VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

November 9, 2007

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

Serial No. 07-0693C
NL&OS/GDM R0
Docket Nos. 50-280/281
License Nos. DPR-32/37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION - GOTHIC MODEL
EXIGENT LICENSE AMENDMENT REQUEST (TAC NOS. MD7033 AND MD7034)
ALTERNATIVE CONTAINMENT ANALYSIS METHODOLOGY

In an October 22, 2007 letter (Serial No. 07-0693), Virginia Electric and Power Company (Dominion) requested an amendment to the licensing basis for Facility Operating License Numbers DPR-32 and DPR-37 for Surry Power Station Units 1and 2, respectively. The proposed amendment will permit the use of an alternate GOTHIC containment analysis methodology in support of the implementation of modifications to resolve Generic Safety Issue (GSI) 191, *Assessment of Debris Accumulation on PWR Sump Performance*, as committed to in Dominion's response to Generic Letter 2004-02, "*Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors.*"

In e-mails dated October 30, 2007 and November 6, 2007, to Mr. Gary Miller and Mr. Thomas Shaub, respectively, the NRC requested additional information and further clarification of the application of the alternative methodology to complete the review of the exigent license amendment regarding the alternative containment analysis methodology. The attachment to this letter provides the requested information and clarification. In addition, the NRC requested Dominion propose an operating license condition to incorporate the alternate methodology into the licensing basis. The following license condition is proposed for Surry Power Station Units 1 and 2:

P(3) VEPCO is authorized to revise the Updated Final Safety Analysis Report (UFSAR) to allow implementation of an Alternative GOTHIC Containment Analysis Methodology as set forth in the licensee's application dated October 22, 2007, and as supplemented on November 2, 2007 and November 9, 2007.

Dominion continues to request approval of the exigent license amendment by November 15, 2007 to support installation of the new containment strainers and the Unit 1 startup following the ongoing refueling outage.

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

Very truly yours,

Gerald T. Bischof
Vice President – Nuclear Engineering

Attachment
1. Response to Request for Additional Information - Gothic Model Exigent License Amendment Request - Alternative Containment Analysis Methodology

Commitments made in this letter: None.

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Gerald T. Bischof, 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 9th day of November, 2007.

My Commission Expires: August 31, 2008.

Margaret B. Bennett
Notary Public

(SEAL)

MARGARET B. BENNETT
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My Commission Expires Aug 31, 2008

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ATTACHMENT

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION - GOTHIC MODEL
EXIGENT LICENSE AMENDMENT REQUEST
ALTERNATIVE CONTAINMENT ANALYSIS METHODOLOGY

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

REQUEST FOR ADDITIONAL INFORMATION - GOTHIC MODEL EXIGENT LICENSE AMENDMENT REQUEST (TAC NOS. MD7033 AND MD7034) ALTERNATIVE CONTAINMENT ANALYSIS METHODOLOGY

Dominion submitted a license amendment request (LAR) to the NRC in a letter dated October 22, 2007 [1], to support resolution of NRC Generic Safety Issue 191 for Surry Power Station. In emails dated October 30, 2007, and November 6, 2007, the NRC requested additional information on the Surry LAR [2]. The answers to the twelve NRC questions are included in this attachment.

NRC Question 1

Discuss why it is acceptable to consider evaporation of drops or liquid film from a superheated thermal conductor and from the floor water pool to be the same. Show that the same heat and mass transfer mechanisms are involved (e.g., the pool is horizontal and at least some thermal conductors have vertical surfaces). What assurance is there that the water coverage of the thermal conductors will be sufficient to be equivalent to the pool?

Dominion Response

The design and orientation of the spray systems provide very high containment coverage with wetting of most surfaces, pooling on platforms and other horizontal surfaces, and a tortuous path to the sump. In the large break LOCA analyses, the Containment Spray (CS) System delivers flow to the containment atmosphere in less than 100 seconds after a High High Containment Pressure. The Surry CS System includes a crane wall header and a dome wall header such that 94% of the cross-sectional area above the operating deck is sprayed. The total containment volume sprayed by CS is 60%. Once activated, the Recirculation Spray (RS) System will also spray structures and components inside and outside the crane wall. The Surry containment is highly compartmentalized and a significant fraction of the spray flow must navigate from the spray headers through several floors and compartments to reach the sump pool. The remaining flow will fall through the floor grating outside the crane wall.

This also applies to the break discharge flow, which is disbursed with significant velocities during this period into the containment. Due to the highly compartmentalized nature of the containment, the break flow must also travel through compartments along with the spray drops that are heated above the operating deck and accumulate as films on platforms and equipment (rather than being directly added to the sump pool as modeled in the lumped parameter GOTHIC model).

The combined spray flow rate is very high compared to the net increase in vapor mass resulting from the increase in liquid-vapor (L/V) interface area. The total spray flow rate can range from a minimum of 7400 gpm for a single train of CS and RS to a maximum of 18,260 gpm for two trains with maximum flow. The most challenging analyses for RS strainer flashing and pump available net positive suction head (NPSHa) involve four RS pump operation and maximum CS flow that depressurize the containment quickly. The maximum spray flow rate of 18,260 gpm corresponds to a mass flow rate through the containment of ~2540 lbm/sec (18,260 gpm*1 ft^3/7.4805 gallons*1 minute/60 seconds* 62.4 lbm/ft^3 of cold spray water). The statepoint calculation for the demonstration case showed an increase in boil-off/vaporization from the liquid pool of 1548 lbm at 1270 seconds with the 40,000 ft^2 increase in L/V interface area (described in the response to RAI #3) compared to the base case. This integrated mass change was less than 50% of the 4506 lbm of liquid that could be boiled-off if 100% of the superheated thermal conductors released their stored energy above the boiling temperature at 1270 seconds.

The total integrated increase in boil-off/vaporization from the combined liquid pool of 1548 lbm at 1270 seconds is very small compared to the integrated spray flow rate that had been wetting conductors since CS System actuation early in the transient and the additional contribution of the break liquid release. With the maximum spray flow rate of 2540 lbm/sec, the integrated CS and RS spray flow from 900 to 1270 seconds is about 94,000 lbm, which is more than enough to wet the superheated conductors to support the credited boil-off mass from the increased L/V interface area.

Based on the above discussion, there is ample coverage and supply of water from the sprays and break discharge to support the boil-off rate and keep surfaces wet.

It is assumed that heat transfer coefficients for vertical surfaces can be represented using the same correlations as the horizontal pool surface. As described in the alternate methodology, in the lumped parameter GOTHIC containment model, a single surface L/V interface area is assumed for the combined pool and the credited conductor surface area. The heat and mass transfer from this surface is controlled by turbulent natural convection. Standard correlations for turbulent natural convection heat transfer [3] indicate that the heat transfer coefficient for horizontal and vertical surfaces differ only by a constant multiplier with convection from a vertical surface about 8% greater than for a horizontal surface at similar atmosphere and surface conditions. Natural convection from a horizontal surface is assumed for the L/V interface area. For wetted conductors with liquid film that are as hot or hotter than the pool, the heat transfer from water to the surface would be underestimated by the combined pool and conductor surface heat transfer. On the vapor side of the surface, the heat and mass transfer correlations are based on turbulent natural convection from a horizontal surface but with a factor to account for the increased heat and mass transfer due to the combined effects of convection and evaporation [3]. This factor was based on comparisons with experiments for evaporative heat transfer from a pool and is expected to underestimate the heat and mass transfer from a vertical surface.

Therefore, the representation of the vertical surfaces with the horizontal pool is considered to be reasonable and conservative.

NRC Question 2

Verify that the thermal conductors counted towards increasing the sump pool interface are not also contributing to heat transfer to the vapor space of the containment.

Dominion Response

The alternate methodology increases the L/V interface area to represent other pooled areas and wetted surfaces in the containment. At the same time, the method continues to allow heat transfer from the thermal conductors, including those superheated conductors that provide part of the justification for increasing the L/V interface area. Although this represents additional surface area providing heat transfer to the vapor space, it does not actually represent any increase in integrated heat transfer during the period of interest. The statepoint confirmation (described in the response to RAI No. 5) considers the stored energy, relative to containment boiling temperature, in the superheated conductors at the time of minimum strainer margin and verifies that the increase in L/V interface area does not result in more flashing than permitted by the available conductor energy at this time. The L/V interface area is reduced if necessary to comply with the statepoint check. Since the stored energy is considered at the point of minimum strainer margin, the energy that has been removed from the conductors prior to that time is already excluded from consideration when verifying an acceptable L/V interface area. Note, it is assumed that the superheated conductors are sufficiently wetted to remove the stored energy during the time period under consideration. This assumption is discussed in the response to RAI No 1.

NRC Question 3

Describe the procedure for including the superheated thermal conductors as part of the liquid/vapor interface when predicting the containment conditions for the available NPSH calculation. How are the superheated thermal conductors identified and how are the thermal conductors in the fraction less than 50% chosen for equivalency with the sump pool determined?

Dominion Response

The alternate methodology considers all metal thermal conductors that are superheated (i.e., surface temperatures greater than liquid saturation temperature at the total containment pressure) at the time of minimum strainer margin. No specific distinction is made between the metal conductors. As a conservatism, only a portion of these conductors are considered to be available for additional heat removal due to wetting and liquid pooling. A value of no more than 50% of the surface area of these conductors was deemed conservative considering the high spray flow coverage and break flow effects discussed in the response to RAI No. 1. This is the maximum value considered for the L/V interface area increase. The equivalency of the effects of this increase in L/V interface area to the superheated thermal conductors is further demonstrated by the statepoint check, which is described in the response to RAI No. 5, and the comparison of heat transfer between the pool surface and thermal conductor surfaces, which is described in the response to RAI No. 1.

NRC Question 4

For GOTHIC output line graphs 38, 39, 70 and 71- what is the difference between graph 38 and 70 for ORS NPSH and between 39 and 71 for IRS NPSH?

Dominion Response

In the GOTHIC model provided to the NRC, Control Variables 25 and 26 perform the original NPSH available (NPSHa) calculations for the outside RS and inside RS pumps, respectively, using a fixed fluid density for 70°F water that was consistent with the original Equation 16 in topical report DOM-NAF-3 submitted to the NRC in November 2005 [4]. These control variables are plotted in graphs 38 and 39. The Surry NPSHa analyses that used the original NPSHa Equation 16 were submitted to the NRC in a letter dated January 31, 2006 [5]. In a letter dated July 14, 2006 [6], the DOM-NAF-3 NPSH analysis methodology was revised to use the fluid density in the pump suction volume instead of the fixed density. Control Variables 85 and 86 modify Control Variables 25 and 26, respectively, to reflect the fluid density change in Equation 16. Control Variables 85 and 86 provide the output for the final NPSHa analyses documented in our letter dated July 28, 2006 [7]. Graphs 70 and 71 display the final control variables for transient NPSHa (units in ft of head) for the ORS and IRS pumps, respectively.

NRC Question 5

Describe the procedure for the "state point confirmation" to assure that the increased mass transfer from the larger pool surface is supported by the energy content of the credited portion of the metal conductors.

Dominion Response

The statepoint confirmation verifies that the amount of available energy in the superheated thermal conductors is sufficient to support the effects of the increased L/V interface area. The superheated thermal conductors are identified as discussed in the response to RAI No. 3. The stored energy of these thermal conductors at the time of minimum strainer margin can be calculated, either externally or using GOTHIC control variables, based on the metal thermal properties and the difference between the conductor surface temperature and the liquid saturation temperature at the total containment pressure (i.e., the boiling temperature, Tsatl) using GOTHIC code output. This stored metal energy is then used to calculate the mass of liquid that would be boiled based on the liquid and vapor enthalpies at the containment pressure. The reduction in containment liquid mass with the larger L/V interface area is restricted to be less than 50% of the boiled liquid from the metal stored energy above Tsatl. The L/V interface area is adjusted as necessary to satisfy the statepoint check, such that a final GOTHIC analysis is limited by the more restrictive of two criteria: 1) increasing L/V interface area by no more than 50% surface area of the superheated thermal conductors; and 2) the reduction in liquid mass from the base case with the minimum pool area is less than 50% of the liquid that could be boiled from the stored energy in the superheated thermal conductors above Tsatl.

NRC Question 6

Please state exactly which cases result in predicting flashing and two phase flow and low available NPSH.

Dominion Response

The limiting RS pump NPSHa analyses were summarized in Table 3.6-1 of our letter dated July 28, 2006 [7]. The double-ended pump suction guillotine (DEPSG) break analyses (Cases 1 through 3) produce a condition where the containment pressure drops to the saturation pressure of the containment bulk liquid. At this point, the water level above the RS strainer is about 0.6 ft. As detailed in the response to RAI No. 8, at least 1.9 ft of margin to saturation above the top of the RS strainer is required to preclude flashing inside the RS strainer. For all DEPSG break cases presented in Table 3.6-1 of Reference 7, flashing in the strainer is predicted for a short period of time during early RS pump operation. While the cold water injection into the RS pump suction branch lines inside the strainer could condense the steam, the two-phase pressure drop could reduce the static pressure and produce inadequate NPSHa for the RS pumps (cold water injection is described in the response to RAI No. 7).

The double-ended hot leg guillotine (DEHLG) break analysis is most limiting at a Technical Specifications Figure 3.8-1 statepoint of 25°F service water (SW), 10.3 psia containment air partial pressure, and 125°F containment air temperature (Cases 4 through 6 in Table 3.6-1 in Reference 7). Case 6 in Table 3.6-1 has a minimum margin to saturation above the RS strainer of 1.69 ft. The containment pressure is greater than the saturation pressure for the DEHLG models but there is no margin to flashing at the most limiting point inside the RS strainer for four RS pump operation. Analyses at higher SW temperatures have adequate margin to flashing.

The application of the proposed GOTHIC methodology will ensure the availability of adequate margin to preclude flashing in the strainer for the cases analyzed.

NRC Question 7

Where is flashing predicted to occur in the strainer?

Dominion Response

The flashing location is case dependent and is a function of break location, initial containment and SW conditions, pump flow rates, and the containment pressure and sump pool temperature transient response generated by GOTHIC. The most limiting analyses using the current DOM-NAF-3 NPSH analysis methodology have a minimum margin of 0.6 ft of static head of water above the RS strainer when the containment pressure drops to the saturation pressure of the bulk liquid. With four RS pump operation, the velocity head and non-recoverable losses reduce the static pressure such that flashing is predicted in the RS strainer modules near the common header from which the RS pumps take suction.

Each RS pump has a suction line from the common header. At each branch line, cold water is injected to provide subcooling that increases NPSHa for the RS pumps. The outside RS pump receives cold water from the containment spray system and each inside RS pump receives cold water diverted from the discharge side of its designated heat exchanger. While the cold water injection would quench any steam before it enters the suction piping, the two-phase pressure drop between the initial flashing point and the cold water injection could be too large to confirm analytically that there is adequate NPSHa at the RS pump impeller. The proposed analysis methodology change confirms that sump conditions do not support any condition for flashing inside the RS strainer for the most limiting hot and cold leg breaks.

NRC Question 8

What NPSH margin is necessary to eliminate flashing and provide adequate available NPSH?

Dominion Response

The proposed method to increase the L/V interface area provides more reasonable, but conservative pool conditions for the RS strainer hydraulic analysis such that flashing is not predicted to occur. With no flashing in the strainer and a single-phase pressure drop, the RS pump NPSH margins previously documented are confirmed to be sufficient. The cold water injection that is added to the pump suction lines after the RS strainer common header provides adequate subcooling. It was recognized that the change in L/V interface area will increase pump NPSHa, but the new NPSHa results were not documented since the purpose of the methodology change was to improve the analytical boundary conditions for the RS strainer to ensure that no flashing occurs.

For the DEPSG break with full engineered safety features (Case 1 in Table 3.6-1 in Reference 7), the increase in L/V interface area of 40,000 ft^2 increased the minimum margin to RS strainer flashing from 0.6 ft to 2.36 ft (Control Variable 90 in the demonstration model provided to the NRC). The vendor margin requirement above the top of the RS strainer (water level plus pressure above saturation pressure) is 1.9 ft for four RS pumps at maximum flow with no debris head loss. The most limiting condition for strainer flashing occurs approximately six minutes after the RS system is put in service. For the most limiting analysis for the Surry Unit 1 RS strainer, up to 27% of the full-debris pressure loss on the strainer fins can be accommodated with no flashing in the six minutes. It is noteworthy that the GOTHIC case that produced these boundary conditions credited a 40% increase in L/V interface area rather than full credit for 50% of the superheated conductor surface area. The statepoint check confirmed that the increased L/V interface area reduced the containment liquid mass by 1548 lbm (this is an integrated effect), or 35% (1548 lbm/4506 lbm) of the liquid mass that could be boiled by the available superheated thermal conductor energy above Tsatl at that time. So, there is margin available to further increase the L/V interface area for that case. Additional margin from this case was not pursued once it was concluded that the strainer debris head loss is not appreciable early in RS system operation.

During the period of minimum margin to strainer flashing, a debris bed is only just beginning to form on the strainer fins. Testing performed by AECL has shown that several hours to days are required for the full debris bed to form and to reach the point where maximum debris pressure loss occurs. At the time the transient low margin condition occurs, the pressure loss due to debris will be below 27% of the full-debris pressure loss, and thus flashing will not actually occur within the strainer. The test results are applicable to the fully installed strainer at Surry Units 1 and 2, as the test arrangement is representative of a segment of the full strainer, and the strainer is designed to operate uniformly over the whole surface area (using tuned flow orifices).

The 27% debris head loss in the first six minutes of RS system operation is the most limiting design constraint for the Surry Units 1 and 2 RS strainer. The margin to RS strainer flashing quickly increases as sump level rises and containment liquid temperature decreases with heat removal through all four RS heat exchangers. In the demonstration case, the margin to flashing is greater than 5.0 ft at 1455 seconds (Control Variable 90), or about 3 minutes after the minimum occurs. The 5.0 ft margin is adequate to preclude flashing for the full debris head loss.

The test information used in the above assessment is from AECL reduced-scale testing of the Surry RS strainer design without assessing impacts from potential chemical effects. This approach provides a more conservative strainer debris head loss than Surry's current licensing basis in UFSAR Section 6.3.1.3 (Rev. 39, 9/27/07). Surry Units 1 and 2 will continue to maintain their current licensing basis until final resolution of GSI-191.

It is also noted that analyses at SW temperatures above 25°F have more margin to flashing than the reported case. Analyses with the new methodology show the DEPSG break to be more limiting than the DEHLG at the same initial plant conditions.

NRC Question 9

Please describe any other available conservatisms that were considered to increase the required amount of ORS and IRS pump NPSH margin instead of reducing the conservatism in L/V interface area.

Dominion Response

Dominion listed the conservatisms in the GOTHIC NPSHa analysis methodology in Section 3.4 of our license amendment request dated October 22, 2007 [1]. During the early phases of RS system operation, it is necessary to increase the containment pressure or water level or decrease the sump temperature to provide adequate margin to RS strainer flashing. Investigations looked at both plant operation and DOM-NAF-3 NPSH methodology changes. The plant operation investigations included: a) plant configuration changes (e.g., delaying RS pump start); b) restricting plant operating limits (containment air partial pressure, containment temperature, and service water temperature controlled by Surry Technical Specification 3.8); and c) operator actions to control the number of RS pumps running. The saturated containment liquid condition occurs for many DEPSG break analyses along the service water temperature operating range with the existing NPSH analysis methodology. GOTHIC sensitivity analyses confirmed that changes to the plant configuration or operating limits would exceed other design limits (e.g., containment depressurization requirements). Also, the fast timing of the LOCA depressurization did not provide a reasonable period of time to credit operator action to decrease strainer flow to two RS pumps (the minimum required to meet design basis requirements) after automatic system actuation.

The DOM-NAF-3 NPSH analysis methodology investigations included several changes that would be more technically accurate and somewhat less conservative, including: a) increasing the containment L/V interface area; b) spray droplet size; c) ECCS injection modeling; and d) reactor coolant system (RCS) and steam generator (SG) noding. In the containment response model, the use of the nominal Sauter mean diameter for spray droplets was evaluated (instead of one-half the Sauter mean) and found to have no significant effect until other changes were implemented, as well as the proposed increase in L/V interface area. In the mass and energy release model, evaluated changes included replacing the large L/V interface area in the broken cold leg volume with an alternate method for ECCS injection and subdividing the RCS and SG components in order to reduce the SG secondary heat transfer rate for cold side breaks. Since the mass release from the vessel side of the break is forced into thermal equilibrium and spilled directly to the sump, a reduction in the intact loop SG heat transfer rate would produce a lower energy release to the sump in the short period of concern for the RS system. With the integral energy release from the vessel side of the break reduced, lower sump temperatures would provide adequate margin to strainer flashing and pump NPSHa. Using this method to model the RCS and SGs in significant detail would capture the large margins in DEPSG break integrated energy release early in the accident that have been demonstrated by Westinghouse in WCAP-16608, Addendum 1 [8], which has been submitted for NRC review.

However, significantly more investigation time would be needed to qualify the detailed RCS and SG models than was available to support the Surry Unit 1 strainer installation schedule as discussed in Reference 1. Given the schedule constraints, it was concluded that the proposed method to increase the L/V interface area would provide adequate margin while maintaining an overall conservative calculation for NPSHa.

NRC Question 10

Section 3.1.4 of the approved topical report states that the minimum sump pool surface area is used for the current analysis. Page 3/16 of Attachment 1 of the October 22, 2007 letter states that the actual pool surface area is used in the approved methodology. Please clarify.

Dominion Response

The minimum sump pool surface area and actual pool surface area are the same value. The minimum/actual sump pool surface area accounts for structures and equipment interferences that reduce the pool surface area from the value calculated using the inner diameter of the containment cylinder. The previous analysis of record for Surry used the LOCTIC code that used the containment inner diameter in its calculations, so the language in DOM-NAF-3 was intended to differentiate by using an actual pool surface area.

NRC Question 11

The graph of forcing function 2T in the GOTHIC input files is titled "DEHLG (MAX) h1" and its description in the forcing function table is "DEPSG (MIN) h1." The input file is named as "ps-full72alv51." Please explain if this graph is for a hot leg (HL) break or a pump suction (PS) break. If this graph for energy release in a HL break, please justify its application in the PS break analysis.

Dominion Response

The graph label for Forcing Function 2T is incorrect. During the Surry model development, the double-ended hot leg guillotine (DEHLG) break model was the first one constructed. The double-ended pump suction guillotine (DEPSG) model was built from that model. During that model conversion, the table description label for Forcing Function 2T was modified to reflect the DEPSG break data, but apparently, the change to the table description did not register in the graphical display of the GOTHIC pre-processor. The DEPSG analysis model that was provided to the NRC includes mass and enthalpy tables for a DEPSG break.

NRC Question 12

Attachment 1, Section 3.2: A larger liquid vapor interface area is used "during the period of the transient when minimum NPSH and minimum margin to saturation on top of the strainer fins occur." (a) Please describe the calculation process as a function of time. Is the larger area only used only during the "period of interest"? (b) The state point confirmation verifies that the increase in L/V interface area does not result in more flashing than permitted by the available conductor energy at this time. How does this answer the question of whether the superheated thermal conductors are being credited twice for adding heat to the atmosphere?

Dominion Response - Part a)

GOTHIC accepts only one value for the containment L/V interface area. Thus, the larger area is used for the entire transient simulation. Figure 2 in Reference 1 shows that initially sump temperature is colder than the vapor space, and the use of a larger L/V conservatively will heat the containment liquid. After the vapor temperature decreases below the sump temperature, a benefit from increasing the L/V interface area is recognized. However, the use of the larger value may not be valid for long-term sump temperature analysis, as the integrated sump boil-off will be larger, and a new statepoint verification at a later time may not support the 50% conductor surface area criterion. The statepoint verification is done at the minimum margin to saturation to confirm that the increased L/V interface area is credited appropriately. Eventually, the superheated conductor temperatures will drop below the boiling temperature; hence, the methodology cannot be applied indefinitely. The new methodology is only applied to show adequate margin at the time of minimum approach to flashing inside the RS strainer. Beyond that point in time, the benefit from increasing the L/V interface area is not necessary because of the rapid, significant increase in margin to flashing that is realized from colder sump temperatures and increasing water level.

Dominion Response - Part b)

In the alternate methodology, the stored energy in the superheated thermal conductors provides a two-tier credit that is captured as follows:

1) The direct heating of the vapor field, which provides for some small amount of energy removal from the superheated conductors as demonstrated by Figure 4 of Attachment 1 in Reference 1; and

2) The increase in the L/V interface area, which attempts to credit the remaining stored energy that would be extracted from the superheated thermal conductors by spray interaction in the containment if GOTHIC had the capability to model the wetting of the superheated conductors.

As described in the response to RAI No. 2, each one of the above energy removal mechanisms is considered separately in GOTHIC. Hence, no double accounting of stored energy is made since the statepoint confirmation (described in the response to RAI No. 5) considers only the remaining stored energy in the superheated conductors at the time of statepoint verification.

References

1. Letter from Gerald T. Bischof (Dominion) to USNRC Document Control Desk, "Virginia Electric and Power Company, Surry Power Station Units 1 and 2, Exigent License Amendment Request, Alternate Containment Analysis Methodology," Serial Number 07-0693, October 22, 2007.

2. Email correspondence from Richard Jervey (NRC) to Dominion Licensing, "RAIs for Consideration - Surry Exigent Amendment," October 30, 2007 and November 6, 2007.

3. NAI-8907-06, Revision 16, "GOTHIC Containment Analysis Package Technical Manual, Version 7.2a(QA)," January 2006.

4. Letter from Leslie N. Hartz (Dominion) to USNRC, "Request for Approval of Topical Report DOM-NAF-3, GOTHIC Methodology for Analyzing the Response to Postulated Pipe Ruptures Inside Containment," Serial Number 05-745, November 1, 2005.

5. Letter from Leslie N. Hartz (Dominion) to USNRC, "Virginia Electric and Power Company, Surry Power Station Units 1 and 2, Proposed Technical Specification Change and Supporting Safety Analyses Revisions to Address Generic Safety Issue 191," Serial Number 06-014, January 31, 2006.

6. Letter from Gerald T. Bischof (Dominion) to USNRC, "Supplement to Request for Approval of Topical Report DOM-NAF-3, GOTHIC Methodology for Analyzing the Response to Postulated Pipe Ruptures Inside Containment," Serial Number 06-544, July 14, 2006.

7. Letter from Gerald T. Bischof (Dominion) to USNRC, "Virginia Electric and Power Company (Dominion), Surry Power Station Units 1 and 2, Response to Request for Additional Information and Supplement to Proposed Technical Specification Change and Supporting Safety Analyses Revisions to Address Generic Safety Issue 191," Serial Number 06-545, July 28, 2006.

8. WCAP-16608-NP, Revision 0, Addendum 1, Appendix C, "Westinghouse Containment Analysis Methodology: PWR LOCA Mass and Energy Release Input Calculation Methodology," R. P. Ofstun and R. J. Espinosa, July 2007.