Stephen A. Byrne
Senior Vice President, Nuclear Operations
803.345.4622

SCE&G®
A SCANA COMPANY

June 7, 2001
RC-01-0116

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

Gentlemen:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
ECCS EVALUATION MODEL REVISIONS ANNUAL REPORT

Attached is the 2001 Emergency Core Cooling System (ECCS) Evaluation Model Revisions Annual Report for the Virgil C. Summer Nuclear Station (VCSNS). This report is being submitted pursuant to 10CFR50.46, which requires licensees to notify the NRC on at least an annual basis of corrections to or changes in the ECCS Evaluation Models.

I declare that the statements and matters set forth herein are true and correct to the best of my knowledge, information, and belief.

If you have any questions, please call Mr. Jeffrey W. Pease at (803) 345-4124.

Very truly yours,

Stephen A. Byrne

JWP/SAB/dr
Attachment

c: N. O. Lorick
N. S. Carns
T. G. Eppink (w/o attachment)
R. J. White
L. A. Reyes
K. R. Cotton

K. M. Sutton
NRC Resident Inspector
NSRC
RTS (O-L-99-0152)
File (818.02-17, RR 8375)
DMS (RC-00-0116)

A001

STATE OF SOUTH CAROLINA :
: **TO WIT** :
COUNTY OF FAIRFIELD :

I hereby certify that on the 7th day of June 2001, before me, the subscriber, a Notary Public of the State of South Carolina personally appeared Stephen A. Byrne, being duly sworn, and states that he is the Senior Vice President, Nuclear Operations of the South Carolina Electric & Gas Company, a corporation of the State of South Carolina, that he provides the foregoing response for the purposes therein set forth, that the statements made are true and correct to the best of his knowledge, information, and belief, and that he was authorized to provide the response on behalf of said Corporation.

WITNESS my Hand and Notarial Seal

Jeffrey W. Penn
Notary Public

My Commission Expires

July 26, 2005
Date

CHANGES TO THE WESTINGHOUSE ECCS EVALUATION MODELS

INTRODUCTION

Provisions in 10 CFR 50.46 require the annual reporting of corrections to or changes in the ECCS Evaluation Model (EM) approved for use in performing safety analyses for the Loss of Coolant Accident (LOCA). This report describes corrections and revisions to the Westinghouse ECCS EM which are applicable to the V. C. Summer Nuclear Station (VCSNS). The current approved Westinghouse ECCS EMs are listed in Table 1 and consist of several computer codes with specific functions.

Westinghouse has completed the evaluation of several items related to the Westinghouse ECCS EM listed in Table 1. Table 2 lists changes or corrections to each of these items. These changes or corrections consist of non-discretionary changes with PCT impacts, non-discretionary changes without PCT impacts, and enhancements/ forward fit discretionary changes as described in WCAP-13451. Generic overviews, prepared by Westinghouse, for each of the Table 2 items are also included.

Tables 3 and 4 summarize the changes or corrections in the ECCS Evaluation Model since the last notification and the associated change in the peak clad temperature (PCT). Non-discretionary changes with no PCT impact are not included. None of the year 2000 model changes are considered significant under 10 CFR 50.46.

Table 5 summarizes the changes made to the ECCS Evaluation Model under 10 CFR 50.59, and Table 6 summarizes the supporting references for this annual report.

TABLE 1

SUMMARY OF WESTINGHOUSE

ECCS EVALUATION MODELS

FOR VCSNS

NAME: 1981 MODEL WITH BASH

APPLICATION: Analysis of Large Break LOCA

CODES USED:	PURPOSE:
SATAN-VI	Blowdown hydraulic transient
BASH	Reflood hydraulic transient
LOCBART	Hot assembly thermohydraulics and fuel rod thermal transient
WREFLOOD/COCO/LOTIC	Containment pressure transient

NAME: 1985 SBLOCA MODEL

APPLICATION: Analysis of Small Break LOCA

CODES USED:	PURPOSE:
NOTRUMP	System Hydraulic transient
SBLOCTA	Fuel rod thermal transient

TABLE 2

CHANGES OR CORRECTIONS TO THE VIRGIL C. SUMMER

NUCLEAR STATION ECCS EVALUATION MODELS

NOT PREVIOUSLY REPORTED

NON-DISCRETIONARY CHANGES WITH PCT IMPACT

LOCBART Cladding Emissivity Errors
LOCBART Vapor Film Flow Regime Heat Transfer Error
LOCBART Dispersed Flow Regime Wall Emissivity Error
NOTRUMP Mixture Level Tracking/Region Depletion Errors

NON-DISCRETIONARY CHANGES WITH NO PCT IMPACT

BASH Isotherm Initialization Error
BASH Implementation of LOCBART Corrections
Inadequately Dimensioned Core Reflux Flow Link Error in NOTRUMP
LOCBART Rod-to-Rod Radiation Error
LOCBART NUREG-0630 Coding Errors
LOTIC2 Nitrogen Addition Logic Error
LOTIC2 Time Step Logic Error
NOTRUMP Core Heat Transfer Error
SATAN6 Momentum Flux Logic Error
SATAN6 Reactor Coolant Pump Logic Error
Large Break LOCA Single Failure Assumption

ENHANCEMENTS/FORWARD-FIT DISCRETIONARY CHANGES

Simplified Isothermal Solution for LOCBART Subroutine RATE
PAD 4.0 Implementation
LOCBART Rod Internal Pressure Model Revisions
Improved Code I/O and Diagnostics, and General Code Maintenance

LOCBART CLADDING EMISSIVITY ERRORS

Background

Section 2-17 of Reference 1, Section 3.2.5 of Reference 2, and Section 3-2 of Reference 3 describe expressions that are used to model radiation heat exchange between the rod, grid, and fluid during the reflood phase of the transient. It was discovered that the cladding surface emissivity values used with Equation 2-93 of Reference 1, Equation 3-47 of Reference 2, and Equation 3-8 of Reference 3 were substantially lower than the values that would be expected to exist during a large break LOCA reflood transient. A review of existing documentation was inconclusive as to the exact values that were intended for use with the equations, so a constant, representative value of 0.7 was used, based on the value used in WCOBRA/TRAC for a similar application (Reference 4). These errors were determined to be a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the LOCBART code showed that these error corrections generally result in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small PCT benefit or penalty for other plants. The generic PCT assessments for this issue were derived from the representative plant calculations as the bounding values for each of the two plant/transient categories (i.e. early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose.

References

1. WCAP-9561 -P-A, "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients", M. Young, et al., March 1984.
2. WCAP-7437-L, "LOCTA-R2 Program: Loss of Coolant Transient Analysis", W.A. Bezella, et al., January 1970.
3. WCAP-10484-P-A, "Spacer Grid Heat Transfer Effects During Reflood", M. Young, et al., March 1991.
4. WCAP-12945-P-A Volume I (Revision 2) and Volumes II-V (Revision 1), "Westinghouse Code Qualification for Best Estimate Loss of Coolant Accident Analysis", S.M. Bajorek, et al., March 1998.

LOCBART VAPOR FILM FLOW REGIME HEAT TRANSFER ERROR

Background

As discussed in Reference 1, the Berenson model for film boiling is used in LOCBART to compute the cladding-to-fluid heat transfer coefficient for conduction across the vapor film in the vapor film flow regime, which occurs near the quench front and is assumed to consist of a conduction component and a radiation component. An error was discovered in LOCBART whereby the multiplier on this correlation was programmed incorrectly, resulting in a relatively minor underprediction of the cladding-to-fluid heat transfer coefficient. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the LOCBART code showed that this error correction generally results in a small-to-moderate PCT benefit for plants with burst-node-limited PCTs occurring coincident with the onset-of-entrainment in reflood and a small PCT benefit or penalty for other plants. The generic PCT assessments for this issue were derived from the representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-PCT, burst-node-limited plants and other plants) that were defined specifically for this purpose.

Reference

1. WCAP-9561 -P-A, "BART-Al: A Computer Code for the Best Estimate Analysis of Reflood Transients", M.Y. Young, et al., March 1984.

LOCBART DISPERSED FLOW REGIME WALL EMISSIVITY ERROR

Background

As discussed in Section 2-18 of Reference 1, the Sun, Gonzalez, and Tien model is used in LOCBART to predict radiant heat exchange between the fuel rod, vapor, and droplets in the dispersed flow regime. An error was discovered in LOCBART whereby the wall emissivity in the dispersed flow regime was substantially lower than the corresponding value identified in Section 2-18 of Reference 1. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the LOCBART code showed that this error correction generally results in a small PCT benefit for plants with PCTs occurring early in reflood and a small-to-moderate PCT benefit for plants with PCTs occurring late in reflood. The generic PCT assessments for this issue were derived from the representative plant calculations as the bounding values for each of the two plant/transient categories (i.e., early-reflood - PCT plants and late-reflood - PCT plants) that were defined specifically for this purpose.

Reference

1. WCAP-9561 -P-A, "BART-Al: A Computer Code for the Best Estimate Analysis of Reflood Transients", M.Y. Young, et al., March 1984.

NOTRUMP – MIXTURE LEVEL TRACKING/REGION DEPLETION ERRORS

Background

Several closely related errors have been discovered in how NOTRUMP deals with the stack mixture level transition across a node boundary in a stack of fluid nodes. Firstly, when the mixture level attempts to transition a node boundary in a stack of fluid nodes, it can occasionally have difficulty crossing the interface (i.e., level hang). When a mixture level hang occurs at a node boundary, this leads to situations where the flow for a given time step is reset and becomes inconsistent with the matrix solution of the momentum equation for an excessive period of time. This results in local mass/energy errors being generated. In addition, it was discovered that the code was not properly updating metal node temperatures as a result of the implementation of the nodal region depletion logic which can be incurred when a fluid node empties or fills. It is noted that several aspects of these errors, namely mixture level tracking and flow resets, are not directly tied to erroneous coding; rather, they are a direct result of modeling choices made and documented in the original code development/licensing. These errors affect all code versions up to and including NOTRUMP Version 37.0. These error corrections were determined to contain both Discretionary and Non-Discretionary Change aspects in accordance with Sections 4.1.1 and 4.1.2 of WCAP-13451.

Affected Evaluation Model

1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of this error leads to a bounding 13°F increase of the calculated PCT for all standard EM applications.

References

1. NSBU-NRC-00-5972, "NRC Report for NOTRUMP Version 38.0 Changes", (Non--Proprietary), June 30, 2000.

BASH ISOTHERM INITIALIZATION ERROR

Background

As discussed in Section 3-6 of Reference 1, the quench front progression in BART is computed using the isotherm migration method. An error was discovered in BASH whereby a variable was not being initialized for cases where a user entered the initial isotherm temperatures and elevations into the BASH input file, instead of letting the code calculate the initial isotherms internally. This error existed in BASH Versions 18.0 and 19.0. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

A survey of BASH-EM analyses under Westinghouse Pittsburgh LBLOCA analysis cognizance found no usage of the erroneous option which is not accessed for standard production applications. As a result, the correction of this error is treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

Reference

1. WCAP-9561-P-A, "BART-A1: A Computer Code for the Best Estimate Analysis of Reflood Transients", M.Y. Young, et al., March 1984.

BASH IMPLEMENTATION OF LOCBART CORRECTIONS

Background

Since BART coding is used in both LOCBART and BASH, the following changes described elsewhere in this report have also been implemented into BASH for consistency:

- LOCBART Cladding Emissivity Errors
- LOCBART Vapor Film Flow Regime Heat Transfer Error
- LOCBART Dispersed Flow Regime Wall Emissivity Error

These changes were determined to be a closely-related group of Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the BASH code showed that these error corrections had a relatively minor effect on the core inlet flooding rate during reflood, which in turn would be expected to have a negligible effect on PCT. As a result, these corrections are being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

INADEQUATELY DIMENSIONED CORE REFLUX FLOW LINK ERROR IN NOTRUMP

Background
An error has been discovered which results in the termination of the NOTRUMP code when attempting to model more than 12 active core nodes. The problem results from an inadequately defined maximum number of core reflux flow links in the code externals. The nature of the error is such that code execution can not be performed when attempting to model more than 12 core nodes due to compiler options selected. This problem only exists in the NOTRUMP Version 37.0 code. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1985 Westinghouse Small Break LOCA Evaluation Model

Estimated Effect
The nature of this error leads to no PCT impact for all EM applications due to the core modeling assumed in these models (i.e. <= 12 core nodes).

LOCBART ROD-TO-ROD RADIATION ERROR

Background

An error was discovered in LOCBART whereby a variable was not being defined for the rod-to-rod radiation calculations. This error caused the radiation heat flux for the hot rod to be calculated incorrectly and caused the radiation heat flux for the adjacent rod to be zero. This error is present only in LOCBART Version 20.0. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the LOCBART code showed that this error correction had a negligible effect on results. As a result, this correction is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

LOCBART NUREG-0630 CODING ERRORS

Background
The following errors were discovered in the LOCBART code related to the programming of the NUREG-0630[1] burst and blockage models for Zircaloy-4 cladding:

1. In Subroutine FBLOK, the assembly blockage corresponding to a burst temperature of 700°C (1292°F) and a temperature ramp rate of 25°C/s (45°F/s) was programmed as 13.6%, instead of the correct value of 13.8% from page 112 of Reference 1.

2. In Subroutine XPAND, the burst temperature corresponding to a burst strain of 48% (for a temperature ramp rate of 10°C/s or 18°F/s) or 45% (for a temperature ramp rate of 25°C/s or 45°F/s) was programmed as 1675°F, instead of the correct value of 1652°F (900°C) from pages 111 and 112 of Reference 1.

As discussed below, it was determined that correcting these errors would either have no effect on results or would be expected to result in a small PCT benefit, so LOCBART updates will be deferred to a future code release. When corrected, these error corrections will represent Non-Discretionary Changes in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect
The error in Subroutine FBLOK affects the calculation of assembly blockage for Zircaloy-4 cladding over the burst temperature range of 1247-1337°F, which is substantially lower than the burst temperatures that are encountered in typical licensing calculations. For a hypothetical case with a burst temperature in the affected range, the difference in assembly blockage is very small and would be expected to have a negligible effect on results.

The error in Subroutine XPAND affects the calculation of burst strain for Zircaloy-4 cladding over the burst temperature range of 1607-1697°F. It was determined that correcting the error would either have no effect on results or would result in a small reduction in burst strain, which would be expected to result in a small decrease in PCT with all other things being equal.

Based on the preceding information, these error corrections will be deferred to a future code release and are treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

Reference
NUREG-0630, "Cladding Swelling and Rupture Models for LOCA Analysis", R. O. Meyer and D. A. Powers, April 1980.

LOTIC2 NITROGEN ADDITION LOGIC ERROR

Background

LOTIC2 calculates the minimum containment backpressure during a large break LOCA transient for plants with an ice condenser containment design. When the accumulators empty, the nitrogen cover gas is released into containment. An error was discovered whereby some of the nitrogen was being released to the upper compartment, instead of correctly being released entirely to the lower compartment. The nitrogen addition logic was corrected to force all nitrogen releases into the lower compartment. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect

Representative plant calculations using the LOTIC2 code showed that this error correction had a negligible effect on containment pressure, which in turn would have a negligible effect on PCT. As a result, this correction is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

LOTIC2 TIME STEP LOGIC ERROR

Background
An error was discovered in LOTIC2 whereby the transient time was being adjusted twice in a typical time step, which led to negative time step sizes under certain conditions. The time step logic was modified to force the transient time to change only once per time step, which eliminates the occurrence of negative time step sizes. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model

Estimated Effect
Representative plant calculations using the LOTIC2 code showed that this error correction had a very minor effect on containment pressure, which in turn would have a negligible effect on PCT. As a result, this correction is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

NOTRUMP CORE HEAT TRANSFER ERROR

Background
An error has been discovered in NOTRUMP which results in either a code abort or the usage of invalid steam table properties and/or heat transfer correlations in the core region under certain conditions. The problem results from the steam cooling core heat transfer correlation attempting to pass sub-cooled properties to steam property routines. Since the property routines do not perform input validity checking, this can result in erroneous properties being returned/utilized by the correlation. This error can only occur when complete subcooling of the core cladding occurs in conjunction with core uncovery. This error affects all code versions up to and including NOTRUMP Version 37.0. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models
1985 Westinghouse Small Break LOCA Evaluation Model

Estimated Effect
The nature of this error leads to no PCT impact for all standard EM applications due to the lack of this type of core uncovery process.

SATAN6 MOMENTUM FLUX LOGIC ERROR

Background

An error was discovered in the SATAN6 momentum flux logic whereby the sonic velocity limit was being applied incorrectly. In some instances, this caused the break flow to hang near the end of the blowdown transient, instead of allowing the calculation to proceed normally to the end of blowdown. The erroneous logic was corrected to ensure proper application of the sonic velocity limit. This error correction was determined to be a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the SATAN6 code showed that this error correction had a very minor effect on blowdown results for typical cases, which in turn would be expected to have a negligible effect on PCT. Even for a case with a more substantial effect on SATAN6 results, the effect on PCT was found to be small, due mainly to the fact that the core heatup near end-of-blowdown is essentially adiabatic. As a result, this correction is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

SATAN6 REACTOR COOLANT PUMP LOGIC ERROR

Background

An error was discovered in the SATAN6 reactor coolant pump logic where, during a time step in which the pump critical flow iteration failed to converge, the pump discharge mass flow rate was incorrectly reset to the value corresponding to the last iteration. This problem was resolved by removing the pump critical flow iteration from the code, since the corresponding logic was found to be of little use for standard licensing applications. This change was determined to contain both Discretionary and Non-Discretionary aspects in accordance with Sections 4.1.1 and 4.1.2, respectively, of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the SATAN6 code showed that these changes had either no effect or a negligible effect on blowdown results, which would be expected to have either no effect or a negligible effect on PCT. As a result, these changes are being reported as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

LARGE BREAK LOCA SINGLE FAILURE ASSUMPTION

Background

A concern was raised by a licensee whereby a single failure in the Solid State Protection System (or Relay Protection System for older plants) could cause the loss of an entire train of safety injection pumps, without causing the loss of the corresponding train of containment heat removal equipment. This situation is contrary to Section 3.6 of Reference 1, which defines the limiting single failure for Appendix K LBLOCA and SECY UPI LBLOCA analysis as the loss of a low pressure injection pump. To address this concern, the analysis guidance has been modified to direct the analyst to assume the loss of an entire train of safety injection pumps, unless a less conservative single failure assumption can be justified. This was determined to represent a Non-Discretionary Change in accordance with Section 4.1.2 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model

Estimated Effect

Recent LBLOCA analyses have generally assumed the loss of an entire train of safety injection pumps as the limiting single failure, since the additional conservatism introduced by this simplification is typically small. A survey of BART-EM and BASH-EM analyses under Westinghouse Pittsburgh LBLOCA analysis cognizance found no domestic applications in which the analyst assumed the loss of a low pressure injection pump as the limiting single failure. As a result, this change is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

Reference

1. WCAP-8471 -P-A, "The Westinghouse ECCS Evaluation Model: Supplementary Information", F. M. Bordelon et. al., April 1975.

SIMPLIFIED ISOTHERMAL SOLUTION FOR LOCBART SUBROUTINE RATE

Background

As discussed in Reference 1, LOCBART was revised in 1999 to correct a logic error that caused the Baker-Just metal-water reaction calculations to be performed three times per time step. During the review of the corresponding code logic, it was determined that the complicated solution technique described in Section 3.3.2 of Reference 2 could be replaced with a simplified isothermal solution, with only a minimal effect on results. This replacement has been accomplished and was determined to represent a Discretionary Change that will be implemented on a forward-fit basis, in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

Representative plant calculations using the LOCBART code confirmed that this change has a negligible effect on results that will be implemented on a forward-fit basis and is being treated as having a 0°F PCT effect for 10 CFR 50.46 reporting purposes.

References

1. Westinghouse Letter NSBU-NRC-00-5970, "1999 Annual Notification of Changes to the Westinghouse Small Break LOCA and Large Break LOCA ECCS Evaluation Models, Pursuant to 10 CFR 50.46 (a)(3)(ii)", H. A. Sepp, May 12, 2000.
2. WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis, F. M. Bordelon et. al., June 1974.

PAD 4.0 IMPLEMENTATION

Background

The Westinghouse Performance Analysis and Design Model (PAD) is used to generate fuel-related input data for use in LOCA licensing calculations. As documented in Reference 1, the Safety Evaluation Report for Version 4.0 of the PAD model was issued by the US NRC on April 24, 2000. Use of PAD Version 4.0 is considered to represent a Discretionary Change and will be implemented on a forward-fit basis, in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP
SECY UPI WCOBRA/TRAC Large Break LOCA Evaluation Model
1996 Westinghouse Best Estimate Large Break LOCA Evaluation Model
1999 Westinghouse Best Estimate Large Break LOCA Evaluation Model, Application to PWRs with Upper Plenum Injection

Estimated Effect

The implementation of PAD Version 4.0 with respect to Appendix K Large Break LOCA and Small Break LOCA analyses will be handled on a forward-fit basis and is assigned a PCT estimate of 0°F for 10 CFR 50.46 reporting purposes.

References

1. WCAP-1 5063-P-A Revision 1, with Errata, "Westinghouse Improved Performance Analysis and Design Model (PAD 4.0)", J. P. Foster and S. Sidener, July 2000.

LOCBART ROD INTERNAL PRESSURE MODEL REVISIONS

Background

In the original LOCTA-IV model[1], the gas in the rod plenum was assumed to remain at a constant, steady-state temperature throughout the entire transient. In order to more accurately track the rod internal pressure history during a Large Break LOCA transient, the use of this assumption in LOCBART has been replaced with the temperature-dependent model that was implemented previously in the SBLOCTA code, as described in Reference 2. In addition, other minor changes were made to the LOCBART rod internal pressure model, including an option to specify the volumes corresponding to the upper and lower annular blankets, and a simplified treatment of the crack and dish volumes. These changes were determined to represent a closely-related group of Discretionary Changes and will be implemented on a forward-fit basis, in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH

Estimated Effect

These changes will be implemented on a forward-fit basis and are assigned an estimated PCT impact of 0°F for 10 CFR 50.46 reporting purposes.

References

1. WCAP-8301, "LOCTA-IV Program: Loss-of-Coolant Transient Analysis", F. M. Bordelon et al., June 1974.
2. Westinghouse Letter NTD-NRC-94-4253, "Revision to the Rod Internal Pressure Model in the Westinghouse SBLOCTA Code (Proprietary)", N. J. Liparulo, August 9, 1994.

IMPROVED CODE I/O AND DIAGNOSTICS, AND GENERAL CODE MAINTENANCE

Background

Various changes in code input and output format have been made to enhance usability and help preclude errors in analyses. This includes both input changes (e.g. more relevant input variables defined and more common input values used as defaults) and input diagnostics designed to preclude unreasonable values from being used, as well as various changes to code output which have no effect on calculated results. In addition, various blocks of coding were rewritten to eliminate inactive coding, optimize the active coding, and improve commenting, both for enhanced usability and to facilitate code debugging when necessary. These changes were determined to be Discretionary Changes in accordance with Section 4.1.1 of WCAP-13451.

Affected Evaluation Models

1981 Westinghouse Large Break LOCA Evaluation Model
1981 Westinghouse Large Break LOCA Evaluation Model with BART
1981 Westinghouse Large Break LOCA Evaluation Model with BASH
1985 Westinghouse Small Break LOCA Evaluation Model with NOTRUMP

Estimated Effect

The nature of these changes leads to an estimated PCT impact of 0°F.

TABLE 3

Small Break Peak Clad Temperature Margin Utilization

Revision Date: 02/23/01

Plant Name: Virgil C. Summer Eval. Model: NOTRUMP Fuel: Vantage +
Utility Name: South Carolina Electric & Gas FQ=2.45 FΔH=1.62 SGTP=10%
Limiting Break Size = 2 inch

Note: Limiting Break Size shifted from 2 to 3 inch. [4,5]

		Reference *	Clad Temperature		Notes
A.	CURRENT ANALYSIS OF RECORD (2/94)	1	PCT=	1823°F	1
B.	PRIOR PERMANENT ECCS MODEL ASSESSMENTS (ΔPCT=107°F TOTAL)				
	1. LUCIFER Error Corrections	2	ΔPCT=	- 16°F	
	2. Effect of SI in Broker Loop	2	ΔPCT=	150°F	
	3. Effect of Improved Condensation Model	2	ΔPCT=	- 150°F	
	4. Axial Nodalization, RIP Model Revision and SBLOCTA Error Correction	3	ΔPCT=	96°F	
	5. Boiling HT Correlation Error	4	ΔPCT=	- 6°F	
	6. Steam Line Isolation Logic Error	4	ΔPCT=	18°F	
	7. NOTRUMP Specific Enthalpy Error	5	ΔPCT=	20°F	
	8. SALIBRARY Double Precision Error	5	ΔPCT=	- 15°F	
	9. SBLOCTA Fuel Rod Initialization Error	6	ΔPCT=	10°F	
C.	10 CFR 50.59 SAFETY EVALUATIONS	Table 5	ΔPCT=	44°F	5
D.	2000 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessment of PCT Margin)				
	1. NOTRUMP Mixture Level Tracking Region Depletion Errors	7	ΔPCT=	13°F	
E.	TEMPORARY ECCS MODEL ISSUES				
	1. None		ΔPCT=	0°F	
F.	OTHER MARGIN ALLOCATIONS				
	1. Burst and Blockage/Time in Life	7	ΔPCT=	245°F	2,3
	2. Margin Recovery (SI Performance Inputs Evaluation)	8	ΔPCT=	36°F	4
LICENSING BASIS PCT + MARGIN ALLOCATIONS				**PCT=2196°F**	

* References for the Peak Clad Temperature Margin Utilization summary can be found in Table 6.

Notes:

1. AOR performed for core power = 2900 MWt and Delta-75 steam generators.
2. This assessment is a function of base PCT plus permanent margin allocation and as such will increase/decrease with margin allocation changes.
3. Value includes previous Burst and Blockage/Time in Life penalty SPIKE Correlation Revision penalty (1999 Annual Report), and consideration of a new penalty due to item C.1 (NOTRUMP Mixture Level Tracking / Region Depletion Errors).
4. The Margin Recovery (SI Performance Evaluation) resulted in a 36°F PCT benefit. Note that the evaluation considered the 2 inch and 3 inch break and resulted in the limiting break equivalent diameter to remain shifted from 2 inch to 3 inch break.
5. The SBLOCA evaluation for increased accumulator pressure and water volume uncertainties causes the limiting break equivalent diameter to shift from 2-inch to 3-inch. See Table 5.

TABLE 4

Large Break Peak Clad Temperature Margin Utilization

Revision Date: 02/23/01

Plant Name: Virgil C. Summer
Utility Name: South Carolina Electric & Gas

Eval. Model: BASH FQ=2.40 FΔH=1.62
Limiting Break Size: Cd = 0.4

Fuel: Vantage + SGTP=10%

Note: AOR was done with FQ=2.50 and FΔH=1.70

		Reference *	Clad Temperature		Notes
A.	CURRENT ANALYSIS OF RECORD (10/95)	10	PCT=	2099°F	1
B.	PRIOR PERMANENT ECCS MODEL ASSESSMENTS (ΔPCT=63°F TOTAL)				
	1. SI Error (Plant Specific) Reanalysis	11	ΔPCT=	- 90°F	1,2
	2. Accumulator Line/Pressurizer Surge Line Data, LOCBART Spacer Grid Single Phase Heat Transfer Error, LOCBART Zirc-Water Oxidation Error, and Reanalysis of Limiting AOR Case	11	ΔPCT=	153°F	1,3
C.	10 CFR 50.59 SAFETY EVALUATIONS	Table 5	ΔPCT=	0°F	
D.	2000 10 CFR 50.46 MODEL ASSESSMENTS (Permanent Assessment of PCT Margin)				
	1. LOCBART Vapor Film Flow Regime Heat Transfer Error	12	ΔPCT=	-15°F	
	2. LOCBART Cladding Emissivity Errors	13	ΔPCT=	-10°F	
E.	TEMPORARY ECCS MODEL ISSUES				
	1. None		ΔPCT=	0°F	
F.	OTHER MARGIN ALLOCATIONS				
	A. None		ΔPCT=	0°F	
LICENSING BASIS PCT + MARGIN ALLOCATIONS			**PCT =**	**2137°F**	

* References for the Peak Clad Temperature Margin Utilization summaries can be found in Table 6.

Notes:

1. AOR is for Delta-75 steam generators and core power of 2900 MWt.
2. This plant specific reanalysis addressed the correction of Safety Injection Performance Inputs. These results incorporated the SATAN/LOCTA Fluid Conditions Translation Error (reported previously) and the Accumulator Pressure and Water Volume Uncertainties Evaluation (reported previously). So these PCT penalties are no longer applicable. IFBA fuel is limiting compared to non-IFBA fuel.
3. This reanalysis was based on the SI Error reanalysis. It modeled a reduction in FQ from 2.5 to 2.4, a reduction in FdH from 1.7 to 1.62, and a reduction P-bar-HA from 1.514 to 1.443. It also addressed the following issues: Accumulator Line/Pressurizer Surge Line Data, LOCBART Spacer Grid Single-Phase Heat Transfer Error, and LOCBART Zirc-Water Error. IFBA fuel is limiting compared to non-IFBA fuel.

TABLE 5

TABLE 5A - 10 CFR 50.59 Safety Evaluations

Revision Date: 09/29/99

Plant Name: Virgil C. Summer
Utility Name: South Carolina Electric & Gas

	Reference	Clad Temperature		Notes
I. SMALL BREAK ECCS SAFETY EVALUATIONS				
A. Increased Accumulator Pressure and Water Volume Uncertainties	14	ΔPCT=	34°F	1,2
B. Annular Axial Blankets	14	ΔPCT=	10°F	2
C. Main Feedwater Temperature Increase	15	ΔPCT=	0°F	
TOTAL 10 CFR 50.59 SMALL BREAK ASSESSMENTS		**PCT=44°F**		
II. LARGE BREAK ECCS SAFETY EVALUATIONS				
A. None		ΔPCT=	0°F	
TOTAL 10 CFR 50.59 LARGE BREAK ASSESSMENTS		**PCT= 0°F**		

Notes:

1. The SBLOCA evaluation for increased accumulator pressure and water volume uncertainties caused the limiting break equivalent diameter to shift from 2-inch to 3-inch. The 34°F value does not include the effect on SBLOCA burst/blockage behavior.
2. Previously reported.

TABLE 6 - References

1. CGE-93-0054-SGUL, "SECL-93-036, Rev. 1," March 9, 1994.
2. CGE-94-205, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Notification and Reporting Information," February 8, 1994.
3. CGE-94-228, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, SBLOCTA Axial Nodalization," October 27, 1994.
4. CGE-95-201, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Notification and Reporting Information," February 3, 1995.
5. CGE-96-202, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Notification and Reporting," February 9, 1996.
6. CGE-96-213, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Small Break LOCA Notification and Reporting," July 8, 1996.
7. CGE-00-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Appendix K (BART/BASH/NOTRUMP) Evaluation Model, Mid-Year Notification and Reporting for 2000," June 30, 2000.
8. CGE-00-006, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Notification and Reporting for 1999," February 25, 2000.
9. CGE-98-037, "Safety Evaluation for Increased Pressure and Level Uncertainties", October 15, 1998.
10. CGE-95-0009-SGUL, "Revised Large Break LOCA Results for Uprating Submittal," October 24, 1995.
11. CGE-99-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 BART/BASH Evaluation Model, Mid-Year Notification and Reporting for 1999," September 17, 1999.
12. CGE-00-044, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Appendix K (BART/BASH/NOTRUMP) Evaluation Model, Mid-Year Notification and Reporting for 2000", June 30, 2000.
13. CGE-00-112, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 BART/BASH Evaluation Model Mid-Year Notification and Reporting for 2000," December 2000.
14. CGE-99-008, "South Carolina Electric and Gas Company, Virgil C. Summer Nuclear Station, 10 CFR 50.46 Notification and Reporting for 1998," March 5, 1999.
15. CGE-00-063, "Safety Evaluation for Increased Main Feedwater Temperature (SECL-00-118)," August 25, 2000.