ENCLOSURE 4

MONTICELLO NUCLEAR GENERATING PLANT

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NUCLEAR MANAGEMENT COMPANY, LLC

MONTICELLO NUCLEAR GENERATING PLANT SAFER/GESTR ECCS-LOCA ANALYSIS – LPCI LOOP SELECTION DETECTABLE BREAK AREA

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Nuclear Management Company, LLC
Monticello Nuclear Generating Plant SAFER/GESTR ECCS-LOCA Analysis - LPCI Loop Selection Detectable Break Area

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The purpose of this document is to report the ECCS-LOCA analysis for the Monticello Nuclear Generating Station (Monticello) to support a change of the minimum detectable break area for the Low Pressure Core Injection (LPCI) Loop Selection Logic System. This evaluation involves the recalculation of the small break Loss-of-Coolant Accident (LOCA) assuming the failure of LPCI Loop Selection Logic System such that LPCI injects into the broken recirculation loop for all small breaks up to 0.4 ft^2. Furthermore, analysis is reported that determines the minimum pressure differential, which would need to be reliably measured, in order to assure accurate actuation of the LPCI Loop Selection Logic System for break sizes as low as 0.4 ft^2.

The analysis was performed with SAFER/GESTR, the evaluation model previously used for the ECCS-LOCA licensing basis analysis for Monticello. The analysis incorporated all updates and corrections to the evaluation model as have been identified to date. Specifically, methodology was applied to assess the affect of axial power shape on the small break ECCS-LOCA analysis results. Top-peaked power shapes assumed in small break cases had been identified as potentially resulting in a limiting case for peak cladding temperature. Since small breaks were analyzed to support the change in minimum detectable LPCI Loop Selection Logic System break area, calculations to confirm a bounding case, considering axial power shape condition, were included in the analysis.

2. SCOPE OF THE ANALYSIS

The most recent ECCS-LOCA analysis for Monticello is reported in Reference 1 to support the introduction of GE14 fuel in the Monticello core. At the conclusion of Cycle 23 (April 2007), the last remaining GE11 fuel bundles will be discharged. ECCS-LOCA analyses performed on the basis of GE14 fuel will then be applicable for all fuel bundles resident in operation at Monticello. The analysis reported in Reference 1 remains the valid basis for all DBA break size analyses and operating domains licensed for Monticello.

The analysis reported here is performed with the same bases, ECCS performance characteristics, plant and fuel design, as the Reference 1 analysis. A series of small break cases are re-calculated for this study, investigating ECCS response under the assumption that the minimum detectable break size of the LPCI Loop Selection Logic System is changed from the current 0.1 ft^2 requirement to 0.4 ft^2. Peak Cladding Temperature (PCT) is calculated for LOCA transients initiated by hypothetical small breaks, which range in size from 0.05 to 0.5 ft^2, applying assumptions consistent with Appendix K to 10CFR50. The PCT for the span of limiting break sizes is calculated with Nominal assumptions, as well.

Operation of the LPCI Loop Selection Logic System depends upon the capability of plant instrumentation to reliably measure the pressure differential between the recirculation loops. Establishment of a minimum detectable break size brings with it the requirement to set the corresponding loop pressure differential that must be reliably measured to support the LPCI loop selection. Based on a 0.4 ft^2 minimum detectable break area the pressure differential is calculated assuming both equal flow in the two recirculation loops as well as maximum allowed flow mismatch between the loops. This pressure differential defines a basis to set system requirements for implementing the revised minimum detectable break limit.

2.1. Acceptance Criteria

Reference 2 outlines the acceptance criteria for ECCS-LOCA analyses. A summary of the acceptance criteria follows:

Criterion 1 – Peak Cladding Temperature: The calculated maximum fuel element cladding temperature shall not exceed 2200 °F.

Criterion 2 – Maximum Cladding Oxidation: The calculated total local oxidation shall not exceed 0.17 times the total cladding thickness before oxidation.

Criterion 3 – Maximum Hydrogen Generation: The calculated total amount of hydrogen generated from the chemical reaction of the cladding with water or steam shall not exceed 0.01 times the hypothetical amount that would be generated if all the metal in the cladding cylinder surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react.

Criterion 4 – Coolable Geometry: Calculated changes in core geometry shall be such that the core remains amenable to cooling.

Criterion 5 – Long-Term Cooling: After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core.

Conformance of the ECCS-LOCA analyses with Criteria 1 through 3 for Monticello is presented in this report. As discussed in Reference 3, conformance with Criterion 4 is demonstrated by conformance to Criteria 1 and 2. The bases and demonstration of compliance with Criterion 5 are documented in Reference 3 and remain unchanged by application of SAFER/GESTR-LOCA.

2.2. Description of Models

Results of a LOCA event are found for Monticello by using standard General Electric Nuclear Energy (GENE) computer models as bases. Four computer models calculate features of the LOCA response – LAMB, TASC, GESTR-LOCA and SAFER. Together these models evaluate the initial fuel stored energy and fuel rod fission gas inventory, short-term and long-term reactor vessel blowdown response to a pipe rupture, the early boiling transition, or dryout, of the fuel, loss of water level in the core, the subsequent core flooding by the ECCS, and the final fuel rod heatup.

The full set of models have been applied and are cited generally as the basis for the complete ECCS-LOCA analysis spectrum, including DBA calculations of Reference 1, which form the licensing analysis basis for Monticello. Though all these models form the basis for a general ECCS-LOCA calculation, for the current analysis, only SAFER calculations are needed to model the ECCS operation for small breaks to implement the new minimum detectable break area limit.

The SAFER model calculates the long-term system response of the reactor over a complete spectrum of hypothetical break sizes and locations. SAFER is compatible with the GESTR-LOCA fuel rod model for gap conductance and fission gas release. SAFER calculates the core and vessel water levels, system pressure response, ECCS performance, and other primary thermal-hydraulic phenomena occurring in the reactor as function of time. SAFER realistically models all regimes of heat transfer that occur inside the core, and provides the PCT and the heat transfer coefficients (which determine the severity of the temperature change) as a function of time.

2.3. SAFER/GESTR Methodology

Compliance to Acceptance Criteria of Reference 2 is demonstrated by calculation of an Upper Bound (UB) PCT and Licensing Basis (LB) PCT, following the methodology of References 4 and 5. Calculations to define the plant-specific break spectrum are performed using nominal values for input. Calculation of the limiting PCT to demonstrate conformance with the requirements of Reference 2 must then include specific inputs and models documented in Appendix K of 10CFR50.

The Licensing Basis PCT is based on the most limiting LOCA (highest PCT) and is defined as:

$$PCT_{Licensing} = PCT_{Nominal} + ADDER$$

The adder is calculated as follows:

$$ADDER^2 = [PCT_{App.\,K} - PCT_{Nominal}]^2 + \Sigma\,(\delta PCT_i)^2$$

where:

$PCT_{App.\,K}$ = Peak cladding temperature from calculation using Appendix K specified models and inputs

$PCT_{Nominal}$ = Peak cladding temperature from nominal calculation

$\Sigma\,(\delta PCT_i)$ = Plant variable uncertainty term.

The plant variable uncertainty term accounts statistically for the uncertainty in parameters that are not specifically addressed by 10CFR50 Appendix K.

To conform to Reference 2 and the SAFER/GESTR-LOCA licensing methodology, the Licensing Basis PCT must be less than 2200 °F.

Conformance evaluation of the nominal PCT is also required through the use of a statistical Upper Bound PCT as defined in Reference 5. The Upper Bound PCT is a function of the Nominal PCT from the limiting break, modeling bias, and plant variable uncertainty. The Upper Bound PCT is defined as:

$$PCT_{Upper\ Bound} = PCT_{Nominal} + \Delta 4\text{-}max_{generic} + (\overline{\Delta 3} + 2s_{\Delta 3})$$

where:

$\Delta 4\text{-}max_{generic}$ = Modeling Bias. This term accounts for errors in modeling processes for which experimental data is available for comparison. These are primarily the LOCA thermal-hydraulic processes.

$(\overline{\Delta 3} + 2s_{\Delta 3})$ = Plant Variable Uncertainties. This term accounts for the uncertainties due to inputs to the model. These are typical plant parameters with associated uncertainties in their measured values.

The Upper Bound PCT is required to be less than the Licensing Basis PCT. This ensures that the Licensing Basis PCT is in all cases greater than the 95th percentile of the PCT distribution for the limiting case LOCA, and for all LOCAs within the design basis. As part of the development of SAFER/GESTR-LOCA licensing methodology, GENE demonstrated that this criterion was satisfied for the BWR/3-4 class of plants. The application methodology was also accepted on a generic basis for Upper Bound PCT up to 1600 °F. For Monticello, fuel and plant-specific evaluations, which are reported and discussed in Section 5, were performed to demonstrate conformance to these licensing criteria.

3. ANALYSIS ASSUMPTIONS

3.1. LPCI Failure Assumption

The LPCI Loop Selection Logic System is designed to identify which of the recirculation loops is ruptured in the event of a LOCA and direct the path of the LPCI flow to the intact loop. To do this, the LPCI Loop Selection Logic System compares pressure measured in each of the recirculation loops. For time periods immediately following a break, the pressure of the broken loop will be lower as the system blows down during the LOCA event. When the pressure difference criterion between the recirculation loops is satisfied, a signal is generated to open the LPCI injection valve and close the recirculation pump discharge valve for the higher pressure (intact) loop. The LPCI flow for Monticello is delivered into the discharge line of the recirculation loop. By directing LPCI flow into the intact recirculation loop by means of the LPCI injection valve and shutting off the recirculation pump discharge valve, LPCI has an intact flow path for travel to the vessel. None of the LPCI inventory will be lost out the break; all will be available for core cooling and reflooding, subject to the transient conditions, during a LOCA.

Performance requirements are imposed on the instrumentation with respect to its capacity to sense recirculation loop pressure difference. The pressure difference between recirculation loops for immediate times following a LOCA is a function of break size. For smaller breaks, the post-event pressure difference between the loops becomes correspondingly smaller. Below some minimum pressure difference, the instrumentation might not detect the break. When this occurs, the analysis conservatively assumes that LPCI Loop Selection Logic System selects the broken loop. The consequence is that some portion of the LPCI flow is diverted out the break and does not reach the vessel.

Previous Monticello ECCS-LOCA analysis assumed the LPCI Loop Selection Logic System was capable of selecting the intact recirculation loop for breaks down to 0.1 ft^2. The analyses presented in this report assume failure of the LPCI Loop Selection Logic System for all break sizes lower than the proposed minimum detectable break area of 0.4 ft^2. Therefore, calculation of the pressure differential between the loops corresponding to the 0.4 ft^2 break area provides a new basis for the instrumentation as to the required pressure difference it must reliably measure for the LPCI Loop Selection Logic System to perform its function.

Until the vessel has depressurized sufficiently after a LOCA event, break flow for small break areas is choked, flow rate determined by break size. The LPCI flow is modeled during this interim period assuming all the break flow comes from LPCI as its source. A portion of the LPCI flow, corresponding to the calculated choked flow, as a function of system pressure, is assumed lost out the break, leaving only a remaining fraction for delivery to the vessel and contributing to core cooling and recovery.

For break sizes below the minimum detectable break area, failure of the LPCI Loop Selection Logic System is assumed in addition to the limiting single failure, as required by regulation, for the analysis. The limiting single failure for the Monticello small break ECCS-LOCA analysis in Reference 1 is a battery failure. This limiting single failure is assumed consistently in the analyses presented in this report.

3.2. Licensing Criteria

The USNRC SER, approving the original SAFER/GESTR-LOCA Evaluation Model (Reference 4), imposed a restriction of 1600°F on the acceptable Upper Bound PCT calculation result for analyses using this methodology. The SER required additional supporting information to allow application of the methodology for Upper Bound PCT beyond this limit. In subsequent submittals, GENE provided this information on a generic basis. The Monticello plant, however, retains the restriction on the Upper Bound PCT and the 1600°F limit as its licensed analysis basis (Reference 5). PLHGR reduction has been applied in the Reference 1 analysis to comply with this restriction. The PLHGR reduction of 15% has been retained in the analysis presented in this report. An Upper Bound PCT based on the limiting small break case was calculated to demonstrate compliance to the 1600°F limit. In conformance with the methodology, a Licensing Basis PCT complying with the provisions of Appendix K is also calculated to show conformance to the Acceptance Criteria of 10CFR50.46, specifically the maximum allowable PCT of 2200°F. The results confirm the bounding nature of the Licensing Basis PCT with respect to the Upper Bound PCT.

3.3. Axial Power Shape

Evaluation model changes and errors discovered subsequent to the analysis of Reference 1 have been resolved in the analysis of these small break cases. Reference 6 identifies a recent change in methodology for small break ECCS-LOCA analyses with regard to the axial power shape assumed in the analysis. [[

]] This was investigated for Monticello. [[

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4. INPUT TO ANALYSIS

The plant operating conditions, used in this analysis, are presented in Table 1. The ECCS parameters remain consistent with Reference 1. The ECCS-LOCA analysis models and correlations used in this evaluation are also consistent those documented in Reference 1. Specific ECCS-LOCA analysis correlations for nominal and Appendix K analysis are restated in Table 2.

Table 1 Plant Operational Parameters

Plant Parameters	**Nominal**	**Appendix K**
Core Thermal Power (MWt)	1775	1810.5
Corresponding Power (% original rated)	100	102
Core Flow (Mlbm/hr)	57.6	57.6
Core Flow (% rated)	100	100
Vessel Steam Dome Pressure (psia)	1025	1040
ECCS Water Enthalpy (Temperature)	88 Btu/lbm (120°F)	88 Btu/lbm (120°F)

Table 2 Evaluation Model Selection

Parameter	Nominal	Appendix K
Decay Heat	1979 ANSI/ANS 5.1	1971 ANS + 20%
Transient Boiling Temperature	Iloeje Correlation	Transition boiling allowed during blowdown only until cladding superheat exceeds 300°F
Break Flow	1.25 Homogeneous Equilibrium Model (Subcooled) 1.0 Homogeneous Equilibrium Model (Saturated)	Moody Slip Flow Model with discharge coefficients of 1.0, 0.8 and 0.6
Metal-Water Reaction	EPRI Coefficients	Baker-Just

The GE14 fuel parameters for the analysis are given in Table 3.

Table 3 GE14 Fuel Parameters

Fuel Parameter		Analysis Value
PLHGR (kW/ft)	-LOCA Analysis Limit	[[
	-Appendix K	
	-Nominal	
MAPLHGR	-LOCA Analysis Limit	
	-Appendix K	
	-Nominal	
Worst Case Pellet Exposure for ECCS Evaluation (MWd/MTU)		]]
Initial Operating MCPR		1.35
	-Appendix K	1.35 ÷ 1.02
	-Nominal	1.35 + 0.02
Number of Fuel Rods per Bundle		92

5. RESULTS

Analyses were performed assuming the range of break sizes specified above (0.05 to 0.5 ft^2) applying assumptions consistent with Appendix K to 10CFR50. For break sizes equal to and less than 0.4 ft^2, the LPCI Loop Selection Logic System was assumed to fail.

The base calculations for the break spectrum were performed assuming a mid-peaked power shape, consistent with prevailing methodology. [[

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A break spectrum applying Nominal assumptions was calculated, still assuming failure of the LPCI Loop Selection Logic System for break sizes at or below 0.4 ft^2. These also were calculated in terms of the limiting power shape assumption.

5.1. LARGE RECIRCULATION LINE BREAKS

The large recirculation line, or DBA, break at rated conditions will cause enough pressure difference between the recirculation loops that identification of the broken loop and alignment of valves from the LPCI Loop Selection Logic System would not be challenged. Therefore, large recirculation line breaks are unaffected by the proposed change in LPCI Loop Selection Logic System and are outside the scope of this current study.

No new analyses assuming a DBA break have been performed for this study. The large break LOCA event for Monticello is analyzed in Reference 1 and that analysis remains valid.

5.2. SMALL RECIRCULATION LINE BREAKS

The most limiting single failure for small recirculation line breaks is the battery failure, which eliminates one division of low pressure ECCS capacity along with eliminating HPCI capacity. The small break cases were reanalyzed for GE14 fuel with Nominal and Appendix K assumptions at rated conditions to determine the small break with the highest PCT under assumption of LPCI Loop Selection Logic System failure below 0.4 ft^2. The results of these analyses are given in Table 4 and Figures 1 and 2.

[[

]] results in a greater PCT than the limiting DBA break result as presented in Reference 1. This small break is the limiting break case and becomes the basis for regulatory compliance according to the revised methodology discussed in Reference 6.

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]] Results of this analysis are given in Table 4 and Figure 3.

5.3. NON-RECIRCULATION LINE BREAKS

The analyses of References 8 and 9 demonstrate that the non-recirculation line break cases are non-limiting. These breaks need not be considered for the current study, as the analysis results are not affected by the LPCI Loop Selection Logic System. For non-recirculation line break cases, delivery of LPCI through either recirculation loop is acceptable. The analyses of References 8 and 9 remain a valid basis for acceptability.

5.4. ALTERNATE OPERATING MODES

The maximum DBA recirculation line suction break has been previously analyzed for MELLLA, Increased Core Flow (ICF) and Single-Loop Operation (SLO) operating modes (References 1 and 8). [[

]] As discussed earlier, for two loop operation cases, large recirculation line, or DBA, breaks will cause enough pressure difference between the recirculation loops that identification of the broken loop and alignment of valves from the LPCI Loop Selection Logic System would not be challenged.

A MAPLHGR multiplier of 0.94 has been applied for conditions lower than 80% core flow to ensure acceptable ECCS-LOCA analysis results given the early dryout which could occur for DBA breaks under these low core flow conditions (Reference 10). Since the evaluation that supports these results is based on a

DBA break, as discussed above, they are not impacted by the analysis presented in this report and the MAPLHGR multiplier remains valid.

For Single Loop Operation, only one recirculation pump will be functioning at the time of the break. LPCI Loop Selection Logic System will trip the operating pump and an interlock will prevent any further action until the reactor pressure decreases to 900 psig. This pressure permissive assures completed recirculation pump coast down before loop selection on smaller breaks for which an operating pump could mask the differential pressure caused by the break. The resulting pressure is then compared between the two loops such that, for a LOCA event during Single Loop Operation, the unbroken loop will be selected for all recirculation line breaks in either loop.

An evaluation has been performed to assess the PCT result for the limited operation mode during startup when the reactor is at low power and the RHR intertie is open (Reference 11). This evaluation concluded that a 0.75 MAPLHGR multiplier is adequate to ensure acceptable ECCS-LOCA analysis results under these conditions. Again, since these evaluations were performed for a DBA break, the conclusion remains valid and is not impacted by this study.

Therefore, in summary, no new analyses to address these operating modes have been performed for this study and the previous analyses remain valid.

5.5. LOOP PRESSURE DIFFERENCE

Calculation of the recirculation loop pressure difference that would correspond to a 0.4 ft^2 break area was performed. Given the 0.4 ft^2 limit as the proposed minimum area requiring response by the system, this pressure difference becomes the lowest pressure difference between the recirculation loops to which the LPCI Loop Selection Logic System would be required to respond and generate loop selection actions. Because the break flow is choked for early periods of the LOCA transient, the pressure difference that will be imposed on the recirculation loops as a result of the break manifests itself as a function corresponding with break area. Consideration was given for equal recirculation loop flow in each of the two loops, as well as the bounding case when the maximum allowed flow mismatch in the loops for Monticello could be present.

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The results reported in this section are based on the first few seconds of the LOCA event. The system parameters of interest, vessel pressure, recirculation loop flows, recirculation loop time constants and detection time, should be similar for alternate operation modes, for example, under uprated conditions. Therefore, the minimum loop pressure difference, which would need to be measured for the LPCI Loop Selection Logic System to support the 0.4 ft^2 minimum break area, would be judged applicable at uprated conditions, pending confirmation that no change in these input parameters would occur.

5.6. COMPLIANCE EVALUATIONS

5.6.1. Licensing Basis PCT Evaluation

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]] The Licensing Basis PCT for Monticello is calculated for GE14 fuel based on the above Appendix K PCT and using the SAFER/GESTR-LOCA licensing methodology approved by the NRC (Reference 5).

Monticello specific variable uncertainties, including backflow leakage, were evaluated for GE14 fuel to determine plant-specific adders. Since the limiting PCT was based on a small break, variable uncertainties on ECCS initiation signal, stored energy, fuel rod gap pressure, and ADS actuation delay were determined to be insignificant:

- Uncertainty due to backflow leakage was found by re-calculation of the limiting case with input adjusted to reduce the leakage multipliers assumed in the analysis by 20%.

- The ECCS initiation signal uncertainty gages the time change that may occur for ECCS delivery owing to the source signal, whether initiated by the high drywell pressure or low-low level signal. For small breaks, the timing of the ECCS initiation will be controlled by the pressure permissives awaiting the slower blowdown, then injection valve opening time and recirculation pump discharge valve closing time. Varying the ECCS initiation method will not impact the small break PCT results.

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The calculated Licensing Basis PCT is 1990°F. This evaluation was performed to assure conformance with 10CFR50.46 acceptance criteria for all the operating points. All criteria were met.

[[

]] The Licensing Basis PCT, based on this rated conditions case, is reported as 1960°F.

5.6.2. Upper Bound Peak Cladding Temperature Limit

Continued compliance to the 1600°F Upper Bound Peak Cladding Temperature limit is demonstrated by calculating the Upper Bound PCT based on the limiting small break case found from this study, and demonstrating that the Licensing Basis PCT is sufficiently conservative.

[[

]] The Upper Bound PCT for Monticello is calculated for GE14 fuel based on the Appendix K PCT, noted above, and using the SAFER/GESTR-LOCA licensing methodology approved by the NRC (Reference 5).

Monticello specific variable uncertainties were applied for decay heat and PLHGR limits:

> To assure the Upper Bound PCT was greater than the 95th percentile of the PCT distribution for the limiting case LOCA, [[

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The Upper Bound PCT was calculated to be 1570°F. This is acceptable with respect to the imposed limit of the NRC SER of Reference 5. It also clearly demonstrates the conservative nature of the Licensing Basis PCT determined from the analysis reported in Section 5.6.1. Since this Upper Bound PCT based on the limiting small break is lower than the Upper Bound PCT cited in Reference 1 (Table 5) for the DBA and MELLLA operating conditions (i.e., <1600°F), this previous analysis result remains the bounding Upper Bound PCT for compliance purposes.

Table 4 Small Break ECCS-LOCA Results - Break Area Sensitivity

(Battery Failure*)

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6. CONCLUSIONS

The analysis presented in this report confirms for Monticello that consequences following a LOCA event are acceptable with respect to ECCS design requirements for small breaks less than 0.4 ft^2, if the break were undetected by the LPCI Loop Selection Logic System. The acceptance criteria of 10CFR50.46 would continue to be met. This sets the minimum break area that need be reliably detected by LPCI Loop Selection Logic System as a basis for system requirements.

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Analyses have been performed based on the GE14 fuel product resident in the Monticello core. As required by methodology, both Nominal and Appendix K assumptions have been applied, as well as limiting assumption on axial power shape. The analysis shows acceptability with respect to the 2200°F limit of 10CFR50.46, as well as the Upper Bound PCT limit of 1600°F imposed by the USNRC on the SAFER/GESTR Evaluation Model.

Previous analyses for DBA breaks and allowed alternate operation modes (MELLLA, SLO, ICF) continue to be valid and are not affected by these analysis results. Analysis results are summarized in Table 5. These results meet all licensing and SAFER/GESTR methodology analysis limits.

Table 5 Monticello ECCS-LOCA Analysis Results for GE14

Parameter	DBA [a]	Small Break	10 CFR50.46 Acceptance Criteria
1. Nominal PCT	[[		
2. Appendix K PCT		]]	
3. Licensing Basis PCT	1960°F	1990°F	≤2200°F [d]
4. Upper Bound PCT	1600°F	1570°F	≤1600°F [e]
5. Maximum Local Oxidation	<5.0%	<5.0%	≤17% [d]
6. Core-Wide Metal-Water Reaction	<0.1%	<0.2%	≤1.0% [d]
7. Coolable Geometry	See results from Items 3 and 5 above		Maintain coolable geometry, which is satisfied by meeting PCT ≤ 2200 °F and Maximum Local Oxidation ≤ 17 %.
8. Core Long-Term Cooling	Satisfied by either: • core reflooded above TAF, or • core reflooded to elevation of jet pump suction and one core spray system in operation		Core temperature acceptably low and long-term decay heat removed

a. DBA Results, Reference 1
[[
c.]]
d. 10CFR50.46 ECCS-LOCA Analysis Acceptance Criteria
e. SAFER/GESTR Methodology Limit, Reference 5

Table 6 Monticello Thermal Limits for GE14

PARAMETER	ANALYSIS LIMIT	
PLHGR – Exposure Limit Curve	MWD/MT	kW/ft
	[[	
		]]
MAPLHGR – Exposure Limit Curve	MWD/MT	kW/ft
	[[	
		]]
Initial Operating MCPR	1.35	
Radial Peaking Factor	1.9	
SLO Multiplier on PLHGR & MAPLHGR	0.90	

7. REFERENCES

1. GE-NE-J1103878-09-02P *"Monticello ECCS-LOCA Evaluation for GE14,"* August 2001.

2. 10CFR50.46, "*Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors*."

3. NEDO-20566A, "General Electric Company Analytical Model for Loss-of-Coolant Analysis in Accordance with 10CFR50.46 Appendix K," General Electric Company, September 1986.

4. NEDE-23785-P-A, "*The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-of-Coolant Accident, Volume III, SAFER/GESTR Application Methodology*," Revision I, General Electric Company, October 1984.

5. Letter, C. O. Thomas (NRC) to J. F. Quirk (GE), Acceptance for Referencing of Licensing Topical Report NEDE-23785P, Revision 1, Volume III (P). "*The GESTR-LOCA and SAFER Models for the Evaluation of the Loss-of-Flow Accident*," June 1, 1984.

6. 10CFR50.46 Notification Letter 2006-01, "*Impact of Top Peaked Power Shape for Small Break LOCA Analysis*," July 28, 2006.

7. NEDE-20566-P-A, "*General Electric Company Analytical Model for Loss-of-Coolant Analysis in Accordance with 10CFR50 Appendix K*," Volume 2, September 1986.

8. NEDC-32514P, "*Monticello SAFER/GESTR-LOCA Loss-of Coolant Accident Analysis*," Revision 1, October 1997.

9. NEDC-31786P, "*Monticello SAFER/GESTR-LOCA Loss-of Coolant Accident Analysis*," December, 1990.

10. NEDC-30492-P, "*Average Power Range Monitor, Rod Block Monitor and Technical Specifications Improvement (ARTS) Program for Monticello Nuclear Generating Plant*," April 1984.

11. NSA 01-459, "*Monticello Nuclear Plant GE14 ECCS-LOCA Evaluation with the RHR Intertie Line Open*," October 10, 2001.

8. SYSTEM RESPONSE PLOTS

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Figure 1-a Water Level in Hot and Average Channels

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Figure 1-b Reactor Vessel Pressure

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Figure 1-c Peak Cladding Temperature

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Figure 1-d Heat Transfer Coefficient

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Figure 1-e ECCS Flows

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Figure 2-a Water Level in Hot and Average Channels

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Figure 2-b Reactor Vessel Pressure

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Figure 2-c Peak Cladding Temperature

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Figure 2-d Heat Transfer Coefficient

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Figure 2-e ECCS Flows

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Figure 3-a Water Level in Hot and Average Channels

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Figure 3-b Reactor Vessel Pressure

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Figure 3-c Peak Cladding Temperature

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Figure 3-d Heat Transfer Coefficient

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Figure 3-e ECCS Flows

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