Reporting of 10 CFR 50.46 Margin Utilization
Small-Break LOCA

Plant Name: Shearon Harris Nuclear Power Plant, Unit 1
Utility Name: Carolina Power & Light Company

A. Analysis of Record[1]

1.	ECCS Analysis	PCT = 1946 °F
2.	Temperature & Pressure Uncertainties	PCT = + 60 °F
3.	RWST Temperature 125°F Assessment	PCT = + 5 °F
4.	Accumulator Volume	PCT = - 0 °F
5.	SI in the Broken Loop (ET-NRC-93-3971, CQL-93-221, CQL-93-225)	PCT = +150 °F
6.	Improved Condensation Model (ET-NRC-93-3971, CQL-93-221, CQL-93-225)	PCT = -150 °F
7.	Hot Assembly Average Rod Burst (CQL-94-206)	PCT = + 0 °F
8.	Revised Burst Strain Limit (CQL-94-206)	PCT = - 0 °F

B. LOCA Model Assessments[1]
(Permanent Assessment of PCT Margin)

1.	Containment Spray During Small Break LOCA (CQL-94-215)	ΔPCT = + 0 °F

C. 10CFR50.59 Safety Evaluations[1]
(Permanent Assessment of PCT Margin)

None — ΔPCT = + 0 °F

D. Current LOCA Model Assessments[1]
(Permanent Assessment of PCT Margin)

1.	Boiling Heat Transfer Correlation Factor (CQL-94-225)	ΔPCT = - 6 °F
2.	Steam Line Isolation Logic Error (CQL-94-225)	ΔPCT = + 18 °F
3.	Core Node Zirc Oxide Intitialization Error (CQL-94-225)	ΔPCT = + 0 °F
4.	Axial Nodalization, RIP Model Revision, and SBLOCTA Error Correction Analysis (CQL-94-228)	ΔPCT = +176 °F

E. Current Permanent PCT — PCT = 2199 °F

F. Current LOCA Model Issues (No PCT Assessments Made; Still Under Investigation)

None

[1] See attached discussion of the components of each category.

SBLOCA PCT COMPONENTS

A. Analysis of Record

1. Westinghouse letter 94-CQL-037, dated 3-31-94
   Evaluation Model: NOTRUMP, F_Q= 2.52, $F_{\Delta H}$= 1.73
   Fuel: Siemens
   SGTP = 15%
   Limiting break: 3", High T_{avg}

   The Westinghouse NOTRUMP Evaluation Model includes the following:

   a. WCAP-10054-P-A/WCAP-10081-NP-A, Lee, N., et. al., "W Small Break ECCS Evaluation Model Using the NOTRUMP Code," September, 1985.

   b. WCAP-10079-P-A/WCAP-10080-NP-A, Meyer, P.E., et. al., "NOTRUMP, A Nodal Transient Small Break and General Network Code," September 1985.

An initial ECCS analysis was performed by Westinghouse in accordance with the NOTRUMP Evaluation Model indicating a predicted SBLOCA PCT of 1946 °F. Westinghouse then made additional evaluations and added penalties to the results of the initial analysis as necessary to produce the final PCT as reported. The results of these evaluations are described as follows:

2. RCS Pressure and Temperature Uncertainties Penalty: The initial analysis was performed over a T_{avg} ranging from 572 to 589 °F and a nominal RCS pressure of 2250 psia. An evaluation was performed to consider the effect of the following RCS pressure and T_{avg} uncertainties:

   T_{avg}: -6.8, +5.3 °F Pressure: -50, +38 psi

   The evaluation considered a database of RCS pressure and RCS T_{avg} sensitivities. A total penalty of 60 °F was assigned.

3. RWST Temperature Assessment Penalty: The initial analysis assumed a value of 120 °F as the Maximum ECCS temperature. The Technical Specification value for this parameter is 125 °F. Westinghouse performed an evaluation based on existing sensitivities that has assigned a 5 °F PCT penalty.

4. Accumulator Volume: The initial analysis was performed at a nominal accumulator volume of 1015 ft^3. The actual Technical Specification nominal accumulator water volume is 1012 ft^3. Based on the actual transient results of the limiting case, the analysis results bound the corrected value.

5, 6. SI in the Broken Loop / Improved Condensation Model: These evaluations were initially reported as assessments to the PCT in an October 28, 1993 30 day report submitted by CP&L (HNP-93-852). They have been included in the current Analysis of Record as evaluations against the ECCS analysis. As such, the effect of the model changes has been treated as a penalty against the initial analyses. The net penalty, as originally reported, is zero. Additional discussion of the topic is provided in the referenced correspondence.

7, 8. Hot Assembly Average Rod Burst / Revised Burst Strain Limit: In determining the Hot Assembly Average Rod Burst Effects, the rod heatup code used in SBLOCA calculations contains a model to calculate the amount of clad strain that accompanies rod burst. However, the methodology which has historically been used is to not apply this burst strain model to the hot assembly average rod. This was done so as to minimize the rod gap and therefore maximize the heat transferred to the fluid channel, which in turn would maximize the hot rod temperature. However, due to mechanisms governing the zirc-water temperature excursion (which is the subject of the SBLOCA Limiting Time-in-Life penalty for the hot rod), modeling of clad burst strain for the hot assembly average rod can result in a penalty for the hot rod by increasing the channel enthalpy at the time of PCT. Therefore, the methodology has been revised such that burst strain will also be modelled on the hot assembly average rod. The Revised Burst Strain Limit Model which limit strains was incorporated into the rod heatup codes used in SBLOCA analysis as a compensating or offsetting effect to the Hot Assembly Average Rod Burst Effects. For cycle 5, the effect of each of these changes was +5°F and -5°F respectively. For cycle 6, the revised methods each have no impact, i.e., +0°F and -0°F respectively.

B. LOCA Model Assessments

1. Westinghouse Nuclear Safety Advisory Letter (NSAL-94-010F, CQL-94-215, dated May 16, 1994) indicated that the current Westinghouse SBLOCA Model does not address ECCS switchover and recirculation because it had been assumed that containment spray would not actuate during the event. Switchover to recirculation could potentially interrupt ECCS flow, cause a reduction in flow, and/or increase the enthalpy of the injected fluid at some Westinghouse plants. Westinghouse performed an evaluation specific to SHNPP and determined that the actuation of Containment Spray would occur after the time of the limiting PCT. Therefore, Westinghouse concluded no additional PCT penalty was warranted.

D. Current LOCA Model Assessments

1. Boiling Heat Transfer Correlation Errors

The mixture velocity for various boiling heat transfer regime correlations did not properly account for drift and slip effects. Also, a minor typographical error was corrected in the Westinghouse Transition Boiling Correlation. The net effect of these errors was to decrease PCT by 6 °F.

2. Steam Line Isolation Errors

A Main Steam Line Isolation model error resulted in a delay in the isolation time. The net effect of this error was to increase PCT by 18 °F.

3. Core Node Zirc Oxide Initialization Error

Errors in code logic resulted in early initialization of fuel region specific, cladding zirc oxide thicknesses. This error had no net impact on PCT.

4. SBLOCTA Axial Nodalizations

The SBLOCTA code is used to model the fuel rod response to the SBLOCA. In an effort to identify a bases for the nodalization scheme used in the SBLOCTA Core model, Westinghouse performed studies to judge the sensitivity of core responses to the the number and size of core axial nodes. The study indicated that the existing number of nodes modeled was inadequate in regions above which core uncovery might be expected. Westinghouse also implemented a revised model for computing the transient fuel rod internal pressure prior to performing any additional analysis to address the impact of the revised nodalization scheme. Re-analysis using the revised nodilization scheme and the revised model for computing the rod internal pressure resulted in net increase in PCT of 176 °F.