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June 27, 2014

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

Serial No. 14-302
NL&OS/ETS R0'
Docket Nos. 50-305
50-336/423
50-338/339
50-280/281
License Nos. DPR-43
DPR-65/NPF-49
NPF-4/7
DPR-32/37

DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

In accordance with 10 CFR 50.46(a)(3)(ii), Dominion Energy Kewaunee, Inc. (DEK), Dominion Nuclear Connecticut, Inc. (DNC) and Virginia Electric and Power Company (Dominion) hereby submit the annual summary of permanent changes to the emergency core cooling system (ECCS) evaluation models for Kewaunee Power Station (KPS), Millstone Power Station (MPS) Units 2 and 3, North Anna Power Station (NAPS) Units 1 and 2, and Surry Power Station (SPS) Units 1 and 2, respectively.

Attachment 1 of this letter provides a report describing plant-specific evaluation model changes associated with the Westinghouse and AREVA Small Break Loss of Coolant Accident (SBLOCA) and Large Break Loss of Coolant Accident (LBLOCA) ECCS evaluation models for KPS, MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2.

For Kewaunee, information was provided that covered the time from January 1, 2013 to Kewaunee's final shutdown on May 7, 2013.

Information regarding the effect of the ECCS evaluation model changes upon the reported SBLOCA and LBLOCA analyses of record results is provided for KPS, MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 in Attachments 2, 3, 4 and 5, respectively. The

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calculated peak cladding temperatures (PCT) for the SBLOCA and LBLOCA analyses for KPS, MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are summarized below.

Kewaunee – Small break – Westinghouse Evaluation Model:	1065°F
Kewaunee – Large break – Westinghouse Evaluation Model:	1980°F
Millstone Unit 2 - Small break - AREVA Evaluation Model :	1801°F
Millstone Unit 2 - Large break - AREVA Evaluation Model :	1845°F
Millstone Unit 3 - Small break - Westinghouse Evaluation Model :	1193°F
Millstone Unit 3 – Large break - Westinghouse Evaluation Model :	1933°F
North Anna Unit 1 - Small break - AREVA Evaluation Model :	1395°F
North Anna Unit 1 - Large break - AREVA Evaluation Model :	1866°F
North Anna Unit 2 - Small break - AREVA Evaluation Model :	1338°F
North Anna Unit 2 - Large break - AREVA Evaluation Model :	1909°F
North Anna Unit 1 - Small break - Westinghouse Evaluation Model :	1834.1°F
North Anna Unit 1 - Large break - Westinghouse Evaluation Model :	1982°F
North Anna Unit 2 - Small break - Westinghouse Evaluation Model :	1834.1°F
North Anna Unit 2 - Large break - Westinghouse Evaluation Model :	1994°F
Surry Units 1 and 2 - Small break - Westinghouse Evaluation Model :	2012°F
Surry Units 1 and 2 - Large break - Westinghouse Evaluation Model :	2081°F

The LOCA results for KPS, MPS 2 and 3, NAPS 1 and 2, and SPS 1 and 2 are confirmed to have sufficient margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements.

This information satisfies the 2013 annual reporting requirements of 10 CFR 50.46(a)(3)(ii).

If you have any further questions regarding this submittal, please contact Mr. Thomas Shaub at (804) 273-2763.

Very truly yours,

Mark D. Sartain
Vice President – Nuclear Engineering

Commitments made in this letter: No new regulatory commitments.

Attachments: (5)

1) Report of Changes in Westinghouse and AREVA ECCS Evaluation Models.

2) 2013 Annual Reporting of 10 CFR 50.46 Margin Utilization - Kewaunee Power Station.

3) 2013 Annual Reporting of 10 CFR 50.46 Margin Utilization - Millstone Power Station Units 2 and 3.

4) 2013 Annual Reporting of 10 CFR 50.46 Margin Utilization – North Anna Power Station Units 1 and 2.

5) 2013 Annual Reporting of 10 CFR 50.46 Margin Utilization – Surry Power Station Units 1 and 2.

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ATTACHMENT 1

2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

REPORT OF CHANGES IN WESTINGHOUSE AND AREVA ECCS EVALUATION MODELS

DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2

REPORT OF CHANGES IN WESTINGHOUSE AND AREVA ECCS EVALUATION MODELS

Kewaunee Power Station

1. Westinghouse identified no changes and errors applicable to the Westinghouse Small Break Loss of Coolant Accident Evaluation Model (SBLOCA EM) with NOTRUMP. Information was provided that covered the time from January 1, 2013 to Kewaunee's final shutdown on May 7, 2013.

2. Westinghouse identified the following changes and errors applicable to the KPS 1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model (BE LBLOCA EM) with application to PWRs with upper plenum injection. Information was provided that covered the time from January 1, 2013 to Kewaunee's final shutdown on May 7, 2013.

   - **General Code Maintenance**. Various changes have been made to enhance the usability of the codes and to help preclude errors in analyses. This includes items such as modifying input variable definitions, units, and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated peak clad temperature (PCT) impact of 0°F.

Millstone Power Station Unit 2

1. AREVA identified no changes and errors applicable to the S-RELAP5 based Small Break LOCA Evaluation Model for Millstone Unit 2.

2. AREVA identified no changes and errors applicable to the SEM/PWR-98 evaluation model for LBLOCA for Millstone Unit 2.

Millstone Power Station Unit 3

1. Westinghouse identified the following change and error to the 1985 Westinghouse SBLOCA EM with NOTRUMP.

   - **SBLOCTA Cladding Strain Requirement for Fuel Rod Burst**. An error was discovered in the minimum local strain required for burst for ZIRLO® cladding in the SBLOCTA code. The coding does not enforce reaching the minimum percent local strain threshold prior to calculating fuel rod burst. However, a review of licensing basis analyses revealed no instances of this error impacting calculated results. Resolution of this issue represents a Non-Discretionary Change to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

     After review of current licensing basis analyses, and the phenomena and physics of a small break LOCA transient, it is concluded that this error has a negligible

effect on small break LOCA analysis results, leading to an estimated Peak Cladding Temperature (PCT) impact of 0°F.

2. Westinghouse identified the following changes and errors applicable to the 2004 Westinghouse BE LBLOCA EM using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) for Millstone Unit 3 during 2013:

   - **General Code Maintenance.** Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated PCT impact of 0°F.

   - **Initial Fuel Pellet Average Temperature Uncertainty Calculation.** In the ASTRUM BE LBLOCA EM, uncertainties are applied to the gap heat transfer coefficient and pellet thermal conductivity to capture the uncertainty in the initial fuel pellet average temperature. This approach was compared to the initial fuel pellet average temperature uncertainties predicted by the PAD code at beginning-of-life conditions and found to be conservative in Section 25-4-2-4 of WCAP-12945-P-A. However, the initial fuel pellet average temperature uncertainty range analyzed at higher burnups in the ASTRUM EM is much wider than the uncertainty range predicted by the PAD code, which may result in excessively low or high analyzed initial fuel pellet average temperatures. This issue has been evaluated to estimate the impact on existing ASTRUM LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

     The issue described above is judged to have either no effect or a negligible effect on existing Millstone Unit 3 LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

   - **Elevations for Heat Slab Temperature Initialization.** An error was discovered in WCOBRA/TRAC whereby an incorrect value would be used in the initial fuel rod temperature calculation for a fuel rod heat transfer node if that node elevation was specified outside of the bounds of the temperature initialization table. This problem has been evaluated for impact on existing analyses and its resolution represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

     Based on inspection of plant analysis input, it was concluded that the input decks for the existing Millstone Unit 3 analysis are not impacted by this error, leading to an estimated PCT impact of 0°F.

   - **Heat Transfer Model Error Corrections.** Several related changes were made to WCOBRA/TRAC to correct errors discovered which affected the heat transfer

models. These errors included calculation of the entrained liquid fraction used in calculation of the drop wall heat flux, application of the grid enhancement factor for grid temperature calculation, calculation of the Reynold's number used in the Wong-Hochrieter correlation for the heat transfer coefficient from fuel rods to vapor, fuel rod initialization and calculation of cladding inner radius with creep, application of grid and two phase enhancement factors and radiation component in single phase vapor heat transfer, and reset of the critical heat flux temperature when J=2. These errors have been evaluated to estimate the impact on existing LBLOCA analysis results. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Based on the results of representative plant calculations, separate effects and integral effects test simulations, it is concluded that the error corrections have a negligible local effect on heat transfer, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Correction to Heat Transfer Node Initialization.** An error was discovered in the heat transfer node initialization logic in WCOBRA/TRAC whereby the heat transfer node center locations could be inconsistent with the geometric node center elevations. The primary effects of this issue are on the interpolated fluid properties and grid turbulent mixing enhancement at the heat transfer node. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP- 13451.

  Based on engineering judgment and the results from a matrix of representative plant calculations, it is concluded that the effect of this error is within the code resolution, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Mass Conservation Error Fix.** It was identified that mass was not conserved in WCOBRA/TRAC one-dimensional component cells when void fraction values were calculated to be slightly out of the physical range (greater than 1.0 or smaller than 0.0). This was observed to result in artificial mass generation on the secondary side of steam generator components. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This error was observed to primarily affect the mass on the secondary side of the steam generator. This issue was judged to have a negligible impact on the Millstone Unit 3 LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Correction to Split Channel Momentum Equation.** An error was discovered in the momentum equation calculations for split channels in WCOBRA/TRAC. This

error impacts the (1) continuity area of the phantom/boundary bottom cell; (2) bottom and top continuity area correction factors for the channel inlet at the bottom of a section and for the channel outlet at the top of a section; and (3) drop entrainment mass rate per unit volume and drop de-entrainment mass rate per unit volume contributions to the momentum calculations for split channels. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the quantities directly impacted by the momentum equation calculations for split channels (velocities, flows, etc.) is negligible, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Heat Transfer Logic Correction for Rod Burst Calculation.** A change was made to the WCOBRA/TRAC coding to correct an error which had disabled rod burst in separate effect test simulations. This change represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

  Based on the nature of the change and the evaluation model requirements for plant modeling in Westinghouse best estimate large break LOCA analyses with WCOBRA/TRAC, it is judged that the existing Millstone Unit 3 analyses are not impacted by this change, leading to an estimated PCT impact of 0°F.

- **Changes to Vessel Superheated Steam Properties.** Several related changes were made to the WCOBRA/TRAC coding for the vessel super-heated water properties, including updating the HGAS subroutine coding to be consistent with Equation 10-6 of the Code Qualification Document (CQD) topical WCAP-12945-P-A, updating the approximation of the enthalpy in the TGAS subroutine to be consistent with the HGAS subroutine coding, and updating the temperature iteration method and convergence criteria in the TGAS subroutine. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  The updates to the calculations of the superheated steam properties had generally less than 1°F impact on the resulting steam temperature values, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Update to Metal Density Reference Temperatures.** It was identified that for one-dimensional components in which heat transfer to stainless steel 304 or 316 is modeled, the reference temperature for the metal density calculation was allowed to vary; as a result the total metal mass was not preserved. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This change primarily impacts the reactor coolant system loop piping modeled in the LBLOCA WCOBRA/TRAC models. It was judged that the effect of this change on the PCT results was negligible, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Decay Heat Model Error Corrections.** The decay heat model in the WCOBRA/TRAC code was updated to correct the erroneously coded value of the yield fraction directly from fission for Group 19 of Pu-239 and to include the term for uncertainty in the prompt energy per fission in the calculation of the decay heat power uncertainty. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  These changes have a negligible impact on the calculated decay heat power, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Correction to the Pipe Exit Pressure Drop Error.** An error was discovered in WCOBRA/TRAC whereby the frictional pressure drop at the split break TEE connection to the BREAK component was incorrectly calculated using the TEE hydraulic diameter instead of the BREAK component length input. This error has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the pressure at the break and the break flow is negligible, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **WCOBRA/TRAC u19 File Dimension Error Correction.** A problem was identified in the dimension of an array used to generate the u19 file in WCOBRA/TRAC. The u19 file is read during HSDRIVER execution and provides information needed to generate the HOTSPOT thermal-hydraulic history and user input files. The array used to write the desired information to the u19 file is dimensioned to 2000 in WCOBRA/TRAC. It is possible, however, for more than 2000 curves to be written to the u19 file. If that is the case, it is possible that the curves would not be stored correctly on the u19 file. A survey of current Best Estimate Large Break LOCA analyses indicated that the majority of plants had less than 2000 curves in their u19 files; therefore these plants are not affected by the change. For those plants with more than 2000 curves,

plant-specific sensitivity calculations indicated that resolution of this issue does not impact the PCT calculation for prior analyses. This represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

As discussed above, resolution of this issue does not impact the PCT calculation for prior LBLOCA analyses, leading to an estimated PCT impact of 0°F for Millstone Unit 3.

- **Revised Heat Transfer Multiplier Distributions.** Some of the changes and error corrections described above affect the WCOBRA/TRAC heat transfer models, the heat transfer node initialization, or the heat transfer renoding logic. This lead to an investigation of the heat transfer multiplier distributions using the results for the Separate Effects Tests (SETs) and Integral Effects Tests (IETs). During this investigation, errors were discovered in the development of the original multiplier distributions, including errors in the grid locations specified in the WCOBRA/TRAC models for the G2 Refill and G2 Reflood tests, and errors in processing test data used to develop the reflood heat transfer multiplier distribution.

  The blowdown, heatup, blowdown cooling, refill, and reflood heat transfer multiplier distributions were redeveloped. The revised heat transfer multiplier distributions have been evaluated for impact on existing analyses. Resolution of these issues represents a closely related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  A plant transient calculation representative of Millstone Unit 3 transient behavior was performed with the latest version of WCOBRA/TRAC. Using this transient, a matrix of HOTSPOT calculations was performed to estimate the effect of the heat transfer multiplier distribution changes. The limiting runs for the Millstone Unit 3 analysis were identified, including consideration of the thermal conductivity degradation (TCD) effects and other evaluations on the analysis of record (AOR) which substantially impacted the ranking or PCTs of the limiting cases. The set of limiting runs for Millstone Unit 3 were selected such that less limiting runs which were not explicitly considered would not become limiting due to the estimated PCT impact from the change in heat transfer multipliers. The heat transfer multipliers for each run were used to identify which bin that multiplier falls into, and an estimated PCT impact for that individual multiplier was assigned. The individual estimated PCT impacts for the run (based on the four multipliers) were summed to estimate the overall impact on the run. Finally, the run results were re-ranked based on the estimated impacts on each run. The change between the estimated 95/95 PCT before and after this process was reported as the estimate of effect for the Millstone Unit 3 analysis.

Using these results and considering the heat transfer multiplier uncertainty attributes from limiting cases for Millstone Unit 3, an estimated PCT effect of -91°F has been established for 10 CFR 50.46 reporting purposes.

For Millstone Unit 3, the above issues resulted in the accumulation of changes to the calculated peak fuel cladding temperature to exceed 50°F, and was previously reported to the NRC in a letter dated September 9, 2013 (Serial No. 13-501) to meet the 30-day reporting requirements of 10 CFR 50.46(a)(3)(ii).

Subsequent to the 30 day report, in the summary of changes provided by Westinghouse in the compendium for 2013, there were four additional changes.

- **HOTSPOT Burst Strain Error Correction.** An error in the application of the burst strain was discovered in HOTSPOT. The equation for the application of the burst strain is given as Equation 7-69 in WCAP-16009-P-A and in WCAP-12945-P-A. The outer radius of the cladding after burst occurs should be calculated based on the burst strain, and the inner radius of the cladding should be calculated based on the outer radius. In HOTSPOT, the burst strain is applied to the calculation of the cladding inner radius. The cladding outer radius is then calculated based on the inner radius. As such, the burst strain is incorrectly applied to the inner radius rather than the outer radius, which impacts the resulting cladding geometry at the burst elevation after burst occurs. Correction of the erroneous calculation results in thinner cladding at the burst node and more fuel relocating into the burst node, leading to an increase in the PCT at the burst node. This issue has been evaluated to estimate the impact on existing BE LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The issue described above was evaluated by executing the most limiting plant-specific HOTSPOT runs with a HOTSPOT version that includes the correction of this error. This plant-specific sensitivity study resulted in an estimated PCT impact of 21°F for Millstone Unit 3.

- **Changes to Grid Blockage Ratio and Porosity.** A change in the methodology used to calculate grid blockage ratio and porosity for Westinghouse fuel resulted in a change to the grid inputs used in the Millstone Unit 3 LBLOCA analysis. Grid inputs affect heat transfer in the core during a LBLOCA. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The updates to the methodology to calculate grid blockage ratio and porosity used as input in Westinghouse LBLOCA models resulted in a negligible change to heat transfer in the core for the fuel type used in Millstone Unit 3. The

estimated penalty associated with the changes is 0°F for 10 CFR 50.46 reporting purposes.

- **Grid Heat Transfer Enhancement Calculation.** An issue was identified which could affect the calculation of the heat transfer at gridded elevations for BE LBLOCA EM. For a specific input condition, the grid heat transfer enhancement factor is calculated based on an erroneous core geometry, which can cause an over-prediction of the heat transfer coefficient at gridded elevations. This issue has been evaluated to estimate the impact on existing LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The effect described above was judged to have a negligible effect on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Burst Elevation Selection.** It is stated on page 11-20 of WCAP-16009-P-A that the burst option is applied at the elevation corresponding to the (WCOBRA/TRAC) burst elevation for the hot assembly rod. This approach was modified to apply the burst option at the HOTSPOT predicted burst elevation as described on page 19 of Attachment 1 to LTR-NRC-06-8. The HOTSPOT code has been updated to incorporate the following changes to the burst elevation selection logic if multiple nodes burst at the same time: (1) the node that has the highest cladding temperature at the time of burst is selected; (2) if multiple nodes have the same burst time and cladding temperature at the time of burst, the lowest ordered elevation of those nodes is selected. These changes represent a closely-related group of Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451.

  This improvement in burst elevation selection is a forward-fit change, leading to an estimated PCT impact of 0°F.

North Anna Power Station Units 1 and 2

1. AREVA identified no changes or errors in the SBLOCA evaluation models for North Anna Units 1 and 2:

2. AREVA identified the following change and error applicable to the Realistic LBLOCA (RLBLOCA), RELAP5 based evaluation model for North Anna Units 1 and 2.

   - **S-RELAP5 routine associated with the RODEX3a fuel rod model.** While performing code restructuring activities a code developer reported an issue in an S-RELAP5 routine associated with the RODEX3a fuel rod model in the code. In RLBLOCA analyses, RODEX3a is used to calculate the fuel rod conditions. The issue involves the trapped stack model in subroutine mdatr3, which is part of the

RODEX3a fuel rod model in the code. The error affects any RODEX3a based S-RELAP5 analysis which contains a "trapped stack" of fuel pellets. A "trapped stack" condition exists in any fuel rod containing a "locked" gap with open gaps lying at lower axial levels. A gap is locked when the calculated gap dimension is less than 0.5 mils. That dimension was chosen for the locked criteria to account for roughness, pellet cocking, and cladding ovality effects. All axial levels below the lowest locked gap are part of a trapped stack.

The erroneous coding in mdatr3 involves incorrect variable addressing which essentially deactivates the trapped stack model. The effect of this error would not be obvious in existing analyses since preliminary assessments indicate the effect of a functioning trapped stack model is very small. Although the effect is small it was determined that it can be conservative or non-conservative depending of the steady-state initial stored energy.

A development version of S-RELAP5 was prepared with the correct evaluation of the trapped stack model and several code validation and plant sample problems were repeated. The assessments included analyses for RLBLOCA Rev 0. The SBLOCA analysis is not affected by this change because RODEX2, as opposed to RODEX3a, is used in the analysis.

The estimated impact of this change on the North Anna Unit 1 and Unit 2 RLBLOCA analyses calculated PCT is -10°F.

For North Anna Unit 2, the above issue resulted in the accumulation of changes to the calculated peak fuel cladding temperature to exceed 50°F, and was previously reported to the NRC in a letter dated October 2, 2013 (Serial No. 13-522) to meet the 30-day reporting requirements of 10 CFR 50.46(a)(3)(ii).

3. Westinghouse identified the following change or error in the SBLOCA evaluation models for North Anna Units 1 and 2 during 2013.

   - **SBLOCTA Cladding Strain Requirement for Fuel Rod Burst**. An error was discovered in the minimum local strain required for burst for ZIRLO® cladding in the SBLOCTA code. The coding does not enforce reaching the minimum percent local strain threshold prior to calculating fuel rod burst. However, a review of licensing basis analyses revealed no instances of this error impacting calculated results. Resolution of this issue represents a Non-Discretionary Change to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

     After review of current licensing basis analyses, and the phenomena and physics of a SBLOCA transient, it is concluded that this error has a negligible effect on SBLOCA analysis results, leading to an estimated PCT impact of 0°F.

4. Westinghouse identified the following changes and errors applicable to the 2004 Westinghouse BE LBLOCA EM using the Automated Statistical Treatment of Uncertainty Method (ASTRUM) based evaluation model for North Anna Units 1 and 2 during 2013.

   - **General Code Maintenance**. Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated PCT impact of 0°F.

   - **Initial Fuel Pellet Average Temperature Uncertainty Calculation.** In the ASTRUM BE LBLOCA EM, uncertainties are applied to the gap heat transfer coefficient and pellet thermal conductivity to capture the uncertainty in the initial fuel pellet average temperature. This approach was compared to the initial fuel pellet average temperature uncertainties predicted by the PAD code at beginning-of-life conditions and found to be conservative in Section 25-4-2-4 of WCAP-12945-P-A. However, the initial fuel pellet average temperature uncertainty range analyzed at higher burnups in the ASTRUM EM is much wider than the uncertainty range predicted by the PAD code, which may result in excessively low or high analyzed initial fuel pellet average temperatures. This issue has been evaluated to estimate the impact on existing ASTRUM LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

     The issue described above had a +1°F PCT change for North Anna Unit 1 and a +5°F PCT change for North Anna Unit 2.

   - **Elevations for Heat Slab Temperature Initialization.** An error was discovered in WCOBRA/TRAC whereby an incorrect value would be used in the initial fuel rod temperature calculation for a fuel rod heat transfer node if that node elevation was specified outside of the bounds of the temperature initialization table. This problem has been evaluated for impact on existing analyses and its resolution represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

     Based on inspection of plant analysis input, it was concluded that the input decks for the existing North Anna Units 1 and 2 analyses are not impacted by this error, leading to an estimated PCT impact of 0°F.

   - **Heat Transfer Model Error Corrections.** Several related changes were made to WCOBRA/TRAC to correct errors discovered which affected the heat transfer models. These errors included calculation of the entrained liquid fraction used in calculation of the drop wall heat flux, application of the grid enhancement factor

for grid temperature calculation, calculation of the Reynold's number used in the Wong-Hochrieter correlation for the heat transfer coefficient from fuel rods to vapor, fuel rod initialization and calculation of cladding inner radius with creep, application of grid and two phase enhancement factors and radiation component in single phase vapor heat transfer, and reset of the critical heat flux temperature when J=2. These errors have been evaluated to estimate the impact on existing LBLOCA analysis results. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Based on the results of representative plant calculations, separate effects and integral effects test simulations, it is concluded that the error corrections have a negligible local effect on heat transfer, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Correction to Heat Transfer Node Initialization.** An error was discovered in the heat transfer node initialization logic in WCOBRA/TRAC whereby the heat transfer node center locations could be inconsistent with the geometric node center elevations. The primary effects of this issue are on the interpolated fluid properties and grid turbulent mixing enhancement at the heat transfer node. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  Based on engineering judgment and the results from a matrix of representative plant calculations, it is concluded that the effect of this error is within the code resolution, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Mass Conservation Error Fix.** It was identified that mass was not conserved in WCOBRA/TRAC one-dimensional component cells when void fraction values were calculated to be slightly out of the physical range (greater than 1.0 or smaller than 0.0). This was observed to result in artificial mass generation on the secondary side of steam generator components. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This error was observed to primarily affect the mass on the secondary side of the steam generator. This issue was judged to have a negligible impact on the North Anna Units 1 and 2 LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Correction to Split Channel Momentum Equation.** An error was discovered in the momentum equation calculations for split channels in WCOBRA/TRAC. This error impacts the (1) continuity area of the phantom/boundary bottom cell;

(2) bottom and top continuity area correction factors for the channel inlet at the bottom of a section and for the channel outlet at the top of a section; and (3) drop entrainment mass rate per unit volume and drop de-entrainment mass rate per unit volume contributions to the momentum calculations for split channels. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the quantities directly impacted by the momentum equation calculations for split channels (velocities, flows, etc.) is negligible, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Heat Transfer Logic Correction for Rod Burst Calculation.** A change was made to the WCOBRA/TRAC coding to correct an error which had disabled rod burst in separate effect test simulations. This change represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

  Based on the nature of the change and the evaluation model requirements for plant modeling in Westinghouse BE LBLOCA analyses with WCOBRA/TRAC, it is judged that the existing North Anna Units 1 and 2 analyses are not impacted by this change, leading to an estimated PCT impact of 0°F.

- **Changes to Vessel Superheated Steam Properties.** Several related changes were made to the WCOBRA/TRAC coding for the vessel super-heated water properties, including updating the HGAS subroutine coding to be consistent with Equation 10-6 of the Code Qualification Document (CQD) topical WCAP-12945-P-A, updating the approximation of the enthalpy in the TGAS subroutine to be consistent with the HGAS subroutine coding, and updating the temperature iteration method and convergence criteria in the TGAS subroutine. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  The updates to the calculations of the superheated steam properties had generally less than 1°F impact on the resulting steam temperature values, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Update to Metal Density Reference Temperatures.** It was identified that for one-dimensional components in which heat transfer to stainless steel 304 or 316 is modeled, the reference temperature for the metal density calculation was allowed to vary; as a result the total metal mass was not preserved. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This change primarily impacts the reactor coolant system loop piping modeled in the LBLOCA WCOBRA/TRAC models. It was judged that the effect of this change on the PCT results was negligible, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Decay Heat Model Error Corrections.** The decay heat model in the WCOBRA/TRAC code was updated to correct the erroneously coded value of the yield fraction directly from fission for Group 19 of Pu-239 and to include the term for uncertainty in the prompt energy per fission in the calculation of the decay heat power uncertainty. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  These changes have a negligible impact on the calculated decay heat power, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Correction to the Pipe Exit Pressure Drop Error.** An error was discovered in WCOBRA/TRAC whereby the frictional pressure drop at the split break TEE connection to the BREAK component was incorrectly calculated using the TEE hydraulic diameter instead of the BREAK component length input. This error has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the pressure at the break and the break flow is negligible, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **WCOBRA/TRAC u19 File Dimension Error Correction.** A problem was identified in the dimension of an array used to generate the u19 file in WCOBRA/TRAC. The u19 file is read during HSDRIVER execution and provides information needed to generate the HOTSPOT thermal-hydraulic history and user input files. The array used to write the desired information to the u19 file is dimensioned to 2000 in WCOBRA/TRAC. It is possible, however, for more than 2000 curves to be written to the u19 file. If that is the case, it is possible that the curves would not be stored correctly on the u19 file. A survey of current BE LOCA analyses indicated that the majority of plants had less than 2000 curves in their u19 files; therefore, these plants are not affected by the

change. For those plants with more than 2000 curves, plant-specific sensitivity calculations indicated that resolution of this issue does not impact the PCT calculation for prior analyses. This represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

As discussed above, resolution of this issue does not impact the PCT calculation for prior LBLOCA analyses, leading to an estimated PCT impact of 0°F for North Anna Units 1 and 2.

- **Revised Heat Transfer Multiplier Distributions.** Some of the changes and error corrections described above affect the WCOBRA/TRAC heat transfer models, the heat transfer node initialization, or the heat transfer renoding logic. This lead to an investigation of the heat transfer multiplier distributions using the results for the Separate Effects Tests (SETs) and Integral Effects Tests (IETs). During this investigation, errors were discovered in the development of the original multiplier distributions, including errors in the grid locations specified in the WCOBRA/TRAC models for the G2 Refill and G2 Reflood tests, and errors in processing test data used to develop the reflood heat transfer multiplier distribution.

  The blowdown, heatup, blowdown cooling, refill, and reflood heat transfer multiplier distributions were redeveloped. The revised heat transfer multiplier distributions have been evaluated for impact on existing analyses. Resolution of these issues represents a closely related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  A plant transient calculation representative of North Anna transient behavior was performed with the latest version of WCOBRA/TRAC. Using this transient, a matrix of HOTSPOT calculations was performed to estimate the effect of the heat transfer multiplier distribution changes. The limiting runs for the North Anna analyses were identified, including consideration of the TCD effects and other evaluations on the analysis of record (AOR) which substantially impacted the ranking or PCTs of the limiting cases. The set of limiting runs for North Anna were selected such that less limiting runs which were not explicitly considered would not become limiting due to the estimated PCT impact from the change in heat transfer multipliers. The heat transfer multipliers for each run were used to identify which bin that multiplier falls into, and an estimated PCT impact for that individual multiplier was assigned. The individual estimated PCT impacts for the run (based on the four multipliers) were summed to estimate the overall impact on the run. Finally, the run results were re-ranked based on the estimated impacts on each run. The change between the estimated 95/95 PCT before and after this process was reported as the estimate of effect for the North Anna analyses.

Using these results and considering the heat transfer multiplier uncertainty attributes from limiting cases for North Anna Unit 1 had a -27°F PCT change and North Anna Unit 2 had a -4°F PCT change.

- **HOTSPOT Burst Strain Error Correction.** An error in the application of the burst strain was discovered in HOTSPOT. The equation for the application of the burst strain is given as Equation 7-69 in WCAP-16009-P-A and in WCAP-12945-P-A. The outer radius of the cladding after burst occurs should be calculated based on the burst strain, and the inner radius of the cladding should be calculated based on the outer radius. In HOTSPOT, the burst strain is applied to the calculation of the cladding inner radius. The cladding outer radius is then calculated based on the inner radius. As such, the burst strain is incorrectly applied to the inner radius rather than the outer radius, which impacts the resulting cladding geometry at the burst elevation after burst occurs. Correction of the erroneous calculation results in thinner cladding at the burst node and more fuel relocating into the burst node, leading to an increase in the PCT at the burst node. This issue has been evaluated to estimate the impact on existing BE LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The impact of fuel pellet TCD and peaking factor burndown was determined for North Anna Units 1 and 2 from the 10th-ranked output of large run sets of plant-specific HOTSPOT calculations. Because many cases may affect the 10^{th}-ranked output, it was not practical to choose a small subset of these cases to re-execute for the evaluation of the error in the application of the burst strain. Therefore, the estimated effect of this issue was determined from the results for other plants with a 17x17 fuel array that have plant-specific HOTSPOT calculations that include the impact of TCD and peaking factor burndown.

  Starting from the most recent HOTSPOT runs which include TCD for these 17x17 plants, a subset of potentially PCT limiting cases was identified and assessed to determine whether a HOTSPOT rerun was required based on the PCT and burst characteristics. Specifically, the PCT (considering burst and nonburst elevations), the time of burst, and the burst strain were considered in this assessment. The correction of the error in the application of the burst strain results in an increase to the PCT at the burst node. The impact is expected to be larger for cases with an earlier burst time and/or a larger burst strain due to the amount of subsequent fuel relocation after burst which increases the linear heat rate.

  To estimate the effect of the error in the application of the burst strain for these 17x17 plants, HOTSPOT cases were executed with a version of HOTSPOT with the error in the application of the burst strain corrected. These HOTSPOT executions correspond to those cases identified to have near limiting PCT, high burst strain, and early burst time. The effect of local uncertainties for both

Integral Fuel Burnable Absorber (IFBA) and non-IFBA fuel was considered in this evaluation.

The estimated effect of the error in the application of the burst strain for these 17x17 plants was then taken as the difference between the maximum PCT when considering the effects of the error in the application of the burst strain and the previously limiting PCT considering the revised heat transfer multipliers distributions.

The average PCT impact for the other 17x17 plants that have plant-specific HOTSPOT calculations that include the impact of TCD and peaking factor burndown was increased by 50% to conservatively determine the estimated effect of the error in the application of the burst strain for North Anna Units 1 and 2.

The issue described above was evaluated based on the results of executing the most limiting plant-specific HOTSPOT runs for similar plants with a HOTSPOT version that includes the correction of this error. This resulted in an estimated PCT impact of 21°F for North Anna Unit 1 and Unit 2.

- **Changes to Grid Blockage Ratio and Porosity.** A change in the methodology used to calculate grid blockage ratio and porosity for Westinghouse fuel resulted in a change to the grid inputs used in the North Anna Units 1 and 2 LBLOCA analysis. Grid inputs affect heat transfer in the core during a LBLOCA. This change represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The updates to the methodology to calculate grid blockage ratio and porosity used as input in Westinghouse LBLOCA models resulted in a negligible change to heat transfer in the core for the fuel type used in North Anna Units 1 and 2. The estimated penalty associated with the changes is 0°F for 10 CFR 50.46 reporting purposes.

- **Grid Heat Transfer Enhancement Calculation.** An issue was identified which could affect the calculation of the heat transfer at gridded elevations for BE LBLOCA EMs. For a specific input condition, the grid heat transfer enhancement factor is calculated based on an erroneous core geometry, which can cause an over-prediction of the heat transfer coefficient at gridded elevations. This issue has been evaluated to estimate the impact on existing LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The effect described above was judged to have a negligible effect on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Vessel Section 7 Mid-Level Elevation Modeling**. Documentation deficiencies have been identified which are associated with the LB LOCA EM and plant specific analyses. The first is an incorrect statement made on page 20-4-5 of WCAP-12945-P-A. The Section 7 mid-level elevation utilized in the sample analysis is stated as being at the bottom of the deep beam device. In the model, the Section 7 mid-level elevation is at the top of the topmost support column flow slot. In addition, the bottom of Section 7 is characterized as being at the bottom of the Hot Leg, but in the model, the bottom of the section is set at the top of the Hot Leg. The similar statement made at page 12-6 of WCAP-16009-P-A could also be incorrect. These are not considered changes to the methodology, but rather, corrections of the documentation. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  Westinghouse considers that for 3 and 4 loop plants with the deep beam design (those with Upper Support Plates of design type 'Flat' and 'Top Hat' in nature), the choice of setting the level breakpoint at either position is equally correct, since there are no geometry aspects in this axial position of the vessel that warrant a critical modeling decision to capture LBLOCA transient phenomena. Furthermore, the level difference was only approximately 5" for a typical application. Since either model is appropriate, there is no PCT penalty to assess for 10 CFR 50.46 reporting purposes. Future analyses can use either coordinate.

- **Burst Elevation Selection.** It is stated on page 11-20 of WCAP-16009-P-A that the burst option is applied at the elevation corresponding to the (WCOBRA/TRAC) burst elevation for the hot assembly rod. This approach was modified to apply the burst option at the HOTSPOT predicted burst elevation as described on page 19 of Attachment 1 to LTR-NRC-06-8. The HOTSPOT code has been updated to incorporate the following changes to the burst elevation selection logic if multiple nodes burst at the same time: (1) the node that has the highest cladding temperature at the time of burst is selected; (2) if multiple nodes have the same burst time and cladding temperature at the time of burst, the lowest ordered elevation of those nodes is selected. These changes represent a closely-related group of Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451.

  This improvement in burst elevation selection is a forward-fit change, leading to an estimated PCT impact of 0°F.

Surry Power Station Units 1 and 2

1. Westinghouse identified one change and error applicable to the 1985 Westinghouse SBLOCA EM with NOTRUMP for Surry Units 1 and 2.

   - **SBLOCTA Cladding Strain Requirement for Fuel Rod Burst.** An error was discovered in the minimum local strain required for burst for ZIRLO® cladding in the SBLOCTA code. The coding does not enforce reaching the minimum percent local strain threshold prior to calculating fuel rod burst. However, a review of licensing basis analyses revealed no instances of this error impacting calculated results. Resolution of this issue represents a Non-Discretionary Change to the Evaluation Model as described in Section 4.1.2 of WCAP-13451.

     After review of current licensing basis analyses and the phenomena and physics of a small break LOCA transient, it is concluded that this error has a negligible effect on small break LOCA analysis results, leading to an estimated PCT impact of 0°F.

2. Westinghouse identified the following changes and errors applicable to the 2004 Westinghouse BE LBLOCA EM using the ASTRUM for Surry Units 1 and 2:

   - **General Code Maintenance.** Various changes have been made to enhance the usability of codes and to streamline future analyses. Examples of these changes include modifying input variable definitions, units and defaults; improving the input diagnostic checks; enhancing the code output; optimizing active coding; and eliminating inactive coding. The nature of these changes leads to an estimated PCT impact of 0°F.

   - **Initial Fuel Pellet Average Temperature Uncertainty Calculation.** In the ASTRUM BE LBLOCA EM, uncertainties are applied to the gap heat transfer coefficient and pellet thermal conductivity to capture the uncertainty in the initial fuel pellet average temperature. This approach was compared to the initial fuel pellet average temperature uncertainties predicted by the PAD code at beginning-of-life conditions and found to be conservative in Section 25-4-2-4 of WCAP-12945-P-A. However, the initial fuel pellet average temperature uncertainty range analyzed at higher burnups in the ASTRUM EM is much wider than the uncertainty range predicted by the PAD code, which may result in excessively low or high analyzed initial fuel pellet average temperatures. This issue has been evaluated to estimate the impact on existing ASTRUM LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

     The issue described above is judged to have either no effect or a negligible effect on existing Surry Units 1 and 2 LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Elevations for Heat Slab Temperature Initialization.** An error was discovered in WCOBRA/TRAC whereby an incorrect value would be used in the initial fuel rod temperature calculation for a fuel rod heat transfer node if that node elevation was specified outside of the bounds of the temperature initialization table. This problem has been evaluated for impact on existing analyses and its resolution represents a Discretionary Change in accordance with Section 4.1.1 of WCAP- 13451.

  Based on inspection of plant analysis input, it was concluded that the input decks for the existing Surry Units 1 and 2 analysis are not impacted by this error, leading to an estimated PCT impact of 0°F.

- **Heat Transfer Model Error Corrections.** Several related changes were made to WCOBRA/TRAC to correct errors discovered which affected the heat transfer models. These errors included calculation of the entrained liquid fraction used in calculation of the drop wall heat flux, application of the grid enhancement factor for grid temperature calculation, calculation of the Reynold's number used in the Wong-Hochrieter correlation for the heat transfer coefficient from fuel rods to vapor, fuel rod initialization and calculation of cladding inner radius with creep, application of grid and two phase enhancement factors and radiation component in single phase vapor heat transfer, and reset of the critical heat flux temperature when J=2. These errors have been evaluated to estimate the impact on existing LBLOCA analysis results. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  Based on the results of representative plant calculations, separate effects and integral effects test simulations, it is concluded that the error corrections have a negligible local effect on heat transfer, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Correction to Heat Transfer Node Initialization.** An error was discovered in the heat transfer node initialization logic in WCOBRA/TRAC whereby the heat transfer node center locations could be inconsistent with the geometric node center elevations. The primary effects of this issue are on the interpolated fluid properties and grid turbulent mixing enhancement at the heat transfer node. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP- 13451.

  Based on engineering judgment and the results from a matrix of representative plant calculations, it is concluded that the effect of this error is within the code resolution, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Mass Conservation Error Fix.** It was identified that mass was not conserved in WCOBRA/TRAC one-dimensional component cells when void fraction values were calculated to be slightly out of the physical range (greater than 1.0 or smaller than 0.0). This was observed to result in artificial mass generation on the secondary side of steam generator components. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This error was observed to primarily affect the mass on the secondary side of the steam generator. This issue was judged to have a negligible impact on the Surry Units 1 and 2 LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Correction to Split Channel Momentum Equation.** An error was discovered in the momentum equation calculations for split channels in WCOBRA/TRAC. This error impacts the (1) continuity area of the phantom/boundary bottom cell; (2) bottom and top continuity area correction factors for the channel inlet at the bottom of a section and for the channel outlet at the top of a section; and (3) drop entrainment mass rate per unit volume and drop de-entrainment mass rate per unit volume contributions to the momentum calculations for split channels. This problem has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the quantities directly impacted by the momentum equation calculations for split channels (velocities, flows, etc.) is negligible, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Heat Transfer Logic Correction for Rod Burst Calculation.** A change was made to the WCOBRA/TRAC coding to correct an error which had disabled rod burst in separate effect test simulations. This change represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

  Based on the nature of the change and the evaluation model requirements for plant modeling in Westinghouse best estimate large break LOCA analyses with WCOBRA/TRAC, it is judged that the existing Surry Units 1 and 2 analyses are not impacted by this change, leading to an estimated PCT impact of 0°F.

- **Changes to Vessel Superheated Steam Properties.** Several related changes were made to the WCOBRA/TRAC coding for the vessel super-heated water properties, including updating the HGAS subroutine coding to be consistent with Equation 10-6 of the Code Qualification Document (CQD) topical WCAP-12945-P-A, updating the approximation of the enthalpy in the TGAS subroutine to be consistent with the HGAS subroutine coding, and updating the

temperature iteration method and convergence criteria in the TGAS subroutine. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

The updates to the calculations of the superheated steam properties had generally less than 1°F impact on the resulting steam temperature values, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Update to Metal Density Reference Temperatures.** It was identified that for one-dimensional components in which heat transfer to stainless steel 304 or 316 is modeled, the reference temperature for the metal density calculation was allowed to vary; as a result the total metal mass was not preserved. Correction of this problem represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  This change primarily impacts the reactor coolant system loop piping modeled in the LBLOCA WCOBRA/TRAC models. It was judged that the effect of this change on the PCT results was negligible, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Decay Heat Model Error Corrections.** The decay heat model in the WCOBRA/TRAC code was updated to correct the erroneously coded value of the yield fraction directly from fission for Group 19 of Pu-239 and to include the term for uncertainty in the prompt energy per fission in the calculation of the decay heat power uncertainty. Correction of these errors represents a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  These changes have a negligible impact on the calculated decay heat power, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Correction to the Pipe Exit Pressure Drop Error.** An error was discovered in WCOBRA/TRAC whereby the frictional pressure drop at the split break TEE connection to the BREAK component was incorrectly calculated using the TEE hydraulic diameter instead of the BREAK component length input. This error has been evaluated for impact on existing analyses and its resolution represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  Based on the results from a matrix of representative plant calculations, it is concluded that the effect of this error on the pressure at the break and the break flow is negligible, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **WCOBRA/TRAC u19 File Dimension Error Correction.** A problem was identified in the dimension of an array used to generate the u19 file in

WCOBRA/TRAC. The u19 file is read during HSDRIVER execution and provides information needed to generate the HOTSPOT thermal-hydraulic history and user input files. The array used to write the desired information to the u19 file is dimensioned to 2000 in WCOBRA/TRAC. It is possible, however, for more than 2000 curves to be written to the u19 file. If that is the case, it is possible that the curves would not be stored correctly on the u19 file. A survey of current BE LBLOCA analyses indicated that the majority of plants had less than 2000 curves in their u19 files; therefore these plants are not affected by the change. For those plants with more than 2000 curves, plant-specific sensitivity calculations indicated that resolution of this issue does not impact the PCT calculation for prior analyses. This represents a Discretionary Change in accordance with Section 4.1.1 of WCAP-13451.

As discussed above, resolution of this issue does not impact the PCT calculation for prior LBLOCA analyses, leading to an estimated PCT impact of 0°F for Surry Units 1 and 2.

- **Revised Heat Transfer Multiplier Distributions.** Some of the changes and error corrections described above affect the WCOBRA/TRAC heat transfer models, the heat transfer node initialization, or the heat transfer renoding logic. This lead to an investigation of the heat transfer multiplier distributions using the results for the Separate Effects Tests (SETs) and Integral Effects Tests (IETs). During this investigation, errors were discovered in the development of the original multiplier distributions, including errors in the grid locations specified in the WCOBRA/TRAC models for the G2 Refill and G2 Reflood tests, and errors in processing test data used to develop the reflood heat transfer multiplier distribution.

  The blowdown, heatup, blowdown cooling, refill, and reflood heat transfer multiplier distributions were redeveloped. The revised heat transfer multiplier distributions have been evaluated for impact on existing analyses. Resolution of these issues represents a closely related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  A plant transient calculation representative of Surry transient behavior was performed with the latest version of WCOBRA/TRAC. Using this transient, a matrix of HOTSPOT calculations was performed to estimate the effect of the heat transfer multiplier distribution changes. The limiting runs for the Surry analysis were identified, including consideration of the TCD effects and other evaluations on the analysis of record (AOR) which substantially impacted the ranking or PCTs of the limiting cases. The set of limiting runs for Surry were selected such that less limiting runs which were not explicitly considered would not become limiting due to the estimated PCT impact from the change in heat transfer multipliers. The heat transfer multipliers for each run were used to identify which bin that multiplier falls into, and an estimated PCT impact for that

individual multiplier was assigned. The individual estimated PCT impacts for the run (based on the four multipliers) were summed to estimate the overall impact on the run. Finally, the run results were re-ranked based on the estimated impacts on each run. The change between the estimated 95/95 PCT before and after this process was reported as the estimate of effect for the Surry analysis.

Using these results and considering the heat transfer multiplier uncertainty attributes from limiting cases for Surry Units 1 and 2, an estimated PCT effect of -7°F has been established for 10 CFR 50.46 reporting purposes.

- **HOTSPOT Burst Strain Error Correction.** An error in the application of the burst strain was discovered in HOTSPOT. The equation for the application of the burst strain is given as Equation 7-69 in WCAP-16009-P-A and in WCAP-12945-P-A. The outer radius of the cladding after burst occurs should be calculated based on the burst strain, and the inner radius of the cladding should be calculated based on the outer radius. In HOTSPOT, the burst strain is applied to the calculation of the cladding inner radius. The cladding outer radius is then calculated based on the inner radius. As such, the burst strain is incorrectly applied to the inner radius rather than the outer radius, which impacts the resulting cladding geometry at the burst elevation after burst occurs. Correction of the erroneous calculation results in thinner cladding at the burst node and more fuel relocating into the burst node, leading to an increase in the PCT at the burst node. This issue has been evaluated to estimate the impact on existing BE LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The issue described above was evaluated by executing the most limiting plant-specific HOTSPOT runs with a HOTSPOT version that includes the correction of this error. This plant-specific sensitivity study resulted in an estimated PCT impact of 51°F for Surry Units 1 and 2.

For Surry Units 1 and 2, the above issues resulted in the accumulation of changes to the calculated peak fuel cladding temperature to exceed 50°F, and was previously reported to the NRC in a letter dated February 27, 2014 (Serial No. 14-082) to meet the 30-day reporting requirements of 10 CFR 50.46(a)(3)(ii).

Subsequent to the 30 day report, in the summary of changes provided by Westinghouse for 2013, there were four additional changes.

- **Changes to Grid Blockage Ratio and Porosity.** A change in the methodology used to calculate grid blockage ratio and porosity for Westinghouse fuel resulted in a change to the grid inputs used in the Surry Units 1 and 2 LBLOCA analysis. Grid inputs affect heat transfer in the core during a LBLOCA. This change

represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

The updates to the methodology to calculate grid blockage ratio and porosity used as input in Westinghouse LBLOCA models resulted in a negligible change to heat transfer in the core for the fuel type used in Surry Units 1 and 2. The estimated penalty associated with the changes is 0°F for 10 CFR 50.46 reporting purposes.

- **Grid Heat Transfer Enhancement Calculation**. An issue was identified which could affect the calculation of the heat transfer at gridded elevations for BE LBLOCA EMs. For a specific input condition, the grid heat transfer enhancement factor is calculated based on an erroneous core geometry, which can cause an over-prediction of the heat transfer coefficient at gridded elevations. This issue has been evaluated to estimate the impact on existing LBLOCA analysis results. The resolution of this issue represents a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

  The effect described above was judged to have a negligible effect on existing LBLOCA analysis results, leading to an estimated PCT impact of 0°F.

- **Vessel Section 7 Mid-Level Elevation Modeling.** Documentation deficiencies have been identified which are associated with the LBLOCA EM and plant specific analyses. The first is an incorrect statement made on page 20-4-5 of WCAP-12945-P-A. The Section 7 mid-level elevation utilized in the sample analysis is stated as being at the bottom of the deep beam device. In the model, the Section 7 mid-level elevation is at the top of the topmost support column flow slot. In addition, the bottom of Section 7 is characterized as being at the bottom of the Hot Leg, but in the model, the bottom of the section is set at the top of the Hot Leg. The similar statement made at page 12-6 of WCAP-16009-P-A could also be incorrect. These are not considered changes to the methodology, but rather, corrections of the documentation. These changes represent a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

  Westinghouse considers that for 3 and 4 loop plants with the deep beam design (those with Upper Support Plates of design type 'Flat' and 'Top Hat' in nature), the choice of setting the level breakpoint at either position is equally correct, since there are no geometry aspects in this axial position of the vessel that warrant a critical modeling decision to capture LBLOCA transient phenomena. Furthermore, the level difference was only approximately 5" for a typical application. Since either model is appropriate, there is no PCT penalty to assess for 10 CFR 50.46 Reporting purposes. Future analyses can use either coordinate.

- **Burst Elevation Selection.** It is stated on page 11-20 of WCAP-16009-P-A that the burst option is applied at the elevation corresponding to the (WCOBRA/TRAC) burst elevation for the hot assembly rod. This approach was modified to apply the burst option at the HOTSPOT predicted burst elevation as described on page 19 of Attachment 1 to LTR-NRC-06-8. The HOTSPOT code has been updated to incorporate the following changes to the burst elevation selection logic if multiple nodes burst at the same time: (1) the node that has the highest cladding temperature at the time of burst is selected; (2) if multiple nodes have the same burst time and cladding temperature at the time of burst, the lowest ordered elevation of those nodes is selected. These changes represent a closely-related group of Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451.

  This improvement in burst elevation selection is a forward-fit change, leading to an estimated PCT impact of 0°F.

Conclusion

The LOCA results for Kewaunee, Millstone Units 2 and 3, North Anna Units 1 and 2, and Surry Units 1 and 2 are confirmed (PCT rackup tables Attachments 2 through 5) to have sufficient margin to the 2200°F limit for PCT specified in 10 CFR 50.46. Based on the evaluation of this information and the resulting changes in the applicable licensing basis PCT results, no further action is required to demonstrate compliance with the 10 CFR 50.46 requirements. Reporting of this information is required per 10 CFR 50.46(a)(3)(ii), which obligates each licensee to report the effect upon calculated temperature of any change or error in evaluation models or their application on an annual basis.

For Kewaunee, information was provided that covered the time from January 1, 2013 to Kewaunee's final shutdown on May 7, 2013.

This information satisfies the annual reporting requirements of 10 CFR 50.46(a)(3)(ii) covering calendar year 2013.

ATTACHMENT 2

2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2013 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name:	Kewaunee Power Station		
Utility Name:	Dominion Energy Kewaunee, Inc.		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	3 Inch CL, High Tav
Analysis Date:	05/14/02		
Vendor:	Westinghouse		
FQ:	2.5	**FdH:**	1.8
Fuel:	422 Vantage +	**SGTP(%):**	10
Notes:	Uprate to 1772 MWt. Effective beginning Cycle 26		

		Clad Temp(°F)
LICENSING BASIS		
	Analysis of Record PCT	1030
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Reactor Coolant Pump Reference Conditions	0
2.	Pressurizer Fluid Volumes	0
3.	Lower Guide Tube Assembly Weight	0
4.	Discrepancy in NOTRUMP REST Draindown Calculation	0
5.	NOTRUMP Bubble Rise/Drift Flux Model Inconsistency Corrections	35
6.	NOTRUMP-EM Refined Break Spectrum	0
7.	Errors in Reactor Vessel Nozzle Data Collections	0
8.	Pump Weir Resistance Modeling	0
9.	Errors in Reactor Vessel Lower Plenum Surface Area Calculations	0
10.	Discrepancy in Metal Masses Used from Drawings	0
11.	Urania-Gadolinia Pellet Thermal Conductivity Calculation	0
12.	Pellet Crack and Dish Volume Calculation	0
13.	Treatment of Vessel Average Temperature Uncertainty	0
14.	Maximum Fuel Rod Time Step Logic	0
15.	Radiation Heat Transfer Logic	0
16.	Interruption of SI during the Switchover to Sump Recirculation	0
17.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	None	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1065**

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Kewaunee Power Station		
Utility Name:	Dominion Energy Kewaunee, Inc.		
Analysis Information			
EM:	UPI (1999)	**Limiting Break Size:**	Split
Analysis Date:	03/25/02		
Vendor:	Westinghouse		
FQ:	2.5	**FdH:** 1.8	
Fuel:	422 Vantage +	**SGTP(%):** 10	
Notes:	Uprate to 1772 MWt. Effective beginning Cycle 26		

		Clad Temp(°F)
LICENSING BASIS		
	Analysis of Record PCT	2084
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Pressurizer Fluid Volumes	0
2.	Vessel Unheated Conductor Noding	0
3.	Level Boundary Selection	0
4.	Containment Relative Humidity Assumption	0
5.	Diffuser Plate Modeling	0
6.	Downcomer Momentum Area	0
7.	Revised Blowdown Heatup Uncertainty Distribution	5
8.	Spacer Grid Heat Transfer Model Inputs	5
9.	Inconsistent Vessel Vertical Level Modeling	0
10.	Revised Downcomer Gap Inputs	-59
11.	Core Support Column Heat Slab Discrepancy	0
12.	HOTSPOT Fuel Relocation Error	10
13.	Revised Upper Plenum Volume Inputs	0
14.	Steam Generator Nozzle Volume Accounting Error	0
15.	Errors in Reactor Vessel Nozzle Data Collections	0
16.	Lower Plenum Unheated Conductors	0
17.	HOTSPOT Burst Temperature Logic Errors	0
18.	Discrepancy in Metal Masses Used From Drawings (Lower Support Plate)	0
19.	HOTSPOT Gap Heat Transfer Logic	0
20.	HOTSPOT Statistical Output Logic	0
21.	Treatment of Vessel Average Temperature Uncertainty	0
22.	Treatment of Interfacial Drag Multipliers in Upper Plenum Injection Plants	0
23.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	50
24.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
25.	Rod Internal Pressure Calculation	0
26.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
27.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0

	28.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**		
	1.	Evaluation of Design Input Changes With Respect To Plant Operation	-115
C.	**2013 ECCS Model Assessments**		
	1.	None	0
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1980**

ATTACHMENT 3

2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2013 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNITS 2 AND 3

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name:	Millstone Power Station, Unit 2
Utility Name:	Dominion Nuclear Connecticut, Inc.

Analysis Information

EM:	PWR SBLOCA, S-RELAP5 Based	**Limiting Break Size:**	0.08 ft^2
Analysis Date:	01/02		
Vendor:	AREVA		
Peak Linear Power:	15.1 kW/ft		
Notes:	None		

			Clad Temp(°F)
LICENSING BASIS			
	Analysis of Record PCT		1941
PCT ASSESSMENTS (Delta PCT)			
A.	**Prior ECCS Model Assessments**		
	1.	Decay Heat Model Error	-133
	2.	Revised SBLOCA Guideline	0
	3.	Core Exit Modeling-Upper Tie Plate Flow Area	-22
	4.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
	5.	S-RELAP5 Choked Flow Error with Non-Condensables Present	0
	6.	Radiation to Fluid Heat Transfer Model Change	-64
	7.	RELAP5 Kinetics Coding Error	4
	8.	RELAP5 Heat Conduction Solution	0
	9.	RODEX2 Thermal Conductivity Degradation	0
	10.	Sleicher-Rouse Correlation Modeling	83
B.	**Planned Plant Modification Evaluations**		
	1.	None	0
C.	**2013 ECCS Model Assessments**		
	1.	None	0
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1801**

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 2
Utility Name:	Dominion Nuclear Connecticut, Inc.

Analysis Information

EM:	SEM/PWR-98	**Limiting Break Size:**	1.0 DECLG
Analysis Date:	11/98		
Vendor:	AREVA		
Peak Linear Power:	15.1 kW/ft		
Notes:	None		

		Clad Temp(°F)
LICENSING BASIS		
	Analysis of Record PCT	1814
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Corrected Corrosion Enhancement Factor	-1
2.	ICECON Coding Errors	0
3.	Setting RFPAC Fuel Temperatures at Start of Reflood	-2
4.	SISPUNCH/ujun98 Code Error	0
5.	Error in Flow Blockage Model in TOODEE2	0
6.	Change in TOODEE2-Calculation of QMAX	0
7.	Change in Gadolinia Modeling	0
8.	PWR LBLOCA Split Break Modeling	0
9.	TEOBY Calculation Error	0
10.	Inappropriate Heat Transfer in TOODEE2	0
11.	End-of-Bypass Prediction by TEOBY	0
12.	R4SS Overwrite of Junction Inertia	0
13.	Incorrect Junction Inertia Multipliers	1
14.	Errors Discovered During RODEX2 V&V	0
15.	Error in Broken Loop SG Tube Exit Junction Inertia	0
16.	RFPAC Refill and Reflood Calculation Code Errors	16
17.	Incorrect Pump Junction Area Used in RELAP4	0
18.	Error in TOODEE2 Clad Thermal Expansion	-1
19.	Accumulator Line Loss Error	-1
20.	Inconsistent Loss Coefficients Used for Robinson LBLOCA	0
21.	Pump Head Adjustment for Pressure Balance Initialization	-3
22.	ICECON Code Errors	0
23.	Containment Sump Modification and Replacement PZR	2
24.	Non-Conservative RODEX Fuel Pellet Temperature	20
25.	Array Index Issues in the RELAP4 Code	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	None	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1845**

10 CFR 50.46 MARGIN UTILIZATION - SMALL BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Nuclear Connecticut, Inc.		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	4 Inches
Analysis Date:	02/07/07		
Vendor:	Westinghouse		
FQ:	2.6	**FdH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	10
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1193
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Errors in Reactor Vessel Lower Plenum Surface Area Calculations	0
2.	Discrepancy in Metal Masses Used From Drawings	0
3.	Urania-Gadolinia Pellet Thermal Conductivity Calculation	0
4.	Pellet Crack and Dish Volume Calculation	0
5.	Treatment of Vessel Average Temperature Uncertainty	0
6.	Maximum Fuel Rod Time Step Logic	0
7.	Radiation Heat Transfer Logic	0
8.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1193**

10 CFR 50.46 MARGIN UTILIZATION - LARGE BREAK LOCA

Plant Name:	Millstone Power Station, Unit 3		
Utility Name:	Dominion Nuclear Connecticut, Inc.		
Analysis Information			
EM:	ASTRUM (2004)	**Limiting Break Size:**	Guillotine
Analysis Date:	04/17/07		
Vendor:	Westinghouse		
FQ:	2.6	**FdH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	10
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1781
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	HOTSPOT Burst Temperature Logic Errors	0
2.	CCFL Global Volume Error	0
3.	HOTSPOT Gap Heat Transfer Logic	0
4.	Discrepancy in Metal Masses Used From Drawings	0
5.	Error in ASTRUM Processing of Average Rod Burnup and Rod Internal Pressure	0
6.	Treatment of Vessel Average Temperature Uncertainty	0
7.	Error in ASTRUM Processing of Average Rod Burnup	0
8.	PBOT and PMID Evaluation	0
9.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	222
10.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
11.	Rod Internal Pressure Calculation	0
12.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
13.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
14.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
2.	Elevations for Heat Slab Temperature Initialization	0
3.	Heat Transfer Model Error Corrections	0
4.	Correction to Heat Transfer Node Initialization	0
5.	Mass Conservation Error Fix	0
6.	Correction to Split Channel Momentum Equation	0
7.	Heat Transfer Logic Correction for Rod Burst Calculation	0
8.	Changes to Vessel Superheated Steam Properties	0

9.	Update to Metal Density Reference Temperatures	0
10.	Decay Heat Model Error Corrections	0
11.	Correction to the Pipe Exit Pressure Drop Error	0
12.	WCOBRA/TRAC U19 File Dimension Error Correction	0
13.	Revised Heat Transfer Multiplier Distributions	-91
14.	HOTSPOT Burst Strain Error Correction	21
15.	Changes to Grid Blockage Ratio and Porosity	0
16.	Grid Heat Transfer Enhancement Calculation	0
17.	Burst Elevation Selection	0

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1933**

ATTACHMENT 4

2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2013 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2

10 CFR 50.46 MARGIN UTILIZATION - AREVA SMALL BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	AREVA SB EM	**Limiting Break Size:**	5.2 Inches (SI Line)
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1404
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
2.	RCCA Reactivity Input	-3
3.	Critical Flow Transition	26
4.	Revised Test Flow Curve for HHSI	-24
5.	Advanced Mark BW Top Nozzle Modification	0
6.	RELAP5 Kinetics and Heat Conduction Model	0
7.	TACO3 – Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	None	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1395**

10 CFR 50.46 MARGIN UTILIZATION - AREVA LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	AREVA RLBLOCA EM	**Limiting Break Size:**	DEGB
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	12
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Forslund-Rohsenow Correlation Modeling	64
2.	RWST Temperature Assumption	8
3.	LBLOCA/Seismic SG Tube Collapse	0
4.	ICECON Code Errors	0
5.	RLBLOCA Choked Flow Disposition	-26
6.	RLBLOCA Changes in Uncertainty Parameters	10
7.	Advanced Mark-BW Top Nozzle Modification	65
8.	GSI-191 Sump Strainer	0
9.	Blowdown Quench	0
10.	Mixture Level Model Limitation in the S-RELAP5 Code	-29
11.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-20
12.	Cold Leg Condensation Under Predicted by S-RELAP5 Following Accumulator Injection	0
13.	Cross-Flow Junction Area in S-RELAP Model	0
14.	Radiation to Fluid Heat Transfer Model Change	-32
15.	MUR Implementation	2
16.	S-RELAP5 Kinetics and Heat Conduction Model	-29
17.	RODEX3A – Thermal Conductivity Degradation	0
18.	Steam Generator Entrainment Bias Factor (FIJ) Change	-4
19.	RLBLOCA Upper Plenum Modeling	8
20.	Sleicher-Rouse Correlation Modeling	14
21.	Liquid Fallback into Surrounding 6 Assemblies	-8
22.	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0

C.	**2013 ECCS Model Assessments**		
	1.	Issue with S-RELAP5 routine associated with the RODEX3a fuel rod model	-10
D.	**Other**		
	1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS		**PCT =**	**1866**

10 CFR 50.46 MARGIN UTILIZATION - AREVA SMALL BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	AREVA SB EM	**Limiting Break Size:**	3 Inches
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1370
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-8
2.	RCCA Reactivity Input	-29
3.	Critical Flow Transition	5
4.	RELAP5 Kinetics and Heat Conduction Model	0
5.	TACO3 – Thermal Conductivity Degradation	0
6.	Advanced Mark BW Top Nozzle Modification	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	None	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1338**

10 CFR 50.46 MARGIN UTILIZATION - AREVA LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	AREVA RLBLOCA EM	**Limiting Break Size:**	DEGB
Analysis Date:	2004		
Vendor:	AREVA		
FQ:	2.32	**FΔH:**	1.65
Fuel:	Advanced Mark-BW	**SGTP (%):**	12
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1789
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Forslund-Rohsenow Correlation Modeling	64
2.	RWST Temperature Assumption	8
3.	LBLOCA/Seismic SG Tube Collapse	0
4.	ICECON Code Errors	0
5.	RLBLOCA Choked Flow Disposition	22
6.	RLBLOCA Changes in Uncertainty Parameters	10
7.	Advanced Mark-BW Top Nozzle Modification	65
8.	GSI-191 Sump Strainer	0
9.	Mixture Level Model Limitation in the S-RELAP5 Code	-19
10.	Point Kinetics Programming Issue with RELAP5-Based Computer Codes	-20
11.	Cold Leg Condensation Under Predicted by S-RELAP5 Following Accumulator Injection	0
12.	Cross-Flow Junction Area in S-RELAP Model	0
13.	Radiation to Fluid Heat Transfer Model Change	-32
14.	S-RELAP5 Kinetics and Heat Conduction Model	-29
15.	RODEX3A – Thermal Conductivity Degradation	0
16.	Steam Generator Entrainment Bias Factor (FIJ) Change	-4
17.	MUR Implementation	20
18.	RLBLOCA Upper Plenum Modeling	0
19.	Sleicher-Rouse Correlation Modeling	14
20.	Liquid Fallback into Surrounding 6 Assemblies	31
21.	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	Issue with S-RELAP5 routine associated with the RODEX3a fuel rod model	-10

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1909**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	2.75 Inches
Analysis Date:	12/20/2010		
Vendor:	Westinghouse		
FQ:	2.32	**FΔH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	7
Notes:	None		

	Clad Temp (°F)
LICENSING BASIS	
Analysis of Record PCT	1834.1
PCT ASSESSMENTS (Delta PCT)	
A. Prior ECCS Model Assessments	
1. NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B. Planned Plant Modification Evaluations	
1. None	0
C. 2013 ECCS Model Assessments	
1. SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
D. Other	
1. None	0
LICENSING BASIS PCT + PCT ASSESSMENTS **PCT =**	**1834.1**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	ASTRUM (2004)	**Limiting Break Size:**	DEGB
Analysis Date:	8/25/2010		
Vendor:	Westinghouse		
FQ:	2.32	**FΔH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	7

Notes: Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1852
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	135
2.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
3.	Rod Internal Pressure Calculation	0
4.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
5.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
6.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	1
2.	Elevations for Heat Slab Temperature Initialization	0
3.	Heat Transfer Model Error Corrections	0
4.	Correction to Heat Transfer Node Initialization	0
5.	Mass Conservation Error Fix	0
6.	Correction to Split Channel Momentum Equation	0
7.	Heat Transfer Logic Correction for Rod Burst Calculation	0
8.	Changes to Vessel Superheated Steam Properties	0
9.	Update to Metal Density Reference Temperatures	0
10.	Decay Heat Model Error Corrections	0
11.	Correction to the Pipe Exit Pressure Drop Error	0
12.	WCOBRA/TRAC U19 File Dimension Error Correction	0
13.	Revised Heat Transfer Multiplier Distributions	-27
14.	HOTSPOT Burst Strain Error Correction	21

15.	Changes to Grid Blockage Ratio and Porosity	0
16.	Grid Heat Transfer Enhancement Calculation	0
17.	Vessel Section 7 Mid-Level Elevation Modeling	0
18.	Burst Elevation Selection	0

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1982**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	2.75 Inches
Analysis Date:	12/20/2010		
Vendor:	Westinghouse		
FQ:	2.32	**FΔH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1834.1
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**1834.1**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA

Plant Name:	North Anna Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	ASTRUM (2004)	**Limiting Break Size:**	DEGB
Analysis Date:	8/20/2010		
Vendor:	Westinghouse		
FQ:	2.32	**FΔH:**	1.65
Fuel:	RFA-2	**SGTP (%):**	7
Notes:	Core Power ≤ 100% of 2951 MWt; SG Model 54F; 17x17 RFA-2 Fuel with ZIRLO® or Optimized ZIRLO™ cladding, Non-IFBA or IFBA, IFMs		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1871
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	101
2.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
3.	Rod Internal Pressure Calculation	0
4.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
5.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
6.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	5
2.	Elevations for Heat Slab Temperature Initialization	0
3.	Heat Transfer Model Error Corrections	0
4.	Correction to Heat Transfer Node Initialization	0
5.	Mass Conservation Error Fix	0
6.	Correction to Split Channel Momentum Equation	0
7.	Heat Transfer Logic Correction for Rod Burst Calculation	0
8.	Changes to Vessel Superheated Steam Properties	0
9.	Update to Metal Density Reference Temperatures	0
10.	Decay Heat Model Error Corrections	0
11.	Correction to the Pipe Exit Pressure Drop Error	0
12.	WCOBRA/TRAC U19 File Dimension Error Correction	0
13.	Revised Heat Transfer Multiplier Distributions	-4
14.	HOTSPOT Burst Strain Error Correction	21

15.	Changes to Grid Blockage Ratio and Porosity	0
16.	Grid Heat Transfer Enhancement Calculation	0
17.	Vessel Section 7 Mid-Level Elevation Modeling	0
18.	Burst Elevation Selection	0

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS PCT = 1994

ATTACHMENT 5

2013 ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM (ECCS) MODEL CHANGES PURSUANT TO THE REQUIREMENTS OF 10 CFR 50.46

2013 ANNUAL REPORTING OF 10 CFR 50.46 MARGIN UTILIZATION

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

Plant Name:	Surry Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	2.75 Inches
Analysis Date:	5/7/2009		
Vendor:	Westinghouse		
FQ:	2.5	**FΔH:**	1.7
Fuel:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	2012
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Urania-Gadolinia Pellet Thermal Conductivity Calculation	0
2.	Pellet Crack and Dish Volume Calculation	0
3.	Treatment of Vessel Average Temperature Uncertainty	0
4.	15X15 Upgrade Fuel	0
5.	Maximum Fuel Rod Time Step Logic	0
6.	Radiation Heat Transfer Logic	0
7.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2012**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA WITH ASTRUM

Plant Name:	Surry Power Station, Unit 1		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	ASTRUM (2004)	**Limiting Break Size:**	DEG
Analysis Date:	10/6/2010		
Vendor:	Westinghouse		
FQ:	2.5	**FΔH:**	1.7
Fuel:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Transition Core (applied to mixed SIF/Upgrade core only)	14
2.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
3.	Pellet Radial Profile Option	-13
4.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
5.	Rod Internal Pressure Calculation	0
6.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
7.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
8.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**	
1.	Evaluation of Additional Containment Metal	0
C.	**2013 ECCS Model Assessments**	
1.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
2.	Elevations for Heat Slab Temperature Initialization	0
3.	Heat Transfer Model Error Corrections	0
4.	Correction to Heat Transfer Node Initialization	0
5.	Mass Conservation Error Fix	0
6.	Correction to Split Channel Momentum Equation	0
7.	Heat Transfer Logic Correction for Rod Burst Calculation	0
8.	Changes to Vessel Superheated Steam Properties	0
9.	Update to Metal Density Reference Temperatures	0
10.	Decay Heat Model Error Corrections	0
11.	Correction to the Pipe Exit Pressure Drop Error	0
12.	WCOBRA/TRAC U19 File Dimension Error Correction	0
13.	Revised Heat Transfer Multiplier Distributions	-7
14.	HOTSPOT Burst Strain Error Correction	51
15.	Changes to Grid Blockage Ratio and Porosity	0

16.	Grid Heat Transfer Enhancement Calculation	0
17.	Vessel Section 7 Mid-Level Elevation Modeling	0
18.	Burst Elevation Selection	0

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2081**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE SMALL BREAK LOCA

Plant Name:	Surry Power Station, Unit 2		
Utility Name:	Virginia Electric and Power Company		
Analysis Information			
EM:	NOTRUMP	**Limiting Break Size:**	2.75 Inches
Analysis Date:	5/7/2009		
Vendor:	Westinghouse		
FQ:	2.5	**FΔH:**	1.7
Fuel:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	2012
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Urania-Gadolinia Pellet Thermal Conductivity Calculation	0
2.	Pellet Crack and Dish Volume Calculation	0
3.	Treatment of Vessel Average Temperature Uncertainty	0
4.	15X15 Upgrade Fuel	0
5.	Maximum Fuel Rod Time Step Logic	0
6.	Radiation Heat Transfer Logic	0
7.	NOTRUMP-EM Evaluation of Fuel Pellet Thermal Conductivity Degradation	0
B.	**Planned Plant Modification Evaluations**	
1.	None	0
C.	**2013 ECCS Model Assessments**	
1.	SBLOCTA Cladding Strain Requirement for Fuel Rod Burst	0
D.	**Other**	
1.	None	0
LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2012**

10 CFR 50.46 MARGIN UTILIZATION - WESTINGHOUSE LARGE BREAK LOCA WITH ASTRUM

Plant Name:	Surry Power Station, Unit 2
Utility Name:	Virginia Electric and Power Company

Analysis Information			
EM:	ASTRUM (2004)	**Limiting Break Size:**	DEG
Analysis Date:	10/6/2010		
Vendor:	Westinghouse		
FQ:	2.5	**FΔH:**	1.7
Fuel:	Mixed: Upgrade/SIF	**SGTP (%):**	7
Notes:	None		

		Clad Temp (°F)
LICENSING BASIS		
	Analysis of Record PCT	1853
PCT ASSESSMENTS (Delta PCT)		
A.	**Prior ECCS Model Assessments**	
1.	Transition Core (applied to mixed SIF/Upgrade core only)	14
2.	Evaluation of Fuel Pellet Thermal Conductivity Degradation	183
3.	Pellet Radial Profile Option	-13
4.	HOTSPOT Burst Temperature Calculation for ZIRLO Cladding	0
5.	Rod Internal Pressure Calculation	0
6.	HOTSPOT Iteration Algorithm for Calculating the Initial Fuel Pellet Average Temperature	0
7.	WCOBRA/TRAC Thermal-Hydraulic History File Dimension used in HSDRIVER Background	0
8.	WCOBRA/TRAC Automated Restart Process Logic Error	0
B.	**Planned Plant Modification Evaluations**	
1.	Evaluation of Additional Containment Metal	0
C.	**2013 ECCS Model Assessments**	
1.	Initial Fuel Pellet Average Temperature Uncertainty Calculation	0
2.	Elevations for Heat Slab Temperature Initialization	0
3.	Heat Transfer Model Error Corrections	0
4.	Correction to Heat Transfer Node Initialization	0
5.	Mass Conservation Error Fix	0
6.	Correction to Split Channel Momentum Equation	0
7.	Heat Transfer Logic Correction for Rod Burst Calculation	0
8.	Changes to Vessel Superheated Steam Properties	0
9.	Update to Metal Density Reference Temperatures	0
10.	Decay Heat Model Error Corrections	0
11.	Correction to the Pipe Exit Pressure Drop Error	0
12.	WCOBRA/TRAC U19 File Dimension Error Correction	0
13.	Revised Heat Transfer Multiplier Distributions	-7
14.	HOTSPOT Burst Strain Error Correction	51

15.	Changes to Grid Blockage Ratio and Porosity	0
16.	Grid Heat Transfer Enhancement Calculation	0
17.	Vessel Section 7 Mid-Level Elevation Modeling	0
18.	Burst Elevation Selection	0

D. Other

1.	None	0

LICENSING BASIS PCT + PCT ASSESSMENTS	**PCT =**	**2081**