VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 22, 2007

10 CFR 50.90
10 CFR 50.91(a)(6)

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

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NL&OS/GDM	R1
Docket Nos.	50-280
	50-281
License Nos.	DPR-32
	DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
EXIGENT LICENSE AMENDMENT REQUEST
ALTERNATIVE CONTAINMENT ANALYSIS METHODOLOGY

Pursuant to 10 CFR 50.90 and 10 CFR 50.91(a)(6), Virginia Electric and Power Company (Dominion) requests an amendment to the licensing basis for Facility Operating License Numbers DPR-32 and DPR-37 for Surry Power Station Units 1 and 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.*

The GOTHIC methodology that was previously approved by the NRC in Topical Report DOM-NAF-3-0.0-P-A, *GOTHIC Methodology for Analyzing the Response to Postulated Pipe Ruptures Inside Containment*, is discussed in detail in the Surry Updated Final Safety Analysis Report (UFSAR). The approved methodology was used to establish boundary conditions (i.e., pressure, liquid temperature and water level) for the Surry Recirculation Spray (RS) strainers that are being installed in the Surry Units 1 and 2 containments. The boundary conditions are required to assess the RS strainer internal hydraulic performance following a loss of coolant accident (LOCA). The NRC-approved methodology contains significant conservatisms, which are specifically included in the GOTHIC net positive suction head available (NPSHa) models to maximize liquid temperature and minimize containment pressure for design basis containment response evaluations. However, these conservatisms are creating bulk conditions that are too conservative for application to sump strainer performance. Specifically, for certain

LOCA analyses, these overly conservative conditions result in a prediction of two-phase flow in the RS strainer and inadequate NPSHa for the RS pumps for a short period of time. Therefore, an alternate containment GOTHIC analysis methodology is proposed to reduce certain overly conservative assumptions to more realistically, yet conservatively, address expected plant conditions in containment following a LOCA. The alternate method relaxes some of the conservatisms in the NPSH analysis methodology in Topical Report DOM-NAF-3-0.0-P-A. The proposed alternate methodology will be used to demonstrate that the RS pumps have adequate NPSHa throughout their required service time. A detailed discussion of the proposed license amendment request is provided in Attachment 1. Upon approval of the proposed license amendment, the Surry UFSAR will be revised to include the alternate GOTHIC methodology as an alternate method for NPSH and LOCA analyses that develop inputs for component design, such as determination of margin for sump strainer design. The proposed UFSAR revision is provided in Attachment 2. It should be noted that the proposed revision is indicated on only the Unit 2 pages of the UFSAR since the new sump strainers were installed, in part, in Unit 2 containment during a previous outage. The UFSAR was updated to reflect the differences between the two units pending installation of the new strainers in Unit 1. As part of the normal UFSAR update process, following installation of the Unit 1 sump strainers during the upcoming Unit 1 refueling outage, the UFSAR will be revised to eliminate the separate UFSAR pages for Units 1 and 2 since both units will have the new strainers installed, and the revised UFSAR pages will indicate that the alternate methodology is applicable to both units.

The proposed amendment request has been reviewed, and it has been determined that no significant hazards consideration exists as defined in 10 CFR 50.92. The basis for this conclusion is included in Attachment 1. In addition, it has been determined that the change qualifies for categorical exclusion from an environmental assessment as set forth in 10 CFR 51.22(c)(9); therefore, no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed change. The basis for this determination is also included in Attachment 1. The proposed license amendment request has been reviewed and approved by the Station Nuclear Safety and Operating Committee.

Finally, it is requested that the proposed licensing basis change be reviewed on an exigent basis to support installation of the Unit 1 containment sump strainer and unit startup following the Unit 1 2007 fall refueling outage currently scheduled for completion in late November 2007. The justification and basis for an exigent review is provided in Attachment 1. Dominion respectfully requests NRC approval of the proposed license amendment by November 15, 2007.

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

Sincerely,

Gerald T. Bischof
Vice President – Nuclear Engineering

Commitments contained in this letter: None

Attachments:
1. Discussion of Change
2. Proposed UFSAR Revision

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 the 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 and correct to the best of his knowledge, information, and belief.

Acknowledged before me this 22nd day of October, 2007.

My Commission Expires: May 31, 2010.

Vicki L. Hull
Notary Public

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ATTACHMENT 1

Discussion of Change

Virginia Electric and Power Company
(Dominion)
Surry Power Station Units 1 and 2

DISCUSSION OF CHANGE

1.0 INTRODUCTION

Pursuant to 10 CFR 50.90 and 10 CFR 50.91(a)(6), Virginia Electric and Power Company (Dominion) requests an amendment to the licensing basis for Facility Operating License Numbers DPR-32 and DPR-37 for Surry Power Station Units 1 and 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.*

The GOTHIC methodology that was previously approved by the NRC in Topical Report DOM-NAF-3, Rev. 0.0-P-A [7.1] was used to establish boundary conditions (i.e., pressure, liquid temperature and water level) for the Surry Recirculation Spray (RS) strainers that are being installed in the Surry Units 1 and 2 containment basements. The boundary conditions are required to assess the RS strainer internal hydraulic performance during early operation following a LOCA. The NRC-approved methodology contains significant conservatisms, which are specifically included in the GOTHIC NPSHa models to maximize liquid temperature and minimize containment pressure for design base containment response evaluations. However, these conservatisms are creating bulk conditions that are too conservative for application to sump strainer performance. Specifically, for certain LOCA analyses, these overly conservative conditions result in a prediction of two-phase flow in the RS strainer and inadequate net positive suction head available (NPSHa) for the RS pumps for a short period of time. Therefore, an alternate containment GOTHIC analysis methodology is proposed to reduce certain overly conservative assumptions to more realistically, yet conservatively, address expected plant conditions in containment following a LOCA. The proposed alternate methodology will be used to demonstrate that the RS pumps have adequate NPSHa throughout their required service time.

The proposed amendment request has been reviewed, and it has been determined that no significant hazards consideration exists as defined in 10 CFR 50.92. In addition, it has been determined that the change qualifies for categorical exclusion from an environmental assessment as set forth in 10 CFR 51.22(c)(9); therefore, no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed change.

2.0 PROPOSED CHANGE

The purpose of the proposed change to the licensing basis is to provide an alternate method for NPSH and LOCA analyses that develop inputs for component design, such as determination of margin for sump strainer design. This method relaxes some of the conservatisms in the NPSH analysis methodology as outlined in Sections 3.1.4 and 3.8.2 of the NRC-approved Dominion methodology Topical Report DOM-NAF-3-0.0-P-A [7.1].

It is important to note that this alternate method does not propose a change to the previously approved methodology for design basis containment response calculations that are implemented and approved consistent with the Standard Review Plan. However, it credits some physical processes within the limitations of the lumped modeling capabilities of GOTHIC that can be applied to component design analysis.

3.0 TECHNICAL EVALUATION

Dominion obtained NRC approval [7.2] for a GOTHIC methodology for simulating containment response following postulated pipe breaks inside the containment. The methodology has been used to support the design and implementation of containment sump strainers in several Dominion nuclear plants.

The GOTHIC NPSH model with previously accepted methodology provides an overly conservative combination of low containment pressure, low sump level and high sump water temperature that provides insufficient margin to prevent flashing and two-phase flow in the strainer ducts when all four recirculation spray pumps are operating. This application of the GOTHIC NPSH model to develop conservative boundary conditions for component design analysis is consistent with Application #6 in Section 2.3 of Reference 7.1. The level of conservatism in the NPSH model must be reduced in order to develop more reasonable boundary conditions for the sump strainer hydraulic analysis.

3.1 Intended Applications

The alternate methodology outlined herein can be used for NPSH and LOCA analyses that develop design inputs for component design, such as determination of margin for sump strainer design (Application 6 as defined in Section 2.3 of Reference 7.1 methodology).

3.2 Description of Alternate Methodology

Sections 3.1.4 and 3.8.2 of the approved methodology [7.1] are proposed to be relaxed to provide for an alternate method of calculating available NPSH and relevant input for suction line/strainer duct hydraulic analysis. The main focus of the alternate methodology is to gain a slight advantage in the heat and mass transfer between the containment vapor and the liquid phase in the pool. The relaxation is accomplished by allowing for a larger liquid-vapor interface area that is set to the sump pool surface area plus an area that is no more than one-half the sum of the surface areas of all the steel conductors with a surface temperature that exceeds the boiling temperature at containment pressure during the period of the transient when minimum NPSH and minimum margin to saturation on top of the strainer fins occur.

The technical basis for the proposed change to the approved methodology is as follows:

As documented in Section 3.1.4 of the approved methodology [7.1], the liquid-vapor interface area is used to calculate the heat and mass transfer between the vapor and the liquid phase. It can be set to zero to prevent any heat and mass transfer at the interface or to a very large value to force thermal equilibrium between the vapor and liquid phases. The default value is the maximum of A_f or A_w, where A_w is the wettable area calculated from total conductor surface area less any area that is too hot to allow a liquid film, and A_f is the nominal floor area defined as $\frac{V}{H}$, where V is the specified free volume and H is the containment height.

The default setting gives a large area for interfacial heat and mass transfer under the assumption that during a LOCA or main steam line break (MSLB) nearly all of the surface area will be wet due to condensation or deposited water from the break. The default value has been used for all of the GOTHIC validation against experimental data for simulated line breaks in containments. The GOTHIC default value is used for the containment lumped volume for containment integrity analyses.

For NPSH analysis, a small liquid-vapor interface area will minimize the heat and mass transfer. It is not obvious that this is conservative since during the early part of the transient, the vapor temperature is typically higher than the pool temperature, and the pool heating would be underestimated. As the containment cools and depressurizes, the vapor temperature falls below the pool temperature, and the pool cooling would also be underestimated. Based on plant specific sensitivity analysis, it has been concluded that the net effect of this combined under heating and cooling is that the pool temperature is higher and the atmosphere pressure is lower with a smaller value of the liquid-vapor interface area. Hence, the actual sump pool surface area was adopted in the approved methodology.

However, under high spray conditions, the containment atmosphere temperature and pressure can rapidly decrease, and the atmosphere temperature can fall to levels substantially less than the surface temperature of the heat conductors. The existing films and pools on these surfaces, as well as the newly deposited spray drops, will tend to evaporate. This will increase the heat removal rate from the conductors and increase the steam content of the containment resulting in higher containment pressure and higher available NPSH. During the rapid depressurization, some of the steel conductors may be left in a superheated state with the surface temperature above the boiling temperature at the containment pressure. Any drops that fall on these surfaces will vaporize and retard the containment depressurization through the addition of steam to the atmosphere. The single lumped volume containment model of the approved methodology cannot adequately account for these effects that will tend to increase available NPSH through an increase in containment pressure. To account for some of these effects, the liquid-vapor interface area will be set to the sump pool surface area plus an area that is no more than one-half the sum of the surface areas of all the steel conductors with a surface temperature that exceeds the boiling temperature at containment pressure during the period of the transient when the minimum NPSH occurs. Furthermore, a state point confirmation will be made to assure that the increased mass transfer from the larger pool surface is supported by the energy content associated with the credited portion of the metal conductors.

3.3 Demonstration Analysis of Alternate Methodology

To demonstrate the benefit of the change, a GOTHIC model for calculating NPSH for the Surry outside RS (ORS) pumps was used to perform a sensitivity study on containment liquid-vapor interface area as follows:

1. The base case was analyzed assuming the actual sump pool surface area consistent with the approved methodology (11,757 ft^2).

2. In accordance with the proposed alternate methodology, the second case was analyzed assuming a liquid-vapor interface area that was set to the sump pool surface of 11,757 ft^2 plus an additional 40,000 ft^2 of area. The additional area represents 39.1% of the total surface areas of all the steel conductors with a surface temperature that exceeds the boiling temperature at containment pressure about the time of minimum NPSH.

Figures 1 and 2 provide a comparison of containment pressure, pool liquid temperature and air temperature. As illustrated by these figures, during the early part of the transient, the vapor temperature is higher than the pool temperature and the specification of larger interface area results in additional pool heating that would be conservative for NPSH analysis. After the four RS pumps start after 900 seconds, the containment cools and depressurizes rapidly and the vapor temperature falls below the pool temperature and the pool cooling is slightly enhanced. Figure 1 illustrates that with the proposed methodology, the containment pressure is higher at the minimum NPSH point for the ORS pumps (i.e., ~1400 seconds).

Figure 3 provides a comparison of containment pressure and saturation pressure at the containment liquid temperature. The increase in the vapor-liquid interface area prevents the pool from reaching saturation at the containment total pressure.

Figure 4 provides a comparison of select containment metal conductor surface temperatures against the liquid saturation temperature at the containment total pressure. The purpose of this figure is to illustrate that following rapid depressurization in the containment some of the steel conductors are left in a superheated state with the surface temperatures above the boiling temperature at the containment total pressure.

The following table provides the surface area of some of the relatively thick metal conductors that are at or above the boiling temperature at the containment total pressure. As illustrated by the table, the credited liquid-vapor interface area is no more than one-half of the available conductor exposed surface areas that exceed the boiling temperature. In this case, 102,363 ft^2 of metal conductor surface meet the criterion after 1200 seconds, but only 40,000 ft^2 was used to increase the liquid-vapor interface area. A state point confirmation of the energy content of conductors with this surface area was shown to be adequate to support the additional mass transfer from the larger pool area.

Conductor Number	Surface Area (ft^2)
TC 11 – Thickness = 0.25 in.	7,180
TC 12 – Thickness = 0.42 in.	11,290
TC 13 – Thickness = 1.53 in	488
TC 15 – Thickness = 0.242 in	7,192
TC 16 – Thickness = 0.439 in	66,345
TC 17 – Thickness = 0.906 in	7,454
TC 18 – Thickness = 1.7 in	2,414
Total	**102,363.00**

**Figure 1: Comparison of Containment Pressure
DEPSG Break with Max ESF**

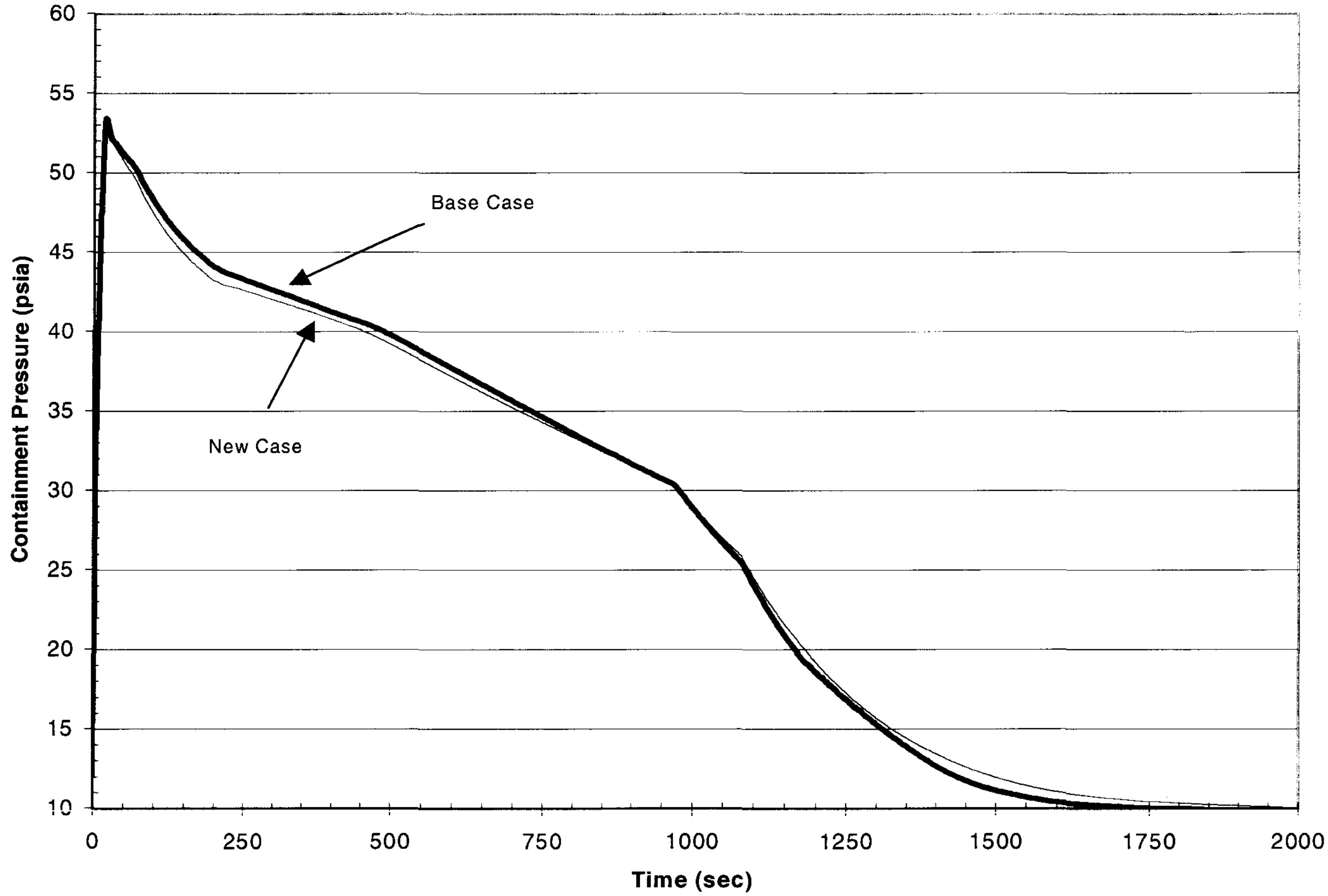


Figure 2: Comparison of Containment Temperatures
DEPSG Break with Max ESF

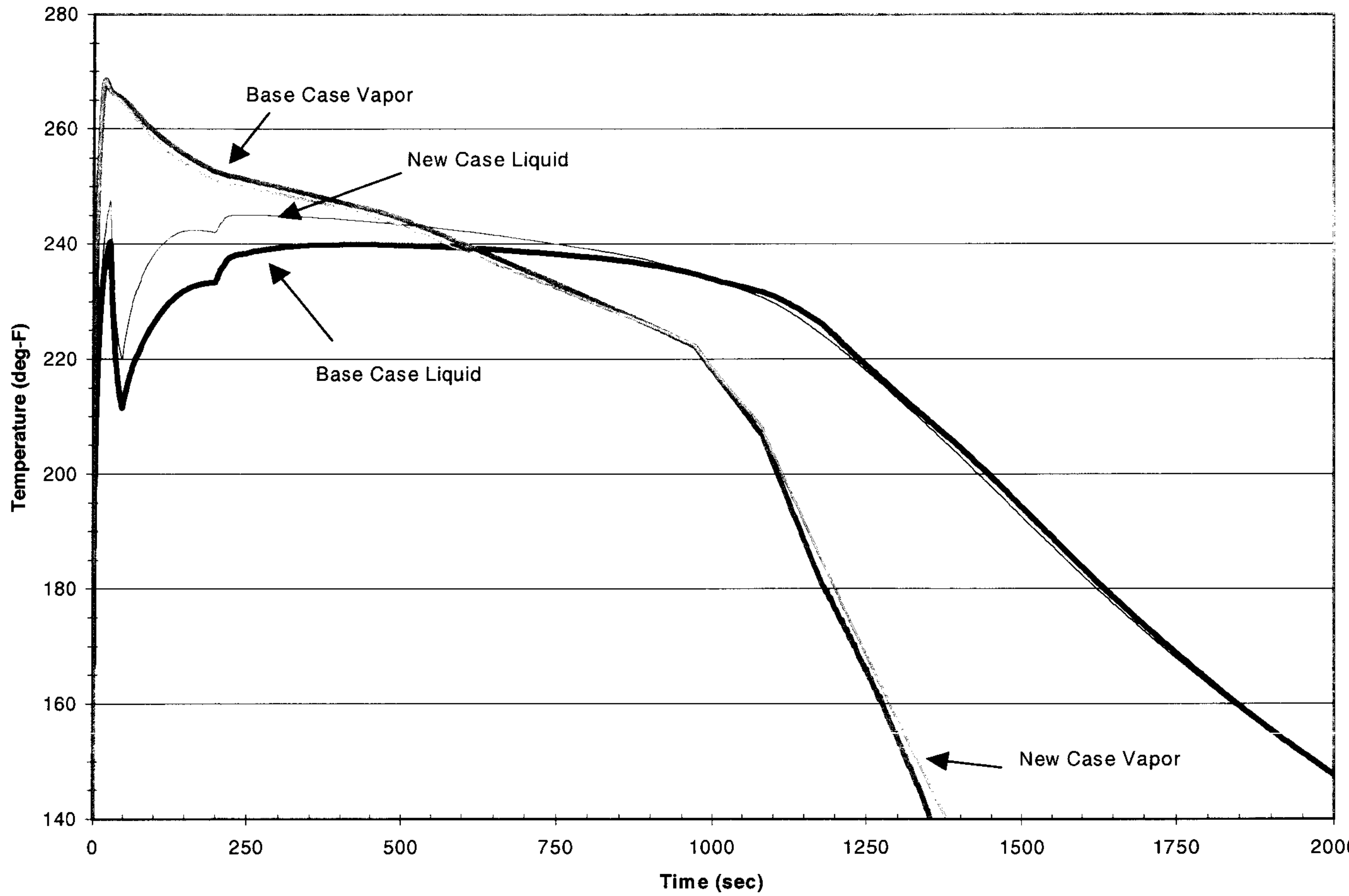
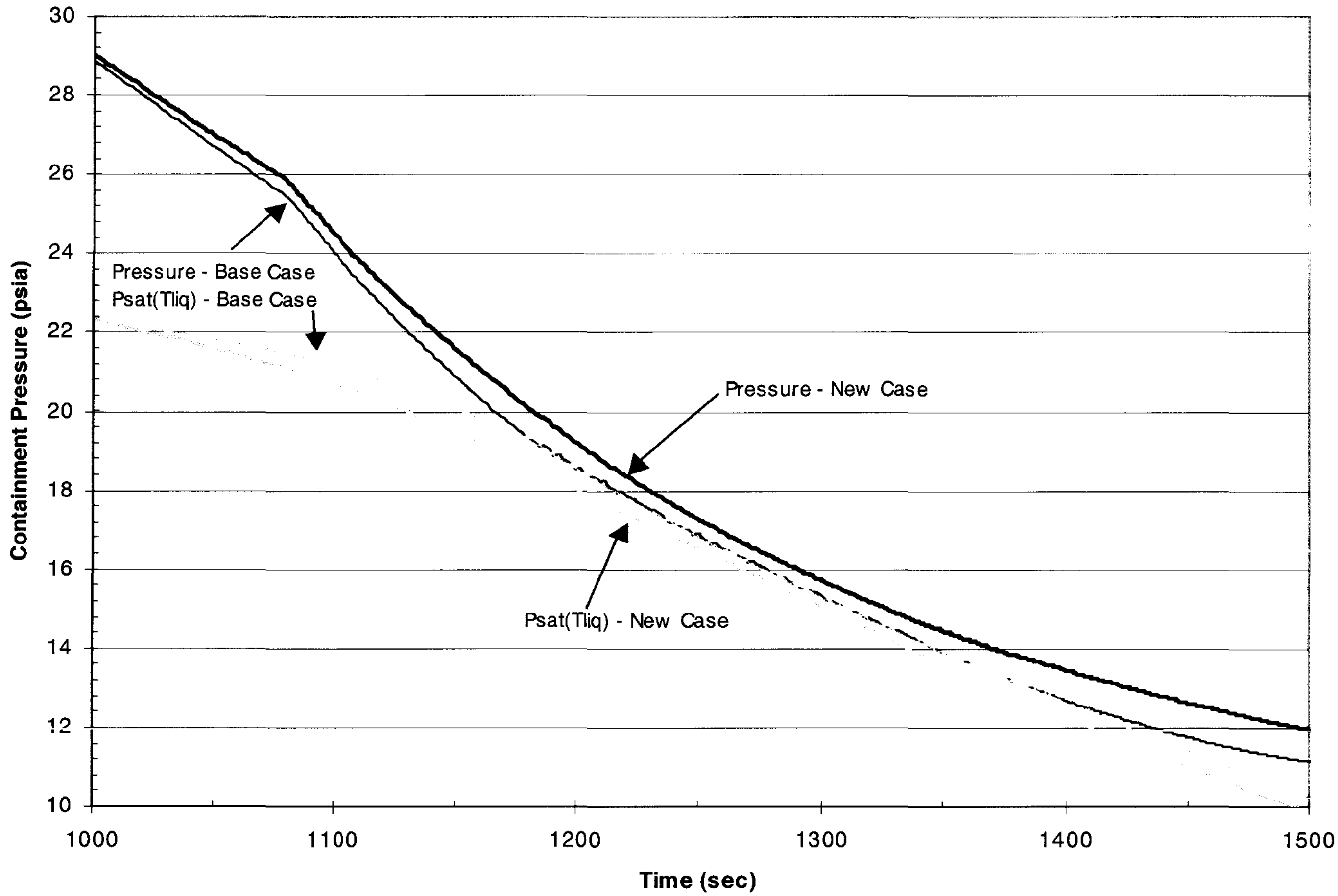


Figure 3: Comparison of Containment Pressure and Saturation Pressure at Liquid Temperature DEPSG Break with Max ESF



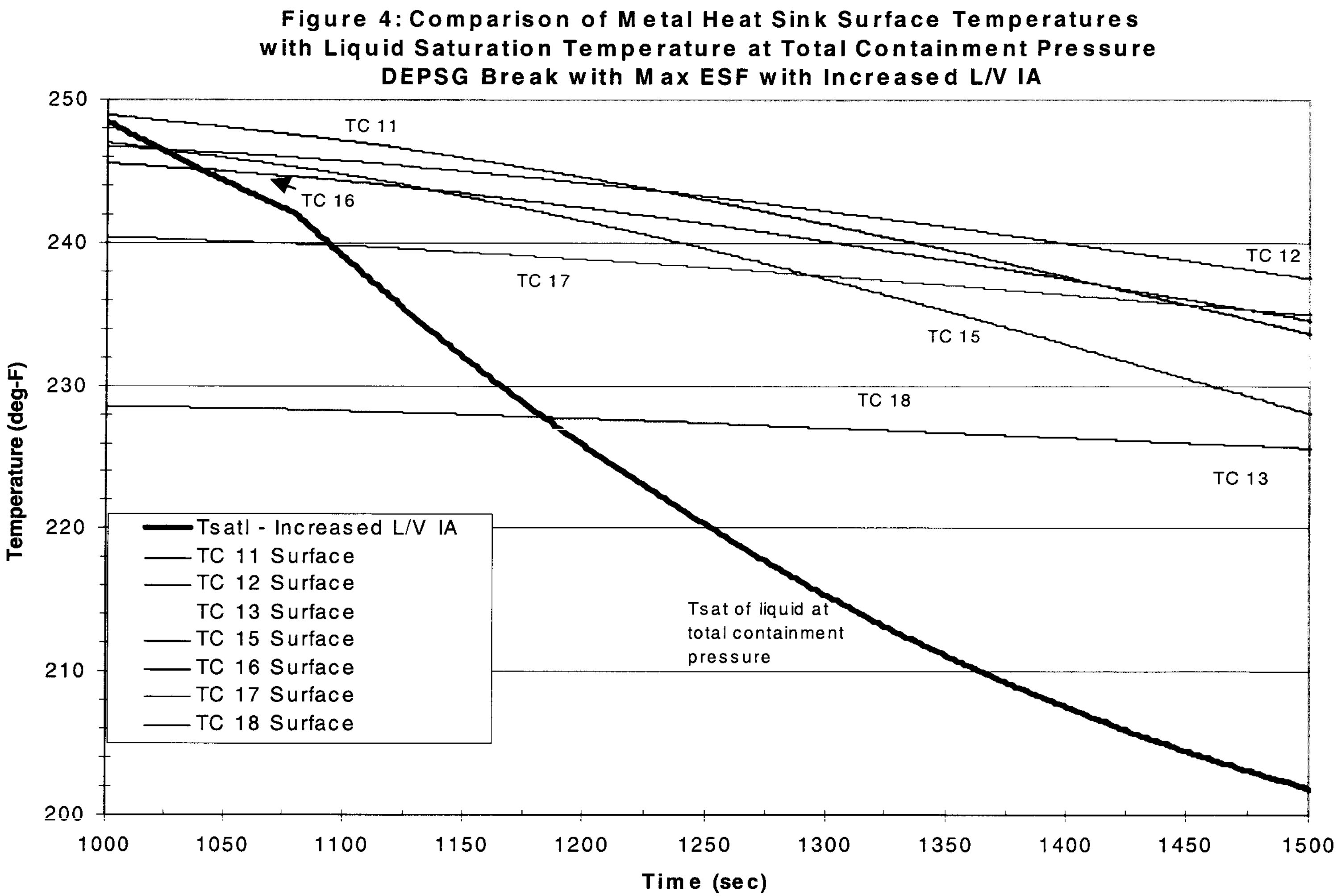


Figure 4: Comparison of Metal Heat Sink Surface Temperatures
with Liquid Saturation Temperature at Total Containment Pressure
DEPSG Break with Max ESF with Increased L/V IA
250
240
230
220
210
200
Temperature (deg-F)
1000
1050
1100
1150
1200
1250
1300
1350
1400
1450
1500
Time (sec)
TC 11
TC 16
TC 12
TC 17
TC 15
TC 18
TC 13
Tsatl - Increased L/V IA
TC 11 Surface
TC 12 Surface
TC 13 Surface
TC 15 Surface
TC 16 Surface
TC 17 Surface
TC 18 Surface
Tsat of liquid at
total containment
pressure

3.4 Overall Conservatisms in the NPSH Analysis Methodology

The following conservative adjustments are made for calculation of containment conditions for NPSHa for LOCA scenarios that develop design inputs for component design, such as determination of margin for sump strainer design [7.1]:

1. The spillage water from the vessel is directly put into the sump with no heat and mass transfer to the atmosphere or structures in the containment.
2. The simplified Reactor Coolant System (RCS) model for the long term mass and energy model uses a 1E+8 interface area for mass and heat transfer in the broken cold legs to ensure that any steam from the intact steam generators (SGs) is forced into thermal equilibrium with the cold safety injection water. This produces only a liquid release (no drops or steam) that is added directly to the sump.
3. One-half the Sauter mean diameter is specified for the spray drop diameter to maximize energy removal from the atmosphere resulting in lower containment pressure and higher sump temperature.
4. A multiplier of 1.2 is applied to the heat transfer coefficient for the containment heat sinks to maximize condensation and to lower containment pressure in the containment.
5. A conservative water holdup volume is subtracted from the containment liquid volume to reduce the sump water height.
6. The upper limit on containment free volume is used to minimize containment backpressure.
7. The minimum initial containment air pressure is used in accordance with plant Technical Specifications.
8. Maximum Refueling Water Storage Tank (RWST) water temperature is used in accordance with plant Technical Specifications.
9. Minimum initial RWST inventory and early RS level actuation setpoint are used to minimize sump level.
10. RS heat exchangers (RSHXs) are modeled assuming maximum service water flow rate, minimum service water temperature, and no fouling or plugging to maximize spray droplet thermal efficiency and to reduce containment backpressure.
11. Liquid Vapor Interface Area is minimized by assuming a minimum sump pool surface area to minimize the evaporative heat and mass transfer with the net effect of leaving more energy in the sump liquid.

12. Due to the lumped parameter modeling of the containment, following spray initiation and containment depressurization, no credit is taken for vaporization of the spray droplets on steel conductors that may be left in superheated state with the surface temperature above the boiling temperature at the containment pressure.

As stated previously, a slight relaxation of assumptions 11 and 12 has been made to credit some real physical processes that cannot be captured by the lumped modeling approach in GOTHIC. However, based on the qualitative arguments presented in this report and the number of conservative assumptions embedded in the analysis, it is concluded that this alternate methodology does not significantly reduce the overall conservatism of the NPSH analysis of LOCA scenarios that develop design inputs for component design.

4.0 JUSTIFICATION AND BASIS FOR THE EXIGENT CIRCUMSTANCES

During the week of July 16-20, 2007, the NRC conducted an audit of the actions that had been completed, or were underway, to resolve GSI-191 containment sump issues at North Anna Power Station. As part of his review, an NRC auditor requested documentation of subcooling margin inside the strainers, as this information was not documented in the hydraulic calculation. During subsequent review of the calculation, it was identified that dynamic head change in the strainer had not been included in the calculation. A new calculation was performed by the strainer vendor that included the dynamic head change component, and it was determined that flashing would not occur in the North Anna strainer and, consequently, the North Anna LHSI and RS pumps had adequate NPSHa.

Upon completion of the North Anna calculation, a new Surry hydraulic calculation was also performed by the strainer vendor that included the dynamic head change component. It was noted that with the inclusion of this additional component, flashing was predicted to occur under certain conditions that would result in the RS pumps having inadequate NPSHa when the four RS pumps were in operation at the same time. (The LHSI strainer was determined to have adequate margin.) To resolve this concern, the approved GOTHIC containment analysis methodology for NPSHa was reviewed to determine whether the predicted flashing was in fact reasonable and whether any overly conservative assumptions could be more realistically adjusted to provide margin to eliminate the potential for flashing in the strainer. After several weeks of reviewing the GOTHIC model conservative inputs and assumptions, it was concluded that an alternate GOTHIC methodology was required to demonstrate that flashing would not occur. The alternate methodology allows for a larger liquid-vapor interface area that accounts for additional heat and mass transfer between the containment vapor and the liquid phase in the pool that is not credited in the existing methodology. Therefore, even though some conservatism is being recaptured, adequate conservatism remains to ensure that plant SSCs (i.e., the RS pumps and the new containment sump strainers) will perform their required safety functions. This determination was just recently completed and discussed with the NRC staff on October 16, 2007.

Furthermore, since an alternate methodology is required that is different than the NRC approved methodology described in the UFSAR, the 50.59 review included in the design change package for the installation of the Unit 1 sump strainer during the fall 2007 RFO indicated that prior NRC approval was required before the strainer could be declared operable and before Unit 1 startup could commence following the RFO. (The operability of the partially installed Surry Unit 2 strainer was addressed separately in accordance with the operability determination process.) Consequently, this Surry specific need for an alternate GOTHIC containment analysis methodology was appropriately assessed in a timely fashion from the North Anna audit and was only recently recognized as requiring NRC approval.

Therefore, it is requested that the proposed license amendment request be reviewed on an exigent basis in support of the Surry Unit 1 strainer installation to: 1) further resolve GSI-191 issues, 2) meet GL 2004-02 corrective action commitments, and 3) support the startup of Surry Unit 1 following the completion of the Unit 1 fall 2007 RFO.

5.0 REGULATORY EVALUATION

5.1 No Significant Hazards Consideration Determination

Virginia Electric and Power Company (Dominion) has reviewed the requirements of 10 CFR 50.92, relative to the proposed change to the Surry Units 1 and 2 licensing basis. The proposed licensing basis change will permit the use of an alternate GOTHIC containment analysis methodology that can be conservatively applied for NPSH and LOCA analyses that develop design inputs for component design, such as determination of margin for sump strainer design. The proposed change will facilitate resolution of Generic Safety Issue 191, *Assessment of Debris Accumulation on PWR Sump Performance*, and Generic Letter 2004-02, *Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors.*

Dominion has evaluated whether a significant hazards consideration is involved with the proposed licensing basis change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. *Does the proposed license amendment involve a significant increase in the probability or consequences of an accident previously evaluated?*

   Response: No.

   The proposed change does not adversely affect accident initiators or precursors and does not implement any physical changes to the facility or changes in plant operation. The proposed change does not alter or prevent the ability of structures, systems, and components (SSCs) to perform their intended function to mitigate the consequences of an initiating event within the assumed acceptance limits, rather it confirms that required SSCs [e.g., the containment sump strainers and the Recirculation Spray (RS) pumps] will perform their safety functions as required. The Updated Final Safety Analysis Report (UFSAR) safety analysis acceptance criteria continue to be met for the proposed change. Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Does the proposed license amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

   Response: No.

   The proposed change does not impact plant equipment design or its function during accident conditions. The hydraulic performance of the GSI-191 strainers is analytically confirmed to be acceptable by using the alternate methodology proposed by this change. No changes in the methods governing normal plant operation are being implemented. The proposed change assures that there is adequate margin available to meet safety analysis criteria and does not introduce failure modes, accident initiators, or equipment malfunctions that would cause a new or different kind of accident. Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

   Response: No.

   The proposed change does not alter the manner in which safety limits, limiting safety system settings or limiting conditions for operation are determined, and the dose analysis acceptance criteria are not affected. The proposed change does not result in plant operation in a configuration outside the analyses or design basis and does not adversely affect systems that respond to safely shutdown the plant and to maintain the plant in a safe shutdown condition. The proposed alternate GOTHIC methodology recovers a small amount of conservatism; however, the analyses to determine the sump strainer boundary conditions retain a sufficient level of conservatism and demonstrate that safety related components will continue to be able to perform their design functions. Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Dominion concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

Surry was designed prior to issuance of the draft General Design Criteria (GDC) published in 1966. Construction permits for Units 1 and 2 (CPPR 43 and 44, respectively) were issued June 25, 1968. The GDC, Appendix A to 10 CFR 50, were published February 20, 1971. The Safety Evaluation Report for the Surry Operating Licenses was issued in February 1972; consequently, these units were not subject to GDC requirements. (Reference SECY-92-223 dated September 18, 1992.) However, the plant was designed to meet the intent of the draft GDC. Consequently, the following GDC requirements were considered during the preparation of the LAR:

- *Criterion 4, Environmental and dynamic effects design bases. Structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping, and discharging fluids, that may result from equipment failures and from events and conditions outside the nuclear power unit. However, dynamic effects associated with postulated pipe ruptures in nuclear power units may be excluded from the design basis when analyses reviewed and approved by the Commission demonstrate that the probability of fluid system piping rupture is extremely low under conditions consistent with the design basis for the piping.*

  The alternate GOTHIC containment analysis methodology appropriately and conservatively models the expected environmental conditions of a post-LOCA environment such that SSCs important to safety (e.g., the containment sump strainers, the RS pumps) will perform their safety functions as expected.

- *Criterion 16, Containment design. Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.*

  The alternate GOTHIC containment analysis methodology adequately addresses post-LOCA conditions and ensures that the reactor containment and associated systems do not challenge the essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment. Furthermore, the alternate methodology contains adequate conservatism to assure that containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

- *Criterion 38, Containment heat removal. A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment* *pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.*

Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

The alternate GOTHIC containment analysis methodology adequately models post-LOCA conditions such that the containment sump strainers and RS pumps will be able to perform their safety functions as designed to facilitate containment heat removal.

- *Criterion 50, Containment design basis. The reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. This margin shall reflect consideration of (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as energy in steam generators and as required by § 50.44 energy from metal-water and other chemical reactions that may result from degradation but not total failure of emergency core cooling functioning, (2) the limited experience and experimental data available for defining accident phenomena and containment responses, and (3) the conservatism of the calculational model and input parameters.*

  The alternate GOTHIC containment analysis methodology adequately models post-LOCA conditions in containment, including calculated pressure and temperature conditions, and is sufficiently conservative to assure that the containment structure and the containment heat removal systems can adequately accommodate the post-LOCA conditions.

5.3 Environmental Consideration

The proposed License Amendment Request meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) as follows:

(i) The proposed change involves no significant hazards consideration.

As described in Section 5.1 above, the proposed change to the licensing basis involves no significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

The proposed change does not involve the installation of any new equipment or the modification of any equipment that may affect the types or amounts of effluents that may be released offsite. The hydraulic performance of the GSI-191 strainers is analytically confirmed to be acceptable by using the alternate methodology proposed by this change. Therefore, there is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

(iii) There is no significant increase in individual or cumulative occupation radiation exposure.

The proposed change does not involve plant physical changes or introduce any new modes of plant operation. The alternate GOTHIC methodology will continue to ensure that post-LOCA conditions are conservatively evaluated. Therefore, there is no significant increase in individual or cumulative occupational radiation exposure.

Based on the above, Dominion concludes that the proposed licensing basis change meets the criteria specified in 10 CFR 51.22 for a categorical exclusion from the requirements of 10 CFR 51.22 relative to requiring a specific environmental assessment by the Commission.

6.0 CONCLUSIONS

Based on the above discussion, the proposed change demonstrates that the alternate GOTHIC methodology can conservatively be applied for NPSH and LOCA analyses that develop inputs for component design, such as determination of margin for sump strainer design.

7.0 REFERENCES

7.1 Topical Report DOM-NAF-3, Rev. 0.0-P-A, "GOTHIC Methodology for Analyzing the Response to Postulated Pipe Ruptures Inside Containment."

7.2 Letter from USNRC to Virginia Electric and Power Company dated August 30, 2006 (Serial No. 06-772), "Kewaunee Power Station (Kewaunee), Millstone Power Station, Unit Nos. 2 and 3 (Millstone 2 and 3), North Anna Power Station, Unit Nos. 1 and 2 (North Anna 1 and 2), and Surry Power Station, Unit Nos. 1 and 2 (Surry 1 and 2) – Approval of Dominion's Topical Report DOM-NAF-3, 'Gothic Methodology for Analyzing the Response to Postulated Pipe Ruptures Inside Containment' (TAC Nos. MC8831, MC8832, MC8833, MC8834, MC8835, and MC8836."

ATTACHMENT 2

Proposed UFSAR Revision

**Virginia Electric and Power Company
(Dominion)
Surry Power Station Units 1 and 2**

GOTHIC containment model includes a separate small volume for the pump suction. The volume elevation and height are set so that the mid-elevation of the volume is at the elevation of the pump first-stage impeller centerline. The volume pressure (with some adjustments for sump depth) can then be used in the NPSHa calculation. The temperature in the suction volume provides the saturation pressure. The junction representing piping between the sump and the suction volume reflects the friction and form pressure drop between the sump and the pump suction. The pump suction volume also allows accurate modeling of the mixing of cold water that is injected into the suction of the RS pumps.

The single volume GOTHIC model does not account for geometry details of the sump or the liquid that is held up in other parts of the containment. GOTHIC does calculate the total amount of liquid in the containment. A correlation is used to define the sump depth or liquid level as a function of the water volume in the containment. The correlation accounts for the sump geometry variation with water depth and accounts for the holdup of water in other parts of the containment.

Worst case conditions for NPSHa depend on the time that the pumps take suction from the sump. Therefore, the parameter settings that minimize NPSHa may vary depending on the timing for the operation of the pumps. In general, settings that reduce containment pressure and increase the sump water temperature reduce the NPSHa.

The water in the sump comes from three sources: direct deposit of mass from the break, condensate from the conductors, and spray drops. The drops from the blowdown will be very small and at the saturation temperature at the containment steam partial pressure when they enter the sump. After the blowdown, the spillage water from the vessel is directly put in the sump with no heat transfer to the atmosphere or walls and equipment in the containment. This is a conservative approach for NPSH analysis. The condensate is generated at the saturation temperature at the steam partial pressure and added directly to the sump. The heat transfer between the conductors and the condensate on the way to the sump is conservatively neglected. Heat and mass transfer at the sump surface is allowed. GOTHIC's model for heat and mass transfer at a pool is in good agreement with experimental data. For NPSH analysis, the liquid temperature is greater than the vapor temperature for most of the event, so a minimum pool area is specified to minimize evaporation. With this overall approach, the predicted sump temperature is conservatively high for the duration of the simulation.

The following adjustments are made to ensure a conservative calculation of NPSHa:

1. The heat and mass transfer to the containment heat sinks are expected to be under-predicted using the Direct heat transfer model. This is non-conservative for NPSH analysis. A multiplier of 1.2 applied to the heat transfer coefficient was shown to provide adequate conservatism in the calculation.
2. All of the spray water is injected as droplets into the containment atmosphere (nozzle spray flow fraction of 1). Analyses are performed using the largest Sauter droplet size. A confirmatory analysis is performed by reducing the Sauter diameter by 2, which sufficiently

covers code and spray performance uncertainty (i.e., variation in nozzle design and orientation, nozzle flow rate and different header elevations) without creating drops too small that may cause excess droplet holdup in the atmosphere. NPSH analyses are relatively insensitive over this range of droplet size, and the two cases together confirm that the effect of sprays on reducing containment pressure is maximized. The minimum NPSHa is reported from the case that provides the smaller NPSHa.

3. A conservative water holdup volume is subtracted from the containment liquid volume to reduce the sump water height.
4. The upper limit on containment free volume is used.
5. The minimum containment air pressure is used.
6. Conservative assumptions for spray and other system parameters are used in accordance with plant-specific sensitivity studies.

INSERT 1

5.4.2.1.7 LOCA -Containment Pressure and Temperature Results

The containment LOCA analysis is performed for the two limiting pipe break locations discussed in Section 5.4.1. Containment analysis parameters are listed in Table 5.4-25. The RS pumps start on 60% RWST level coincident with a CLS High High containment pressure signal.

The results of the containment pressure analysis are tabulated in Table 5.4-19. The initial containment conditions which yield the highest peak calculated containment pressure are the maximum pressure, temperature, and relative humidity, and are given in Table 5.4-18. The containment pressure and temperature transients for the hot leg double-ended guillotine are given on Figures 5.4-1 and 5.4-2, respectively.

The maximum peak containment pressure occurs after a DEHLG. As shown in Table 5.4-19, the calculated containment pressure is below the containment design pressure of 45 psig. The DEHLG is the design basis accident (DBA) for the containment structure (containment integrity DBA).

A single failure analysis is not necessary for the peak containment pressure evaluation since the peak pressure for each break case analyzed occurs early in the transient before any of the engineered safety feature (ESF) systems start.

The results of the containment depressurization analysis are tabulated in Table 5.4-20. Only a DEPSG is considered for the containment depressurization analysis since, as described earlier, this break produces the highest energy flow rates during the post-blowdown period. The containment pressure is less than 1.0 psig within one hour and less than 0 psig within 4 hours as

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The analyses included an additional 1 ft^2 thermal conductor to determine a conservative containment liner temperature response in accordance with Section 3.3.3 of DOM-NAF-3A. The conductor used a 1.2 multiplier on the Direct/DLM heat transfer coefficient. The peak liner temperature for the proposed configuration was 251.1°F at 490 seconds, so the sustained superheat does not adversely affect the containment liner.

5.4 REFERENCES

1. [Deleted]
2. USAEC, Division of Reactor Licensing 1972. *Safety Evaluation Report for Virginia Electric Power Company, Surry Power Station Units 1 and 2. Docket 50-280 and 50-281.*
3. [Deleted]
4. [Deleted]
5. [Deleted]
6. [Deleted]
7. [Deleted]
8. [Deleted]
9. [Deleted]
10. [Deleted]
11. *Westinghouse LOCA Mass and Energy Release Model for Containment Design - March 1979 Version,* WCAP-10325-P-A, May 1983 (Proprietary), WCAP-10326-A (Non-Proprietary).
12. *Westinghouse ECCS Evaluation Model - 1981 Version,* WCAP-9220-P-A, Rev. 1, February 1982 (Proprietary), WCAP-9221-A, Rev. 1 (Non-Proprietary).
13. Docket No. 50-315, *Amendment No. 126, Facility Operating License No. DPR-58 (TAC No. 7106), for D. C. Cook Nuclear Plant Unit 1,* June 9, 1989.
14. EPRI 294-2, *Mixing of Emergency Core Cooling Water with Steam; 1/3 Scale Test and Summary,* (WCAP-8423), Final Report June 1975.
15. *Westinghouse Mass and Energy Release Data For Containment Design,* WCAP-8264-P-A, Rev. 1, August 1975 (Proprietary), WCAP-8312-A (Non-Proprietary).
16. ANSI/ANS-5.1-1979, *American National Standard for Decay Heat Power in Light Water Reactors,* August 1979.
17. Topical Report DOM-NAF-3, Rev. 0.0-P-A, *GOTHIC Methodology For Analyzing the Response to Postulated Pipe Ruptures Inside Containment,* September 2006.

18. Letter from W.L. Stewart to Harold R. Denton (NRC), *Supplement to An Amendment to Operating Licenses DPR-32 and DPR-37 - Proposed Reduction in Boron Concentrations - Surry Power Station Units 1 and 2,* Serial No. 521B, November 30, 1983.

INSERT 2

INSERT 1

A modification of the NPSH methodology used for developing component design inputs was submitted to the NRC in Reference 19. This alternate methodology can be used for NPSH and LOCA analyses that develop design inputs for component design, such as determination of margin for sump strainer design. The NRC approved the alternate methodology in Reference 20, thus confirming that it can be used for the intended application stated in Reference 19.

INSERT 2

19. Letter from G. T. Bischof of Virginia Electric and Power Company to USNRC Document Control Desk, *Virginia Electric and Power Company, Surry Power Station Units 1 and 2, License Amendment Request, Alternative Containment Analysis Methodology,* Serial No. 07-0693, October 22, 2007.

20. Letter from USNRC to Virginia Electric and Power Company, *Safety Evaluation Report approving the Alternative Containment Analysis Methodology* ...., November XX, 2007.