docket Numbers 50-413 and 50-414, Proposed Technical Specification (TS) Amendment, TS 3.4.13, "RCS Operational Leakage," TS5.5.9, "Steam Generator (SG) Program," TS 5.6.8, "Steam Generator (SG) Tube Inspection Report," License Amendment Request to Revise TS for Permanent Alternate Repair Criteria, June 30, 2011.
4. E-mail from USNRC (Andrew Johnson) to Duke Energy (Jon Thompson) transmitting NRC Letter, "Catawba Nuclear Station, Request for Additional Information Regarding the Steam Generator License Amendment Request to Revise Technical Specification for Permanent Alternate Repair Criteria," November 15, 2011. (ADAMS Accession No. ML120090321)
5. LTR-SGMMP-11-28 P-Attachment, "Response to USNRC Request for Additional Information Regarding the Catawba License Amendment Request for Permanent Application of the Alternate Repair Criterion, H*," January 4, 2012.
6. SG-SGMP-11-16, "H* Technical Basis Independent Review by MPR Associates: Technical Questions and Responses," April 2011

Introduction

In Reference 1, Dominion Generation submitted a license amendment request (LAR) for permanent application of the alternate repair criterion H* at Surry Units 1 and 2. Reference 2 transmitted the NRC request for additional information (RAI) regarding the Dominion Generation LAR for permanent application H* for Surry Units 1 and 2.

Prior to the Dominion Generation LAR for Surry, Duke Energy had submitted a LAR for permanent application of H* at Catawba Unit 2 (Reference 3). Whereas the Surry technical justification is contained in WCAP-17345-P, Revision 2, the Catawba technical justification is contained in WCAP-17330-P, Revision 1. Although the questions in Reference 2 and Reference 4 are quite similar, some of them do not apply for Catawba and others require different numerical information for Surry than those in Reference 4 for Catawba. Consequently, the responses contained in this document respond specifically to the questions contained in Reference 2 and are specific to WCAP-17345-P, Revision 2. A separate response, Reference 5, was provided for the questions contained in Reference 4.

The Model 44F SG technical justification is also contained in WCAP-17345-P, Revision 2. LAR submittals by several utilities for permanent application H* for the Model 44F steam

generators (SGs) are anticipated. Because the need for the Surry responses to Reference 2 is immediate, the responses provided in this document may not be sufficient for the Model 44F SGs. Should this be the case, a revision to these responses will be issued that provides the complete information for the Model 44F SGs.

The questions from Reference 2 that require Westinghouse responses are reproduced below followed by the response. Responses to questions 12 and 15 will be provided by Dominion Generation.

Question 1:

> *WCAP-17345-P, Revision 2 - The footnote on page 3-53 states that Figure 3-36 shows the same data as Figure 3-32 in Revision 0 of the WCAP, but without the data that correspond to negative tubesheet CTE variation. The footnote states that while only a few percent of the data shown in Figure 3-32 of Revision 0 reflect negative values of tubesheet CTE, these cases do result in upward scatter, but must be included to properly represent the top 10% of the Monte Carlo rank order results. This being the case, why does Figure 3-36 in Revision 2 properly represent the top 10% of the Monte Carlo rank order results? Why are the minimum H* values in Figure 3-36 of Revision 2 substantially different from those in Figure 3-32 of Revision 0?*

Response:

The footnote on page 3-53 of WCAP-17345-P, Revision 2 erroneously states that Figure 3-36 in WCAP-17345-P, Revision 2 and Figure 3-32 in WCAP-17345-P, Revision 0 are from the same database. The title of Figure 3-36 in WCAP-17345-P, Revision 2 is correct; it applies to the Model D5 SG at normal operating (NOP) conditions. Figure 3-32 in WCAP-17345-P, Revision 0 applies to the Model F SGs at NOP conditions. Because the figures apply to different models of SGs, the H* values are also different.

A prior NRC staff question (Ref: February 2011 meeting with the NRC staff) challenged the data scatter in Figure 3-32 in WCAP-17345-P, Revision 0 and other similar figures, specifically in the context of the efficacy of the "break-line" concept. Figure 3-36 in WCAP-17345-P, Revision 2 shows the value of H* against the value of alpha (α), the square root of the sum of the squares of the component pairs of Monte Carlo selected values of coefficients of thermal expansion (CTE) of the tubesheet and the tube.

The footnote on page 3-53 of WCAP-17345-P, Revision 2 correctly notes that scatter in the Revision 0 figures is the result of the Monte Carlo process that results in samples with negative variations of the tubesheet coefficient of thermal expansion with corresponding large negative variations in tube coefficient of thermal expansion. It is known from the prior work that the maximum values of H* are likely to occur at positive variations of tubesheet CTE and negative variations of tube CTE. In the Monte Carlo analysis, described further in the response to Question 3, approximately half of the H* values include a negative variation

of tubesheet CTE and a corresponding large negative variation of tube CTE; however, the frequency of occurrence in the rank order range of interest is low.

As noted above, the probabilistic response surface is presented in terms of the combined variable α, the square root of the sum of the squares of the individual tube and tubesheet (TS) CTE components. The SRSS combination of tube and tubesheet variables negates the sign of the negative variation of both the tube and TS CTE and artificially inflates the value of α, resulting in the upward data scatter shown on Figure 3-32 in WCAP-17345-P, Revision 0.

To address this issue in the H* analysis, Monte Carlo picks with a negative variation in TS CTE were assigned an H* value corresponding to a TS CTE variation of zero but with the Monte Carlo selected value of tube CTE. The complete process used for these points, discussed in the response to Question 3, results in a conservative value of H*.

Question 2:

Question 2 in Reference 4 does not apply to Surry as noted in Reference 2.

Response:

None required.

Question 3:

WCAP-17345-P, Revision 2, Section 3.4 – Confirm that the Monte Carlo analyses performed for the Model 51F SGs using the thick shell model are based upon sampling of the full H/CTE response surfaces in Figure 8-5 of WCAP 17092 Rev 0. If this is incorrect, and only a "reduced" response surface is used, explain how the reduced response surfaces are used in the Monte Carlo analysis. If for a particular Monte Carlo iteration a negative variation of tubesheet CTE is randomly generated, what is done with this value (e.g., is tubesheet CTE assumed to have nominal value)? Why doesn't the use of a reduced response surface bias the rank ordering above 90% in the non-conservative direction?*

Response:

The Monte Carlo sampling for both the Model 44F and 51F steam generators is based on sampling the full H*/CTE response surfaces in Figure 8-5 of WCAP 17091-P and WCAP 17092-P, Revision 0, which are based on application of the thick-shell model.

The Monte Carlo process randomly samples from the response surface by means of an interpolation scheme. In approximately half of the cases, the sampling results have negative tubesheet CTEs. Because the ultimate objective is to define specific combinations of

tubesheet and tube CTEs that represent a specific rank order of H* values for input to the C^2 model, the salient question is how points with negative tubesheet CTEs are treated in the probabilistic calculation of H* using the C^2 model.

Each of the 10,000 simulations in the general Monte Carlo procedure uses the following process:

1. Pick a random normal deviate to represent the tubesheet CTE variation.
2. Pick a random normal deviate for each tube in the steam generator to represent the tube CTE variation.
3. For each tube, assign an H* value corresponding to the current tubesheet CTE variation and the tube's CTE variation by interpolating an H* value on the response surface. If the tubesheet CTE variation is negative, interpolate as though the tubesheet CTE variation is zero (i.e., mean value).
4. Apply sector ratios as discussed in LTR-SGMP-09-100 P Attachment , Rev. 1.
5. Store the largest H* value along with the corresponding tube and tubesheet CTE variations.

Steps 1-5 represent one iteration of the Monte Carlo process. This process is repeated 10,000 times, and the results sorted in ascending order by H* value.

Step 3 of the process slightly distorts the rank order of the H* values because artificially higher values of H* are assigned to the combination of randomly selected CTEs when the selected tubesheet CTE is negative. The true H* rank order of these cases is lower than the apparent value of H* for these cases. The effect is to displace the rank order of H*s with positive values of tubesheet CTE to lower positions in the H* vector.

In order to obtain, the 95/50 full bundle H* value, the 9500^{th} value in the H* rank order is chosen. In the event that the 9500^{th} value contained a negative tubesheet CTE variation, the next higher rank order value with a positive tubesheet CTE was chosen. In practice, only one or two rank orders needed to be traversed to find an H* with a positive tubesheet variation. The parameters associated with this value were used in the calculation of H* with the C^2 model. Since higher rank orders are more conservative (larger H* distance), the process of using the first higher rank order with a positive tubesheet CTE variation is conservative. The same process is utilized when determining the H* value for the higher probabilistic goals applicable to the Model 51F and 44F SGs, that is, the 95/95 whole plant value of H*.

Question 4:

WCAP-17345-P, Revision 2, Table 3-28 - Provide a similar table applicable to the Model 51F NOP case, for the appropriate range of rank orders centered about the 9874 rank order value.

Response

Table 4-1 provides the requested information. (Please note that it was clarified by e-mail that the desired centerpoint of the table is rank order 9834.)

Table 4-1
Variation of CTEs Over a Range of Rank Order Statistics for Model 51F

a,c,e

Rank	H*	Tube CTE	Tubesheet CTE	Alpha[1]
9828				
9829				
9830				
9831				
9832				
9833				
9834				
9835				
9836				
9837				
9838				
9839				
9840				

Notes:
1. Defined as SQRT((Tube CTE)^2 + (Tubesheet CTE)^2)

Question 5:

WCAP-17345-P, Revision 2, Table 3-29 - Provide C^2 H values for rank orders 9888 and 9892. This will lend additional confidence to inferences drawn from this table on page 3-56. In addition, provide a similar table applicable to the Model D5 SLB case. [Note, this question is essentially the same as question 5 in the Catawba RAI. Although the requested information is specific to Model F and D5 SGs, the staff believes that the inferences to be drawn from this information should be equally applicable to the Surry Model 51F SGs. Thus, the staff is not requesting a table similar to 3-29 that is specifically applicable to the Model 51F SGs. However, if the data already exists for Model 51F SGs, please submit that in lieu of the data for the Model D5 SGs.]*

Response:

The data for the Model 44F and Model 51F SGs are not currently available. To generate the data requires multiple FEA analyses. While feasible to perform, the schedule to do so is incompatible with the near-term licensing review objectives for the Surry LAR.

Analysis code note: The structural code employed for the prior H* calculations was *ANSYS Workbench*, Version 11. Version 12.1 of *ANSYS Workbench* was released following the issue of WCAP-17330-P, Revision 1. The updates to this version of *ANSYS Workbench* include changes to the contact modelling and solver options. Westinghouse has benchmarked and configured this version of the *ANSYS* code and has verified the results and conclusions of the previous H* analyses obtained with Version 11. However, there are minor numerical differences in the results. The net difference of applying version 12.1 of the ANSYS code compared to version 11 of the *ANSYS* code is a slight variation in the average circumferential contact pressure, typically on the order of ± 40 psi. Version 11 generally produces the lower contact pressures. Consequently, there may be small differences in the values provided for points already included in WCAP-17330-P, Revision 1.

Table 5-1 provides the requested additional probabilistic Model F NOP results at a [ ]^{a,c,e} inch radius for rank orders 9888 and 9892. Table 5-2 provides the requested probabilistic Model D5 SLB results at an [ ]^{a,c,e} inch radius for rank orders from 9533 through 9539.

Table 5-1: Model F NOP Results at [ ]^{a,c,e} inches

Variation Input			
MC	T CTE	TS CTE	C^2 H*
#	$n\sigma$	$m\sigma$	in.
9888	[ ]^{a,c,e}	[ ]^{a,c,e}	[ ]^{a,c,e}
9892	[ ]^{a,c,e}	[ ]^{a,c,e}	[ ]^{a,c,e}

Table 5-2: Model D5 SLB Results at [ ]a,c,e inches

Variation Input			
MC	T CTE	TS CTE	C^2 H*
#	$n\sigma$	$m\sigma$	in.
9533	[ ] a,c,e	[ ] a,c,e	[ ] a,c,e
9534	[ ] a,c,e	[ ] a,c,e	[ ] a,c,e
9536	[ ] a,c,e	[ ] a,c,e	[ ] a,c,e(1)
9538	[ ] a,c,e	[ ] a,c,e	[ ] a,c,e
9539	[ ] a,c,e	[ ] a,c,e	[ ] a,c,e
Notes: (1) Refer to LTR-SGMP-11-58, "WCAP-17330-P Revision 1 Erratum"			

Although the uncertainty in the narrow range of rank order H* values for the Model D5 (Table 5-2) is slightly larger than the uncertainty for the Model F (Table 5-1 and Table 3-29 of WCAP-17330-P, Rev. 1), the inferences drawn from these data on page 3-56 of WCAP-17330-P, Rev. 1 remain valid. It is expected that small variations will occur due to factors such as variation in extremely small absolute values of the structural displacements (e.g., due to round-off effects) that are the inputs to the C^2 model. This uncertainty is on the order of 2% of the final H* value, which is more than adequately covered by other conservatisms in the H* value that are discussed in the responses to the other questions.

Question 6:

Question 6 in Reference 4 does not apply to Surry as noted in Reference 2.

Response:

None required.

Question 7:

WCAP-17345-P, Revision 2, Tables 3-34 to 3-48 - The numerical methods used to generate the accumulated pullout loads in these tables appear to contain two sources of non-conservatism. One, the distance below the top of the tubesheet (TTS) where the contact pressure transitions from zero to a positive non-zero value is assumed to be the lowermost elevation for which a C^2 calculation was performed and yielding a zero value contact pressure. The staff believes a more realistic and more conservative estimate of the contact pressure zero intercept value can be obtained by extrapolating the C^2 results at lower elevations to the zero intercept location. Two, the method used to interpolate the H distance between specific locations where C^2 analyses were performed assumes that the distribution of contact pressure between these locations is a constant value equal to average value between these locations. Provide revisions to Tables 3-34 to 3-48, if and as needed, to address the staff's concern.*

Response

Figure 3-26 in WCAP-17345-P, Revision 2 shows the contact pressure distribution at the critical radius [ ]a,c,e inches for the Model 51F SGs as determined in Table 3-22 of the report. Table 3-16 of WCAP-17345-P, Revision 2 contains the numerical data that supports Figure 3-26. The last calculated zero-contact-pressure point is at approximately [ ]a,c,e inches from the top of the tubesheet and the first non-zero contact pressure point is at [ ]a,c,e inches from the top of the tubesheet with a contact pressure of [ ]a.c.e psi. Because the pullout force is an integration of the contact pressure profile, the area under the curve resulting from linear extrapolation of the first two non-zero points is negligible and does not significantly affect the calculation of the H* depth.

Figure 3-20 in WCAP-17345-P, Revision 2 shows the contact pressure distribution at the critical radius [ ]a,c,e inches for the Model 44F SGs as determined in Table 3-22 of the report. Unless the first non-zero contact pressure point is ignored, extrapolation of the first two non-zero data points results in positive contact pressure between the tube and the tubesheet. In this case, the H* distance could be reduced to account for the resulting positive contact pressure at the top of the tubesheet. Because there is no reason to reject the first non-zero contact pressure point, it is concluded that the extrapolation suggested in the question is not a realistic approach.

As discussed in Reference 5, linear extrapolation of data points to determine a presumed zero contact pressure intercept, while conservative, is not realistic. While a higher point density in the contact pressure curve would likely provide more certainty in the result, the current density of points is considered to be adequate. Reference 5 notes that the addition of more axial points of calculation tends to smooth out the transition in the contact pressure profile. A sharp break in the contact pressure curve would not be expected in the physical structure; rather, a smooth transition from zero to non-zero contact pressure would be expected.

The small, potential conservatism added by extrapolating the contact pressure profile as suggested in the question for the Model 51F SGs is more than adequately accommodated by the previously un-quantified conservatism in the H* calculation discussed below.

Calculation of Conservatism in CTE Variances Used in Probabilistic Analysis

The CTE variances used in the probabilistic analysis were derived from a large set of heterogeneous data across a broad range of temperatures. Since the issuance of the first H* reports in 2009 (i.e., WCAP-17091-P and WCAP-17092-P), further analysis of CTE data at specific temperatures was performed in LTR-SGDA-11-87 in response to a question from the independent review by MPR Associates (Reference 6). (LTR-SGDA-11-87 is Reference 3-16 in WCAP-17345-P, Revision 2 and is provided as Appendix A in this document.) The additional statistical analysis was performed on the data to extract instrumentation uncertainty contributions (at high-confidence levels). Table 7-1 compares the values used in the analysis with the values from the more recent statistical analysis. Values are listed at 300° and 600°, the higher temperature values being pertinent to the Model 51F and 44F (3-loop) limiting conditions. As can be seen, the more accurately calculated values of CTE variance are significantly lower than those used in the current technical justification of H*.

The effect of applying the more realistic CTE variations on H* can be estimated by considering the ratio by which the standard deviations have been reduced. Since the difference between the mean H* and the probabilistic H* is entirely based on CTE differences, a first-order approximation to the reduction in H* length that would result from using the refined CTE variances can be obtained by multiplying the difference between the current mean and probabilistic H*'s by the above ratio. For conservatism, the more limiting of the tube/tubesheet CTE variance ratios from Table 7-2 were used.

Table 7-4 shows the effects of applying the improved CTE variability values to the H* analysis. Note that the H* values in Table 7-4 do not include crevice pressure or Poisson contraction because neither of these are related to CTE. As can be seen from Table 7-4, the recommended 95/95 whole plant H* length for the model 51F is conservative by approximately 3.2 inches and the recommended 95/95 whole plant H* length for the Model 44F's is conservative by approximately 4.4 inches. This shows that the current H* calculations are adequately conservative to account for small differences in judgment on the calculation process even without considering the major conservatisms identified previously

(i.e., neglecting residual contact pressure). Additional conservatism to further support this conclusion is identified below in the response to Question 8.

Table 7-1
CTE Values Without Instrumentation Error

Temperature (°F)	Tube CTE Standard Deviations, %		
	As used in WCAP-17345,Rev. 2	Improved 50% Confidence	Improved 95% Confidence
300	2.33	[ ]^{a,c,e}	[ ]^{a,c,e}
600	2.33	[ ]^{a,c,e}	[ ]^{a,c,e}
Temperature (°F)	**Tube Sheet CTE Standard Deviations, %**		
	As used in WCAP-17330,Rev. 1	**Improved 50% Confidence**	**Improved 95% Confidence**
300	1.62	[ ]^{a,c,e}	[ ]^{a,c,e}
600	1.62	[ ]^{a,c,e}	[ ]^{a,c,e}

Table 7-2
Ratio of CTE Variances (Improved/Used in Current H*)

Temperature (°F)	Tube CTE Standard Deviation Ratios	
	50% Confidence	95% Confidence
300	[ ]^{a,c,e}	[ ]^{a,c,e}
600	[ ]^{a,c,e}	[ ]^{a,c,e}
Temperature (°F)	**Tubesheet CTE Standard Deviation Ratios**	
	50% Confidence	**95% Confidence**
300	[ ]^{a,c,e}	[ ]^{a,c,e}
600	[ ]^{a,c,e}	[ ]^{a,c,e}

Table 7-3
Summary of H* Lengths from WCAP-17345, Revision 2

Model/Case	Mean H* (inches)	Probabilistic H* (inches)	Difference, Probabilistic – Mean	Limiting σ Ratio from Table 7-2
44F, 95/50 Whole Bundle	[			]
44F, 95/95 Whole Bundle				
44F, 95/50 Whole Plant				
44F, 95/95 Whole Plant				
51F, 95/50 Whole Bundle				
51F, 95/95 Whole Bundle				
51F, 95/50 Whole Plant				
51F, 95/95 Whole Plant				

a,c,e

Table 7-4
Estimate of Conservatism of H* Length Related to CTE Variance

Model/Case	Difference x Limiting Ratio(1)	New Probabilistic H*(2)	Difference (Licensed H* - New Probabilistic H*)
44F, 95/50 Whole Bundle	[		]
44F, 95/95 Whole Bundle			
44F, 95/50 Whole Plant			
44F, 95/95 Whole Plant			
51F, 95/50 Whole Bundle			
51F, 95/95 Whole Bundle			
51F, 95/50 Whole Plant			
51F, 95/95 Whole Plant			

a,c,e

(1) The product of the probabilistic minus mean H*times the limiting ratio (i.e. [ ]a,c,e)
(2) The sum of the mean H* and the adjusted probabilistic minus mean difference (i.e., [ ]a,c,e).

Question 8:

WCAP-17345-P, Revision 2, Figures 3-48 and 3-49 - These figures were generated with the thick shell model. Were "spot checks" performed with the C^2 model to determine whether adjustments to the curves in these figures are needed to approximate what the curves would look like if entirely generated with the C^2 model? If not, why are the curves in their present form conservative?

Response

The Model 51F contact pressure results reported for the normal operating (NOP) condition in WCAP-17345-P, Revision 2 are conservative with respect to the crevice pressure distribution. The contact pressure distributions developed in WCAP-17345-P, Revision 2 for the Model 51F and for the Model 44F assume that the crevice pressure is distributed over the full depth of the tubesheet. No "spot checks" were performed to test if the crevice pressure correction distribution as shown in Figures 3-48 and 3-49 of WCAP-17345, Revision 2, determined by the thick shell equations, required an adjustment when applied to the C^2 results. The adjustment to the final H* length in Table 3-51 of WCAP-17345-P, Revision 2 was made to be consistent with the methodology described in WCAP-17092-P, the 2009 H* technical justification for the Model 51F SGs and WCAP-17091-P, the 2009 technical justification for the Model 44F SGs.

The contact pressure results based on application of the C^2 model already represent a practical worst case with respect to crevice pressure, therefore, any further adjustment to the H* value using the curves shown in Figures 3-48 and 3-49 of WCAP-17345-P, Revision 2 is unnecessary. The basis of this conclusion is explained below.

As discussed in Section 6.4.8 of the original H* technical justification for the Model 51F and 44F SGs, WCAP-17092-P and WCAP-17091-P, respectively, the crevice pressure distribution was proportionally adjusted through the thickness of the tubesheet to reflect the predicted H* tube length because the tube below the postulated 360°, 100% through-wall flaw, is assumed to be absent. The crevice pressure at, and below, the flaw depth is the same as the primary side pressure. Increasing the crevice pressure over the length of the predicted H*, so that it is equal to the primary side pressure, reduces the tube to tubesheet contact pressure and increases the length of H*. Conversely, reducing the crevice pressure over the length of H* increases the tube to tubesheet contact pressure and decreases the length of H*.

The current contact pressure results for the Model 51F SGs (Figures 3-24 through 3-29 in WCAP-17345-P, Revision 2) show that there is zero contact pressure for a short distance below the top of the tubesheet at NOP conditions for tubesheet radii up through 30.193 inches. For the Model 44F SGs, Figures 3-18 through 3-23 in WCAP-17345-P, Revision 2 show that the contact pressures at nominal material properties are positive at all points below the top of the tubesheet. However, when the probabilistic material properties are applied, a length of zero contact pressure occurs near the top of the tubesheet (see Tables 3-38 through 3-42 in WCAP-17345-P, Revision 2). The H* length and the leakage factors are

calculated based on only the length of positive contact pressure. Therefore, the crevice pressure in the crevice below the top of the tubesheet to the point of departure from zero contact pressure experiences the full primary to secondary pressure differential because that length of crevice is at the secondary side pressure condition. Figure 8-1 shows a comparison of the unmodified crevice pressure distribution used in the C^2 analysis (i.e., the crevice pressure is distributed over the full depth of the tubesheet) and the crevice pressure distribution that has been adjusted to reflect the final contact pressure distribution reported in Table 3-48 in WCAP-17345-P, Revision 2 for the critical radius in the Model 51F SG and Table 3-46 for the Model 44F SG. In effect, the normalization of the crevice pressure distribution must be based on the shorter distance defined by the distance between the point of departure from zero-contact pressure to the predicted H* length (i.e., the location of the assumed flaw).

Regarding Figures 8-1(a and b), the differential pressure curve labelled "Unmodified" is based on the crevice pressure distribution applied over the full depth of the tubesheet. The normalized crevice pressure distribution from WCAP 17092-P and WCAP-17091-P shows the crevice pressure at the top of the tubesheet to be [ ]^{a,c,e} x P_{pri}, resulting in a differential pressure of [ ]^{a,c,e} for the Model 51F and similarly for the Model 44F. The "Modified" pressure differential curve is based on the full pressure differential applicable to the plant. For example, the full pressure differential for the Model 51F SG (Surry) is 1581 psid (2250-669 = 1581). This full pressure differential applies between the point of departure from zero contact pressure near the top of the tubesheet and the H* distance further into the tubesheet. For convenience, a straight line fit was assumed between these points to represent the differential pressure across the tube to demonstrate that the current analysis for H* is inherently conservative.

When the normalization length of the crevice is decreased, the pressure differential across the tube over the H* length increases. The increased pressure differential results in a large increase in the contact pressure between the tube and the tubesheet at the upper portion of the tube in the C^2 analysis. This effect was not included in the current analysis for H* because including it required iterating the probabilistic contact pressure distribution at both ends of the tube portion within the tubesheet with positive contact pressure between the tube and the tubesheet. The double iteration significantly increases the time required to perform the analysis and it is conservative to neglect it. The net effect of including the increased pressure differential reduces the final H* distance by approximately 1.76 inches (without CTE correction) for the Model 51F SGs and by approximately 2.55 inches (without CTE correction) for the Model 44F SGs.

Figure 8-2 (a and b) are plots of the contact pressure between the tube and the tubesheet using the probabilistic results from Tables 3-41 and 3-42 in WCAP-17345-P, Revision 2 and the adjusted crevice pressure distributions shown in Figure 8-1 (a and b). The increase in contact pressure due to adjusting the crevice pressure at the top of the tubesheet occurs regardless of the predicted length of H* if the underlying contact pressure distribution includes a length of zero contact pressure at the top of the tubesheet. Therefore, neglecting the crevice pressure distribution adjustment in the zero contact pressure length for any predicted H* length provides additional margin to the calculation of H*. The conservative application of crevice pressure distribution in the current analysis results in an under-

prediction of the actual tube to tubesheet contact pressure by about 20% and in an overestimate of the H* length by approximately 1.76 inches for the Model 51F and by approximately 2.55 inches for the Model 44F, before the additional crevice pressure adjustment from Figure 3-49 and Figure 3-48 in WCAP-17345-P, Rev. 2 is added.

Figure 8-3 shows that no adjustment to the final probabilistic contact pressure distribution for crevice pressure distribution is necessary. The probabilistic contact pressure distribution is the contact pressure profile that is determined by the C^2 model when the probabilistic values of inputs (CTEs, displacements) are input to the C^2 model. The unadjusted (for crevice length) crevice pressure differential distribution, when applied to the probabilistic contact pressure distribution, results in a near-worst-case result for H* because the contact pressure is much less sensitive to crevice pressure variations than it is to variations of the other input parameters such as temperature and pressure.

For example, at the critical radius in the Model 51F tubesheet, [ ]^{a,c,e} inch, and [ ]^{a,c,e} for the Model 44F, if the applied tubesheet displacements and temperatures throughout the tubesheet depth are kept the same as shown in Tables 3-16 and 3-10 in WCAP-17345-P, Rev. 2 for the Model 51F and Model 44F, respectively, but the crevice pressure differential is held constant at 1 psi throughout the depth of the tubesheet (i.e., primary pressure in the full length of the crevice), the result is the "DP=1 psi" curve in Figure 8-3. Similarly, if the C^2 model inputs are kept the same, but the crevice pressure differential is held constant at 1581 psi for the Model 51F and 1549 psi for the Model 44F throughout the depth of the tubesheet (i.e., secondary pressure in the crevice), the results are as shown in Figures 8-3(a and b). These are the bounding conditions for crevice pressure. It is not possible for a variation in crevice pressure differential to produce a contact pressure distribution less than, or greater than, the space bounded by these two curves. The current probabilistic contact pressure distribution, with the unmodified crevice pressure differential, is also shown on Figure 8-3. With respect to H*, the difference between the contact pressure distribution with the unmodified crevice pressure distribution used in WCAP-17345-P, Rev. 1, and the contact pressure distribution with the worst-case assumption of a 1 psi differential, is small.

When the modified crevice pressure differential distribution (i.e., based on the shorter crevice length) is applied, the result is increased contact pressure as illustrated in Figure 8-4. An increased contact pressure results in a reduced H* value. However, for consistency with the H* calculation process established in WCAP-17092-P and WCAP-17091-P, the H* distance is increased by 1.13 inches for the Model 51F and 1.34 for the Model 44F for crevice pressure distribution in the current analysis methodology, not decreased as it should be from the results shown in Figure 8-4(a and b). Therefore, the 1.13 inches (Model 51F) and 1.34 inches (Model 44F) from the current crevice pressure adjustment shown in Figures 3-49 and 3-48 in WCAP-17345-P, Rev. 2 represent excess conservatism, and further refinement of the crevice pressure adjustment curve as it is applied in the C^2 analysis methodology is not required.

a,c,e

Figure 8-1(a): Model 51F Plot of Crevice Pressure Differential acting towards the tubesheet on the inner diameter of the tube wall as a function of depth into the tubesheet. The zero (0) elevation is the top of the tubesheet.

a,c,e

Figure 8-1(b): Model 44F Plot of Crevice Pressure Differential acting towards the tubesheet on the inner diameter of the tube wall as a function of depth into the tubesheet. The zero (0) elevation is the top of the tubesheet.

a,c,e

Figure 8-2(a): Plot of Modified and Unmodified Crevice Pressure for Model 51F results for 95/95 Case (results not Poisson adjusted). The zero (0) elevation is the top of the tubesheet.

a,c,e

Figure 8-2(b): Plot of Modified and Unmodified Crevice Pressure for Model 44F results for 95/95 Case (results not Poisson adjusted). The zero (0) elevation is the top of the tubesheet.

a,c,e

Figure 8-3(a): Model 51F tube to tubesheet contact pressure as a function of crevice pressure assumption. The zero (0) elevation is the top of the tubesheet

a,c,e

Figure 8-3(b): Model 44F tube to tubesheet contact pressure as a function of crevice pressure assumption. The zero (0) elevation is the top of the tubesheet

a,c,e

Figure 8-4(a) Model 51F: Composite plot showing the effect on contact pressure of adjusting crevice pressure distribution to account for zero contact pressure near the top of the tubesheet.

a,c,e

Figure 8-4(b) Model 44F: Composite plot showing the effect on contact pressure of adjusting crevice pressure distribution to account for zero contact pressure near the top of the tubesheet.

Question 9:

In addition to the potential non-conservatisms in the H estimate discussed in Question 7 above, there is uncertainty associated with the computed probabilistic H* values calculated with the C^2 model as illustrated in Table 3-29. Depending on the response to question 8 above, there also may be some uncertainty associated with the H* adjustments for the crevice pressure distribution. What change to the proposed H* value of 17.89-inches is needed to ensure that it is a conservative value?*

Response:

The responses to RAI 7 and RAI 8 indicate that no adjustments to the Model 51F or Model 44F probabilistic NOP H* estimates are necessary to account for the uncertainty associated with the C^2 model results shown in Table 3-30 of WCAP-17345-P, Rev. 2. The current H* estimate of 17.89 inches for the Model 51F SGs is conservative by greater than 6 inches compared to the technically justifiable value even without accounting for the significant conservatism of neglecting residual contact pressure and other conservatism identified previously. Similarly, the current H* estimate of 18.11 inches for the Model 44F SGs is conservative by greater than 9 inches compared to the technically justifiable value even without accounting for the significant conservatism of neglecting residual contact pressure and other conservatism identified previously.

The probabilistic H* value for the Model 51F SGs, before any adjustments, cited in Table 3-51 in WCAP-17345-P, Rev. 2 is [ ]a,c,e in and the value for the Model 44F SGs is [ ]a,c,e inches (see Table 3-50 of WCAP-17345-P, Rev. 2). The probabilistic H* value for the contact pressure distribution shown in the response to Question 8, Figure 8-2 (a), is [ ]a,c,e in for the Model 51F SGs. The probabilistic H* value for the contact pressure distribution shown in the response to Question 8, Figure 8-2(b) is [ ]a,c,e for the Model 44F SGs.

Table 9-1 summarizes the adjustments to the probabilistic H* estimate compared to the adjustments that are demonstrated above in the current technical basis for H*. It is seen from Table 9-1 that a margin of [ ]a,c,e inches exists in the currently recommended H* length of 17.89 inches for the Model 51F SGs when the conservatism in the crevice pressure adjustment and the measurement error in the CTE data are quantified and the proper adjustments are made. Similarly, Table 9-2 shows that a margin of [ ]a,c,e inches exists in the currently recommended H* length of 18.11 inches for the Model 44F SGs when the conservatism in the crevice pressure adjustment and the measurement error in the CTE data are quantified and the proper adjustments are made. This previously un-quantified conservatism significantly exceeds the potential increase in the H* length if different judgments are made in the details of the H* calculation as suggested in Questions 7, 8 and 9. Based on this, it is concluded that no adjustment to the recommended probabilistic H* values of 17.89 inches for the Model 51F SGs and 18.11 inches for the Model 44F SGs are necessary and that the H* lengths recommended in WCAP-17345-P, Revision 2 are significantly conservative.

Table 9-1
Conservatism in Current Model 51F H* Calculation

Source	WCAP-17345-P, Rev 2	Refined Calculations
	in	in
Unmodified H* Value		
Adjustments		
Poisson Correction		
Crevice Pressure and BET Adjustment		
CTE Uncertainty Adjustment (RAI 7)		
Total Adjustments		
Final Probabilistic H*	**17.89**	[ ]a,c,e

a,c,e

Notes:
(1) Recalculated for [ ]a,c,e inch H* based on Figure 8-2(a).
(2) Crevice pressure margin ([ ]a,c,e inch) plus BET adder of 0.3 inch included in Pcrev correction (Figure 3-49 of WCAP-17345, Rev 2)
(3) See response to Question 7.

Table 9-2
Conservatism in Current Model 44F H* Calculation

Source	WCAP-17345-P, Rev 2	Refined Calculations
	in	in
Unmodified H* Value		
Adjustments		
Poisson Correction		
Crevice Pressure and BET Adjustment		
CTE Uncertainty Adjustment (RAI 7)		
Total Adjustments		
Final Probabilistic H*	**18.11**	[ ]a,c,e

a,c,e

Notes:
(1) Recalculated for [ ]a,c,e inch H* based on Figure 8-2(b).
(2) Crevice pressure margin ([ ]a,c,e inch) plus BET adder of 0.3 inch included in Pcrev correction (Figure 3-48 of WCAP-17345, Rev 2)
(3) See response to Question 7.

Question 10:

Question 10 in Reference 4 does not apply to Surry as noted in Reference 2.

Response:

None required.

Question 11

Question 11 in Reference 4 does not apply to Surry as noted in Reference 2.

Response:

None required.

Question 12:

BET measurements for Surry 2, documented in Westinghouse letter LTR-SGMP-09-111 P-Attachment, Revision 1, range to a maximum of 0.91 inches. BET measurements for Surry 1 led to the plugging of 6 tubes (Dominion letter 11-289 dated May 24, 2011) with BETs exceeding 1-inch. Apart from tubes with this reported range of BETs, Dominion letter 10-715, Attachment 1, page 10 of 23, states that a total of 20 tubes in the Unit 1 and 2 SGs were identified as not being expanded within the tubesheet and were plugged. Explain how the inspections and analyses performed were sufficiently systematic to ensure that all inservice tubes at Units 1 and 2 have been expanded against the tubesheet to within 1-inch of the top of the tubesheet.

Response

(To be provided by Dominion Generation)

Question 13:

Question 13 in Reference 4 does not apply to Surry as noted in Reference 2.

Response:

None required.

Question 14:

> *WCAP-17345-P, Revision 2, Tables 3-50 and 3-51 – Are the footnotes in these tables correct and complete? For Model 51F, Table 3-27 implies we have direct C^2 calculations for rank orders 9025, 9673, and 9901. Thus, for Table 3-51, it seems all four cases are based on interpolated values. Similarly, for Model 44F, Table 3-27 implies we have direct C^2 calculations for rank orders 9158, 9697, and 9760. Thus, for Table 3-50, it seems only the "whole plant, 95/95" case is based on direct C^2 calculations and the other cases are interpolated values. If the staff's understanding is incorrect, clarify for which rank orders direct C^2 calculations were performed and provide the H* calculations for these cases in a form similar to Tables 3-45 to 3-48.*

Response:

The points that were directly calculated with the C^2 model are shown on Figure 3-43 for the Model 51F SGs and on Figure 3-46 for the Model 44F SGs. The specific rank orders are identified in Table 3-30 of WCAP-17345.P, Revision 2. The range of rank orders defined by the three points for the Model 44F is 9158 through 9760, and for the Model 51F, 9025 through 9901. Only one of the rank orders of interest, which define the key probabilistic targets in Tables 3-50 and 3-51, is a point that was directly calculated using the C^2 model (Model 44F, whole plant, 95/50). However, both Figures 3-43 and 3-46 show that the rank order in the range of interest is a straight line function. Consequently, because the points of interest lay within the range of calculated values, and the function is linear, it is appropriate to interpolate to determine the H* values. The foot notes on Tables 3-50 and 3-51 are a carryover from the prior report, WCAP-17330-P, Revision 1, Table 3-50, and are not appropriate in WCAP-17345-P, Revision 2.

Question 15:

> *Verify that regulatory commitments pertaining to monitoring for tube slippage and for primary to secondary leakage, as described in Dominion letter dated December 16, 2010 (NRC ADAMS Accession No. ML103550206), Attachment 1, page 10 of 23, remain in place. In addition, revise the proposed amendment to include a revision to technical specification limit on primary to secondary leakage from 150 gallons per day (gpd) to 83 gpd (150 divided by the proposed 1.8 leakage factor), or provide a regulatory basis for not making this change.*

Response:
Dominion Generation

Appendix A
LTR-SGMP-11-87
(Reference 3-16 of WCAP-17345-P, Revision 2)

To: G. W. Whiteman
B. J. Bedont
C. D. Cassino

Date: May 5, 2011

cc:

From: A. O. Roslund
Ext: 724-722-6473
Fax: 724-722-5889

Your ref:
Our ref: LTR-SGDA-11-87

Subject: High-Confidence Variances for Tube and Tubesheet CTE for H*

References:

1. WCAP-17071-P, Revision 2, "H*: Alternate Repair Criteria for the Tubesheet Expansion Region in Steam Generators with Hydraulically Expanded Tubes (Model F)".
2. LTR-0026-0087-2, "Independent Technical Review of H* Steam Generator Tube Alternate Repair Criterion," MPR Associates, April 11, 2011.
3. SG-SGMP-11-16, "H* Technical Basis Independent Review by MPR Associates: Technical Questions and Responses," April 2011.

The purpose of this letter is to document the methodology by which high confidence variances for tube and tubesheet CTE for H* were calculated in response to questions from MPR in the independent review of H*.

<u>Electronically Approved*</u>
Prepared by: A. O. Roslund
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*Electronically approved records are authenticated in the Electronic Document Management System.

Introduction

The calculation of H* at high probability and confidence in Reference 1 entails the use of standard deviations for the coefficient of thermal expansion (CTE) for the tube and tubesheet, both of which are modeled as normal distributions. The justification for modeling them as normal and the means and standard deviations of the CTEs are contained in Appendix B of Reference 1. The standard deviations used for the tube and tubesheet were 2.33% and 1.62%, respectively. These standard deviations are essentially best estimate (50% confidence) from the data used. During the independent review of the H* technical basis (References 2 and 3), it was requested that Westinghouse calculate high-confidence variances of the standard deviations for the CTEs to show that the values used were conservative. The data used in the following analysis were from tests that Westinghouse contracted ANTER to perform as documented in Reference 1, Appendix B.

Methodology

ANTER tested 30 alloy 600 TT CTE specimens and 40 SA-508 tubesheet specimens. The results were given as CTEs in 25°F increments from 100°F to 700°F. The tubesheet data are in Table 1 through Table 4. The tube data are in Table 5 through Table 7. In order to determine the instrumentation error, one specimen each of the tube and tubesheet material was run ten times. These results are shown in Table 8 and Table 9.

Best estimate (50% confidence) standard deviations were calculated from the standard formula,

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(\bar{x} - x_i)^2}{n-1}}$$

High confidence (95%) standard deviations are obtained by the standard Chi-Squared adjustment:

$$\sigma_{95} = \sigma_{50}\sqrt{\frac{n-1}{\chi^2_{n-1,0.95}}}$$

Results for the tube and tubesheet are in Table 10 and Table 11. Results for the tube and tubesheet instrumentation error (multiple runs) are in Table 12 and Table 13. Note that a higher CTE variance is conservative for the purposes of calculating H*, while a lower instrumentation variance is conservative. Therefore, the above equation is used for adjusting material standard deviations, which results in a higher standard deviation at high confidence. For instrumentation variance, the above equation is used with a 0.05 instead of 0.95, which results in a high-confidence lower bound. The

standard formula below was used to calculate a high confidence standard deviation for the tube and tubesheet without instrumentation error:

$$\sigma_{95,Material} = \sqrt{\sigma_{95,total}^2 - \sigma_{95,instrumentation}^2}$$

Results are in Table 14. As can be seen, the standard deviation values used in the H* analyses (2.33% for the tube and 1.62% for the tubesheet) are conservative compared to the true high-confidence standard deviations at temperatures of 200°F and greater. The range of temperatures applicable to the operating conditions of population of H* candidate plants is between 200°F and 650°F.

Table 1
Tubesheet CTEs (µin / in °F)

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 2Tubesheet CTEs (µin / in °F)

Temp (°F)	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 3
Tubesheet CTEs (μin / in °F)

Temp (°F)	Sample 21	Sample 22	Sample 23	Sample 24	Sample 25	Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 4
Tubesheet CTEs (µin / in °F)

Temp (°F)	Sample 31	Sample 32	Sample 33	Sample 34	Sample 35	Sample 36	Sample 37	Sample 38	Sample 39	Sample 40
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 5
Tube CTEs (Model F) (µin / in °F)

Temp (°F)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 6
Tube CTEs (Model D5) (μin / in °F)

Temp (°F)	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16	Sample 17	Sample 18	Sample 19	Sample 20
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 7
Tube CTEs (Model 44F) (μin / in °F)

Temp (°F)	Sample 21	Sample 22	Sample 23	Sample 24	Sample 25	Sample 26	Sample 27	Sample 28	Sample 29	Sample 30
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 8
Tube CTEs (Multiple runs on same specimen) (µin / in °F)

Temp (°F)	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 9
Tubesheet CTEs (Multiple runs on same specimen) (μin / in °F)

Temp (°F)	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
100										
125										
150										
175										
200										
225										
250										
275										
300										
325										
350										
375										
400										
425										
450										
475										
500										
525										
550										
575										
600										
625										
650										
675										
700										

a,c,e

Table 10
Mean and Standard Deviation, Tube Material

Temperature (°F)	Mean (μin/in°F)	Best Estimate Standard Deviation (%)	95% Confidence Standard Deviation (%)
100	6.95	3.40	4.35
125	7.03	2.84	3.64
150	7.10	2.38	3.04
175	7.16	2.00	2.55
200	7.23	1.69	2.16
225	7.28	1.45	1.86
250	7.34	1.27	1.63
275	7.39	1.14	1.46
300	7.43	1.05	1.35
325	7.48	0.99	1.27
350	7.52	0.95	1.21
375	7.56	0.92	1.17
400	7.59	0.89	1.14
425	7.63	0.87	1.12
450	7.66	0.86	1.10
475	7.69	0.85	1.08
500	7.72	0.84	1.07
525	7.76	0.83	1.07
550	7.79	0.83	1.06
575	7.82	0.82	1.05
600	7.85	0.81	1.03
625	7.88	0.79	1.01
650	7.91	0.77	0.98
675	7.94	0.74	0.95
700	7.97	0.72	0.92

Table 11
Mean and Standard Deviation, Tubesheet Material

Temperature (°F)	Mean (μin/in°F)	Best Estimate Standard Deviation (%)	95% Confidence Standard Deviation (%)
100	6.11	2.71	3.34
125	6.23	2.30	2.83
150	6.35	1.96	2.42
175	6.45	1.69	2.08
200	6.55	1.48	1.82
225	6.63	1.31	1.62
250	6.71	1.19	1.46
275	6.79	1.09	1.35
300	6.85	1.02	1.26
325	6.91	0.97	1.19
350	6.97	0.92	1.14
375	7.02	0.89	1.10
400	7.07	0.86	1.06
425	7.12	0.84	1.03
450	7.16	0.82	1.01
475	7.20	0.80	0.99
500	7.24	0.79	0.97
525	7.28	0.77	0.95
550	7.32	0.76	0.94
575	7.35	0.76	0.93
600	7.39	0.75	0.92
625	7.43	0.74	0.92
650	7.48	0.75	0.92
675	7.52	0.76	0.93
700	7.57	0.78	0.96

Table 12
Standard Deviation for Instrumentation Error, Tube Material

Temperature (°F)	Best Estimate Standard Deviation (%)	95% Confidence Standard Deviation (%)
100	2.28	1.66
125	2.01	1.46
150	1.77	1.29
175	1.57	1.14
200	1.39	1.01
225	1.24	0.91
250	1.12	0.81
275	1.01	0.74
300	0.92	0.67
325	0.85	0.62
350	0.79	0.58
375	0.75	0.55
400	0.71	0.52
425	0.69	0.50
450	0.67	0.49
475	0.66	0.48
500	0.65	0.48
525	0.65	0.47
550	0.64	0.47
575	0.63	0.46
600	0.62	0.46
625	0.61	0.44
650	0.59	0.43
675	0.56	0.41
700	0.53	0.38

Table 13
Standard Deviation for Instrumentation Error, Tubesheet Material

Temperature (°F)	Best Estimate Standard Deviation (%)	95% Confidence Standard Deviation (%)
100	2.08	1.52
125	1.82	1.32
150	1.59	1.16
175	1.40	1.02
200	1.25	0.91
225	1.13	0.82
250	1.03	0.75
275	0.95	0.69
300	0.89	0.65
325	0.85	0.62
350	0.82	0.60
375	0.79	0.58
400	0.78	0.57
425	0.78	0.57
450	0.77	0.56
475	0.78	0.57
500	0.79	0.57
525	0.79	0.58
550	0.79	0.58
575	0.80	0.58
600	0.80	0.59
625	0.80	0.58
650	0.79	0.57
675	0.77	0.56
700	0.74	0.54

Table 14
High-Confidence Tube and Tubesheet Standard Deviations with Instrumentation Error Removed

Temperature (°F)	Tube (%)	Tubesheet (%)
100		
125		
150		
175		
200		
225		
250		
275		
300		
325		
350		
375		
400		
425		
450		
475		
500		
525		
550		
575		
600		
625		
650		
675		
700		

a,c,e

ATTACHMENT 3

WESTINGHOUSE ELECTRIC COMPANY LLC LETTER CAW-12-3370, "APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE"

RELATED TO LICENSE AMENDMENT REQUEST FOR PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2

Westinghouse

Westinghouse Electric Company
Nuclear Services
1000 Westinghouse Drive
Cranberry Township, PA 16066
USA

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852

Direct tel: (412) 374-4643
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e-mail: greshaja@westinghouse.com
Proj letter: VRA-12-6

CAW-12-3370

January 24, 2012

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: LTR-SGMMP-11-29 Rev. 1 P-Attachment, "Response to USNRC Request for Additional Information Regarding the Surry Units 1 & 2 License Amendment Request for Permanent Application of the Alternate Repair Criterion, H*" (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-12-3370 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Virginia Electric and Power Company.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-12-3370, and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, PA 16066.

Very truly yours,

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared J. A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

J. A. Gresham, Manager
Regulatory Compliance

Sworn to and subscribed before me
this 24th day of January 2012

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Cynthia Olesky, Notary Public
Manor Boro, Westmoreland County
My Commission Expires July 16, 2014
Member, Pennsylvania Association of Notaries

(1) I am Manager, Regulatory Compliance, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in LTR-SGMMP-11-29 Rev. 1 P-Attachment, "Response to USNRC Request for Additional Information Regarding the Surry Units 1 & 2 License Amendment Request for Permanent Application of the Alternate Repair Criterion, H*" (Proprietary), for submittal to the Commission, being transmitted by Virginia Electric and Power Company Letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse for Surry Power Station, Units 1 and 2, is that associated with the technical justification of the H* Alternate Repair Criteria for hydraulically expanded steam generator tubes and may be used only for that purpose.

This information is part of that which will enable Westinghouse to:

(a) License the H* Alternate Repair Criteria.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of the information to its customers for the purpose of licensing the H* Alternate Repair Criteria.

(b) Westinghouse can sell support and defense of the H* criteria.

(c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical justification and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

ATTACHMENT 4

RAI RESPONSES TO QUESTIONS 12 AND 15

RELATED TO LICENSE AMENDMENT REQUEST FOR PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2

Question 12:

BET measurements for Surry 2, documented in Westinghouse letter LTR-SGMP-09-111 P-Attachment, Revision 1, range to a maximum of 0.91 inches. BET measurements for Surry 1 led to the plugging of 6 tubes (Dominion letter 11-289 dated May 24, 2011) with BETs exceeding 1-inch. Apart from tubes with this reported range of BETs, Dominion letter 10-715, Attachment 1, page 10 of 23, states that a total of 20 tubes in the Unit 1 and 2 SGs were identified as not being expanded within the tubesheet and were plugged. Explain how the inspections and analyses performed were sufficiently systematic to ensure that all inservice tubes at Units 1 and 2 have been expanded against the tubesheet to within 1-inch of the top of the tubesheet

Response:

The tubesheet expansion regions of the inservice Surry Unit 1 and Unit 2 steam generator (SG) tubes have been evaluated using eddy current bobbin probe data. Tubes identified as having only the tube-end tack expansion (i.e., the full depth hydraulic tubesheet expansion was not performed) were reported as "NTE" (no tube expansion). Surry tubes having the NTE condition have been removed from service by plugging.

For inservice tubes that have a nominal full depth hydraulic expansion, the bottom of the expansion transition (BET) position was determined using eddy current bobbin probe data. Tubes whose measured BET position extends greater than one inch into the tubesheet were removed from service by plugging. Dominion's May 24, 2011 letter (Serial No. 11-289) stated that eight tubes were plugged in Unit 1 as a result of BET measurements exceeding one inch (versus six tubes as stated in Question 12); six tubes were plugged in SG A and two in SG B. No Unit 2 SG tubes were plugged as a result of BET measurements.

Question 15:

Verify that regulatory commitments pertaining to monitoring for tube slippage and for primary to secondary leakage, as described in Dominion letter dated December 16, 2010 (NRC ADAMS Accession No. ML103550206), Attachment 1, page 10 of 23, remain in place. In addition, revise the proposed amendment to include a revision to technical specification limit on primary to secondary leakage from 150 gallons per day (gpd) to 83 gpd (150 divided by the proposed 1.8 leakage factor), or provide a regulatory basis for not making this change.

Response:

<u>Commitments</u>

The two regulatory commitments cited in Question 15 from Dominion's December 16, 2010 letter (Serial No. 10-715) are repeated below and are updated with the current status. Note that the commitments to monitor for tube slippage and to establish an administrative operational leakage limit remain in place.

Commitment	Due Date/Event	Status
Dominion commits to monitor for tube slippage as part of the SG tube inspection program for Unit 1 and Unit 2.	Starting with Unit 2 Refueling Outage 22 and during subsequent Unit 1 and Unit 2 SG inspections	Initial monitoring of Unit 1 A, B, and C SGs was completed during Fall 2010 RFO, Unit 2 A SG during Fall 2009 RFO, and Unit 2 B and C SGs during Spring 2011 RFO; no slippage was detected. The SG tube inspection program/CMOA for both units includes the commitment for continuing tube slippage monitoring. **This commitment remains in place.**
Dominion commits to the following: For the Condition Monitoring assessment, the component of operational leakage from the prior cycle from below the H* distance will be multiplied by a factor of 1.80 and added to the total accident leakage from any other source and compared to the allowable accident induced leakage limit. For the Operational Assessment, the difference between the allowable accident induced leakage and the accident induced leakage from sources other than the tubesheet expansion region will be divided by 1.80 and compared to the observed operational leakage. An administrative operational leakage limit will be established to not exceed the calculated value. **NOTE:** The commitment statement in letter Serial No. 10-715 reflected a 2.03 leakage factor. The permanent alternate repair criteria amendment request in letter Serial No. 11-403 includes a 1.80 leakage factor versus the previous 2.03 value.	For every operating cycle following Unit 2 Refueling Outage 22 and Unit 1 Refueling Outage 23	An administrative operational leakage limit associated with the PARC and the 1.80 leakage factor will be established in the CMOA starting with the Unit 1 Spring 2012 RFO and the Unit 2 Fall 2012 RFO. **This commitment remains in place.**

Primary to Secondary Leakage Limit

The primary to secondary leakage limit in TS 3.1.C and TS 4.13 is being revised from 150 gallons per day to 83 gallons per day. The marked-up and proposed TS pages for this revision are provided in Attachments 5 and 6, respectively. The associated TS Bases pages are provided for information.

In addition, the marked-up page TS 4.13-1 includes a minor revision that is administrative in nature. This minor revision is to reinstate the superscripted number 1 at the end of the TS 4.13.B text to denote that Note 1 applies to TS 4.13.B. The evolution of TS 4.13.B is as follows:

- Amendments 251/250 were issued on March 29, 2007 and revised the TS requirements related to SG tube integrity and RCS leakage definitions and requirements. This TS revision added the new TS 4.13 for RCS OPERATIONAL LEAKAGE and the new associated Bases. The new TS 4.13.B included the superscripted number 1 as reference to Note 1. In addition, the new Bases related to TS 4.13.B included a sentence that stated "The surveillance is modified by a Note, which states that the Surveillance is not required to be performed until 12 hours after establishment of steady state operation." This sentence is currently in the TS 4.13 Bases and is identical to the original statement.

- Unit 1 Amendment 264/-- was issued on May 7, 2009 and incorporated the modified interim alternate repair criteria for SG tube inspection and repair applicable to the Unit 1 B SG. This amendment included a revision to TS 4.13.B limiting the primary to secondary leakage for the Unit 1 B SG to less than or equal to 20 gallons per day during Operating Cycle 23. The revised TS 4.13.B included the superscripted number 1.

- On September 30, 2009, letter Serial No. 09-455B was submitted to the NRC for review of the one-time alternate repair criteria for SG tube inspection and repair applicable to the Units 1 and 2. The marked-up TS 4.13.B in this letter included the superscripted number 1, but it was omitted on the typed page TS 4.13-1. Approval of the one-time alternate repair criteria by Amendments 267/266 was issued on November 5, 2009, and the pages issued with the amendments did not include the superscripted number 1.

As noted in the first bullet, the Bases related to TS 4.13.B currently includes the sentence that states "The surveillance is modified by a Note, which states that the Surveillance is not required to be performed until 12 hours after establishment of steady state operation." Thus, the reinstatement of the superscripted number 1 at the end of the TS 4.13 text is consistent with the current associated TS 4.13.B Bases. In addition, this administrative change reflects information previously approved by the NRC and corrects the typographical error that omitted the superscript.

ATTACHMENT 5

MARKED-UP TECHNICAL SPECIFICATIONS PAGES

RELATED TO LICENSE AMENDMENT REQUEST FOR PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2

C. RCS Operational LEAKAGE

Applicability

The following specifications are applicable to RCS operational LEAKAGE whenever Tavg (average RCS temperature) exceeds 200°F (200 degrees Fahrenheit).

Specifications

1. RCS operational LEAKAGE shall be limited to:

   a. No pressure boundary LEAKAGE,

   b. 1 gpm unidentified LEAKAGE,

   c. 10 gpm identified LEAKAGE, and

   d. 83 ~~150~~ gallons per day primary to secondary LEAKAGE through any one steam generator (SG).

2.a. If RCS operational LEAKAGE is not within the limits of 3.1.C.1 for reasons other than pressure boundary LEAKAGE or primary to secondary LEAKAGE, reduce LEAKAGE to within the specified limits within 4 hours.

   b. If the LEAKAGE is not reduced to within the specified limits within 4 hours, the unit shall be brought to HOT SHUTDOWN within the next 6 hours and COLD SHUTDOWN within the following 30 hours.

3. If RCS pressure boundary LEAKAGE exists, or primary to secondary LEAKAGE is not within the limit specified in 3.1.C.1.d, the unit shall be brought to HOT SHUTDOWN within 6 hours and COLD SHUTDOWN within the following 30 hours.

This LCO deals with protection of the reactor coolant pressure boundary (RCPB) from degradation and the core from inadequate cooling, in addition to preventing the accident analyses radiation release assumptions from being exceeded. The consequences of violating this LCO include the possibility of a loss of coolant accident (LOCA).

APPLICABLE SAFETY ANALYSES - Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses for LOCA; the amount of leakage can affect the probability of such an event. The safety analysis for an event resulting in steam discharge to the atmosphere assumes that primary to secondary LEAKAGE from all steam generators (SGs) is 1 gpm or increases to 1 gpm as a result of accident induced conditions. The LCO requirement to limit primary to secondary LEAKAGE through any one SG to less than or equal to ~~150~~ 83 gallons per day is significantly less than the conditions assumed in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a main steam line break (MSLB) accident. Other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leakage contaminates the secondary fluid.

The UFSAR (Ref. 2) analysis for SGTR assumes the contaminated secondary fluid is released via power operated relief valves or safety valves. The source term in the primary system coolant is transported to the affected (ruptured) steam generator by the break flow. The affected steam generator discharges steam to the environment for 30 minutes until the generator is manually isolated. The 1 gpm primary to secondary LEAKAGE transports the source term to the unaffected steam generators. Releases continue through the unaffected steam generators until the Residual Heat Removal System is placed in service.

The MSLB is less limiting for site radiation releases than the SGTR. The safety analysis for the MSLB accident assumes 1 gpm total primary to secondary LEAKAGE, including 500 gpd leakage into the faulted generator. The dose consequences resulting from the MSLB and the SGTR accidents are within the limits defined in the plant licensing basis.

The RCS operational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LIMITING CONDITIONS FOR OPERATION - RCS operational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

   No pressure boundary LEAKAGE is allowed, being indicative of material deterioration. LEAKAGE of this type is unacceptable as the leak itself could cause further deterioration, resulting in higher LEAKAGE. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE.

b. Unidentified LEAKAGE

One gallon per minute (gpm) of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air monitoring and containment sump level monitoring equipment can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

c. Identified LEAKAGE

Up to 10 gpm of identified LEAKAGE is considered allowable because LEAKAGE is from known sources that do not interfere with detection of unidentified LEAKAGE and is well within the capability of the RCS Makeup System. Identified LEAKAGE includes LEAKAGE to the containment from specifically known and located sources, but does not include pressure boundary LEAKAGE or controlled reactor coolant pump (RCP) seal leakoff (a normal function not considered LEAKAGE). Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE through Any One SG

The (previous) limit of 150 gallons per day per SG is based on the operational LEAKAGE performance criterion in NEI 97-06, Steam Generator Program Guidelines (Ref. 3). The Steam Generator Program operational LEAKAGE performance criterion in NEI 97-06 states, "The RCS operational primary to secondary leakage through any one SG shall be limited to 150 gallons per day." The limit is based on operating experience with SG tube degradation mechanisms that result in tube leakage. The operational leakage rate criterion in conjunction with the implementation of the Steam Generator Program is an effective measure for minimizing the frequency of steam generator tube ruptures.

APPLICABILITY - In REACTOR OPERATION conditions where T_{avg} exceeds 200°F, the potential for RCPB LEAKAGE is greatest when the RCS is pressurized.

In COLD SHUTDOWN and REFUELING SHUTDOWN, LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for LEAKAGE.

LCO 3.1.C.5 measures leakage through each individual pressure isolation valve (PIV) and can impact this LCO. Of the two PIVs in series in each isolated line, leakage measured through one PIV does not result in RCS LEAKAGE when the other is leaktight. If both valves leak and result in a loss of mass from the RCS, the loss must be included in the allowable identified LEAKAGE.

The limit of 83 gallons per day reduced the previous limit of 150 gallons per day related to the response to an NRC request for additional information associated with the Permanent Alternate Repair Criteria for Steam Generator Tube Inspection and Repair (Ref. 5 and 6).

ACTIONS

3.1.C.2.a

Unidentified LEAKAGE or identified LEAKAGE in excess of the LCO limits must be reduced to within limits within 4 hours. This completion time allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

3.1.C.2.b and 3.1.C.3

If any pressure boundary LEAKAGE exists, or primary to secondary LEAKAGE is not within limit, or if unidentified or identified LEAKAGE cannot be reduced to within limits within 4 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to HOT SHUTDOWN within 6 hours and COLD SHUTDOWN within the following 30 hours. This action reduces the LEAKAGE and also reduces the factors that tend to degrade the pressure boundary.

The allowed completion times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In COLD SHUTDOWN, the pressure stresses acting on the RCPB are much lower, and further deterioration is much less likely.

REFERENCES

1. UFSAR, Chapter 4, Surry Units 1 and 2.
2. UFSAR, Chapter 14, Surry Units 1 and 2.
3. NEI 97-06, "Steam Generator Program Guidelines."
4. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."
5. NRC Letter dated 1/18/2012 and titled Request for Additional Information Regarding the Steam Generator License Amendment Request to Revise Technical Specifications for Permanent Alternate Repair Criteria (NRC ADAMS Accession No. ML 12006A001).
6. Dominion Letter Serial No. 12-028 dated February 14, 2012 and titled Response to Request for Additional Information Related to License Amendment Request for Permanent Alternate Repair Criteria for Steam Generator Tube Inspection and Repair.

Structural integrity requires that the primary membrane stress intensity in a tube not exceed the yield strength for all ASME Code, Section III, Service Level A (normal operating conditions) and Service Level B (upset or abnormal conditions) transients included in the design specification. This includes safety factors and applicable design basis loads based on ASME Code, Section III, Subsection NB (Ref. 5) and Draft Regulatory Guide 1.121 (Ref. 6).

The accident induced leakage performance criterion ensures that the primary to secondary LEAKAGE caused by a design basis accident, other than a SGTR, is within the accident analysis assumptions. The accident analysis assumes that accident induced leakage does not exceed 1 gpm. The accident induced leakage rate includes any primary to secondary LEAKAGE existing prior to the accident in addition to primary to secondary LEAKAGE induced during the accident.

The operational LEAKAGE performance criterion provides an observable indication of SG tube conditions during plant operation. The limit on operational LEAKAGE is contained in Specification 3.1.C, "RCS Operational LEAKAGE," and limits primary to secondary LEAKAGE through any one SG to ~~150~~ 83 gallons per day. This limit is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line break. If this amount of LEAKAGE is due to more than one crack, the cracks are very small, and the above assumption is conservative.

APPLICABILITY - Steam generator tube integrity is challenged when the pressure differential across the tubes is large. Large differential pressures across SG tubes can only be experienced when T_{avg} exceeds 200°F.

RCS conditions are far less challenging in COLD SHUTDOWN and REFUELING SHUTDOWN than during INTERMEDIATE SHUTDOWN, HOT SHUTDOWN, REACTOR CRITICAL and POWER OPERATION. In COLD SHUTDOWN and REFUELING SHUTDOWN, primary to secondary differential pressure is low, resulting in lower stresses and reduced potential for LEAKAGE.

ACTIONS - The actions are modified by a Note clarifying that the conditions may be entered independently for each SG tube. This is acceptable because the required actions provide appropriate compensatory actions for each affected SG tube. Complying with the required actions may allow for continued operation, and subsequent affected SG tubes are governed by subsequent condition entry and application of associated required actions.

4.13 RCS OPERATIONAL LEAKAGE

Applicability

The following specifications are applicable to RCS operational LEAKAGE whenever T_{avg} (average RCS temperature) exceeds 200°F (200 degrees Fahrenheit).

Objective

To verify that RCS operational LEAKAGE is maintained within the allowable limits, the following surveillances shall be performed at the frequencies specified in the Surveillance Frequency Control Program.

Specifications

A. Verify RCS operational LEAKAGE is within the limits specified in TS 3.1.C by performance of RCS water inventory balance[1, 2]

B. Verify primary to secondary LEAKAGE is ≤ ~~150~~ 83 gallons per day through any one SG. If it is not practical to assign the LEAKAGE to an individual SG, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG.[1]

Notes:

1. Not required to be completed until 12 hours after establishment of steady state operation.
2. Not applicable to primary to secondary LEAKAGE.

BASES

SURVEILLANCE REQUIREMENTS (SR)

SR 4.13.A

Verifying RCS LEAKAGE to be within the Limiting Condition for Operation (LCO) limits ensures the integrity of the reactor coolant pressure boundary (RCPB) is maintained. Pressure boundary LEAKAGE would at first appear as unidentified LEAKAGE and can only be positively identified by inspection. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. Unidentified LEAKAGE and identified LEAKAGE are determined by performance of an RCS water inventory balance.

The RCS water inventory balance must be performed with the reactor at steady state operating conditions (stable pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The surveillance is modified by two notes. Note 1 states that this SR is not required to be completed until 12 hours after establishing steady state operation. The 12 hour allowance provides sufficient time to collect and process all necessary data after stable unit conditions are established.

Steady state operation is required to perform a proper inventory balance since calculations during maneuvering are not useful. For RCS operational LEAKAGE determination by water inventory balance, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems that monitor the containment atmosphere radioactivity and the containment sump level. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. These leakage detection systems are specified in the TS 3.1.C Bases.

Note 2 states that this SR is not applicable to primary to secondary LEAKAGE because LEAKAGE of 83 ~~150~~ gallons per day cannot be measured accurately by an RCS water inventory balance.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

<u>SR 4.13.B</u>

This SR verifies that primary to secondary LEAKAGE is less than or equal to 83 ~~150~~ gallons per day through any one SG. Satisfying the primary to secondary LEAKAGE limit ensures that the operational LEAKAGE performance criterion in the Steam Generator Program is met. If this SR is not met, compliance with LCO 3.1.H, "Steam Generator Tube Integrity," should be evaluated. The 83 ~~150~~ gallons per day limit is measured at room temperature as described in Reference 4. The operational LEAKAGE rate limit applies to LEAKAGE through any one SG.

If it is not practical to assign the LEAKAGE to an individual SG, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG. The surveillance is modified by a Note, which states that the Surveillance is not required to be performed until 12 hours after establishment of steady state operation. For RCS primary to secondary LEAKAGE determination, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

The primary to secondary LEAKAGE is determined using continuous process radiation monitors or radiochemical grab sampling in accordance with the EPRI guidelines (Ref. 4). The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

ATTACHMENT 6

PROPOSED TECHNICAL SPECIFICATIONS PAGES

RELATED TO LICENSE AMENDMENT REQUEST FOR PERMANENT ALTERNATE REPAIR CRITERIA FOR STEAM GENERATOR TUBE INSPECTION AND REPAIR

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2

C. RCS Operational LEAKAGE

Applicability

The following specifications are applicable to RCS operational LEAKAGE whenever Tavg (average RCS temperature) exceeds 200°F (200 degrees Fahrenheit).

Specifications

1. RCS operational LEAKAGE shall be limited to:

   a. No pressure boundary LEAKAGE,

   b. 1 gpm unidentified LEAKAGE,

   c. 10 gpm identified LEAKAGE, and

   d. 83 gallons per day primary to secondary LEAKAGE through any one steam generator (SG).

2.a. If RCS operational LEAKAGE is not within the limits of 3.1.C.1 for reasons other than pressure boundary LEAKAGE or primary to secondary LEAKAGE, reduce LEAKAGE to within the specified limits within 4 hours.

   b. If the LEAKAGE is not reduced to within the specified limits within 4 hours, the unit shall be brought to HOT SHUTDOWN within the next 6 hours and COLD SHUTDOWN within the following 30 hours.

3. If RCS pressure boundary LEAKAGE exists, or primary to secondary LEAKAGE is not within the limit specified in 3.1.C.1.d, the unit shall be brought to HOT SHUTDOWN within 6 hours and COLD SHUTDOWN within the following 30 hours.

This LCO deals with protection of the reactor coolant pressure boundary (RCPB) from degradation and the core from inadequate cooling, in addition to preventing the accident analyses radiation release assumptions from being exceeded. The consequences of violating this LCO include the possibility of a loss of coolant accident (LOCA).

APPLICABLE SAFETY ANALYSES - Except for primary to secondary LEAKAGE, the safety analyses do not address operational LEAKAGE. However, other operational LEAKAGE is related to the safety analyses for LOCA; the amount of leakage can affect the probability of such an event. The safety analysis for an event resulting in steam discharge to the atmosphere assumes that primary to secondary LEAKAGE from all steam generators (SGs) is 1 gpm or increases to 1 gpm as a result of accident induced conditions. The LCO requirement to limit primary to secondary LEAKAGE through any one SG to less than or equal to 83 gallons per day is significantly less than the conditions assumed in the safety analysis.

Primary to secondary LEAKAGE is a factor in the dose releases outside containment resulting from a main steam line break (MSLB) accident. Other accidents or transients involve secondary steam release to the atmosphere, such as a steam generator tube rupture (SGTR). The leakage contaminates the secondary fluid.

The UFSAR (Ref. 2) analysis for SGTR assumes the contaminated secondary fluid is released via power operated relief valves or safety valves. The source term in the primary system coolant is transported to the affected (ruptured) steam generator by the break flow. The affected steam generator discharges steam to the environment for 30 minutes until the generator is manually isolated. The 1 gpm primary to secondary LEAKAGE transports the source term to the unaffected steam generators. Releases continue through the unaffected steam generators until the Residual Heat Removal System is placed in service.

The MSLB is less limiting for site radiation releases than the SGTR. The safety analysis for the MSLB accident assumes 1 gpm total primary to secondary LEAKAGE, including 500 gpd leakage into the faulted generator. The dose consequences resulting from the MSLB and the SGTR accidents are within the limits defined in the plant licensing basis.

The RCS operational LEAKAGE satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LIMITING CONDITIONS FOR OPERATION - RCS operational LEAKAGE shall be limited to:

a. Pressure Boundary LEAKAGE

   No pressure boundary LEAKAGE is allowed, being indicative of material deterioration. LEAKAGE of this type is unacceptable as the leak itself could cause further deterioration, resulting in higher LEAKAGE. Violation of this LCO could result in continued degradation of the RCPB. LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE.

b. Unidentified LEAKAGE

One gallon per minute (gpm) of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air monitoring and containment sump level monitoring equipment can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

c. Identified LEAKAGE

Up to 10 gpm of identified LEAKAGE is considered allowable because LEAKAGE is from known sources that do not interfere with detection of unidentified LEAKAGE and is well within the capability of the RCS Makeup System. Identified LEAKAGE includes LEAKAGE to the containment from specifically known and located sources, but does not include pressure boundary LEAKAGE or controlled reactor coolant pump (RCP) seal leakoff (a normal function not considered LEAKAGE). Violation of this LCO could result in continued degradation of a component or system.

d. Primary to Secondary LEAKAGE through Any One SG

The limit of 83 gallons per day reduced the previous limit of 150 gallons per day related to the response to an NRC request for additional information associated with the Permanent Alternate Repair Criteria for Steam Generator Tube Inspection and Repair (Ref. 5 and 6). The previous limit of 150 gallons per day per SG is based on the operational LEAKAGE performance criterion in NEI 97-06, Steam Generator Program Guidelines (Ref. 3). The Steam Generator Program operational LEAKAGE performance criterion in NEI 97-06 states, "The RCS operational primary to secondary leakage through any one SG shall be limited to 150 gallons per day." The limit is based on operating experience with SG tube degradation mechanisms that result in tube leakage. The operational leakage rate criterion in conjunction with the implementation of the Steam Generator Program is an effective measure for minimizing the frequency of steam generator tube ruptures.

APPLICABILITY - In REACTOR OPERATION conditions where T_{avg} exceeds 200°F, the potential for RCPB LEAKAGE is greatest when the RCS is pressurized.

In COLD SHUTDOWN and REFUELING SHUTDOWN, LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for LEAKAGE.

LCO 3.1.C.5 measures leakage through each individual pressure isolation valve (PIV) and can impact this LCO. Of the two PIVs in series in each isolated line, leakage measured through one PIV does not result in RCS LEAKAGE when the other is leaktight. If both valves leak and result in a loss of mass from the RCS, the loss must be included in the allowable identified LEAKAGE.

ACTIONS

3.1.C.2.a

Unidentified LEAKAGE or identified LEAKAGE in excess of the LCO limits must be reduced to within limits within 4 hours. This completion time allows time to verify leakage rates and either identify unidentified LEAKAGE or reduce LEAKAGE to within limits before the reactor must be shut down. This action is necessary to prevent further deterioration of the RCPB.

3.1.C.2.b and 3.1.C.3

If any pressure boundary LEAKAGE exists, or primary to secondary LEAKAGE is not within limit, or if unidentified or identified LEAKAGE cannot be reduced to within limits within 4 hours, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to HOT SHUTDOWN within 6 hours and COLD SHUTDOWN within the following 30 hours. This action reduces the LEAKAGE and also reduces the factors that tend to degrade the pressure boundary.

The allowed completion times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems. In COLD SHUTDOWN, the pressure stresses acting on the RCPB are much lower, and further deterioration is much less likely.

REFERENCES

1. UFSAR, Chapter 4, Surry Units 1 and 2.
2. UFSAR, Chapter 14, Surry Units 1 and 2.
3. NEI 97-06, "Steam Generator Program Guidelines."
4. EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines."
5. NRC Letter dated 01/18/2012 and titled Request for Additional Information Regarding the Steam Generator License Amendment Request to Revise Technical Specifications for Permanent Alternate Repair Criteria (NRC ADAMS Accession No. ML12006A001).
6. Dominion Letter Serial No. 12-028 dated February 14, 2012 and titled Response to Request for Additional Information Related to License Amendment Request for Permanent Alternate Repair Criteria for Steam Generator Tube Inspection and Repair.

Structural integrity requires that the primary membrane stress intensity in a tube not exceed the yield strength for all ASME Code, Section III, Service Level A (normal operating conditions) and Service Level B (upset or abnormal conditions) transients included in the design specification. This includes safety factors and applicable design basis loads based on ASME Code, Section III, Subsection NB (Ref. 5) and Draft Regulatory Guide 1.121 (Ref. 6).

The accident induced leakage performance criterion ensures that the primary to secondary LEAKAGE caused by a design basis accident, other than a SGTR, is within the accident analysis assumptions. The accident analysis assumes that accident induced leakage does not exceed 1 gpm. The accident induced leakage rate includes any primary to secondary LEAKAGE existing prior to the accident in addition to primary to secondary LEAKAGE induced during the accident.

The operational LEAKAGE performance criterion provides an observable indication of SG tube conditions during plant operation. The limit on operational LEAKAGE is contained in Specification 3.1.C, "RCS Operational LEAKAGE," and limits primary to secondary LEAKAGE through any one SG to 83 gallons per day. This limit is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line break. If this amount of LEAKAGE is due to more than one crack, the cracks are very small, and the above assumption is conservative.

APPLICABILITY - Steam generator tube integrity is challenged when the pressure differential across the tubes is large. Large differential pressures across SG tubes can only be experienced when T_{avg} exceeds 200°F.

RCS conditions are far less challenging in COLD SHUTDOWN and REFUELING SHUTDOWN than during INTERMEDIATE SHUTDOWN, HOT SHUTDOWN, REACTOR CRITICAL and POWER OPERATION. In COLD SHUTDOWN and REFUELING SHUTDOWN, primary to secondary differential pressure is low, resulting in lower stresses and reduced potential for LEAKAGE.

ACTIONS - The actions are modified by a Note clarifying that the conditions may be entered independently for each SG tube. This is acceptable because the required actions provide appropriate compensatory actions for each affected SG tube. Complying with the required actions may allow for continued operation, and subsequent affected SG tubes are governed by subsequent condition entry and application of associated required actions.

4.13 RCS OPERATIONAL LEAKAGE

Applicability

The following specifications are applicable to RCS operational LEAKAGE whenever T_{avg} (average RCS temperature) exceeds 200°F (200 degrees Fahrenheit).

Objective

To verify that RCS operational LEAKAGE is maintained within the allowable limits, the following surveillances shall be performed at the frequencies specified in the Surveillance Frequency Control Program.

Specifications

A. Verify RCS operational LEAKAGE is within the limits specified in TS 3.1.C by performance of RCS water inventory balance.[1, 2]

B. Verify primary to secondary LEAKAGE is ≤ 83 gallons per day through any one SG. If it is not practical to assign the LEAKAGE to an individual SG, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG.[1]

Notes:

1. Not required to be completed until 12 hours after establishment of steady state operation.
2. Not applicable to primary to secondary LEAKAGE.

BASES

SURVEILLANCE REQUIREMENTS (SR)

SR 4.13.A

Verifying RCS LEAKAGE to be within the Limiting Condition for Operation (LCO) limits ensures the integrity of the reactor coolant pressure boundary (RCPB) is maintained. Pressure boundary LEAKAGE would at first appear as unidentified LEAKAGE and can only be positively identified by inspection. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. Unidentified LEAKAGE and identified LEAKAGE are determined by performance of an RCS water inventory balance.

The RCS water inventory balance must be performed with the reactor at steady state operating conditions (stable pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows). The surveillance is modified by two notes. Note 1 states that this SR is not required to be completed until 12 hours after establishing steady state operation. The 12 hour allowance provides sufficient time to collect and process all necessary data after stable unit conditions are established.

Steady state operation is required to perform a proper inventory balance since calculations during maneuvering are not useful. For RCS operational LEAKAGE determination by water inventory balance, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

An early warning of pressure boundary LEAKAGE or unidentified LEAKAGE is provided by the automatic systems that monitor the containment atmosphere radioactivity and the containment sump level. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. These leakage detection systems are specified in the TS 3.1.C Bases.

Note 2 states that this SR is not applicable to primary to secondary LEAKAGE because LEAKAGE of 83 gallons per day cannot be measured accurately by an RCS water inventory balance.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 4.13.B

This SR verifies that primary to secondary LEAKAGE is less than or equal to 83 gallons per day through any one SG. Satisfying the primary to secondary LEAKAGE limit ensures that the operational LEAKAGE performance criterion in the Steam Generator Program is met. If this SR is not met, compliance with LCO 3.1.H, "Steam Generator Tube Integrity," should be evaluated. The 83 gallons per day limit is measured at room temperature as described in Reference 4. The operational LEAKAGE rate limit applies to LEAKAGE through any one SG.

If it is not practical to assign the LEAKAGE to an individual SG, all the primary to secondary LEAKAGE should be conservatively assumed to be from one SG. The surveillance is modified by a Note, which states that the Surveillance is not required to be performed until 12 hours after establishment of steady state operation. For RCS primary to secondary LEAKAGE determination, steady state is defined as stable RCS pressure, temperature, power level, pressurizer and makeup tank levels, makeup and letdown, and RCP seal injection and return flows.

The primary to secondary LEAKAGE is determined using continuous process radiation monitors or radiochemical grab sampling in accordance with the EPRI guidelines (Ref. 4). The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.