Exelon Generation®

Kenneth F. Robinson
Manager-Engineering Services

Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby, MD 20657

410 495 5208 Office
443 532 5709 Mobile
www.exeloncorp.com

ken.robinson@exelon.com

10 CFR 50.46

April 23, 2014

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

Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 and 2; Docket Nos. 50-317 and 50-318
Facility Operating License Nos. DPR-53 and DPR-69

Subject: 10 CFR 50.46 30-day Report for Changes to the Emergency Core Cooling System Performance Analysis

This letter is submitted pursuant to 10 CFR 50.46(a)(3)(ii) to provide notification of a significant change to the peak cladding temperature analysis result for the small break loss-of-coolant accident (SB LOCA) analysis. Because the effect on the SB LOCA peak cladding temperature of the analysis error is greater than 50°F from the temperature calculated for the limiting transient using the last acceptable model, the analysis error qualifies as significant as defined in 10 CFR 50.46(a)(3)(i) and, consequently, is provided in Attachment (1).

The results of the SB LOCA analysis conforms to the Emergency Core Cooling System acceptance criteria of 10 CFR 50.46(b). The analysis vendor, AREVA, informed Calvert Cliffs on April 7, 2014 of an error in the approved methodology which results in this reportable condition. Attachment (2) contains the results of the change in the peak cladding temperature.

There are no regulatory commitments contained in this letter.

Should you have questions regarding this matter, please contact Mr. Douglas E. Lauver at (410) 495-5219.

Respectfully,

FOR

Kenneth F. Robinson
Manager-Engineering Services

KFR/PSF/bjd

Attachment: (1) 10 CFR 50.46 – 30 Day Report
(2) AREVA Supporting Document

A002
NRR

cc: NRC Project Manager, Calvert Cliffs
NRC Regional Administrator, Region I
NRC Resident Inspector, Calvert Cliffs
S. Gray, MD-DNR

ATTACHMENT (1)

10 CFR 50.46 – 30 DAY REPORT

Calvert Cliffs Nuclear Power Plant, LLC
April 23, 2014

INTRODUCTION

This letter is submitted pursuant to 10 CFR 50.46(a)(3)(ii) to provide notification of a significant change to the peak cladding temperature analyses small break loss-of-coolant accident (SB LOCA) analysis.

Because the effect on the peak cladding temperature of the analysis error is greater than 50°F from the temperature calculated for the limiting transient using the last acceptable model, the analysis error qualifies as significant as defined in 10 CFR 50.46(a)(3)(i) and, consequently, is provided below.

The analysis error also exists in the Large Break LOCA (LB LOCA) Evaluation Model, however the impact of the error on that analysis is 0°F, and is therefore not significant.

REFERENCE ANALYSES

SB LOCA

The Calvert Cliffs Units 1 and 2 SB LOCA analysis was performed with the AREVA Evaluation Model approved in Reference 1.

An error was discovered in that the correlation for vapor absorptivity used in S-RELAP5 was being applied outside of its intended range of applicability (no limit was imposed on the pressure at which the correlation was applied). The equation used for the absorption coefficient of vapor contains the term of the pressure which needs to be truncated in order to obtain the correct emissivity values for an optically thick steam. Correction of this error is expected to result in an absolute change in peak clad temperature from the prior analysis of record of greater than 50°F. The peak clad temperature results are provided in Table 1.

An error that exists in the model was previously reported in Reference 2. The assessment of the previously reported error and the error reported herein against the analysis results approved in Reference 1 is shown below. Note that the Calvert Cliffs SB LOCA analysis of record has significant margin to the peak clad temperature limit of 2200°F.

Table 1, AREVA SB LOCA PCT Analysis Results

Item	PCT, °F
Analysis of Record	1,626
S-RELAP5 Sleisher-Rouse correlation (previously reported)	+69
S-RELAP5 vapor absorptivity correlation	+63
Total	1758

SCHEDULE

The approved method for performing SB LOCA analyses is EMF-2328, Revision 0. AREVA has updated this topical report and submitted EMF-2328, Revision 0, Supplement 1 to the Nuclear Regulatory Commission in March, 2012, with an expected approval date of January, 2015. Calvert Cliffs SB LOCA analysis could be re-analyzed to include the correction of the previously reported Sleisher Rouse correlation error and the latest vapor absorptivity correlation error following that approval with a target schedule approximately six months later.

REFERENCES

1. Letter from Mr. D. V. Pickett (NRC) to Mr. G. H. Gellrich (CCNPP), dated February 18, 2011, Amendment re: Transition from Westinghouse Nuclear Fuel to AREVA Nuclear Fuel
2. Letter from Mr. J. J. Stanley (CCNPP) to Document Control Desk (NRC), dated January 19, 2012, 10 CFR 50.46 30-day Report for Changes to the Emergency Core Cooling System Performance Analysis

ATTACHMENT (2)

AREVA Supporting Document

Calvert Cliffs Nuclear Power Plant, LLC
April 23, 2014

While preparing an update of the boiling water reactor (BWR) loss-of-coolant accident (LOCA) Appendix K methodology using S-RELAP5, the THTF level swell assessment for BWR was reviewed for rod wall temperatures and determined to be non-conservative relative to the data. The observation was unexpected since other assessments (including the THTF steady-state and reflood tests) showed good or conservative agreement. The issue was discovered as part of a proactive response to discussions with Nuclear Regulatory Commission. The THTF facility, operated by Oak Ridge National Labs, is a large high pressure thermal-hydraulic loop with non-nuclear (electrically heated) rods simulating a nuclear fuel bundle. The facility is designed to simulate the thermal hydraulic environments expected during small break (SB) LOCA events. Some of the phenomena simulated are applicable as well to the pressurized water reactor large break (LB) LOCA.

Further investigation found that the correlation for vapor absorptivity used in S-RELAP5 was being applied outside of its intended range of applicability (no limit on the pressure at which the correlation was applied).

The vapor absorptivity correlation applied to the S-RELAP5 based methodologies is provided in the S-RELAP5 Models and Correlation Code Manual (Reference 1), pg. 4-41. The equation used for the absorption coefficient of vapor contains the term of the pressure which needs to be truncated in order to obtain the correct emissivity values for an optically thick steam. The applicability of the pressure limit is described in literature by S.S. Penner (Reference 2). No lower pressure limit on the vapor absorptivity correlation is required as the correlation is developed for optically thin gases, which already applies at low pressures.

Results show that limiting the vapor absorptivity correlation to within its intended pressure range allows S-RELAP5 to predict the wall temperatures for THTF within the uncertainty bands or above the uncertainty bands (conservative).

A development version of S-RELAP5 was prepared containing the pressure limit for the calculation of the vapor absorptivity in order to assess the impact on the current analysis of record (AOR) for the SB LOCA. The peak cladding temperature (PCT) increase was developed by comparing the AOR after the Sleicher-Rouse error correction with the new PCT results obtained with the corrected version of S-RELAP5. The limiting case and multiple break sizes around the limiting case were rerun with the developmental code version of S-RELAP5.

The estimated impact of this change on the Calvert Cliffs Unit 1 and 2 SB LOCA analysis calculated PCT is +63°F, leading to a new calculated PCT of 1758°F.

For the realistic large break (RLB) LOCA, single phase steam only exists for a very limited time just before the beginning of reflood. During the majority of the blowdown phase and during the entire reflood phase, which are the important RLB LOCA phases, the core is in a dispersed flow regime. The S-RELAP5 methodology uses the FLECHT-SEASET reflood tests to determine the heat transfer bias and uncertainty under these conditions. In addition, the transient progression is very quick and the system depressurizes in the first few seconds after the break opening. Due to the fast depressurization, the amount of time that the correlation for vapor absorptivity used in RLB LOCA is applied outside of the range of applicability is limited and therefore the results predicted in the AOR remain valid.

The estimated impact of this change on the Calvert Cliffs Unit 1 and 2 RLB LOCA analysis calculated PCT is 0°F.

Table 1, Calvert Cliffs RLB LOCA PCT for ANP-2384-000 Report

Analysis	PCT (F)	Delta PCT (°F)	Year	Notes
Analysis of Record	1670		2009	September 2009
CR 2010-3095		0	2010	RLBLOCA & S-RELAP5 – FIJ Multiplier & Underpredicting Liquid Entrained to SG Tubes
CR 2011-1688		0	2011	RLBLOCA Upper Plenum Modeling
CR 2011-7155		+8	2011	S-RELAP5 Sleicher-Rouse correlation
CR 2012-2301		0	2012	Liquid fallback into surrounding 6 assemblies
CR 2012-8277		0	2012	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications
CR 2013-4230		+6	2013	S-RELAP5 routine associated with the RODEX3 fuel rod model in the code
CR 2012-8371		**0**	**2014**	**S-RELAP5 vapor absorptivity correlation**
Total Delta		+14		
Total	1684			

Table 2, Calvert Cliffs RLB LOCA PCT for ANP-3043-001 Report

Analysis	PCT (F)	Delta PCT (°F)	Year	Notes
Analysis of Record	1620		2011	December 2011
CR 2011-7155		+8	2011	S-RELAP5 Sleicher-Rouse correlation
CR 2012-8277		0	2012	Cathcart-Pawel Uncertainty Implementation in RLBLOCA Applications
CR 2013-4230		+6	2013	S-RELAP5 routine associated with the RODEX3 fuel rod model in the code
CR 2012-8371		**0**	**2014**	**S-RELAP5 vapor absorptivity correlation**
Total Delta		+14		
Total	1634			

Table 3, Calvert Cliffs SB LOCA PCT- ANP-2871-003

Analysis	PCT (F)	Delta PCT (°F)	Year	Notes
Analysis of Record	1626		2009	September 2009
CR 2011-7155		+69	2011	S-RELAP5 Sleicher-Rouse correlation
CR 2012-8371		**+63**	**2014**	**S-RELAP5 vapor absorptivity correlation**
Total Delta		+132		
Total	1758			

REFERENCES

1. AREVA Document EMF-2100(P), Rev. 16, "S-RELAP5 Models and Correlation Code Manual"
2. S.S. Penner, "Quantitative Molecular Spectroscopy and Gas Emissivities" Addison Wesley Publishing Company, Inc.