ENCLOSURE 1

SAFETY EVALUATION

THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO LICENSE AMENDMENT NO. 151 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-69

FOR MAXIMUM EXTENDED LOAD LINE LIMIT ANALYSIS PLUS MELLLA+

NINE MILE POINT NUCLEAR STATION, LLC

EXELON GENERATION COMPANY, LLC.

DOCKET NO. 50-410

NINE MILE POINT NUCLEAR STATION, UNIT 2

ADAMS Accession No.: Non-Proprietary Safety Evaluation: ML16013A217

Replaces previously issued Non-Proprietary Safety Evaluation Enclosure 2 under ADAMS Accession No. ML15223B144 on September 2, 2015

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Proprietary information pursuant to Section 2.390 of Title 10 of the *Code of Federal Regulations* has been redacted from this document.

Redacted Information is identified by text enclosed within double brackets [[ ]].

ADAMS Accession No.: Non-Proprietary Safety Evaluation: ML16013A217

Replaces previously issued Non-Proprietary Safety Evaluation Enclosure 2 under ADAMS Accession No. ML15223B144 on September 2, 2015

SAFETY EVALUATION SUMMARY BY THE OFFICE OF NUCLEAR REACTOR REGULATION

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Summary Of Findings

U.S. Nuclear Regulatory Commission (NRC) approval of the requested operating domain expansion will allow Nine Mile Point Nuclear Station, Unit 2 (NMP2), to implement operational changes that will increase operational flexibility for power maneuvering, compensate for fuel depletion, and maintain efficient power distribution in the reactor core without the need for more frequent rod pattern changes. The Maximum Extended Load Line Limit Analysis Plus (MELLLA+) license amendment request supports operation of NMP2 at the current licensed thermal power (CLTP) of 3,988 Megawatts – Thermal (MWt) with core flow as low as 85% of rated core flow. By operating in the MELLLA+ domain, a significantly lower number of control rod movements will be required than in the present operating domain. This represents a significant improvement in operating flexibility. It also provides safer operation, because reducing the number of control rod manipulations: (a) minimizes the likelihood of fuel failures, and (b) reduces the likelihood of accidents initiated by reactor maneuvers required to achieve an operating condition where control rods withdrawals are required.

The proposed MELLLA+ expansion of the NMP2 operating domain would reduce the core flow at high reactor power without additional limitations and would reduce the safety margin; however, the NRC staff finds that the measures proposed by the licensee for NMP2 in the safety analysis report (SAR) would to satisfy the regulatory criteria. The following measures are proposed to maintain the same safety margin under MELLLA+ than under the current licensed conditions:

1. Feedwater (FW) temperature must be maintained within a range of 20°F, which satisfies the requirement of the MELLLA+ Safety Evaluation Report (SER) to avoid FW heater out of service in MELLLA+ conditions. The existing NMP2 License Condition 7 restricts FW operation to within 20°F of the design FW temperature which satisfies MELLLA+ SER Limitation and Condition 12.5b.

2. Single Loop Operation (SLO) is not allowed in the MELLLA+ domain.

3. The isotopic enrichment of Boron-10 in the Standby Liquid Control System (SLCS) has been increased from 25% to 92% to achieve a lower integrated heat load to containment during anticipated transient without scram (ATWS) under MELLLA+ conditions. Note that the Boron-10 enrichment increase has already been approved in a separate license amendment request and it is implemented in Cycle-15. In addition, pump discharge pressure for the SLCS pump will be increased to accommodate greater over-pressure during transient accident conditions.

   To provide additional protection against spurious, noise-induced scrams on the DSS-CD [detect and suppress confirmation density] system, **[[**

   ]] These MCPR Margin criteria are confirmed or can be updated on a cycle-specific basis following the process described in Section 2.4 of the SAR and in Section 6 of the DSS-CD LTR."

4. With the automated FW runback initiated within approximately 25 seconds, TRACG04 calculations show that post-CHF [critical heat flux] minimum stable film boiling temperature (Tmin) conditions are not achieved during anticipated transients without scram - core instability (ATWSI) events; therefore, the TRACG04 Tmin and quench models are not relied upon to demonstrate acceptable criteria in NMP2, which is acceptable.

5. Typically, the limiting Anticipated Operational Occurrences (AOOs) result in larger delta-CPR [critical power ratio] when initiated at nominal conditions than when initiated at lower flows inside the MELLLA+ domain. This is the case in NMP2 and the MELLLA+ operating domain expansion does not significantly change the operating limit because the largest delta CPR values occur at the 105% core flow conditions. Note that changes to the Safety Limit Minimum Critical Power Ratio (SLMCPR), including uncertainty penalties, do propagate to the OLMCPR and the final OLMCPR increases.

Critical operator actions have been assumed to occur consistent with the ATWS analysis. The NMP2 control system automatically performs actions that are typically accomplished by operators in other plants. Specifically, the NMP2 control system initiates a FW runback within 25 seconds of ATWS detection, and SLC boron injection within 98 seconds. Critical operator actions in NMP2 are: (1) place the reactor switch in shutdown mode, and (2) terminate and prevent injection. Through training exercises on the simulator (the site audit report, the NMP2 operators have demonstrated their proficiency in executing the two critical actions, with conservative timing, that are assumed in the safety analysis.

The NRC staff determined that the licensee has adequately accounted for the effects of the proposed MELLLA+ operating domain extension on the nuclear design, demonstrated that the fuel design limits will not be exceeded during normal or anticipated operational transients, and demonstrated that the effects of postulated reactivity accidents will not cause significant damage to the pressure vessel or impair the capability to cool the core. The detailed discussion of the NRC staff evaluation is provided in Section 3.4 of this Safety Evaluation (SE).

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RELATED TO LICENSE AMENDMENT NO. 151 TO

RENEWED FACILITY OPERATING LICENSE NO. NPF-69

FOR MAXIMUM EXTENDED LOAD LINE LIMIT ANALYSIS PLUS

NINE MILE POINT NUCLEAR STATION, LLC

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-410

NINE MILE POINT NUCLEAR STATION, UNIT

1.0 INTRODUCTION

By letter dated November 1, 2013, as supplemented by letters dated January 21, February 14, February 25, March 10, May 14, June 13, October 10, December 11, 2014, and February 18, 2015, by Nine Mile Point Nuclear Station, LLC (NMPNS, the licensee), submitted a license amendment request (LAR) for changes to the Nine Mile Point Nuclear Station, Unit No. 2 (NMP2), Technical Specifications (TSs). As a part of its review, the U.S. Nuclear Regulatory Commission (NRC) staff performed an audit on the licensee's training on its simulator with respect to operator actions related to the plant operations in the Maximum Extended Load Line Limit Analysis Plus (MELLLA+) at the plant site. The publicly-available versions of the submissions are in the Agencywide Documents Access and Management System (ADAMS) under Accession Nos. ML13316B107, ML13316B109, ML13316B110 (Package No. ML13316B090); ML14023A654; ML14051A138; ML14064A321, ML14064A322, ML14064A323, ML14064A324; ML14071A466; ML14139A416; ML14169A034; ML14288A241; ML14351A426; ML14351A427; ML14351A428; and ML15051A464. The publicly available version of the Simulator Audit Report is available in ADAMS under the accession No. ML15114A160.

Non-Publicly-available versions of the licensee submissions are in ADAMS under the Accession Nos. ML13316B113 and ML13316B115 (November 1, 2013), ML14064A325 (December 31, 2013), ML14051A140 (February 14, 2014), ML14064A327 (February 28, 2014), ML14071A467 (March 10, 2014), ML14351A429 (December 11, 2014), and ML15051A465 (February 18, 2015). A non-publicly available version of the Simulator Audit Report is in ADAMS under the accession No. ML14363A090 (March 14, 2014).

Enclosure 3

The LAR proposes a revision to the NMP2 TSs to allow plant operation in the expanded MELLLA+ domain under the previously approved Extended Power Uprate (EPU) conditions of 3,988 megawatts thermal (MWt) rated core thermal power. This submittal was revised in letter dated June 13, 2014, to remove Standby Liquid Control System (SLCS) TS changes related to increases in isotopic enrichment of Boron-10. The SLCS TS changes were approved on March 14, 2014, in License Amendment No.143.

Specifically, the proposed amendment includes changes to the NMP2 TSs necessary to: (1) implement the MELLLA+ expanded operating domain, (2) change the stability solution to Detect and Suppress Solution - Confirmation Density (DSS-CD), (3) use the TRACG04 analysis code, and (4) increase the Safety Limit Minimum Critical Power Ratio (SLMCPR) for two recirculation loops in operation.

The following is a list of the proposed changes to the NMP2 TSs:

- Revise Safety Limit (SL) 2.1.1.2 by increasing the SLMCPR for two recirculation loops in operation from ≥ 1.07 to ≥ 1.09.
- Revise the acceptance criterion in TS 3.1.7, "Standby Liquid Control SLC System," Surveillance Requirement (SR) 3.1.7.7 by increasing the discharge pressure from ≥ 1,327 pounds per square inch gauge (psig) to ≥ 1,335 psig.
- Change the Required Actions for Condition F of TS 3.3.1.1, "Reactor Protection System (RPS) Instrumentation."
- Change Condition G of TS 3.3.1.1.
- Add new Conditions J and K to TS 3.3.1.1.
- Correct an editorial error in Note 3 to TS SR 3.3.1.1.13 (id est, meaning "that is") i.e., "ORRM" is changed to "OPRM" (Oscillation Power Range Monitor).
- Eliminate TS SR 3.3.1.1.16 and references to it in TS Table 3.3.1.1-1, "Reactor Protection System Instrumentation."
- Change the allowable value (AV) for TS Table 3.3.1.1-1, Function 2.b, Average Power Range Monitor (APRM) - Flow Biased Simulated Thermal Power (STP) - Upscale from "≤ 0.55W + 60.5% (Rated Thermal Power) RTP and ≤ 115.5% RTP" to "≤ 0.61W + 63.4% RTP and ≤ 115.5% RTP."
- Add a new note to TS Table 3.3.1.1-1, Function 2.b that requires the Flow Biased Simulated Thermal Power - Upscale scram setpoint to be reset to the values defined by the Core Operating Limits Report (COLR) to implement the Automated Backup Stability Protection (BSP) Scram Region in accordance with Required Action F.2 of TS 3.3.1.1.
- Add a new note to TS Table 3.3.1.1-1, Function 2.e, OPRM - Upscale to denote that following implementation of DSS-CD, DSS-CD is not required to be armed while in the DSS-CD Armed Region during the first reactor startup and during the first controlled shutdown that passes completely through the DSS-CD Armed Region. However, DSS-CD is considered operable and capable of automatically arming for operation at recirculation drive flow rates above the DSS-CD Armed Region.
- Change the mode of applicability for TS Table 3.3.1.1-1, Function 2.e, OPRM-Upscale from Mode 1 to ≥ 18% RTP.
- Change the allowable value for TS Table 3.3.1.1-1, Function 2.e, from "As specified in the COLR" to "NA (not applicable)."

- TS Limiting Condition for Operation (LCO) 3.4.1, "Recirculation Loops Operating," is modified to prohibit operation in the Maximum Extended Load Line Limit Analysis (MELLLA) domain or MELLLA+ expanded operating domain as defined in the COLR when in operation with a single recirculation loop.
- Add Required Action B.2 to TS 3.4.1 to identify that intentional operation in the MELLLA domain or MELLLA+ domain as defined in the COLR is prohibited when a recirculation loop is declared "not in operation" due to a recirculation loop flow mismatch not within limits.
- Revise TS 5.6.5.a.4 to replace "Reactor Protection System Instrumentation Setpoint for the OPRM - Upscale Function Allowable Value for Specification 3.3.1.1" with "The Manual BSP Scram Region Region I, the Manual BSP Controlled Entry Region Region II, the modified APRM Simulated Thermal Power - High setpoints used in the OPRM Function 2.e, Automated BSP Scram Region, and the BSP Boundary for Specification 3.3.1.1."
- Add TS 5.6.8, "OPRM Report," to define the contents of the report required by new Required Action F.3 of TS 3.3.1.1.

The NRC approval of the requested operating domain expansion will allow NMP2 to implement operational changes that will increase operational flexibility for power maneuvering, compensate for fuel depletion, and maintain efficient power distribution in the reactor core without the need for more frequent rod pattern changes. MELLLA+ supports operation of NMP2 at the current licensed thermal power (CLTP) of 3,988 MWt with core flow as low as 85% of rated core flow. By operating in the MELLLA+ domain, a significantly lower number of control rod movements will be required than in the present operating domain. This represents a significant improvement in operating flexibility. It also provides safer operation, because reducing the number of control rod manipulations: (1) minimizes the likelihood of fuel failures; and (2) reduces the likelihood of accidents initiated by reactor maneuvers required to achieve an operating condition where control rods withdrawals are required.

The supplements dated January 21, February 14, February 25, March 10, May 14, June 13, October 10, December 11, 2014, and February 18, 2015, provided additional information that clarified the application and did not expand the scope of the November 1, 2013, application. However, in the letter dated June 13, 2014, the licensee revised the licensee's analysis of the no significant hazards consideration determination. Therefore, subsequent to the original publication of the NRC staff's initial proposed no significant hazards consideration determination noticed in the *Federal Register* (FR) on June 6, 2014, 79 FR 32763, the NRC staff evaluated the changes proposed by the supplements and NRC staff revised its proposed no significant hazards consideration determination and published it in the FR on August 5, 2014 (79 FR 45491).

Further, as a part of its application for the license transfer and conforming amendment of the Renewed Facility Operating License for Nine Mile Point Nuclear Station, Units 1 and 2, in the letter dated March 28, 2014, ADAMS Accession No. ML14087A274, Exelon Generation Company, LLC (EGC or licensee), has stated that:

> Prior to the license transfers, CENG [Constellation Energy Nuclear Group, LLC] made docketed submittals to the NRC that requested specific licensing actions,

such as license amendment requests, relief requests, exemption requests, etc. Furthermore, in the application for the license transfers, Exelon stated that upon transfer of the licenses, Exelon would assume all current regulatory commitments made for these units. Accordingly, Exelon hereby adopts and endorses those docketed requests currently before the NRC for review and approval. Exelon requests that the NRC continue to process those pending actions on the schedules previously requested by CENG.

1.1 Background

NMP2 is a boiling-water reactor (BWR) plant of the BWR/5 design with a Mark-II containment. The NRC licensed NMP2 on July 2, 1987, under NPF-69, for full-power operation at the original licensed thermal power (OLTP) of 3,323 MWt, and it entered commercial operation on July 2, 1987. NMP2 has performed a previous power uprate. This power uprate, termed a "stretch uprate," was approved on April 28, 1995, and increased the licensed thermal power from 3,323 MWt to 3467 MWt, an approximate 4.3% increase from the original licensed thermal power. On October 31, 2006, the NRC renewed the license for NMP2 until October 31, 2046. An EPU, which increased the power level by 15%, was approved by License Amendment No. 140 dated December 22, 2011, for NMP2 that increased the power level to 3,988 MWt.

NMP2 is located on a 900-acre site owned NMPNS, and is situated on the southeast shore of Lake Ontario, Oswego County, New York; approximately 6.2 miles northeast of the city of Oswego. NMP2 and supporting facilities occupy about 45 acres, and share the site with the existing Nine Mile Point Nuclear Station, Unit No. 1 (NMP1), which has been in commercial operation since 1969. The Nine Mile Point site is adjacent to the James A. FitzPatrick Nuclear Power Plant which is owned by Entergy Nuclear FitzPatrick, LLC. NMP2 is located 900 feet (ft) east of Unit 1 and about 2,350 ft. west of the James A. FitzPatrick Plant. Condenser cooling for NMP2 is provided from a counterflow, natural-draft, hyperbolic concrete cooling tower. The ultimate heat sink for emergency core cooling is Lake Ontario. The low population zone surrounding NMP2 encompasses an area within a 4-mile radius from the NMP1 stack. The nearest population center with a population in excess of 25,000 is the city of Syracuse, approximately 32.8 miles southeast of the site.

The construction permit for NMP2 was issued by the Atomic Energy Commission on June 24, 1974. The plant was designed and constructed based on Appendix A to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "General Design Criteria [GDC] for Nuclear Power Plants," in the *Federal Register* on February 20, 1971 (36 FR 3255) (hereinafter referred to as "final GDC").

Section 1.2.1 of the NMP2 Updated Safety Analysis Report (USAR), Revision 21, ADAMS Package Accession No. ML14364A276 (non-public), contains the principal design criteria for the design, construction, and operation of NMP2. Section 3.1, "Conformance with the NRC General Design Criteria," of NMP2 USAR contains an evaluation of the design bases of NMP2 as compared to the GDC in Appendix A to 10 CFR Part 50. In addition, a list of the NMP2 USAR sections with further information pertinent to each criterion is also provided. Based on the evaluation contained therein, the licensee concluded that NMP2 fully complies with the GDC, with the exception of inapplicable portions of Criterion 56.

1.2 Licensee's Approach

In its November 1, 2013, application to operate NMP2 in the MELLLA+ expanded operating domain, Exelon Generation Company, LLC (EGC), submitted Licensing Topical Report (LTR) NEDC-33576P, Revision 0, "Safety Analysis Report (SAR) for Nine Mile Point Nuclear Station Unit 2 (NMP2) Maximum Extended Load Line Limit Analysis Plus." The MELLLA+ is an extension of the reactor operating domain. Under MELLLA+, the operating power is maintained constant, but the recirculation core flow is allowed to operate within a wider window than under EPU. For NMP2, the MELLLA+ flow window is between 85% and 105% core flow. This operating flexibility reduces the need for frequent control rod motion. A secondary effect is increased fuel utilization by increased plutonium (P_u) production with increased void fraction levels, which harden the neutron flux spectrum.

The current operating core in NMP2 contains only General Electric Hitachi (GEH) GE14 fuel. NRC approved the applicability of GEH methods to expanded operating domains using GE14 fuel. The NMP2 SAR calculations are based on a full equilibrium core of GE14 fuel.

In GEH TR NEDC-33576P, Revision 0, the licensee documents the results of all significant safety evaluations (SEs) performed to justify the expansion of the core flow operating domain for NMP2 to the MELLLA+. These analyses support operation of NMP2 at the post-EPU CLTP of 3988 MWt with core flow as low as 85% of rated flow.

These analyses are based on the approved methodology identified in the following staff-approved LTRs:

The MELLLA+ SER (MELLLA+ LTR)

The NEDC-33006P-A, Revision 3, June 2009, "General Electric Boiling Water Reactor Maximum Extended Load line Limit Analysis Plus," LTR evaluates the impact of operation in the expanded operating domain on BWRs regarding: (1) safety systems and components capability and performance, and (2) response to the design bases and special events that demonstrate plants can meet the regulatory and safety requirements. The LTR dispositions the principal review topics generically or proposes that plant-specific analyses will be provided in the MELLLA+ applications to quantify the impact.

All topics in the SAR are dispositioned as either "Generic (see Section 3.2 of this safety evaluation (SE))" or "Plant-specific (see Section 3.3 of this SE)," as outlined in NEDC-33006P-A, the MELLLA+ SER.

The METHODS SER

The NEDC-33173P-A, "Applicability of GE Methods to Expanded Operating Domains," Revision 4, LTR extends the use of GEH's analytical methods and codes to MELLLA+. Plant-specific MELLLA+ applications must demonstrate compliance with the limitations in the NRC staff SE approving NEDC-33173P, or any supplements or revisions.

The DSS-CD SER

The NEDC-33075P, "Detect and Suppress Solution-Confirmation Density Licensing Topical Report," Revision 7, LTR presents stability detect and suppress methodology for application to MELLLA+ operation. The NRC staff reviewed and approved the stability methodology presented in this LTR for application to MELLLA+ operation. Specifically, the NEDC-33075P stability detect and suppress methodology ensures that the stability response for operation at the higher MELLLA+ rod line can be detected and suppressed such that GDC 12 requirements can be met.

The DSS-CD TRACG APPLICATION SER

The NEDE-33147P and NEDE-33147P-A, "DSS-CD TRACG Application," Revision 4, demonstrates how GEH used TRACG calculations to demonstrate that the DSS-CD stability solution can effectively detect and suppress instability events and meet the associated regulatory requirements. The NRC staff reviewed and accepted the TRACG code for this specific application.

All the limitations from the licensing topical reports (LTRs) listed above have been addressed.

1.3 Method of NRC Review

The NRC staff's review is based on the submitted documents, which include LTRs, SERs, an SAR, the licensee responses to the formal requests for additional information (RAIs), and the information obtained during a number of meetings and conference calls with the licensee. To evaluate the NMP2 operation in the MELLLA+ expanded operating domain, the staff performed this review mainly using relevant sections of the review guidance in Review Standard 001 (RS-001), Revision 0, "Review Standard for Extended Power Uprates EPU," relevant sections of the Standard Review Plan (SRP) [NUREG-0800], and the findings of the MELLLA+ staff SER, NEDC-33006P-A, Revision 3, "General Electric Boiling Water Reactor Maximum Extended Load Line Limit Analysis Plus."

Although the MELLLA+ LAR is not an EPU, and RS-001 guidance is not wholly applicable, the NRC staff determined that RS-001 provides a good framework for the review of this application. The NRC staff, however, recognizes that there are sections in RS-001 that are unnecessary for the MELLLA+ application review.

This SE is organized in the following sections:

- Section 3.1: Overview of NEDC-33576P;
- Section 3.2: The licensee's justification of its confirmation of the generic dispositions of various topics in SER NEDC-33006P-A;
- Section 3.3: The licensee's plant specific evaluation of its acceptance of the various topics in the SER for NEDC-33006P-A;
- Section 3.4: The NRC Staff Evaluation of various topics – Licensee's Plant-Specific Evaluations;
- Section 3.5: Limitation of Applicable SERs;

- Section 3.6: Use of TRACG;
- Section 4.0: Changes to the Operating License and Changes to Technical Specification; and
- Section 5.0: Conclusions.

2.0 REGULATORY EVALUATION

The NRC staff's review is based on the following sources (see Section 8.0, References):

1. RS-001.

2. Regulatory Guide (RG) 1.174, "An approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis."

3. RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."

4. Relevant sections of the SRP, specifically:

   (a) Chapter 4, "Reactor"
   - Section 4.2, "Fuel System Design"
   - Section 4.3, "Nuclear Design"
   - Section 4.4, "Thermal and Hydraulic Design"
   - Section 4.6, "Emergency Systems"

   (b) Chapter 5, "Reactor Coolant System and Connected Systems"
   - Section 5.2.2, "Overpressure Protection"
   - Section 5.4.6, "Reactor Core Isolation Cooling System (BWR)"
   - Section 5.4.7, "Residual Heat Removal (RHR) System"

   (c) Chapter 7, Branch Technical Position 7-19 Revision 6, "Guidance for Evaluation of Diversity and Defense-In-Depth in Digital Computer-Based Instrumentation and Control Systems"

   (d) Chapter 9 "Auxiliary Systems"
   - Section 9.3.5, "Standby Liquid Control System"

   (e) Chapter 15, "Transient and Accident Analysis"
   - Section 15.1, "Increase in Heat Removal by the Secondary System"
   - Section 15.2, "Decrease in Heat Removal by the Secondary System"
   - Section 15.3, "Decrease in RCS Flow Rate"
   - Section 15.4, "Reactivity and Power Distribution Anomalies"
   - Section 15.5, "Increase in Reactor Coolant Inventory"
   - Section 15.6, "Decrease in Reactor Coolant Inventory"
   - Section 15.7, "Radioactive Release from a Subsystem or Component"
   - Section 15.8, "Anticipated Transients Without Scram"
   - Section 15.9, "Boiling Water Reactor Stability"

   (f) Chapter 18, "Human Factors Engineering"

   (g) Chapter 19, "Severe Accidents," Appendix D.

5. In 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," it establishes standards for the calculation of emergency cooling system (ECCS) performance and acceptance criteria for that calculated performance.

6. Appendix K to 10 CFR Part 50, "ECCS Evaluation Models," which establishes required and acceptable features of evaluation models for heat removal by the ECCS after the blowdown phase of a loss-of-coolant accident (LOCA).

7. In 10 CFR 50.36(c)(iii)(3), "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, facility operation will be within safety limits, and the limiting conditions for operation will be met." There are specifications that the Commission established in its regulatory requirements related to the contents of the TSs. Specifically, 10 CFR 50.36(a)(1) states, in part, "[e]ach applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section."

8. In 10 CFR 50.36(c)(2), titled "Limiting condition for operation," subparagraph (ii) requires that technical specification limiting condition for operation for a nuclear reactor must be established for each item that meeting one or more of the specific criteria.

9. In 10 CFR 50.44, titled "Combustible gas control for nuclear power reactors," it requires that plants be provided with the capability of controlling combustible gas concentrations in the containment atmosphere.

10. In 10 CFR 50.55a(h) titled "Protection and safety systems."

11. In 10 CFR 50.59 titled "Changes, tests, and experiments."

12. In 10 CFR 50.62, "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants," it requires as licensees to provide the means to address an ATWS event, an anticipated operational occurrences (AOO) defined in Appendix A of this part, followed by the failure of the reactor trip portion of the protection system specified in GDC 20 of Appendix A, "Protection systems function."

13. In 10 CFR 50.63, "Loss of all alternating current power," it requires that the plant withstand and recover from a station blackout (SBO) event of a specified duration.

14. In 10 CFR 50.67, titled "Accident source term."

15. In 10 CFR 50.120, titled "Training and qualification of nuclear power plant personnel."

16. NUREG-0711, titled "Human Factors Engineering Program Review Model," Revision 3.

17. NUREG-0800, titled "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [light-water reactor] Edition:" Chapter 18, provides review guidance for "Human Factors Engineering."

18. NUREG-1764, titled "Guidance for the Review of Changes to Human Actions," Revision 1.

The NRC staff's review is also based on the following GDC in Appendix A of 10 CFR 50:

The GDCs discussed below are those currently specified in Appendix A of 10 CFR Part 50. Section 1.2.1 of the NMP2 USAR contains the principal design criteria for the design, construction, and operation of NMP2. Section 3.1 of NMP2 USAR contains an evaluation of the design bases of NMP2 as compared to the GDCs in Appendix A to 10 CFR Part 50. Based on the evaluation contained therein, the licensee concluded that NMP2 fully complies with the GDC, with the exception of inapplicable portions of GDC 56.

1. GDC 1, "Quality Standards and Records;" requires structures, systems, and components important to safety to be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

2. GDC 2, "Design Basis for Protection Against Natural Phenomena,"

3. GDC 4, "Environmental and Dynamic Effects Design Bases," insofar as it requires that structures, systems, and components (SSCs) important to safety shall be designed to accommodate the effects of and to be compatible with environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, and also protected against dynamic effects associated with flow instabilities and loads such as those resulting from water hammer.

4. GDC 5, "Sharing of structures, systems, and components," insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be demonstrated that sharing will not impair its ability to perform its safety function.

5. GDC 10, "Reactor Design," insofar as the reactor core and associated coolant, control, and protection system (RPS) shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any conditions of normal operation, including the effects of anticipated operational occurrences.

6. GDC 11, "Reactor Inherent Protection," insofar as the reactor core must be designed so that the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.

7. GDC 12, "Suppression of Reactor Power Oscillations," insofar as unstable oscillations with the potential of violating specified acceptable fuel design limits (SAFDLs) must either be impossible or readily detected and suppressed.

8. GDC 13, "Instrumentation and Control," insofar as instrumentation and controls must be provided to monitor variables and systems affecting the fission process over anticipated ranges for normal operation, AOOs, and accident conditions, and to maintain the variables and systems within prescribed operating ranges.

9. GDC 15, "Reactor Coolant System Design," insofar as it requires that the reactor coolant system (RCS) and associated auxiliary, control, and protection systems be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary (RCPB) are not exceeded during any condition of normal operation, including AOOs.

10. GDC 16, "Containment Design," insofar as it requires that the containment and associated systems be designed to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment, and to assure that the containment design conditions important to safety are not exceeded as long as postulated accident conditions require.

11. GDC 19, "Control Room," insofar as it requires that adequate radiation protection be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 roentgen equivalent man (rem) whole body, or its equivalent, to any part of the body for the duration of the accident.

12. GDC 20, "Protection System Functions," insofar as the RPS must be designed to initiate the reactivity control systems automatically to assure that acceptable fuel design limits are not exceeded as a result of AOOs and to automatically initiate operation of systems and components important to safety under accident conditions.

13. GDC 21, "Protection System Reliability and Testability," requires that the system be designed for high functional reliability and in service testability, with redundancy and independence sufficient to preclude loss of the protection function from a single failure and preservation of minimum redundancy despite removal from service of any component or channel.

14. GDC 22, "Protection System Independence," requires that the system be designed so that natural phenomena, operating, maintenance, testing, and postulated accident conditions do not result in loss of the protection function.

15. GDC 23, "Protection System Failure Modes," requires that the system be designed to fail to a safe state in the event of conditions such as disconnection, loss of energy, or postulated adverse environments.

16. GDC 24, "Separation of Protection and Control Systems," requires that interconnection of the protection and control systems be limited to assure safety in case of failure or removal from service of common components.

17. GDC 25, "Protection System Requirements for Reactivity Control Malfunctions," insofar as the RPS must be designed to assure that SAFDLs are not exceeded for any single malfunction of the reactivity control systems.

18. GDC 26, "Reactivity Control System Redundancy and Capability," insofar as two independent reactivity control systems must be provided, with both systems capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes, including AOOs, so that SAFDLs are not exceeded.

19. GDC 27, "Combined Reactivity Control System Capability," insofar as the reactivity control systems must be designed to have a combined capability, in conjunction with poison addition by the ECCS, of reliably controlling reactivity changes under postulated accident conditions with appropriate margin for stuck rods to assure the capability to cool the core is maintained.

20. GDC 28, "Reactivity Limits," insofar as the reactivity control systems must be designed to assure that the effects of postulated reactivity accidents can neither result in damage to the RCPB greater than limited local yielding; nor disturb the core, its support structures, or other reactor vessel internals so as to significantly impair the capability to cool the core.

21. GDC 29, "Protection Against Anticipated Operational Occurrences," insofar as the protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of AOOs.

22. GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," insofar as it requires that the RCPB be designed with sufficient margin to assure that it behaves in a nonbrittle manner and that the probability of rapidly propagating fracture is minimized.

23. GDC 33, "Reactor Coolant Makeup," insofar as a system to supply reactor coolant makeup for protection against small breaks in the RCPB shall be provided. The system safety function shall be to assure that SAFDLs are not exceeded as a result of reactor coolant loss due to leakage from the RCPB and rupture of small piping or other small components, which are part of the boundary. The system shall be designed to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available), the system safety function can be accomplished using the piping, pumps, and valves used to maintain coolant inventory during normal reactor operation.

24. GDC 34, "Residual Heat Removal," insofar as a system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that SAFDLs and the design conditions of the RCPB are not exceeded.

25. GDC 35, "Emergency Core Cooling," insofar as an emergency system to provide abundant emergency core cooling must be provided to transfer heat from the reactor core following any LOCA.

26. GDC 38, "Containment Heat Removal," insofar as it requires that a containment heat removal system be provided and that its function shall be to rapidly reduce the containment pressure and temperature following a LOCA and maintain them at acceptably low levels.

27. GDC 40, "Testing of Containment Heat Removal System."

28. GDC 41, "Containment Atmosphere Cleanup," insofar as it requires systems to: (1) control fission products, hydrogen, oxygen, and other substances that may be released into the reactor containment; (2) reduce the concentration and quality of fission products released to the environment following postulated accidents; and (3) control the concentration of hydrogen or oxygen and other substances in the containment atmosphere following postulated accidents to assure that containment integrity is maintained.

29. GDC 42, "Inspection of Containment Atmosphere Cleanup Systems."

30. GDC 50, "Containment Design Basis," insofar as it requires that the containment and its associated heat removal systems be designed so that the containment structure can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated temperature and pressure conditions resulting from any LOCA.

31. GDC 54, "Piping Systems Penetrating Containment," insofar as it requires that piping systems penetrating containment be designed with the capability to periodically test the operability of the isolation valves to determine if valve leakage is within acceptable limits.

32. GDC 56, "Primary Containment Isolation," This criterion provides the requirements for lines that connects directly to the containment atmosphere and penetrate primary reactor containment.

3.0 TECHNICAL EVALUATION

3.1 Overview of NEDC-33576P

The NMP2 MELLLA+ SAR, NEDC-33576P, Revision 0, contains information divided into the following 11 sections:

- SAR Section 1.0 – Introduction
- SAR Section 2.0 – Reactor Core and Fuel Performance
- SAR Section 3.0 – Reactor Coolant and Connected Systems

- SAR Section 4.0 – Engineered Safety Features
- SAR Section 5.0 – Instrumentation and Control
- SAR Section 6.0 – Electrical Power and Auxiliary Systems
- SAR Section 7.0 – Power Conversion Systems
- SAR Section 8.0 – Radwaste Systems and Radiation Sources
- SAR Section 9.0 – Reactor Safety Performance Evaluations
- SAR Section 10.0 – Other Evaluations
- SAR Section 11.0 – Licensing Evaluations

The NMP2 MELLLA+ SAR also includes three appendices that evaluate the disposition of limitations of applicable SERs. A complete listing of the required limitations and conditions is presented in Appendices A, B, and C of the SAR. These appendices address the limitations from the MELLLA+ SER, the Methods SER, and the DSS-CD SER. Note that, in prior MELLLA+ applications, a fourth appendix was included to account for one limitation of the TRACG application for DSS-CD; however, Revision 7 of the DSS-CD SER incorporates the TRACG application and the one limitation no longer applies. Therefore, the staff determined that a fourth appendix was not necessary for NMP2.

All topics are dispositioned in the NMP2 MELLLA+ SAR as either "Generic and Confirmed for NMP2 (see Section 3.2 of this SE)" or "Plant-Specific and Acceptable for NMP2 (see Section 3.3 of this SE)" as outlined in NEDC-33006-A, in the MELLLA+ SER.

3.1.1 <u>NMP2 MELLLA+ SAR Section 1.0, "Introduction"</u>

Section 1 of the SAR describes the report approach, as well as the differences between generic and plant-specific assessments. Generic assessments are those SEs that can be disposed of by either: (1) a reference bounding calculation, (2) demonstration of a negligible impact of MELLLA+ operation, (3) or deferring to the plant-specific analyses during the reload process. Plant specific evaluations are provided for those items where a generic assessment is not applicable. The licensee committed to supplement the SAR with the fuel-and cycle-dependent analyses including the plant-specific thermal limits assessment. The NRC staff reviewed the Supplemental Reload Licensing Report (SRLR) for the initial MELLLA+ implementation in Cycle-15 and confirmed that the analyses documented in the SRLR support the conclusions in the SE.

Table 1-1 of the SAR list all the computer codes used. Figure 1-1 of the NMP2 SAR reproduced here as Figure-1 defines the MELLLA+ operating domain. **[[**

]]

[[ ]]

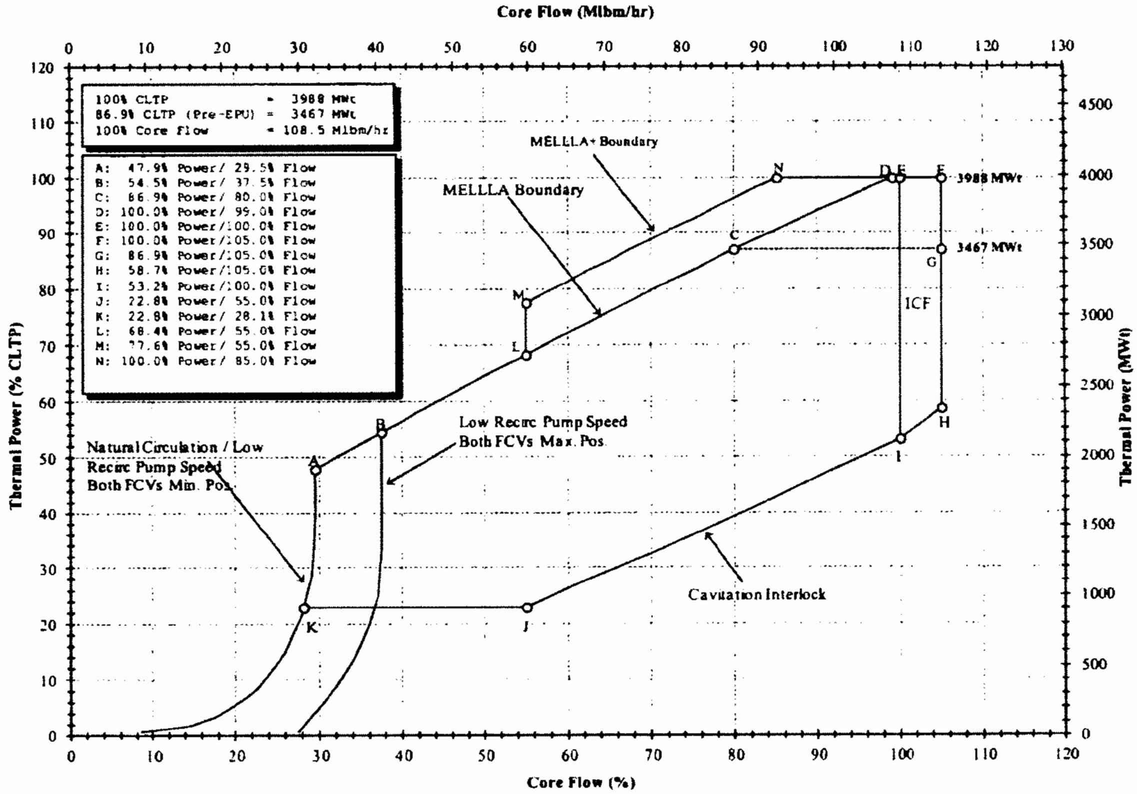

Figure-1. MELLLA+ Operating Domain for NMP2

Section 1.2.4 of the SAR describes the allowed operational enhancements, which are covered by the approved MELLLA+ SER.

The following enhancements are not allowed in the MELLLA+ domain:

1. Single loop operation; and

2. The MELLLA+ SER specifically restricts operation in the MELLLA+ domain with the FW heater out of service. NMP2 will implement this limitation based on Licensing Condition 7, which requires a 20°F FW Operational Temperature Band.

3.2 <u>Licensee's Confirmation of Generic MELLLA+ Dispositions for NMP2</u>

As discussed above, the MELLLA+ SER provided the generic disposition of the topics related the expansion in MELLLA+ the operating domain for BWRs. The SAR provides the licensee's evaluation of the generic disposition topics and confirms that these evaluations are applicable to NMP2. For the topics that were dispositioned generically, the NMP2 SAR stated that operation in the MELLLA+ domain was justified based on the following:

1. Provided or referenced a bounding analysis for the limiting condition;

2. Demonstrated that there is a negligible effect;

3. The system or component is unaffected by the MELLLA+ power/flow (P/F) map operating domain expansion; or

4. The sensitivity to MELLLA+ is small enough that the required plant cycle-specific reload analysis process is sufficient and appropriate for establishing the MELLLA+ licensing basis.

This section of the SE summarizes the licensee's discussions regarding the disposition of the SAR topics Sections 3.2.1 to 3.2.9 of this SE. The topics in each subsection of this section of the SE are consistent with the SAR. Section 3.2.10 of this SE provides the staff's evaluation and conclusion of the licensee's generic MELLLA+ dispositions.

As indicated in Section 3.1 of this SE the plant specific evaluations are addressed in Section 3.3 of this SE.

3.2.1 <u>SAR Section 2.0, "Reactor Core and Fuel Performance"</u>

As required by the MELLLA+ SER, the following topics in SAR Section 2.0 were evaluated generically with the approved methodology described in the MELLLA+ SER. Section 2.0 of the SAR provided the summary of the generic evaluations that confirmed the applicability of these topics for NMP2. The licensee concluded that no plant-specific evaluations are required for Section 2, "Reactor Core and Fuel Performance," topics as NMP2 meets all conditions of the MELLLA+ SER for generic disposition. However, the NRC staff performed a plant specific evaluation. The NRC staff's plant-specific evaluation is provided in Section 3.4 of this SE.

<u>SAR Section 2.1, "Fuel Design and Operation"</u>

<u>SAR Section 2.1.1, "Fuel product Line"</u>

As stated in part by the licensee:

> NMP2 currently operates with GE14 fuel. The cycle in which MELLLA+ operating domain expansion is implemented shall contain GE14 fuel. [[ ]] no new fuel product line design is introduced, and there is no change to fuel design limits required by the MELLLA+ introduction at NMP2. Therefore, the SRLR will confirm that there are no new fuel products as a result of MELLLA+ and will validate the conclusion that no additional fuel and core design evaluation is required for NMP2.
>
> [[
>
>]]

<u>SAR Section 2.1.2, Core Design and Fuel Thermal Margin Monitoring Threshold"</u>

As stated in part by the licensee:

> [[ ]] there are no changes to the NMP2 fuel or fuel design limits as a result of MELLLA+. NMP2 continues to use GE14 fuel. The CLTP remains at 3,988 MWt. This validates the conclusion that there are no changes needed to the fuel thermal monitoring threshold for NMP2.
>
> Also, [[ ]] and per Methods LTR SER Limitation and Condition 9.17, the range of void fraction, axial and radial power shape, and rod positions in the core does change slightly as a result of MELLLA+ operating domain expansion. For NMP2, the predicted bypass void fraction at the D-Level local power range monitor (LPRM) satisfied the [[ ]] design requirement. The cycle-specific SRLR will confirm that the void fraction is < 5% according to Methods LTR SER Limitation and Condition 9.17.
>
> [[
>
>]]

<u>SAR Section 2.2, "Thermal limits Assessment"</u>

As stated in part by the licensee:

> The effect of MELLLA+ on the MCPR safety and operating limits, maximum average planar linear heat generation rate (MAPLHGR), and LHGR limits is described below. As required by Limitation and Condition 9.6 of the Methods LTR SER, the GE14 fuel bundle R-factors generated for this project are consistent with GNF [Global Nuclear Fuel] standard design practices, which use an axial void profile shape with 60% average in-channel voids. This is consistent with lattice axial void conditions expected for the hot channel operating state as shown in SAR Figure 2-18. As required by Methods LTR SER Limitation and Condition 9.15, the nodal void reactivity biases applied in TRACG are applicable to the lattices representative of fuel loaded in the core.

<u>SAR Section 2.2.1, "Safety Limit MCPR"</u>

As stated in part by the licensee:

> [[ ]] the SLMCPR analysis for NMP2 reflects the actual plant core loading pattern and is performed for each reload core. The cycle-specific SLMCPR will be determined using the methods defined in NEDC-33576NP. As required by MELLLA+ LTR SER Limitation and Condition 12.6, the SLMCPR will be calculated at the rated statepoint (100% CLTP / 100% CF [core flow]), the upper right comer of the MELLLA+ upper boundary (100% CLTP / 85% CF), the lower left corner of the MELLLA+ upper boundary (77.6% CLTP /55% CF), and the CLTP at the ICF [increased core flow] statepoint (100% CLTP / 105% CF) (i.e., Figure 1-1 statepoints E, N, M, and F, respectively). See Section 1.2.1 for further information on the P/F statepoints.
>
> The currently approved off-rated CF uncertainty applied to the SLO operation is used for the minimum CF statepoint N and at 55.0% CF statepoint M. The calculated values will be documented in the SRLR.
>
> As required by Methods LTR SER Limitation and Condition 9.5 and MELLLA+ LTR SER Limitation and Condition 12.24.3, for MELLLA+ operation, a +0.02 addition will be added to the cycle-specific SLMCPR. The cycle-specific SLMCPR analysis will incorporate the +0.02 adder for MELLLA+ operation. The calculated values will be documented in the SRLR. A TS change will be requested if the current value is not bounding.
>
> [[
>
>]]

SAR Section 2.2.2, "Operating Limit MCPR"

The licensee stated in part that:

> [[ ]] the OLMCPR for NMP2 is calculated by adding the change in MCPR due to the limiting AOO event to the SLMCPR. [[
>
>]] if the Methods LTR SER and MELLLA+ LTR SER penalties are ignored for NMP2. The OLMCPR for NMP2 is determined on a cycle-specific basis from the results of the reload transient analysis, as described in NEDC-33576NP. The NMP2 cycle-specific analysis results are documented in the SRLR and included in the COLR. The MELLLA+ operating conditions do not change the methods used to determine this limit. A +0.01 adder will be applied to the resulting OLMCPR as required by Limitation and Condition 9.19 of the Methods LTR SER. In the event that the cycle-specific reload analysis is based on TRACG rather than ODYN for AOO, No 0.01 adder to the OLMCPR is required.
>
> [[
>
>]]

SAR Section 2.2.3, "Maximum Average Planar Linear Heat Generation Rate Limits"

The licensee stated in part that:

> [[ ]] the NMP2 MAPLHGR limits ensure that NMP2 does not exceed regulatory limits established in 10 CFR 50.46. Section 4.3 of this MELLLA+ SAR presents the evaluation to demonstrate that NMP2 meets the regulatory limits in the MELLLA+ operating domain. [[
>
>]] The MELLLA+ operating conditions do not change the methods used to determine this limit.

SAR Section 2.2.4, "Linear Heat Generation Rate Limits"

The licensee stated in part that:

> [[ ]] the NMP2 LHGR limits ensure that the plant does not exceed fuel Thermal-Mechanical (T-M) design limits. There are no changes to the NMP2 fuel or fuel design limits as a result of MELLLA+. NMP2 continues to use GE14 fuel. [[

]] The MELLLA+ operating conditions do not change the methods used to determine this limit.

SAR Section 2.2.5, "P/F Ratio"

The licensee stated in part that:

[[

]]

SAR Section 2.3, "Reactivity Characteristics"

SAR Section 2.3.1, "Hot Excess Reactivity"

As stated in part by the licensee:

[[

]] NMP2 continues to operate on a 24-month cycle. The MELLLA+ operating conditions do not change the NMP2 methods used to evaluate that sufficient hot excess reactivity exists to match the 24 -month cycle conditions.

[[

]]

SAR Section 2.3.2, "Strong Rod Out Shutdown Margin"

The licensee stated that:

[[

]] NMP2 current design and TS cold shutdown margin limits are unchanged by MELLLA+. The MELLLA+ operating conditions do not change the NMP2 methods used to evaluate that SRO shutdown margin meets the current NMP2 design and TS cold shutdown limits.

> [[
>
>]]

SAR Section 2.3.3, "SLCS Shutdown Margin"

As stated in part by the licensee:

> [[
>
>]] NMP2 current design and SLS TS requirements for minimum natural boron equivalent are unchanged by the SLS performance modification or MELLLA+. The MELLLA+ operating conditions do not change the NMP2 methods used to evaluate that SLS shutdown margin meets the current NMP2 design and SLS TS requirements. The SLS performance modifications are to increase the boron injection rate to support ATWS evaluations and do not affect the SLS shutdown margin evaluation.
>
> [[
>
>]]

SAR Section 2.4, "Stability"

The licensee stated in part that:

> The DSS-CD stability solution has been shown to provide an early trip signal upon instability inception prior to any significant oscillation amplitude growth and MCPR degradation *for both core-wide and regional mode oscillations. NMP2 will implement the DSS-CD solution consistent with the MELLLA+ LTR. DSS-CD implementation includes any limitations and conditions in the DSS-CD SER. In accordance with DSS-CD SER Limitation and Condition 5.1, because NMP2 is implementing DSS-CD using the NRC approved GEH Option III platform, a plant-specific review is not required. There were no changes proposed in the bounding uncertainty or in the process to bound the uncertainty in the MCPR.

SAR Section 2.4.1 "DSS-CD Setpoints"

As stated in part by the licensee:

> [[

]] As a part of DSS-CD implementation, the applicability checklist is incorporated into the reload evaluation process and is documented in the SRLR. DSS-CD implementation also includes incorporation of appropriate [[ ]] analyses to be performed if a specific reload analysis [[ ]] DSS-CD is incorporated per the requirements of the DSS-CD LTR. This implementation requires that a process for reviewing the DSS-CD setpoints for each reload analysis is in place. [[ ]] no further review of MELLLA+ is necessary to evaluate the adequacy of the DSS-CD setpoints.

<u>SAR Section 2.4.2, "Armed Region"</u>

The licensee stated in part that:

> [[ ]] no further review of MELLLA+ is necessary to evaluate the adequacy of the armed region.

<u>SAR Section 2.4.3, "Backup Stability Protection BSP"</u>

The licensee stated in part that:

> [[ ]] NMP2 will incorporate the DSS-CD solution in accordance with the requirements of the DSS-CD LTR. Implementation of DSS-CD in accordance with the DSS-CD LTR requires that NMP2 confirm the BSP approach is adequate as a part of the reload. [[ ]] no further review of BSP is required.

<u>SAR Section 2.5, "Reactivity Control"</u>

<u>SAR Section 2.5.1, "Control Rod Scram"</u>

As stated in part by the licensee:

> [[ ]] the NMP2 hydraulic control unit accumulators supply the initial scram pressure and, as the scram continues, the reactor becomes the primary source of pressure to complete the scram. The NMP2 reactor dome pressure is 1,035 psia (1,020 psig) and does not change as a result of MELLLA+ operating domain expansion. [[

]]

SAR Section 2.5.2, "CRD Positioning and Cooling"

The licensee stated in part that:

> [[ ]] for NMP2, the reactor coolant temperature does not increase. [[
>
>]]

SAR Section 2.5.3, "CRD Integrity"

As stated in part by the licensee:

> [[ ]] the NMP2 CRD mechanism has been analyzed for an abnormal pressure operation (the application of the maximum CRD pump discharge pressure) that bounds the ASME RPV [Reactor Pressure Vessel] overpressure condition. [[
>
>]] Also, as stated in SAR Section 3.1.2, for the ASME RPV overpressure condition, the peak RPV bottom head pressure is unchanged and remains less than the limit of 1,375 psig. [[
>
>]] and no further evaluation of CRD integrity is required as result of MELLLA+.

SAR Section 2.6, "Additional Limitations and Conditions Related to Reactor Core Fuel Performance"

The licensee reported in part that:

> For that subset of limitations and conditions relating to Reactor Core and Fuel Design, which did not fit conveniently into the organizational structure of the M+ [MELLLA+] LTR, the required information is presented in this Section of SAR. The information is identified by either the [MELLLA+] LTR SER limitation and condition, or the Methods LTR SER limitation and condition to which it relates.

SAR Section 2.6.1, "TGBLA/PANAC Version"

The licensee stated in part that:

> The most recent version TGBLA and PANAC at the time of analyses was used for cycle-specific analyses, as required by Methods LTR SER Limitation and Condition 9.1.

SAR Section 2.6.2, "MELLLA+ LTR SER Limitation and Condition 12.24.1"

The licensee stated in part that:

> [[
>]]

SAR Section 2.6.3, "LHGR and Exposure Qualification"

The licensee stated_in part that:

> Methods LTR SER Limitation and Condition 9.12 states that once the PRIME LTR (Attachment 10 - NEDC-33576P, Revision 0) and its application are approved, future license applications for EPU and MELLLA+ referencing LTR NEDC-33173P-A must utilize the PRIME T-M methods. The PRIME LTR was approved on January 22, 2010 and implemented in GESTAR II in September 2010. The NMP2 MELLLA+ SAR has a PRIME T-M basis. PRIME fuel parameters have been used in all analyses requiring fuel performance parameters.
>
> The T-M evaluation performed in support of the NMP2 MELLLA+ SAR was performed using the PRIME T-M methodology.

SAR Section 2.6.4, "GEXL-PLUS and Pressure Drop Database"

The licensee stated in part that:

> The applicability of the GE14 experimental GEXL-PLUS and pressure drop database is confirmed for operation in the MELLLA+ domain.
>
> The Methods LTR NEDC-33173P-A documents all analyses supporting the conclusions in this section that the application ranges of GEH codes and methods are adequate in the MELLLA+ operating domain. In accordance with MELLLA+ LTR SER Limitation and Condition 12.1, the range of mass fluxes and P/F ratios in the GEXL database covers the intended MELLLA+ operating domain. The database includes low flow, high qualities, and void fractions. There are no restrictions on the application of the GEXL-PLUS correlation in the MELLLA+ operating domain.

Section 2 of the SAR provides as function of the cycle exposure a comparison of NMP2 fuel performance versus other plants and cycles in Figures 2-1 through 2-6 for peak bundle power, peak bundle flow, peak LHGR, and exit void fraction for the peak bundle, maximum void and core average.

Section 2 of the SAR also provides power distributions, linear heat generation rates LHGR, and critical power ratios CPR at three points during the cycle.

3.2.2 SAR Section 3.0, "Reactor Coolant and Connected Systems"

SAR Section 3.1.1, "Flow-Induced Vibration"

As stated by the licensee in part that:

> For NMP2, maximum main steam [MS] line (MSL) flow in the MELLLA+ operating domain does not increase. MELLLA+ does not result in any increase to the NMP2 maximum MSL flow, and there is no effect on the FIV experienced by the SRVs or piping during normal operation.

SAR Section 3.2, "Reactor Vessel"

SAR Section 3.2.2, "Reactor Vessel Structural Evaluation"

The licensee stated in part that:

> For NMP2, there are no increases in the reactor operating pressure, or maximum steam or FW flow rates for the MELLLA+ operating domain expansion. Other NMP2 mechanical loads do not increase as a result of the MELLLA+ operating domain expansion. Therefore, there is no change in the stress and fatigue for the NMP2 reactor vessel components, and no further evaluation of NMP2 reactor vessel structural integrity is required.

SAR Section 3.3, "Reactor Internals"

SAR Section 3.3.1, "Reactor Internal Pressure Differences"

SAR Section 3.3.1.1, "Fuel Assembly and Control Rod Guide Tube Lift Forces"

The licensee stated in part that:

> For NMP2, the difference between the 100% CLTP / 105% core flow ICF operation point core exit steam flow and the 100% CLTP / 85% core flow MELLLA+ operation point core exit steam flow is essentially unchanged (less than a 0.4% increase). The differences between the vessel steam flow and FW flow rates for the two P/F points are essentially unchanged, as well (both less than a 0.2% decrease). The dome pressures for the two P/F points are identical. The small differences between the core exit

> steam flows, vessel steam flows and FW flow rates have a negligible effect on the fuel assembly and CRGT [control rod guide tube] lift forces calculated for normal, upset, emergency and faulted conditions. Therefore, because the NMP2 CF at the MELLLA+ statepoint at 85% CF is less than the current licensed operating domain statepoint at 105% CF, the normal, upset, emergency and faulted fuel assembly and CRGT lift forces for the MELLLA+ operating domain [[
>
>]]
> and no further evaluation of these forces is required.

SAR Section 3.3.1.2, "Reactor Internal Pressure Differences for Normal, Upset, Emergency and Faulted Conditions,"

The licensee stated in part that:

> For NMP2, the difference between the 100% CLTP / 105% core flow ICF operation point core exit steam flow and the 100% CLTP / 85% core flow MELLLA+ operation point core exit steam flow is less than a 0.4% increase. The differences between the vessel steam flow and FW flow rates for the two P/F points are both less than a 0.2% decrease. The dome pressures for the two P/F points are identical. The small differences between the core exit steam flows, vessel steam flows and FW flow rates have a negligible effect on the RIPDs [Reactor Internal Pressure Flted conditions. Therefore, because the NMP2 CF at the MELLLA+ statepoint at 85% CF is less than the current licensed operating domain statepoint at 105% CF, the normal, upset, emergency and faulted condition RIPDs for the MELLLA+ operating domain [[
>]] which includes ICF up to 105% RCF. [[
>
>]] and no further evaluation of these pressure differentials is required for normal, upset, emergency and faulted conditions.

SAR Section 3.4.1, "Flow-Induced Vibration (FIV) / FIV Influence on Piping"

The licensee stated in part that:

> For NMP2, there are no increases in the recirculation system, MS, or FW flow rates as a result of MELLLA+ operating domain expansion as compared to the current licensed operating domain, and there is no increase in flow in these systems for MELLLA+. Therefore, there is no increase in FIV for the safety-related thermowells and probes, as compared to the current licensed operating domain, and no further evaluation is required.

SAR Section 3.4.2, "Flow-Induced Vibration / FIV Influence on Reactor Internals"

The licensee stated in part that:

> For NMP2, the MELLLA+ operating domain expansion results in decreased core and recirculation flow as well as no increase in the MS, FW flow rates. The reduced CF and recirculation flow in the MELLLA+ domain **[[**
>
> **]]** Therefore, no further evaluation of FIV influence on reactor internals is required for the NMP2 MELLLA+ operating domain expansion.

SAR Section 3.5, "Piping Evaluation"

SAR Section 3.5.1.1, "Main Steam and Feedwater Piping Inside Containment"

The licensee stated in part that:

> **[[** **]]** for NMP2, the MS and connected branch piping (i.e., RCIC steam lines) and FW temperatures, pressures, and flows are within the rated operating parameters for the MS and FW systems. MS and FW temperatures, flows, and pressures at MELLLA+ conditions are bounded by the EPU temperatures, flows, and pressures, and as such are within the design values used in the design of the piping and supports chosen for worst case conditions. NMP2 MS and FW piping inside containment is designed in accordance with the original code of record, ASME BPV Code, Section III, Subsection NB, 1974 Edition. **[[**
>
> **]]** the temperatures, pressures, and flows in NMP2 MS and FW systems for MELLLA+ operation are within the range of rated operating parameters for those systems, and no further evaluation is

> required related to the NMP2 RCPB piping for MS and FW inside containment.
>
> [[ ]] the moisture carryover (MCO) for NMP2 may increase to a maximum of 0.25 wt. % during the cycle when NMP2 is operating at or near the MELLLA+ minimum CF rate. NMP2 implements programs adequate to manage this change in the erosion/corrosion rate as described in Section 10.7.2.
> [[
>]]
>
> The effect of MELLLA+ on the EPU AP load SC 09-01 evaluation has determined that the amplified response spectra (ARS) remains conservative for the rated power MELLLA+ Point N (Figure 1-1). The off-rated SC 09-01 methods show minor shifts in the ARS for selected nodes (P/F map Points A and N in Figure 1-1) as compared to the EPU bounding spectrum. The review of the EPU SC 09-01 AP load assessments show the minor shifts represent an insignificant change in the total load combination for these piping systems such that the conclusions reached for the EPU assessment remain unchanged.

<u>SAR Section 3.5.1.2, "Reactor Recirculation and Control Rod Drive Systems"</u>

The licensee stated in part that:

> [[ ]] for NMP2, the reactor recirculation and control rod drive (CRD) system temperatures, flows, and pressures at MELLLA+ conditions are bounded by the EPU temperatures, flows, and pressures, and as such are within the design values used in the design of the piping and supports chosen for worst case conditions.

<u>SAR Sections 3.5.1.3 "Other RCPB Piping Systems"; 3.5.1.3.1, "Reactor Coolant Pressure Boundary Piping – HPCS, LPCS, RHR/LPCL, and SLCS"; 3.5.1.3.2, "Other RCPB Piping Systems – RPV Head Vent Line and SRV Discharge Lines"; 3.5.1.3.3, "Other RCPB Piping System – RWCU"; and 3.5.1.3.4, "Other RCPB Piping – Safety Related Thermowelds"</u>

The licensee's technical justification is summarized below:

> Because all of the piping systems in Section 3.5.1.3 meet the criteria listed [[
>]] their susceptibility to erosion/corrosion does not increase, and no further evaluation of these other RCPB piping systems is required.

<u>SAR Section 3.5.1.4, "Other Than Category "A" RCPB Material"</u>

As stated in part by the licensee:

Category "A" materials exists in the RCPB piping. Category "A" is assumed to mean intergranular stress corrosion cracking (IGSCC) Category "A" that is a resistant material to IGSCC for BWR piping weldments in accordance with Generic Letter (GL) 88-01. Other than Category "A" is assumed to mean non-resistant or cracked materials for IGSCC BWR piping weldments in accordance with GL 88-01 (IGSCC Categories B through G). USAR Section 5.2-5 is only a general RCPB list and is not specifically related to IGSCC. The SER for GL 88-01, along with the associated technical evaluation, establishes the IGSCC categories and initial IGSCC related bases. The current IGSCC program is located within the in-service inspection (ISI) program plan (CNG-NMP2-ISI-003). CNG-NMP2-ISI-003, Section 6.1 specifically identifies 49 welds that are in the IGSCC other than Category "A" (Categories D and E shown in Tables 6-1 and 6-2 and summarized in Table 6-5 and Appendix E). CNG-NMP2-ISI-003-10 shows the implementation schedule and has the "ASME Section XI Category Item No." column as either "GLD" or "GL-E," which identifies the location of the weld.

The NMP2 ISI program for all ASME Code Class 1 and 2 RCPB piping is in accordance with an NRC staff approved alternate risk-informed inspection program utilizing the NRC approved Electric Power Research Institute (EPRI) methodology, Technical Report TR-1 12657, Revision B-A. In addition to the ASME Code, Section XI and the alternate risk-informed programs, NMP2 implements an augmented IGSCC inspection program in accordance with GL 88-01, NUREG-0313, and as modified by Boiling-Water Reactor Vessel and Internals Project (BWRVIP)-75 for IGSCC Category D weld examination frequency using normal water chemistry. NMP2 implements ASME Section XI, Appendix VIII for the performance demonstration for ultrasonic examination systems administrated through the EPRI performance demonstration initiative (PDI) program. Appendix VIII provided the requirements for the performance demonstration for ultrasonic examination procedures, equipment, and personnel to detect and size flaws. All of the above programs have been credited as an aging management program during the NMP2 license renewal process.

Continued implementation of the current program ensures the prompt identification of any degradation of RCPB components experienced during MELLLA+ operating conditions.

[[**]]** confirms that the augmented inspection program at NMP2 is adequate to address concerns related to other than Category "A" materials in the RCPB. **[[**

]]

SAR Section 3.5.2, "Balance-of-Plant Piping"

SAR Section 3.5.2.1, "Main Steam and Feedwater (Outside Containment)"

As stated by the licensee in part:

> Implementation of MELLLA+ does not increase the maximum operating temperature, pressure, flow rate, or mechanical loads for the MS and FW piping outside containment. MS and FW system temperatures, flows, and pressures at MELLLA+ conditions are bounded by the EPU temperatures, flows, and pressures, and as such are within the design values used in the design of the piping and supports chosen for worst case conditions. As such, the NMP2 MS and FW piping outside containment is unaffected by the operation in the MELLLA+ domain.

SAR Section 3.5.2.2, "Other Balance of Plant Piping Systems"

SAR Section 3.5.2.2.1, "Other Balance of Plant Piping Systems – RCIC, HPCS, LPCS, and RHR"

As stated by the licensee in part:

> Implementing the MELLLA+ does not change the maximum operating temperature, pressure, or flow rate, nor increase mechanical loads for any of the following systems: reactor core isolation cooling (RCIC), HPCS [high-pressure core spray], LPCS [low-pressure core spray], and RHR. In RCIC, HPCS, LPCS, and RHR system temperatures, flows, and pressures at MELLLA+ conditions are bounded by the EPU temperatures, flows, and pressures. As such, they are within the design values used in the design of the piping and supports chosen for worst case conditions. The above components are, therefore, unaffected by operation in the MELLLA+ domain.

SAR Section 3.5.2.2.2, "Other Balance of Plant Piping Systems, Offgas System, and Neutron Monitoring System"

The licensee's technical justification is summarized below:

> Implementation of MELLLA+ does not change the NMP2 reactor operating pressure or power level; therefore, these systems are unaffected by operation in the MELLLA+ domain.

SAR Section 3.6, "Reactor Recirculation System"

SAR Section 3.6.1, "System Evaluation"

As stated in part by the licensee:

> The NMP2 RRS operating conditions in the MELLLA+ operating domain are within the operating conditions in the current licensed operating domain (CLOD). For NMP2, there are no increases in the RRS temperature or flow rates as a result of MELLLA+ operating domain expansion as compared to the CLOD. For NMP2, there are no increases beyond design rated parameters in the RRS temperature, pressure, or flow rates as a result of MELLLA+ operating domain expansion as compared to the current licensed operating domain. RRS system temperature for the current licensed operating domain at 100% CF is 533.7°F and in the MELLLA+ operating domain at 85% CF is 530.7°F. RRS system pressures, at the discharge of the recirculation pump, will increase from 1,314.5 psia for the current licensed operating domain to 1,340.5 psia in the MELLLA+ operating domain. This slight increase in pressure is due to the adjustment of the FCV to approximately the 59% opened position and is within the design operating pressure of the RRS system components. For NMP2, SLO is not allowed in the MELLLA+ operating domain. [[
>
>]]

SAR Section 3.6.2, "Net Positive Suction Head"

The licensee's technical justification is summarized below:

> [[
>
>]] flow rate and FW temperature and they are changed by MELLLA+. Therefore, no further evaluation of reactor recirculation system NPSH is required.

SAR Section 3.6.3, "Single-Loop Operation"

The licensee's technical justification is summarized below:

> SLO [single-loop operation] is not allowed in the MELLLA+ operating domain.

SAR Section 3.7, "Main Steam Line Flow Restrictors"

As stated by the licensee in part:

> There is no increase in NMP2 MS flow as a result of MELLLA+ operating domain expansion. Thus, **[[** **]]** as a result of operating in the MELLLA+ domain.

SAR Section 3.8, "Main Steam Isolation Valves"

The licensee stated in part that:

> There is no increase in NMP2 MS pressure, flow, or pressure drop as a result of MELLLA+ operating domain expansion. The total MSL pressure drop at the TSVs is not significantly changed for MELLLA+. The main steam isolation valve (MSIV) pressure drop is also not significantly changed; **[[** **]]** as a result of operating in the MELLLA+ domain.

SAR Sections 3.9, "Reactor Core Isolation Cooling;" SAR Section 3.9.1, "System Hardware;" SAR Section 3.9.2, "System Initiation;" and SAR Section 3.9.3, "Net Positive Suction Head"

The licensee's technical justification is summarized below:

> Implementation of MELLLA+ does not change normal reactor operating pressure, decay heat loads, SRV setpoints, or RCIC system hardware, as the system initiation and NPSH requirements are unchanged for operation in the MELLLA+ domain. The RCIC system is further discussed in Section 3.5.3 of this SE.

SAR Section 3.10, "Residual Heat Removal System"

SAR Section 3.10.1, "LPCI Mode"

The low-pressure coolant injection (LCPI) mode, as it supports the LOCA response, is discussed in the NMP2 SAR, Section 4.2.4, "Low Pressure Coolant Injection."

SAR Section 3.10.2, "Suppression Pool and Containment Spray Cooling Modes"

The licensee's technical justification is summarized below:

[[

]]

SAR Section 3.10.3, "Shutdown Cooling Mode"

The licensee's technical justification is summarized below:

> Implementation of **[[** **]]** and this system is unaffected by operation in the MELLLA+ domain.

SAR Section 3.10.4, "Steam Condensing Mode"

This topic is not applicable to NMP2.

SAR Section 3.10.5, "Fuel Pool Cooling Assist"

The licensee's technical justification is summarized below:

> The fuel pool cooling assist mode uses existing RHR heat removal capacity and provides supplemental fuel pool cooling in the event that the fuel pool heat load exceeds the capability of the fuel pool cooling and cleanup system. **[[** **]]** therefore, operating in the MELLLA+ domain has no effect on the Fuel Pool Cooling Assist mode.

SAR Section 3.11, "Reactor Water Cleanup System"

SAR Section 3.11.1, "System Performance"

The licensee's technical justification is summarized below:

> For NMP2, there is no total increase in the quantity of fission products, corrosion products, and other soluble and insoluble impurities in the reactor water. In addition, there is no significant change in the FW line temperature, pressure, or flow rate. The FW flow rate in the MELLLA+ operating domain decreases slightly from the flow rate in the CLOD. The reactor pressure for the CLOD and in the MELLLA+ operating domain does not change. Therefore, the FW system resistance and operating conditions do not change, and the pressure at the reactor water cleanup (RWCU)/FW system interface does not change. The reactor and recirculation system parameters are bounded by, or unchanged, from EPU conditions. Therefore, there is no adverse effect on the RWCU inlet conditions due to MELLLA+. Because there is no change to the pressure or fluid thermal conditions experienced by the RWCU system, and because there is no increase in the quantity of fission products, corrosion products, and other soluble and insoluble impurities in the reactor water, the implementation of MELLLA+ has no effect on the RWCU system.

SAR Section 3.11.2, "Containment Isolation"

The licensee's technical justification is summarized below:

> For NMP2, there is no change in the FW line temperature, pressure, or flow rate. FW line temperature for the CLOD and in the MELLLA+ operating domain is 440.5 °F (upstream of the RWCU return). The FW flow rate in the MELLLA+ operating domain decreases slightly from the maximum flow rate in the CLOD. As such, the FW flow rates in the MELLLA+ operating domain remain within the FW flow rates in the CLOD. The reactor pressure for the CLOD and in the MELLLA+ operating domain does not change. As such, the FW system resistance and operating conditions do not change, and the pressure at the RWCU/FW system interface does not change for RWCU return lines. [[
>
>]]

3.2.3 SAR Section 4.0, "Engineered Safety Features"

The following Sections provide the summary of the licensee's discussions of its generic evaluation and confirmation of the following topics of SAR Section 4.0 for NMP2, using the approved methodology in the MELLLA+ SER.

SAR Section 4.1, "Containment System Performance"

SAR Section 4.1.1.1, "Long-Term Suppression Pool Cooling Temperature Response"

The licensee's technical justification is summarized below:

As result of operating in the MELLLA+ domain, the sensible and decay heat "do not increase", thus, prior results of the long –term SPC temperature response "remains bounded"

SAR Section 4.1.2.3, "SRV Piping - Containment Dynamic Loads" and Section 4.1.2.4, "SRV - Containment Dynamic Loads"

The licensee's technical justification is summarized below:

The safety relief valve (SRV) discharge containment loads depend on the SRV setpoints, reactor sensible and decay heat, and long-term SP temperature response. In the NMP2 SAR, Sections 4.1.2.3 and 4.1.2.4, the licensee provided an evaluation of the NMP2-specific containment dynamic loads due to SRV discharge. The licensee stated that because the SRV setpoints, reactor sensible and decay heat, and **[[** **]]** do not change from the current operating domain to the MELLLA+ operating domain, the containment loads due to SRV discharge are unaffected.

SAR Section 4.1.3, "Containment Isolation," SAR Section 4.1.4, "Generic Letter 89-10"

The licensee's technical justification is summarized below:

[[**]]** Therefore, no containment isolation system evaluations are required for NMP2.

SAR Section 4.1.5, "Generic Letter 89-16"

The licensee stated that

GL 89-16 is not applicable to NMP2.

SAR Section 4.1.6, "Generic Letter 95-07"

The licensee's technical justification is summarized below:

[[

]]

Therefore, it has no effect on operating in the MELLLA+ domain.

SAR Section 4.1.7, "Generic Letter 96-06"

The licensee's technical justification is summarized below:

[[

]]

Therefore, it has no effect on operating in the MELLLA+ domain.

SAR Section 4.2, "Emergency Core Cooling"

SAR Section 4.2.1, "High Pressure Coolant Injection"

The licensee stated in part that:

This system does not exist at NMP2.

SAR Section 4.2.2, "High Pressure Core Spray"

The licensee's technical justification is summarized below:

There is no change in the reactor operating pressure, decay heat, and the SRV setpoints as a result of operating in the MELLLA+ domain. [[

]] and no further evaluation of HPCS is required.

SAR Section 4.2.3, "Low Pressure Core Spray"

The licensee's technical justification is summarized below:

> [[ ]] there is no change to the reactor pressure as a result of MELLLA+ operating domain expansion. [[
>
>]] and no further evaluation of the LPCS system is required.

SAR Section 4.2.4, "Low Pressure Coolant Injection"

The licensee's technical justification is summarized below:

> [[ ]] there is no change to the reactor pressure as a result of MELLLA+ operating domain expansion. [[
>
>]] and no further evaluation of the LPCS system is required.

SAR Section 4.2.5, "Automatic Depressurization System"

The licensee's technical justification is summarized below:

> [[
>
>]]
> In addition, [[
>]] As such, operating in the MELLLA+ domain does not affect the operation of the ADS.

SAR Section 4.2.6, "ECCS Net Positive Suction Head"

The licensee's technical justification is summarized below:

> The ECCS and containment heat removal pumps are the RHR and core spray (CS) pumps. MELLLA+ does not result in an increase core power and decay heat or the heat addition to the SP during a LOCA, SBO, or Appendix R Fire event. The licensee stated that there are no physical changes in the piping arrangement that could impact the NPSH analysis. There is no change in the operator actions to throttle the RHR and CS pumps. NMP2 does not credit containment accident pressure for calculating the available NPSH for the ECCS pumps. For NMP2, the most limiting case for ECCS NPSH is confirmed to occur at the long-term suppression pool temperature during a LOCA, **[[**
> **]]**,
>
> The suppression pool temperature following an ATWS is bounded by EPU.
>
> The MELLLA+ LTR SER Limitation and Condition 12.23.9 requires that plant-specific applications must review the safety system specifications to ensure that all of the assumptions used for the ATWS SE indeed apply to their plant-specific conditions including providing information on crucial systems like HPCI [high-pressure coolant injection] and physical limitations like NPSH and maximum vessel pressure that RCIC and HPCI can inject. NMP2 does not have a HPCI system. In response to an NRC RAI for the EPU LAR, NMP2 performed NPSH evaluation for ECCS pumps for variety of scenarios including DBA-LOCA [design basis accident – loss-of-coolant accident] and ATWS. The NPSH evaluation did not credit containment accident overpressure. As discussed above, MELLLA+ suppression pool temperature for DBA-LOCA is bounded by EPU. In addition, MELLLA+ ATWS suppression pool temperature is also bounded by EPU ATWS as shown in Table 9-4. Therefore, reduction in MELLLA+ containment pressure has no effect on the ECCS pump operability in regard to NPSH. Therefore, NMP2 complies with MELLLA+ LTR SER Limitation and Condition 12.23.9 related to NPSH and ECCS pump operability.
>
> The EPU analysis of ECCS NPSH remains bounding for MELLLA+. The NRC reviewed the ECCS NPSH requirements as part of the EPU LAR, and stated in the NRC's SER for the NMP2 EPU LAR dated December 22, 2011, that the NMP2 ECCS NPSH meets the guidance in RG 1.1, does not credit containment accident pressure to ensure adequate NPSH, and meets NRC staff guidance on NPSH uncertainty and operation in maximum erosion zone.
>
> Therefore, operation in the MELLLA+ domain does not affect the available NPSH for the ECCS pumps.

SAR Section 4.3, "Emergency Core Cooling System Performance"

SAR Section 4.3.4, "Local Cladding Oxidation"

The licensee stated in part that:

> For the NMP2 SAR, Sections 4.3.2 and 4.3.3, show acceptable PCT [peak cladding temperature] results that meet the 2,200 °F limit. **[[**
>
> **]]** for operation in the MELLLA+ domain.

SAR Section 4.3.5, "Core-Wide Metal Water Reaction"

The licensee reported in part that:

> **[[** **]]** for NMP2, SAR Sections 4.3.2 and 4.3.3 show acceptable PCT results that meet the 2,200 °F limit. **[[**
>
> **]]**

SAR Sections 4.3.6, "Coolable Geometry," and 4.3.7, "Long-Term Cooling"

The licensee's technical justification is summarized below:

> Compliance with the coolable geometry and long-term cooling acceptance criteria were demonstrated generically for GEH BWRs. **[[**
>
> **]]**

SAR Section 4.3.8, "Flow Mismatch Limits"

The licensee stated in part that:

> For most plants, the limits on flow mismatch are more relaxed at lower CF rates. The drive flow mismatch affects the CF coastdown following the break. The effect of the drive flow mismatch on the LOCA evaluation is similar to a small change in the initial CF. **[[**
>
> **]]**

SAR Section 4.4, "Main Control Room Atmosphere Control System"

The licensee's technical justification is summarized below:

> There is no change in the NMP2 source term or release rates as a result of MELLLA+ operating domain expansion. This topic is discussed in SAR Section 8.0. As such, operating in the MELLLA+ domain has no effect on this system.

SAR Sections 4.5, "Standby Gas Treatment System;" 4.5.1, "Flow Capacity;" and 4.5.2, "Iodine Removal Capability"

The licensee's technical justification is summarized below:

> With respect to flow capacity, **[[ ]]** the design flow capacity of the NMP2 standby gas treatment system (SGTS) was selected to maintain the secondary containment at the required negative pressure to minimize the potential for exfiltration of air from the Reactor Building. **[[ ]]** No further evaluation is required.
>
> With respect to iodine removal capacity, **[[ ]]** the core fission product inventory is not changed by the MELLLA+ operating domain expansion (SAR Section 8.3), and coolant activity levels are defined by TS and do not change, so no change occurs in the SGTS adsorber iodine loading, decay heat rates, or iodine removal efficiency. **[[ ]]** No further evaluation of this topic is required.

SAR Section 4.6, "Main Steam Isolation Valve Leakage Control System"

NMP2 does not use a MSIV leakage control system (LCS).

SAR Section 4.7, "Post-LOCA Combustible Gas Control System"

The licensee stated in part that:

> In the NMP2 SAR, Section 4.7, the licensee provided an evaluation of the post-LOCA combustible gas control system. The NRC revised 10 CFR 50.44, "Combustible gas control for nuclear power reactors," in September 2003. The revised rule eliminated the requirements for hydrogen recombiners and relaxed the requirements for hydrogen and oxygen monitoring in containment. Revised 10 CFR 50.44 no longer defines a design-basis LOCA hydrogen release and eliminates requirements for hydrogen recombiners to mitigate such a release. The licensee has adopted the revised rule per License Amendment No. 124, issued in April 2008. This amendment also eliminated the requirements for hydrogen recombiners for the purpose of mitigating post-LOCA hydrogen release, although NMP2 has chosen to leave the recombiners in place and remain functional. NMPNS made commitments to maintain the hydrogen and oxygen monitoring systems capable of diagnosing beyond DBAs [design basis accidents]. The MELLLA+ operating domain expansion has no effect on the design of these systems or on the ability of these systems to perform their intended functions. However, as this system is no longer required to be maintained as a post-LOCA combustible gas control system, no further evaluation is necessary relative to the MELLLA+ operating domain expansion.

3.2.4 SAR Section 5.0, "Instrumentation and Control"

SAR Section 5.1.1, "Average Power Range, Intermediate Range, and Source Range Monitors"

The licensee stated in part that:

> The APRM output signals are calibrated to read 100% at the CLTP. There is no change in NMP2 core power as a result of the MELLLA+ operating domain expansion. In addition, **[[**
>
> **]]** The APRMs, IRMs, and SRMs are installed at NMP2 in accordance with the requirements established by the GEH design specifications. NMP2 uses normal plant procedures to adjust the IRMs to ensure adequate overlap with the SRMs and APRMs. As such, operating in the MELLLA+ domain does not affect the Average Power Range, Intermediate Range, and SRMs.

SAR Section 5.1.2, "Local Power Range Monitors"

The licensee stated in part that:

> **[[** **]]**, there is no change in the neutron flux experienced by the NMP2 LPRMs resulting from operating in the MELLLA+ domain expansion. Analysis was performed to confirm that bypass voiding at the D Level LPRM does not exceed 5%. Therefore, **[[**
>
> **]]** The LPRMs are installed at NMP2 in accordance with the requirements established by the GEH design specifications. As such, the operability, neutronic life, and accuracy of the LPRM detectors are unaffected by operating in the MELLLA+ domain.

SAR Section 5.1.3, "Rod Block Monitors"

The licensee stated in part that:

> **[[** **]]** and as described in SAR Sections 5.1.1 and 5.1.2, the **[[**
>
> **]]** As such there is no change in RBM performance by operating in the MELLLA+ domain.

SAR Section 5.1.4. "Rod Worth Minimizer"

The licensee stated in part that:

> [[ ]] the function of the RWM is to support the operator by enforcing rod patterns until reactor power has reached appropriate levels. The RWM functions to limit the local power in the core to control the effects of the postulated control rod drop accident (CRDA) at low power. [[ ]] Therefore, no further evaluation is required.
>
> [[ ]] the NMP2 RWM supports the operator by enforcing rod patterns until reactor power has reached appropriate levels. [[ ]] Therefore, no further evaluation is required.

SAR Section 5.1.5, "Traversing Incore Probes"

The licensee stated in part that:

> To address the MELLLA+ LTR SER Limitation and Condition 12.15, bypass voiding above the D-Level, an analysis was performed to identify the region on the MELLLA+ P/F map that has potentially unacceptable bypass voiding for the thermal traversing incore probes (TIPs) installed at NMP2. In the absence of bypass voiding greater than 5% no actions are required regarding the TIPs resulting from the MELLLA+ operating domain expansion. [[ ]]
>
> [[ ]]
>
> Analysis shows that there is a small region of the MELLLA+ power flow domain near point M in Figure 5-1 where the hot channel voiding at the TIP exit exceeds 5% thus requiring specific attention per Limitation and Condition 12.15. [[

>]] TIP operation and LPRM calibration in the remainder of the MELLLA+ domain are not adversely affected by the void conditions in the bypass region. NMPNS control room operators and Reactor Engineers will be trained on this requirement and station procedures will be modified accordingly.
>
> [[ ]] there is no change in the neutron flux experienced by the NMP2 TIPs resulting from the MELLLA+ operating domain expansion.
>
> [[ ]] The TIPs are installed at NMP2 in accordance with the requirements established by the GEH design specifications.

<u>SAR Section 5.2, "Balance of Plant Monitoring and Control," SAR 5.2.1, "Pressure Control System," SAR Section 5.2.2, "Turbine Steam Bypass Sytem (Normal Operation)," SAR Section 5.2.3, "Turbine Steam Bypass Sytem (Safety Analysis)," SAR Section 5.2.4, "Feedwater Control System (Normal Operation)," SAR Section 5.2.5, "Feedwater Control System (Safety Analysis)," and SAR Section 5.2.6, "Leak Detection System"</u>

The licensee stated in part that:

> With respect to the topics in SAR Sections 5.2.1 through 5.2.6, because there is no change in the pressure, steam flow, or system dynamic characteristics, there are no safety or non-safety-related changes to these systems resulting from the implementation of MELLLA+.

<u>SAR Section 5.3, "Technical Specification Instrument Setpoints"</u>

<u>SAR Section 5.3.2, "Rod Block Monitor"</u>

The licensee stated in part that:

> [[ ]] for NMP2, there is no change in reactor power level as a result of MELLLA+ operating domain expansion. NMP2 has an ARTS [APRM/RBM Techincal Specifications] system [[
>
>]]
>
> Therefore, no further evaluation of the RBM TS values is required as a result of MELLLA+.

3.2.5 SAR Section 6.0, "Electrical Power and Auxiliary Systems"

SAR Section 6.1, "Alternating Current Power"

The licensee stated in part that:

> [[ ]] there is no change in the NMP2 reactor thermal power or the electrical output from the station that results from the MELLLA+ operating domain expansion. [[
>
>]]

SAR Section 6.2, "Direct Current Power"

The licensee stated in part that:

> [[
>]] as a result of MELLLA+ operating domain expansion. The MELLLA+ operating domain expansion does not change system requirements for control or motive power loads.

SAR Section 6.3, "Fuel Pool"

SAR Section 6.3.1, "Fuel Pool Cooling"

The licensee stated in part that:

> [[ ]] NMP2 reactor power level does not increase as a result of MELLLA+ operating domain expansion. [[
>
>]]

SAR Section 6.3.2, "Crud Activity and Corrosion Products"

The licensee stated in part that:

> [[
>
>]]

SAR Section 6.3.3, "Radiation Levels"

The licensee stated in part that:

> [[
>
>]]

SAR Section 6.3.4, "Fuel Racks"

The licensee stated in part that:

> [[ ]] the MELLLA+ operating domain expansion does not increase the NMP2 core power level. [[
>
>]]

SAR Section 6.4, "Water Systems"

The licensee stated in part that:

> [[ ]] for NMP2, the MELLLA+ operating domain expansion does not affect the performance of the safety-related emergency service water system or the RHR service water system during and following the most limiting design basis event, the LOCA, as discussed in SAR Section 4.3. [[
>
>]]

SAR Section 6.5, "Standby Liquid Control System"

SAR Section 6.5.1, "Shutdown Margin"

The licensee stated in part that:

> [[
>]]
> Because no new fuel product line designs are introduced for MELLLA+ operating domain expansion, the USAR Section 9.3.5 limit for minimum reactor coolant boron concentration of 780 ppm natural boron does not change as a result of MELLLA+ operating domain expansion.

SAR Section 6.6, "Heating, Ventilation, and Air Conditioning"

The licensee stated in part that:

> **[[** **]]** for NMP2, HVAC systems, the process temperatures and heat loads from motors and cables are bounded by the EPU process temperatures and heat loads and as such are within the design of the HVAC equipment chosen for worst case conditions. **[[**
>
> **]]** and implementation of MELLLA+ has no effect on these systems.

SAR Section 6.7, "Fire Protection"

The licensee stated in part that:

> **[[** **]]** for NMP2, these parameters do not change as a result of MELLLA+ operating. As discussed in Section 1.2.3, decay heat does not change as a result of MELLLA+ operating domain expansion. Reactor vessel water level response is unchanged by MELLLA+ operating domain expansion. Operator response times are not affected by MELLLA+ because: **[[**
>
> **]]**
>
> The effect of MELLLA+ operating domain expansion on PCTs was evaluated SAR Section 4.3 by the licensee and found to be acceptable. The effect of MELLLA+ operating domain expansion on peak suppression pool (SP) temperatures and containment pressure response are evaluated in the SAR, Section 4.1 and found to be concluded to be bounded by EPU conditions in SAR Sectin 4.1. **[[**
>
> **]]**

SAR Section 6.8, "Other Systems Affected"

The licensee stated in part that:

> **[[** **]]** the NMP2 systems evaluated **[[** **]]** were

reviewed for MELLLA+ operating domain expansion to ensure that all significantly affected systems were addressed. This topic confirms that those systems that are significantly affected by the MELLLA+ operating domain expansion are addressed in this report. Other systems not addressed by this report are not significantly affected by the MELLLA+ operating domain expansion.

3.2.6 <u>SAR Section 7.0, "Power Conversion Systems"</u>

<u>SAR Sections 7.1, "Turbine-Generator," 7.2, "Condenser and Steam Jet Air Ejectors," 7.3, "Turbine Steam Bypass," and 7.4, "Feedwater and Condensate Systems"</u>

The licensee stated in part that:

> Implementation of MELLLA+ does not change power level, the reactor operating pressure, MS steam flow rates, FW flowrates, or FW fluid temperature ranges; therefore, the power conversion systems are unaffected by operation in the MELLLA+ domain.

3.2.7 <u>SAR Section 8.0, "Radwaste Systems and Radiation Sources"</u>

<u>SAR Section 8.1, "Liquid and Solid Waste Management"</u>

<u>SAR Section 8.1,2, "Solid Volumes"</u>

The licensee stated in part that:

> [[ ]] there is no change in the reactor power level as a result of MELLLA+ operating domain expansion. For NMP2, there are no increases in the MS or FW flow rates. The NMP2 MCO will be monitored and controlled to ≤ 0.25 wt. % within the analytical assumption of 0.35 wt. % used in the determination of post-shutdown radiation levels.

<u>SAR Section 8.2, "Gaseous Waste Management"</u>

<u>SAR Section 8.2.1, "Offsite Release Rate"</u>

The licensee stated in part that:

> [[ ]] the NMP2 radiological release rate is administratively controlled to remain within existing release rate limits. In addition, none of the applicable identified parameters are affected by the MELLLA+ operating domain expansion. There is no change to the offgas system. [[ ]]

SAR Section 8.2.2, "Recombiner Performance"

The licensee stated in part that:

> [[ ]] the NMP2 radiolytic gas flow rate, the catalytic recombiner temperature, and the offgas condenser heat load, as well as components downstream of the offgas condenser does not change as a result of MELLLA+ operating domain expansion. Therefore, the NMP2 recombiner performance is unaffected by the MELLLA+ operating domain expansion.

SAR Section 8.3, "Radiation Sources in the Reactor Core"

The licensee stated in part that:

> [[ ]] the reactor power does not increase as a result of the MELLLA+ operating domain expansion. NMP2 core average exposure is [[ ]] No further evaluation of radiation sources in the reactor core is required.

SAR Section 8.4, "Radiation Sources in Reactor Coolant"

SAR Section 8.4.1, "Coolant Activation products"

The licensee stated in part that:

> [[ ]] the reactor power does not increase as a result of MELLLA+ operating domain expansion. The NMP2 steam flow rate does not change as a result of MELLLA+ operating domain expansion. [[ ]]

SAR Section 8.6, "Normal Operation Off-Site Doses"

SAR Section 8.6.1, "Plant Gaseous Emissions"

The licensee stated in part that:

> [[ ]] the reactor power does not change as a result of the MELLLA+ operating domain expansion. The NMP2 steam flow rate does not change as a result of the MELLLA+ operating domain expansion. [[ ]]

SAR Section 8.6.2, "Gamma Shine from the Turbine"

The licensee stated in part that:

> [[ ]] and as discussed in SAR Section 3.2.1, the change in flux as a result of the MELLLA+ operating domain expansion is insignificant. The NMP2 steam flow rate does not change as a result of the MELLLA+ operating domain expansion. [[ ]]

3.2.8 SAR Section 9.0, "Reactor Safety Performance Evaluations"

SAR Section 9.1, "Anticipated Operational Occurrences"

AOOs are also discussed in Section 3.4.8 of this SE.

SAR Section 9.1.3, "Non-Limiting Events"

The licensee stated in part that:

> [[ ]]

SAR Section 9.2, "Design Basis Accidents and Events of Radiological Consequence"

SAR Section 9.2.1, "Design Basis Events"

SAR Section 9.2.1.1, "Control Rod Drop Accident"

The licensee stated in part that:

> **[[**
>
> **]]** For Event 1, the source term is based on fission products from failed fuel and the instantaneous transport to the condenser remains conservative for MELLLA+, therefore Event 1 is unchanged for MELLLA+. The source term for Event 2 is based on the maximum activity allowed under the MSL radiation monitor safety limit, therefore the analyzed condition in Event 2 is bounding for MELLLA+.
>
> The CRDA release is dependent on the source terms and maximum peaking factor. Operation in the MELLLA+ operating domain does not affect the alternate source term (AST) CRDA source term and the peaking factor remains bounding. **[[**
>
> **]]**

SAR Section 9.2.1.2 "Instrument Line Break Accident (ILBA)"

The licensee stated in part that:

> **[[**
>
> **]]**

Therefore, the ILBA evaluation is not affected by the MELLLA+ operating domain expansion.

SAR Section 9.2.1.3, "Main Steam Line Break Accident (MSLBA) (Outside Containment)"

The licensee stated in part that:

[[

]] In addition, the analysis of record for the worst-case MSLBA radiological consequences is at hot standby conditions, which is outside of the MELLLA+ operating domain. Therefore the NMP2 MSLBA evaluation is not affected by the MELLLA+ operating domain Expansion.

SAR Section 9.2.1.4, "Loss-of-Coolant Accident (Inside Containment)"

The licensee stated in part that:

[[

]] Therefore, the NMP2 LOCA evaluation is not affected by the MELLLA+ operating domain expansion.

SAR Section 9.2.1.5, "Feedwater Line Break"

The licensee stated in part that:

> [[
>
>]] Therefore, the NMP2 FW line break evaluation is not affected by the MELLLA+ operating domain expansion.

SAR Section 9.2.1.7, "Fuel Handling Accident (FHA)"

The licensee stated in part that:

> [[
>
>]] Therefore, the NMP2 FHA evaluation for the MELLLA+ operating domain is bounded by the analysis for the CLOD.

SAR Section 9.2.1.8, "Offgas Failure"

The licensee stated in part that:

> [[
>
>]]. Therefore, the NMP2 offgas system failure evaluation is not affected by the MELLLA+ operating domain expansion.

SAR Section 9.2.1.9, "Cask Drop"

The licensee stated in part that:

> [[
>
>]] Therefore the NMP2 cask drop evaluation for the MELLLA+ operating domain is bounded by the analysis for the current licensed operating domain.

SAR Section 9.2.2, "Other Events with Radiological Consequences"

The licensee stated that:

> This topic is not applicable to NMP2.

SAR Section 9.3, "Special Events"

SAR Section 9.3.2, "Station Blackout"

The licensee stated in part that:

> **[[** **]]** there is no change in the reactor power level as a result of the MELLLA+ operating domain expansion. As discussed in Section 1.2.3, there is no significant change in decay heat as a result of the MELLLA+ operating domain expansion. For NMP2, there are no increases in reactor operating pressure as result of MELLLA+ operating domain expansion. For NMP2, there are no significant changes in the MS flow rate. **[[**
>
> **]]**

3.2.9 SAR Section 10.0, "Other Evaluations"

SAR Section 10.1, "High Energy Line Break"

SAR Section 10.1.1, "Steam Lines"

The licensee stated in part that:

> **[[** **]]** a review of the heat balances produced for operating in the MELLLA+ expansion domain confirms that there is no effect on the steam pressure or enthalpy at the postulated break locations (e.g., MS and RCIC). **[[**
>
> **]]**

SAR Section 10.1.2, "Balance-of-Plant Liquid Lines"

The licensee stated in part that:

> [[ ]] a review of the heat balances produced for operating in the MELLLA+ domain confirmed that there is no effect on the liquid line conditions at the postulated FW break locations. [[ ]]

SAR Section 10.1.3, "Other Liquid Lines"

The licensee stated in part that:

> [[ ]] a review of the heat balances produced for operating in the MELLLA+ domain confirmed that there is no effect on the liquid line conditions (excluding FW, which is addressed in the NMP2 SAR, Section 10.1.2) at the postulated break locations. [[ ]] The scope of these evaluations includes MELLLA+ operating domain expansion effects on subcompartment pressures and temperatures, pipe whip, jet impingement, and flooding, consistent with the plant licensing basis.

SAR Section 10.2, "Moderate Energy Line Break"

SAR Section 10.2.1, "Flooding"

The licensee stated in part that:

> [[ ]] a review of the NMP2 auxiliary flow rates and system inventories shows that MELLLA+ operating domain expansion does not affect the flow rates of moderate energy piping systems. Also, for NMP2, no operational modes evaluated for MELB [moderate energy line break] are affected by MELLLA+ operating domain expansion. [[ ]]

SAR Section 10.2.2, "MELB Environmental Qualification"

The licensee stated in part that:

> **[[** **]]** a review of the NMP2 auxiliary flow rates and system inventories shows that operating in the MELLLA+ domain does not affect the flow rates of moderate energy piping systems. Also, for NMP2, no operational modes evaluated for MELB [moderate energy line break] are affected by MELLLA+ operating domain expansion. **[[**
>
> **]]**

SAR Section 10.3, "Environmental Qualification"

SAR Section 10.3.1, "Electrical Equipment"

The licensee stated in part that:

> **[[** **]]** the reactor power does not increase as a result of MELLLA+ operating domain expansion. There is no change in normal operation radiation levels. There is also no change in decay heat. For NMP2, there are no increases in reactor operating pressure, MS or FW flow rates. **[[**
>
> **]]** as result of operating in the MELLLA+ domain.

SAR Section 10.3.2, "Mechanical Equipment With Non-Metallic Components"

The licensee stated in part that:

> **[[** **]]** for NMP2, normal process temperatures are not affected by MELLLA+. **[[**
>
> **]]** as result of operating in the MELLLA+ domain.

SAR Section 10.3.3, "Mechanical Component Design Qualification"

> [[ ]] for NMP2, normal process temperatures, pressures, and flow rates are not affected by MELLLA+. [[
>
>]]

SAR Section 10.7, "Plant Life"

SAR Section 10.7.2, "Flow-Accelerated Corrosion"

The licensee stated in part that:

> [[ ]] for NMP2, there are no significant changes in MS or FW temperatures or MS or FW flow rates. As discussed in SAR Section 3.3.3, there is an increase in MCO during the cycle for a short duration. This increase in MCO has no significant effect on FAC [flow-accelerated corrosion] parameters. Therefore, there is no significant change in the potential for FAC in the MS system.
>
> The evaluation of and inspection for flow-induced erosion/corrosion in piping systems affected by flow-accelerated corrosion (FAC) is addressed by compliance with NRC GL 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning." The requirements of GL 89-08 are implemented at NMP2 by utilization of the Electric Power Research Institute (EPRI) generic program, CHECWORKS™. NMP2-specific parameters are entered into this program to develop requirements for monitoring and maintenance of specific system piping. The FAC monitoring programs are adequate to manage potential effects of MELLLA+ operating domain expansion.
>
> In addition to FAC, a periodic non-destructive examination program was established to inspect safety-related piping and heat exchangers at known or suspected high corrosion, biofouling or silt buildup areas in response to GL 89-13. This program is supplemented by visual inspections of opened piping and heat exchangers whenever possible.
>
> The Maintenance Rule also provides oversight for other mechanical and electrical components important to plant safety, to monitor performance and guard against age-related degradation. The longevity of NMP2 equipment is not affected by the MELLLA+ operating domain expansion.

> [[ ]] and SAR Section 3.3.4.e, the MCO for NMP2, may increase to a maximum value of 0.25 wt. % for a period of time during the cycle when NMP2 is operating at or near the MELLLA+ minimum CF rate. The EPU FAC evaluation for steam piping assumed a 0.25 wt. % MCO, which bounds the maximum predicted 0.236 wt. % MCO in the MELLLA+ operating domain. NMP2 implements programs adequate to manage this change in the erosion/corrosion rate.
> [[
>
>]]

SAR Section 10.8, "NRC and Industry Communications"

The licensee stated in part that:

> The evaluations and calculations included in this MELLLA+ SAR, along with any supplements, demonstrate that operating in the MELLLA+ domain can be accomplished within the applicable design criteria. Because these evaluations of plant design and safety analyses inherently include any effect as a result of NRC and industry communications, it is not necessary to review prior communications.

3.2.10 NRC Staff's Conclusions – Licensee's Confirmation of Generic MELLLA+ Dispositions

The NRC staff has concluded that for the generic dispositions discussed in Sections 3.2.1 through 3.2.9 above, operation in the MELLLA+ domain does not change the operation of the NMP2 from its current licensing basis. In general, this conclusion was based on several limitations or conditions of operating in the MELLLA+ domain, including the following:

- Reactor power level unchanged
- Fuel design unchanged
- Reactor temperature and pressure unchanged
- Design and accident containment pressure and temperature and SP temperature unchanged
- Reduced core flow in the MELLLA+ domain
- No change to safety and balance of plant (BOP) system hardware or capability
- Operating temperatures, pressures, and flows for safety and BOP systems unchanged
- Sensitivity to MELLLA+ is small enough that the required plant cycle-specific reload analysis process is sufficient and appropriate for establishing the MELLLA+ licensing basis
- Approximately the same decay heat loads for the core and SFP
- Source term or release rates unchanged
- Core fission product inventory unchanged

Based on the above, the NRC staff finds that the licensee's confirmations of generic dispositions are acceptable, and the NRC staff also concludes that the above topics have been dispositioned by one of the four criteria proposed by the licensee as noted at the beginning of Section 3.2 of this SE.

3.3 Licensee's Plant-specific Dispositions for NMP2

3.3.1 SAR Section 2.0, "Reactor Core and Fuel Performance"

Even though the licensee concluded that the topics in this section met the generic disposition of the MELLLA+ SER, the NRC staff performed a review to confirm these conclusions. The following subsections of the SAR Section 2 are addressed in this SE as follows:

- SAR Section 2.1, "Fuel Design and Operation" – SE Section 3.4.1
- SAR Section 2.2, "Thermal Limits Assessment" – SE Section 3.4.1
- SAR Section 2.3, "Reactivity Characteristics" – SE Section 3.4.1
- SAR Section 2.4, "Stability" – SE Section 3.4.1
- SAR Section 2.5, "Reactivity Control" – SE Section 3.4.1
- SAR Section 2.6, "Additional Limitations and Conditions Related to Reactor Core and Fuel Performance" – SE Section 3.6

The NRC staff has reviewed the impact on the fuel system of the proposed MELLLA+ operating domain extension based on the licensee-provided analyses for normal operation, AOOs, and infrequent and special events. The complete NRC staff evaluation of these results is documented in Sections 3.4.8 and 3.4.9 of this SE. As seen in these evaluations, operation at the lower MELLLA+ core flow rates has an impact on transient response, and the effect on fuel becomes slightly more severe for some events. To mitigate these events, the licensee proposes to use more restrictive setpoints consistent with the AOO ΔCPR methodology, so that the final safety limit minimum critical power ratio (SLMCPR) limit is maintained. The licensee analyses demonstrate that, with the proposed NMP2 MELLLA+ setpoints, fuel damage is not expected for any AOO or analyzed special events, and core coolability is always maintained. Thus, the NRC staff concludes that the impact on fuel, while operating with the more restrictive setpoints at the lower MELLLA+ flows, is minimal.

3.3.2 SAR Section 3.0, "Reactor Coolant and Connected Systems"

Following the approved methodology in the MELLLA+ SER, Section 3.0 of the SAR evaluated NMP2 on a plant-specific basis for the following topics.

SAR Section 3.1, "Nuclear System Pressure Relief And Overpressure Protection"

SAR Section 3.1.2, "Overpressure Relief Capacity"

The licensees SAR states:

> The pressure relief system prevents overpressurization of the nuclear system during AOOs, the plant ASME upset overpressure protection event, and postulated ATWS events. The SRVs along with other functions provide this protection. For NMP2, the limiting overpressure event is the main steam isolation valve closure with scram on high flux (MSIVF) event. The peak RPV bottom head pressure is unchanged and remains less than the ASME limit of 1,375 psig.
>
> The SRV setpoint tolerance is independent of the MELLLA+ operating domain expansion. The AOO, ASME overpressure, and ATWS response evaluations for MELLLA+ are performed using existing NMP2 SRV setpoint tolerances. The SRV setpoint tolerances are monitored at NMP2 for compliance to the TS requirements.
>
> [[ ]] There are no changes made to the NMP2 licensing basis for the ASME overpressure event.
>
> [[ ]]. The SRV tolerance assumed in the NMP2 ASME overpressure event analysis is 3%. The tolerance is consistent with the actual SRV performance testing conducted on the NMP2 SRVs per TS SR 3.4.4.1.
>
> [[ ]] There are no changes to the existing licensing basis assumptions and code inputs used for the NMP2 ASME overpressure event analysis.
>
> The ASME overpressure analysis for NMP2 was performed at the 105% ICF core flow statepoint, and at the 85% minimum CF statepoint using an approximate MELLLA+ equilibrium core. The analysis of the limiting overpressure event for NMP2 demonstrates that no change in overpressure relief capacity is required. [[

]] This process is unchanged by MELLLA+.

The licensee's evaluation concludes that, for NMP2, the limiting overpressure event is the Main Steam Isolation Valve Closure with Scram on High Flux. The peak RPV bottom head pressure is unchanged and remains less than the ASME limit of 1,375 psig for AOOs. The SRV tolerance assumed in the NMP2 ASME overpressure event analysis is 3%. The NRC staff finds this tolerance to be consistent with the actual SRV performance testing at NMP2.

For non-AOOs, the licensee concludes in their ATWS analysis concludes that overpressure relief capacity is adequate.

Systems providing overpressure protection for the RCPB are also discussed in Section 3.5.2 of the SE.

<u>SAR Section 3.2.1, "Reactor Vessel/Fracture Toughness"</u>

MELLLA+ operation results in slightly higher fluxes at the vessel because of the reduced moderation. The NMP2 SAR estimates that the change in peak fluence is **[[**
]] which is negligible, and does not require changes to the current operating practices.

1. Reactor Internals
   a. Reactor Internals Pressure Differences Acoustic and Flow-Induced Loads for faulted conditions.

The plant-specific LOCA analysis concludes that the loads **[[**
]] as a result of MELLLA+ operating domain expansion.

   b. Reactor Internals Structural Evaluation for Normal, Upset, and Emergency Conditions.

[[
]]

   c. Steam Dryer Separator Performance.

The analysis indicates that there will be a small approximately 0.1 wt. % increase in moisture in the separators. The separator moisture content is monitored during operation to ensure it remains within acceptable limits.
The licensee states:

> The MELLLA+ operating domain expansion results in a slightly higher operating neutron flux in the upper portion of the core due to decreased water density. The effect of this water density reduction is **[[**
> **]]** in peak vessel and peak shroud flux. In accordance with MELLLA+ LTR SER Limitation and Condition 12.8, the

MELLLA+ flux is calculated using the GEH flux evaluation methodology contained in NEDC-32983P-A, which is consistent with Regulatory Guide (RG) 1.190 and was approved by the NRC in November 2005. The evaluation is based on an idealized equilibrium core loading which is not a bounding core design. This core loading is intended to show general trends for the purpose of comparison and demonstrating the anticipated effect on flux and fluence. The NMP2 RG 1.190 fluence program monitors actual core operations to determine the effect on fracture toughness. The MELLLA+ operating domain flux distribution is assumed to be similar to that of current licensed operating domain flux distribution, whereas the magnitude of flux level is proportional to the thermal power. The change to the NMP2 54 effective full power years (EFPYs) vessel internal diameter (ID) peak fluence as a result of implementing MELLLA+ is [[

]] Key flux/fluence comparisons at 120% OLTP are provided in Table 3-1.

Because there is no change to the NMP2 54 EFPY Vessel ID peak fluence as a result of MELLLA+, there is no change to the beltline adjusted reference temperature (ART). The pressure/temperature curves do not require revision as a result of MELLLA+ operating domain expansion.

Because there is no change to the NMP2 54 EFPY Vessel ID peak fluence as a result of MELLLA+, there is no change to the upper shelf energy (USE). NMP2 continues to meet the 50 ft-lb requirement in 10 CFR 50, Appendix G.

Because there is no change to the NMP2 54 EFPY Vessel ID peak fluence as a result of MELLLA+, there is no change to the Weld Inspection Relief criteria for circumferential welds. Therefore, the inspection relief request does not require revision as a result of MELLLA+ operating domain expansion.

As a result of MELLLA+ there is no change in the NMP2 54 EFPY Vessel ID peak fluence. Therefore, there are no changes to the NMP2 ART, USE, or Weld inspection relief values as a result of MELLLA+.

SAR Section 3.3, "Reactor Internals"

SAR Section 3.3.1, "Reactor Internal Pressure Differences"

SAR Section 3.3.1.3, "Reactor Internal Pressure Differences (Acoustic and Flow-Induced Loads) for Faulted Conditions"

The licensee states:

> As part of the RIPDs, the faulted acoustic and flow induced loads in the RPV annulus on jet pump, core shroud and core shroud support resulting from the recirculation line break LOCA have been considered in the NMP2 evaluation. **[[**
>
> **]]** and NMP2 RIPDs for faulted conditions continue to be acceptable.

Based on the above discussion, the NRC staff concludes that operating in the MELLLA+ domain does not affect these loads.

SAR Section 3.3.2, "Reactor Internals Structural Evaluation (Normal, Upset, and Emergency, Conditions)"

[[

]]

Based on the above, the NRC staff concludes that operating in the MELLLA+ domain has no effect on this topic.

SAR Section 3.3.2.1, "Reactor Internals Structural Evaluation for Faulted Condition"

[[

]]

Based on the above, the NRC staff concludes that operating in the MELLLA+ domain has no effect on this topic.

SAR Sections 3.3.3, "Steam Separator and Dryer Performance,"

The licensee states:

> The performance of the NMP2 steam separator-dryer has been evaluated to determine the moisture content of the steam leaving the RPV. Compared to the current licensed operating domain (100% CF statepoint), the average separator inlet flow decreases and the average separator inlet quality increases at MELLLA+ conditions. These factors, in addition to the core radial power distribution, affect the steam separator-dryer performance. Steam separator-dryer performance was evaluated at equilibrium cycle limiting conditions of high radial power peaking and 85% RCF to assess their capability to provide the quality of steam necessary to meet operational criteria at MELLLA+ operating conditions.
>
> The evaluation of steam separator and dryer performance indicates that MCO increases at MELLLA+ conditions. This increase resulted in a MCO value above the original moisture performance specification of 0.10 wt. %. Section 3.3.4 identifies a plant-specific moisture performance specification based on as installed hardware.

SAR Section 3.3.4, "Steam Line Moisture Performance Specification"

The licensee stated in SAR Section 3.3.3 that the plant-specific analysis indicates that the MCO value increases above the original moisture performance specification of 0.10 wt. % at MELLLA+ conditions. The MCO for NMP2 may increase during the cycle when NMP2 is operating at or near the MELLLA+ minimum CF rate.

The licensee further states:

> The effect of increased MCO on plant operation has been analyzed to verify acceptable steam separator-dryer performance under MELLLA+ operating conditions for a maximum moisture content of 0.25 wt. %. MCO is monitored during operation to ensure adequate operating limitations are implemented as required to maintain MCO within analyzed conditions. The amount of time NMP2 is operated with higher than the original design moisture content (0.10 wt. %) is minimized by operations.
>
> The NMP2 plant-specific evaluation concluded that the performance of the steam dryer and separator remains acceptable and the dryer skirt remains covered at L4, the low water level alarm in the MELLLA+ region.
>
> The moisture content of the steam leaving the RPV increases in the MELLLA+ domain. The effect of the increase has been analyzed in the plant specific evaluations that use the MCO value from SAR Sections

3.3.3 and 3.3.4. The effects of increased moisture are discussed in the following SAR Sections and summarized below:

a. SAR Section 3.5.1, "Reactor Coolant Pressure Boundary Piping": **[[** **]]** the MCO for NMP2 may increase to a maximum of 0.25 wt. % during the cycle when NMP2 is operating at or near the MELLLA+ minimum CF rate.

b. SAR Section 8.1, "Liquid and Solid Waste Management": Although the volume of waste generated is not expected to increase, potentially higher MCO in the reactor steam would result in a slightly higher loading on the condensate demineralizers. Because the higher moisture content will occur infrequently, the MELLLA+ operating domain expansion will not cause the condensate demineralizer backwash frequency to be changed significantly as discussed in SAR Section 8.1.2. The reactor water cleanup (RWCU) filter demineralizer backwash frequency is not affected because there is no effect on RWCU inlet conditions for MELLLA+, as discussed in SAR Section 3.11.

c. SAR Section 8.4.2, "Fission and Activation Corrosion Products": Steam separator and dryer performance for MELLLA+ operation is discussed in SAR Section 3.3.3. The moisture content of the MS leaving the vessel may increase up to 0.25 wt. % at times while operating near the minimum CF in the MELLLA+ operating domain. The distribution of the fission and activated corrosion product activity between the reactor water and steam is affected by the increased moisture content. With increased MCO, additional activity is carried over from the reactor water with the steam. The maximum allowable moisture content leaving the reactor vessel is 0.25 wt. %.

d. SAR Section 8.5, "Radiation Levels": As discussed in SAR Section 8.4, the moisture content of the MS leaving the vessel may increase at certain times while operating in the MELLLA+ operating domain. However, the NMP2 MCO will be monitored and controlled to ≤ 0.25 wt. %, which is within the analytical assumption of 0.35 wt. % used in the determination of normal operation radiation levels. The overall radiological effect of the increased moisture content is a function of the plant water radiochemistry and the levels of activated corrosion products maintained.

e. SAR Section 10.7.2, "Flow Accelerated Corrosion": The EPU flow accelerated corrosion (FAC) evaluation for MS and extraction steam piping assumed a 0.25 wt. % MCO for mechanical thermal conditions. This 0.25 wt. % MCO value bounds the maximum predicted MCO value of 0.236 wt. % for MELLLA+ based on equilibrium fuel cycle burnup assumptions. The predicted MCO is a function of fuel loading and rod patterns throughout the burnup history. The MSIVs allowable moisture content was found to be acceptable for MELLLA+ operation based on GEH engineering judgment, operating experience, and NMP2's MSIV inspection/maintenance program. The increased moisture content will not create a significant change in wear on MS piping and components based on the evaluations performed using $CHECWORKS_{TM}$ and design assessments for the components. MCO will be managed with monitoring to identify and track the duration of MCO above 0.1 wt. % based on taking chemical samples once per month. The FAC monitoring program was reviewed for potential changes to the program. No changes to the FAC program are required. The FAC related piping and component wear is managed by the FAC program and Maintenance Rule as discussed in SAR Section 10.7.2.

f. SAR Section 5.2.4, "Main Steam Flow-FW Flow Mismatch": Operation at the higher MCO performance specification is acceptable. With a dryer moisture performance specification up to 0.35 wt. %, the additional coolant removed from the RPV must be returned to the reactor in order to maintain correct water level. The FW system may be required to provide a slightly higher flow rate. The effect of the increased MSL MCO is to cause a slight imbalance in the FW control system control point. With a plant bias of 0.48 inches per percent this translates to ~ 0.12 inches of bias in the water level.

(g) SAR Section 3.4.1, "Piping Components with Flow-Induced Vibration - Safety Related": Adequate margin exists to the FIV of the sample probes and thermowells due to the large margin available in the design.

SAR Section 3.6.4, "Flow Mismatch"

Addressed in SAR Section 4.3.8

SAR Section 3.9.4, "Inventory Makeup Level Margin to TAF"

The makeup capacity of RCIC and the level margin to the TAF are evaluated in SAR Section 9.1.3.

SAR Section 3.10.1, "Low Pressure Coolant Injection Mode"

The LPCI mode, as it supports the LOCA response, is discussed in SAR Section 4.2.4, Low Pressure Coolant Injection.

SAR Section 3.10.5, "Fuel Pool Cooling Assist Mode"

The licensee stated in part that:

> The fuel pool cooling assist mode, using existing RHR heat removal capacity, provides supplemental fuel pool cooling in the event that the fuel pool heat load exceeds the capability of the fuel pool cooling and cleanup system. **[[**

]] Therefore, there is no effect on the fuel pool cooling assist mode.

3.3.3 SAR Section 4.0, "Engineered Safety Features"

SAR Section 4.1, "Containment System Performance"

SAR Section 4.1.1, "Short-Term Pressure and Temperature Response"

With respect to its plant-specific evaluation, the licensee states:

> NMP2 short-term RSLB containment temperature and pressure responses are affected by the change in enthalpy as a result of MELLLA+ operating domain expansion. The short-term RSLB analyses cases at MELLLA+ demonstrate that peak DW temperatures from the short-term RSLB for the current licensed operating domain and the MELLLA+ operating domain are bounded by the CLTP results reported in the MELLLA+ SAR which remain below the design limit of 340 °F.
>
> For NMP2, there are two peak pressures; the first peak occurring approximately 25 seconds (end of initial vessel inventory blowdown) and the second peak occurring approximately150 seconds (end of blowdown phase). The first peak is typically determined by standard short-term analysis, while the second peak is determined by the extended short-term analysis. The first peak is lower than the second peak; the difference is approximately 0.5 psi for EPU. The extended short-term analysis is not sensitive to the subtle initial changes in vessel mass and energy associated with operation at various points in the operating domain. Due to the extended time frame until the DW reaches the second peak pressure conditions, it is recognized that the minor variability in the initial vessel inventory energy associated with various points in the operating range would have negligible effect in comparison to the overall mass and energy contributions to the DW at the time of the second peak. Therefore, the effect of MELLLA+ is assessed from the results of the standard short-term analysis using more detailed LAMB break flow model, which captures the subcooling effect when operating in MELLLA+ operating domain. Several short-term cases are analyzed for MELLLA+ statepoints and results compared to EPU short-term results. The results show that EPU short-term peak pressure bounds the MELLLA+ peak pressures. The peak DW-to-wetwell differential pressures for operation in the MELLLA+ operating domain are bounded by those previously reported in the MELLLA+ SAR for the current CLTP operation. **[[**

]]

SAR Section 4.1.2, "Containment Dynamic Loads"

SAR Section, 4.1.2.1, "Loss-of-Coolant Accident Loads"

The licensee stated in part that:

> As described in the MELLLA+LTR, a [[ ]] evaluation is performed to determine the effect of MELLLA+ on the LOCA containment dynamic loads. Results from [[
>
>]] are used to evaluate the effect of the MELLLA+ operating domain expansion on LOCA containment dynamic loads. The LOCA dynamic loads include vent clearing jet loads, pool swell, CO [condensation oscillation], and chugging.
>
> These loads have been defined generically for Mark II plants as part of the Mark II containment program and are described in detail in the Mark II Containment Dynamic Forcing Functions Report (DFFR). The DFFR was reviewed and approved by the NRC in NUREG-0808 and NUREG-0487. The specific application of these loads to NMP2 is described in Section 6A.4 of the NMP2 USAR.
>
> The results of the [[ ]] LOCA containment dynamic loads evaluation demonstrate that existing vent clearing jet loads, pool swell, CO, and chugging load definitions remain bounding for operation in the MELLLA+ operating domain. Therefore, the LOCA containment dynamic loads are not affected by the MELLLA+ operating domain expansion.
>
> [[
>
>]]

SAR Section 4.1.2.2, "Subcompartment Pressurization"

The licensee stated that:

> Reduced FW temperature increases the subcooling in the FW and reactor recirculation lines, which increases the break flow rates for liquid line breaks. The current subcompartment pressurization loads evaluations consider the current licensed operating domain, which includes an operational band of-20°F (with a minimum FW temperature of 420.5°F at rated power). This analysis concludes that break flow rates for liquid line breaks such as FW and recirculation line breaks for the MELLLA+ expanded operating domain are bounded by the break flow rates for the current licensed operating domain. This operation band remains valid for the MELLLA+ operating domain.

SAR Section 4.1.2.2.1, "Annulus Pressurization Load Evaluation"

The licensee stated that:

> The results from the updated dynamic analyses, including effects from both EPU and the nonconservative assumptions, were compared against those used as input to the component structural analyses of record. The effect of the increase in AP loads on the total component stresses is reduced when the AP loads are combined with the SSE seismic loads by the square root of the sum of the squares in the faulted load combination. The SSE seismic loads in the load combination are not affected by EPU. The effect of MELLLA+ on the EPU AP load SC 09-01 evaluation has determined that the ARS remains conservative for the rated power MELLLA+. The off-rated SC 09-01 methods show minor changes in the sub compartment pressurization related to the updated methods associated with SC 09-01 when combined with the jet reaction loads and jet impingement loads using conservative assumptions. The minor changes in ARS frequency when combined in the faulted load combination with seismic show that the conclusions reached for the EPU assessment remain bounding with a few locations showing minor increases. The results of these evaluations show that all reactor vessel and internals, and associated vessel attachments and supports remain within design basis faulted allowable limits.
>
> Because the MELLLA+ operating domain AP subcompartment pressurization are bound by the current licensed operating domain, no further evaluation of this topic is required.
>
> The evaluation of the NMP2-specific AP subcompartment pressurization is determined to be acceptable for NMP2.

SAR Section 4.1.2.2.2, "Drywell Head Subcompartment Pressurization Evaluation"

The licensee stated that:

> The pressure loading on the DW head refueling bulkhead plate to a postulated break in the RCIC head spray line in the DW head subcompartment is not affected by MELLLA+. The pressure and temperature/enthalpy for the RCIC is either not affected or may be slightly reduced in value compared to EPU. The postulated RSLB in the DW affects the upward pressure loading on the bulkhead plate and remains bounded by the EPU evaluation as the fluid enthalpy at the break location is not significantly affected (less than 1%), while the break location pressure is the same as at CLTP. Therefore, the DW head refueling bulkhead plate design margins is unchanged.
>
> Because the MELLLA+ operating domain DW head subcompartment pressurization is bound by the current licensed operating domain, no further evaluation of this topic is required.
>
> The evaluation of the NMP2-specific DW head subcompartment pressurization is determined to be acceptable for NMP2.

SAR Section 4.1.2.2.3, "Biological Shield Wall Subcompartment Pressurization Evaluation"

As stated by the licensee:

> The differential pressure loading on the biological shield wall (BSW) is not significantly affected by MELLLA+. The pressure and temperature/ enthalpy for the high energy systems penetrating the BSW (recirculation, LPCS, HPCS, feedwater) are either not affected or may be slightly reduced in value compared to EPU. The peak BSW differential pressure load resulting from the limiting recirculation pump discharge line break at CLTP and MELLLA+ conditions remains bounded by the EPU evaluations and remains below the BSW design differential pressure. In addition, the EPU AP load SC 09-01 evaluation for the BSW remains conservative when considering MELLLA+ and the off-rated operating conditions.
>
> Because the MELLLA+ operating domain BSW subcompartment pressurization is bound by the current licensed operating domain, no further evaluation of this topic is required.
>
> The evaluation of the NMP2-specific BSW subcompartment pressurization is determined to be acceptable for NMP2.

SAR Section 4.3, "Emergency Core Cooling System Performance"

SAR Sectin 4.3.1, "Break Spectrum Response and Limiting Single Failure"

The licensee stated that:

> [T]he break spectrum response is determined by the ECCS network design and is common to all BWRs. SAFER evaluation experience shows that the basic break spectrum response is not affected by changes in CF. **[[**
>
> **]]**
>
> The factors influencing the selection of the small break limiting single failure for NMP2 are **[[**
>
> **]]**.

SAR Section 4.3.2, "Large Break Peak Clad Temperature"

The licensee stated that:

> The effect of MELLLA+ operating domain expansion on the NMP2 LOCA performance is similar to that observed in the current licensed operating domain, which includes the MELLLA operating domain low CF region. The PCT response following a large recirculation line break has two peaks. The first peak is determined by the boiling transition during CF coastdown early in the event. The second peak is determined by the core uncovery and reflooding.
>
> MELLLA+ operating domain expansion has two effects on the boiling transition and first peak PCT. First, the reduced CF causes the boiling transition to occur earlier and lower in the bundle. Second, the reduced CF causes the initial subcooling in the downcomer to be higher so that the break flow is greater in the early phase of the LOCA event. For a given power level, the early boiling transition times (boiling transitions that occur before jet pump uncovery) for NMP2 occur earlier in the event and penetrate lower in the fuel bundle as the CF is reduced, but the effect of the early boiling transition on the LOCA PCT depends on the particular conditions. The licensee performed the plant-specific evaluation for the following cases:
>
> Effect of MELLLA+ at Rated Power
>
> **[[**
>
> **]]**

Effect of MELLLA+ at Less Than Rated Power

MELLLA+ LTR SER Limitation and Condition 12.10.a requires the MELLLA+ SAR to provide a discussion on the P/F combination scoping calculations that were performed to identify the limiting statepoints in terms of DBA-LOCA PCT response for the operation within the MELLLA+ boundary. The PCT results of the evaluations show that there are no unusual trends in PCT in the MELLLA+ region and that there is margin to the 2,200°F PCT limit.

Effect of Axial Power Shape

As required by MELLLA+ LTR SER Limitation and Condition 12.11 and Methods LTR SER Limitation and Condition 9.7 for MELLLA+ applications, the small and large break ECCS-LOCA analyses shall include top-peaked and mid-peaked power shape in establishing the MAPLHGR and determining the PCT. This limitation is applicable to both the licensing basis PCT and the upper bound PCT. The plant-specific applications should report the limiting small and large break licensing basis and upper bound PCTs.

SAR Section 4.3.3, "Small Break Peak Clad Temperature"

The licensee, in its submission, stated the following:

[[

]]

Effect of MELLLA+ at Rated Power

The PCT results are shown in the table at the end of this section. [[

]]

MELLLA+ LTR SER Limitation and Condition 12.13 requires that the MELLLA+ plant-specific SAR include calculations for the limiting small break at rated power/RCF and rated power/MELLLA+ boundary, if the small break PCT at rated power/RCF is within [[ ]] of the limiting Appendix K PCT. For

NMP2, the small break PCT is limiting. Therefore, small break PCT calculations are performed for MELLLA+ flow, and the PCT results are shown in the table at the end of this section.

Effect of MELLLA+ at Less Than Rated Power

MELLLA+ LTR SER Limitation and Condition 12.l0.b requires that the MELLLA+ SAR provide a justification as to why the transition statepoint ECCS-LOCA response bounds the 55% CF statepoint.

[[

]] The PCT results summarized below show that there are no unusual trends in PCT in the MELLLA+ region and that there is margin to the 2,200°F PCT limit.

Effect of Axial Power Shape

As required by MELLLA+ LTR SER Limitation and Condition 12.11 and Methods LTR SER Limitation and Condition 9.7 for MELLLA+ applications, the small and large break ECCS-LOCA analyses have included top-peaked and mid-peaked power shapes in establishing the MAPLHGR and determining the PCT. This limitation is applicable to both the licensing basis PCT and the upper bound PCT. The plant-specific applications have confirmed that the limiting small and large break with [[

]]

Small Break Licensing Basis PCT

> The MELLLA+ SAR provides justification for the elimination of the 1,600°F upper bound PCT limit and generic justification that the licensing basis PCT will be conservative with respect to the upper bound PCT. The NRC SER in the MELLLA+ SAR accepted this position by noting that, because plant-specific upper bound PCT calculations have been performed for all plants, other means may be used to demonstrate compliance with the original SER limitations. These other means are acceptable provided there are no significant changes to a plant's configuration that would invalidate the existing upper bound PCT calculations. The changes in magnitude of the PCT due to MELLLA+ demonstrate that this plant configuration change does not invalidate the existing upper bound PCT calculations.
>
> MELLLA+ LTR SER Limitations and Conditions 12.12.a and 12.12.b and Methods LTR SER Limitation and Condition 9.8 also require that the ECCS-LOCA evaluation be performed for all statepoints in the upper boundary of the expanded operating domains. **[[**
>
>]] The calculated GE14 licensing basis PCT is 1,580°F, based on the limiting case scenario. **[[**
>
>]]

SAR Section 4.7, "Post-Loca Combustible Gas Control System"

The licensee states that:

> 10 CFR 50.44 was revised in September 2003 and no longer defines a design basis LOCA hydrogen release. This new revision eliminates the requirements for hydrogen control systems to mitigate such a release. NMP2 has adopted the revised ruling per NMP2 license amendment Number 124, issued in April 2008, which relaxed the requirements for hydrogen and oxygen monitoring. This amendment also eliminated the requirements for hydrogen recombiners for the purpose of mitigating post-LOCA hydrogen release, although NMP2 has chosen to leave the recombiners in place and remain functional. NMPNS made commitments to maintain the hydrogen and oxygen monitoring systems capable of diagnosing beyond DBAs. MELLLA+ operating domain expansion has no effect on the design of these systems or on the ability of these systems to perform their intended functions. However, as this system is no longer required to be maintained as a post-LOCA combustible gas control system, no further evaluation is necessary relative to the MELLLA+

operating domain expansion. The generic disposition of the system (under the MELLLA+ LTR) is no longer applicable.

3.3.4 SAR Section 5.0, "Instrumentation And Control"

SAR Section 5.1.5, "Traversing Incore Probes"

The licensee stated the following:

> To address the MELLLA+ LTR SER Limitation and Condition 12.15, bypass voiding above the D-Level, an analysis was performed to identify the region on the MELLLA+ P/F map that has potentially unacceptable bypass voiding for the thermal traversing incore probes (TIPs) installed at NMP2. In the absence of bypass voiding greater than 5% no actions are required regarding the TIPs resulting from the MELLLA+ operating domain expansion. **[[**
> **]]**
>
> Analysis shows that there is a small region of the MELLLA+ power flow domain near point M in SAR Figure 5-1 where the hot channel voiding at the TIP exit exceeds 5% thus requiring specific attention per Limitation and Condition 12.15.
>
> TIP operation and LPRM calibration in the remainder of the MELLLA+ domain are not adversely affected by the void conditions in the bypass region. NMPNS control room operators and Reactor Engineers will be trained on this requirement and station procedures will be modified accordingly.
>
> **[[** **]]** there is no change in the neutron flux experienced by the NMP2 TIPs resulting from the MELLLA+ operating domain expansion. The TIPs are installed at NMP2 in accordance with the requirements established by the GEH design specifications. No further evaluation is needed for MELLLA+.

SAR Section 5.3, "Technical Specification Instrument Setpoints"

The licensee stated:

> The TS instrument AVs and the nominal trip setpoints (NTSPs) are those sensed variables which initiate protective actions and are generally associated with the safety analysis. The determination of the AV and NTSP includes consideration of measurement uncertainty and are derived from the AL [allowable limit]. Standard GEH setpoint methodology is used to generate the AV and NTSPs from the related ALs. The MELLLA+ operating domain expansion results in the development of two analytical limits (ALs). GEH uses the approved simplified process to determine the instrument AVs and nominal trip

setpoints (NTSPs) for MELLLA+ applications. The NRC staff has previously reviewed and accepted the simplified approach in the review of NEDC-33004P-A. Consistent with that approval for NMP2, the following criteria are satisfied for using the simplified process:

1. [[

   ]]

2. NRC-approved GEH or plant-specific methodologies are used.

3. [[
   ]]

4. [[

   ]]

However, complete setpoint calculations, using the setpoint methodology described in NEDC-31336P-A have been performed for the APRM Flow Biased Scram and Rod Block for TLO, to better support NMP2 in implementing the guidance provided by Regulatory Issue Summary (RIS) 2006-17 and Technical Specification Task Force (TSTF)-493.

SAR Section 5.3.1, "APRM Flow-Biased Scram"

The licensee stated:

> The MELLLA+ APRM Flow Biased STP Scram AL line is established to [[
>
>]]
>
> The MELLLA+ APRM flow-biased AL expressions are:
>
> - AL $_{M+ROD\ BLOCK}$ = 0.61W + 60.1%, for the Rod Block
> - AL $_{M+SCRAM}$ = 0.61W + 66.1%, for the scram
>
> SLO is not applicable to the MELLLA+ operating domain as discussed in SAR Section 3.6.3. Therefore, for SLO, the flow-biased setpoints [ALs] are unchanged.

The evaluation of APRM flow-biased scram setpoints is consistent with the methods described for [[ ]] of this topic in the MELLLA+ LTR. The APRM flow-biased scram setpoints for the NMP2 [[ ]] are acceptable."

3.3.5 SAR Section 6.0, "Electrical Power And Auxiliary Systems"

SAR Section 6.5, "Standby Liquid Control System"

The SLCS is discussed in Section 3.4.8 of this SE.

SAR Section 6.5.2, "System Hardware"

The licensee states:

> MELLLA+ LTR describes that the SLS is typically designed for injection at a maximum reactor pressure equal to the upper analytical setpoint for the lowest group of SRVs operating in the relief mode. [[
>
>]]
>
> The NMP2 reactor operating pressure is unchanged by MELLLA+ operating domain expansion. The numerical values showing no increases in reactor operating pressure are presented in SAR Table 1-2. As discussed in SAR Section 3.1.2, there are no changes to the NMP2 SRV setpoints as a result of MELLLA+ operating domain expansion. Because the reactor dome pressure and SRV setpoints are unchanged for MELLLA+, the SLS process parameters do not change. Therefore, the capability of the SLS to perform its shutdown function is not affected by MELLLA+. [[
>
>]] Therefore, the NMP2 SLS remains capable of performing its shutdown function.

SAR Section 6.5.3, "ATWS Requirements"

The licensee states:

> The SLS ATWS performance is evaluated in the SAR Section 9.3.1, [[
>]]
> The representative MELLLA+ evaluation shows that the SLS maintains the capability to mitigate an ATWS and that the current boron injection rate is sufficient relative to the peak SP temperature. The ATWS analysis in SAR Section 9.3.1 also demonstrates that there is no increase in the peak vessel dome pressure during the time the SLS is in operation.

The licensee also states in part that:

> [[
>
>]] The pressure margin for the pump discharge relief valves remains above the minimum value needed to ensure the SLS relief valve closure prior to the analyzed SLS initiation time in the event of an early initiation of the SLS during the initial ATWS transient pressure response. Consequently, the current NMP2 SLS process parameters associated with the minimum boron injection rate do not need to change. Therefore, SLS operation during an ATWS is not affected by the MELLLA+ operating domain expansion.

3.3.6 SAR Section 8.0, "Radwaste Systems and Radiation Sources"

SAR Section 8.4, "Radiation Sources in the Reactor Coolant"

SAR Section 8.4.2, "Fission and Activated Corrosion Products"

The licensee states:

> For NMP2, reactor power, MS and FW flow rates do not change as a result of operating in the MELLLA+ domain. Therefore, the MELLLA+ operating domain expansion does not affect the total activity concentration in the reactor coolant.
>
> The moisture content of the MS leaving the vessel has been conservatively assumed to increase up to 0.35 wt. % at times while operating near the minimum CF in the MELLLA+ operating domain. The distribution of the fission and activated corrosion product activity between the reactor water and steam is affected by the increased moisture content. With increased MCO, additional activity is carried over from the reactor water with the steam [as discussed in the SAR, Sections 3.3.3 and 3.3.4.]
>
> For NMP2, certain individual activation product concentrations were observed to exceed design basis levels at 0.35 wt. % moisture content. However, total activation product activity was below 30% of the total design basis activation product activity for water and below 95% of the total design basis activation product activity for steam. There are no individual design basis requirements for individual activation products. No fission product concentrations exceeded the design basis.
>
> [[
>
>]]

SAR Section 8.5, "Radiation Levels"

SAR Section 8.5.1, "Normal Operational Radiation Levels"

The licensee stated that:

> The MELLLA+LTR describes that plant radiation levels for normal and post-shutdown operation are directly dependent upon radiation levels and radionuclide species in the reactor coolant (steam and water) except where the core is directly involved. [[
>
>]].
>
> For NMP2, reactor power does not change as a result of the MELLLA+ operating domain expansion. The NMP2 MS flow rate does not change as a result of the MELLLA+ operating domain expansion. Numerical values demonstrating the MS flow rate does not increase are provided in Table 1-2. Because there is no change in power or steam flow rate for the MELLLA+ expanded operating domain, the radiation levels from the coolant activation products do not vary significantly. As discussed in Section 8.4, the moisture content of the MS leaving the vessel may increase at certain times while operating in the MELLLA+ operating domain. However, the NMP2 MCO will be monitored and controlled to ≤ 0.25 wt. % within the analytical assumption of 0.35 wt. % used in the determination of normal operation radiation levels. The overall radiological effect of the increased moisture content is a function of the plant water radiochemistry and the levels of activated corrosion products maintained. NMP2 maintains appropriate health physics and ALARA [as low as reasonably achievable] controls to address any increase in the normal operation levels.

SAR Section 8.5.2, "Post-Shutdown Radiation Levels"

> For NMP2, reactor power does not change as a result of the MELLLA+ operating domain expansion. The NMP2 MS flow rate does not change as a result of the MELLLA+ operating domain expansion. Numerical values demonstrating the MS flow rate does not increase are provided in Table 1-2. The shutdown radiation levels are dominated by the accumulated contamination of some fission and activated corrosion products. As discussed in SAR Section 8.4, the moisture content of the MS leaving the vessel may increase at certain times while operating in the MELLLA+ operating domain. However, the NMP2 MCO will be monitored and controlled to ≤ 0.25 wt. % within the analytical assumption of 0.35 wt. % used in the determination of post-shutdown radiation levels. The overall radiological effect of the increased moisture content is a function of the plant water radiochemistry and the levels of activated

corrosion products maintained. NMP2 maintains appropriate health physics and ALARA controls to address any increase in the shutdown radiation levels.

SAR Section 8.5.3, "Post-Accident Radiation Levels"

Post-accident radiation levels depend primarily upon the core inventory of fission products and TS levels of radionuclides in the coolant. As power level is unchanged, operation in the MELLLA+ domain does not change the core inventory or the TS limitation on the levels of radionuclides in the coolant, therefore, the licensee concluded that post-accident **[[**

]] SAR Section 9.2 discusses DBA radiological consequences.

3.3.7 SAR Section 9.0, "Reactor Safety Performance Evaluations"

SAR Section 9.1, "Anticipated Operational Occurrences"

The licensee also stated that:

The NMP2 USAR defines the licensing basis AOOs. SAR Table 9-1 of the MELLLA+ LTR provides an assessment of the effect of the MELLLA+ operating domain expansion on each of the limiting AOO events and key non-limiting events. SAR Table 9-1 of the MELLLA+ LTR includes fuel thermal margin, overpressure, and loss of water level events. The overpressure protection analysis events are addressed in SAR Section 3.1.

SAR Section 9.1.1, "Fuel Thermal Margin Events"

The licensee states:

[[

]].

The fuel loading error is categorized as an Infrequent Incident. However, if the licensee does not meet the requirements of GESTAR II, the fuel loading error event would be analyzed as an AOO. NMP2 does not meet the requirements of NEDC-33576NP. Therefore, the fuel loading error event is evaluated as an AOO for each reload.

The thermal margin event analysis is performed as part of the reload process for each reload core and results are documented in the SRLR. From MELLLA+ LTR SER Limitation and Condition 12.4, **[[**

]] In accordance with Methods LTR SER Limitation and Condition 9.19, an additional 0.01 will be added to the OLMCPR for conditions above the stretch power uprate power level or above the MELLLA boundary (MELLLA+ conditions), until such time that GEH expands the experimental database supporting the Findlay-Dix void-quality correlation to demonstrate the accuracy and performance of the void-quality correlation based on experimental data representative of the current fuel designs and operating conditions during steady-state, transient, and accident conditions. In the event that the cycle-specific reload analysis is based on TRACG rather than ODYN for AOO, no 0.01 adder to the OLMCPR is required.

In accordance with M±LTR SER Limitation and Condition 12.16, an RWE analysis was performed to confirm the adequacy of the generic RBM setpoints. The RWE was simulated using the three-dimensional core simulator PANACEA. The analysis was performed with an approximate equilibrium core at the MELLLA+ 100% power, 85% CF statepoint for a comprehensive set of RBM setpoints. The results of this RWE analysis confirmed the validity of the generic RBM setpoints. The RWE results also meet the 1% cladding circumferential plastic strain acceptance criterion.

In accordance with Methods LTR SER Limitations and Conditions 9.9, 9.10, and 9.11, acceptable fuel rod T-M performance for both $U0_2$ and GdO_2 fuel rods was demonstrated. Results for all AOO pressurization transient events analyzed, including EOOS, showed at least 10% margin to the fuel centerline melt and the 1% cladding circumferential plastic strain acceptance criteria. The minimum calculated margin to the fuel centerline melt criterion for AOO pressurization transient events was 19.2%. The minimum calculated margin to the cladding strain criterion was 18.2%. Fuel rod T-M performance will be evaluated as part of the RLAs performed for the cycle-specific core. Documentation of acceptable fuel rod T-M response will be included in the SRLR or COLR.

SAR Section 9.1.2, "Power and Flow Dependent Limits"

The licensee states:

The operating MCPR, LHGR, and/or MAPLHGR thermal limits are modified by a flow factor when the plant is operating at less than 100% CF. The MCPR flow factor ($MCPR_f$) and the LHGR flow factor ($LHGRFAC_f$) are primarily based upon an evaluation of the slow recirculation flow increase event.

SAR Table 9-2 summarizes the results of the slow recirculation flow increase analysis and compares them with the MCPR flow limit. The reference limits bound the slow recirculation flow results performed for the

MELLLA+ operating domain. **[[**

]]

Similarly, the thermal limits are modified by a power factor ($MCPR_p$) when the plant is operating at less than 100% power. **[[**

]]

[[

]]

The licensee, therefore, concluded that the power and flow dependent limits are acceptable.

The NRC staff determined that these limits were confirmed in the SRLR for operation under MELLLA+ conditions.

<u>Summary of Licensee's Evaluations of SAR Section 9.1</u>

The licensee has performed a review of AOO transients and reported the results in Chapter 9 of the NMP2 SAR (NEDC-33576NP). Table 3 contains a summary of the AOO analysis evaluation. The AOOs analyzed in the NMP2 SAR for the MELLLA+ domain extension include:

a. Generator Load Rejection Without Bypass (LRNBP)
b. Turbine Trip Without Bypass (TTNBP)
c. Feedwater Controller Failure Maximum Demand (FWCF)
d. Loss of Feedwater Heater (LFWH)
e. Rod Withdrawal Error (RWE)

These AOOs were evaluated at the current licensed power CLTP and two flows: (1) the increased core flow (ICF) limit of 105% and (2) the MELLLA+ reduced core flow limit of 85%.

Table-1. Comparison of AOO analyses results at 85% and 105% core flow

Event	Parameter	Units	CLTP ICF 105% Rated Core Flow	CLTP 85% Rated Core Flow
LRNBP				
	Peak Neutron Flux	%	520	402
	Peak Heat Flux	% Initial	133	125
	Peak Vessel Pressure	psig	1283	1275
	GE14 ΔCPR	NA	0.30	0.26
TTNBP				
	Peak Neutron Flux	%	511	367
	Peak Heat Flux	% Initial	130	122
	Peak Vessel Pressure	psig	1280	1273
	GE14 ΔCPR	NA	0.30	0.25
FWCF				
	Peak Neutron Flux	%	474	338
	Peak Heat Flux	% Initial	131	123
	Peak Vessel Pressure	psig	1257	1249
	GE14 ΔCPR	NA	0.28	0.23
LFWH				
	GE14 ΔCPR	NA	NA	0.14
RWE				
	GE14 ΔCPR	NA	NA	0.29

The operating limits to CPR and LHGR are adjusted upwards when operating at off-nominal conditions by power and flow-dependent factors. The licensee has calculated the slow recirculation flow increase under MELLLA+ conditions to evaluate the power- and flow-dependent limits for a representative MELLLA+ equilibrium core. The results of these analyses are documented in Section 9.1.of the NMP2 SAR. These results indicate that the existing limits in NMP2 are adequate for MELLLA+ operation.

Non-limiting events in NMP2 are treated via the generic disposition of these events.

SAR Section 9.2, "Design Basis Accidents and Events of Radiological Consequences

SAR Section 9.2.1, "Design Basis Events"

SAR Section 9.2.1.6, "Liquid Radwaste Tank Failure"

The licensee states:

> [[
>
>]] The moisture content of the MS increases in a small area of the MELLLA+ operating domain near the minimum CF and 100% CLTP as discussed in SAR Sections 3.3.4 and 8.4. SAR Section 8.5 discusses the analysis of the radioactive nuclide inventory in the radwaste tank. [[
>
>]] Therefore, the liquid radwaste tank failure accident does not present a radiological concern at NMP2 for operation in the MELLLA+ operating domain.

SAR Section 9.3, "Special Events"

Special events (ATWS events), except for SBO, are discussed in more detail in Section 3.4.9 of this SE.

3.3.8 SAR Section 10.0, "Other Evaluations"

SAR Section 10.4, "Testing"

SAR Section 10.4.1, "Steam Separator-Dryer Performance," SAR Section 10.4.2, "APRM Calibration," SAR Section 10.4.3, "Core Performance," SAR Section 10.4.4, "Pressure Regulator," SAR Section 10.4.5, "Water Level Setpoint Changes," and SAR Section 10.4.6, "Neutron Flux Noise Surveillance"

The licensee proposed several tests in each of the above topic. The NRC staff finds that the proposed tests are reasonable and acceptable even though several tests were performed during the EPU implementation. See Section 4.4 of this SE for the NRC staff's finding on this topic.

SAR Section 10.5, "Individual Plant-Examination," SAR Section 10.5.1, "Initiating Event Categories and Frequency," 10.5.2, "Component and System Reliability," 10.5.3, "Operator Response," 10.5.4, "Success Criteria," 10.5.5, "External Events," 10.5.6, "Shutdown Risks," and 10.5.7, "PRA Quality"

These SAR Sections provide the licensee's assessment of the risk increase, including CDF and LERF, associated with operation in the MELLLA+ range.

The licensee stated that:

> In accordance with MELLLA+LTR SER Limitation and Condition 12.21, a plant-specific probabilistic risk assessment (PRA) evaluation was performed, which included CDF and LERF effects associated with operation in the MELLLA+ operating domain. The evaluation scope included all of the elements of Section 10.5, Individual Plant Examination, of the MELLLA+ LTR. The associated PRA report is provided as Attachment 4 to the NMPNS MELLLA+ LAR. The proposed MELLLA+ operating region for NMP2 has been reviewed to determine the effect on the PRA. The PRA is based on the EPU MELLLA operating region and includes internal events as well as fire and seismic initiating events. The effect of MELLLA+ on the PRA is very low and meets NRC guidelines in RG 1.174 for CDF and LERF. MELLLA+ has no effect on the risk associated with accidents initiated during shutdown conditions.

Based on these results, the licensee concluded that the proposed MELLLA+ operating region is acceptable on a risk basis.

SAR Section 10.6, "Operator Training and Human Factors"

The licensee states:

> Some additional training is required to prepare for NMP2 operation in the MELLLA+ operating domain.
>
> The operator responses to anticipated occurrences, accidents, and special events are not significantly affected by operation in the MELLLA+ domain. Significant events result in automatic plant shutdown (scram). Some events result in automatic RCPB pressure relief, ADS actuation and/or automatic ECCS actuation (for low water level events). MELLLA+ operating domain expansion does not cause changes in any of the automatic safety functions. After the automatic responses have initiated, the operator actions for plant safety (e.g., maintaining safe shutdown, core cooling, and containment cooling) do not change for MELLLA+ operating domain expansion.
>
> As part of the NMPNS MELLLA+ LAR, the SLS has been modified by increasing the isotopic enrichment of Boron-10 in the sodium pentaborate solution as described in SAR Section 6.5. This results in an effect in the

ATWS response and is evaluated in SAR Section 9.3.1.

Simulator changes and fidelity validation will be performed in accordance with applicable ANSI standards currently being used at the training simulator. SAR Section 10.9 addresses the MELLLA+ operating domain effects on the Emergency Operating Procedures (EOPs) and the abnormal operating procedures (AOPs). Operators will be trained regarding changes to procedures, including the limitation to not perform LPRM calibrations in the prohibited region to the left of the line illustrated on SAR Figure 5-1.

Training required to operate NMP2 following the MELLLA+ operating domain expansion will be conducted prior to operation in the MELLLA+ domain. Training for the MELLLA+ startup testing program will be performed using "just in time" training of plant operation personnel where appropriate. Data obtained during operation in the MELLLA+ domain will be incorporated into additional training, as needed. The classroom training will cover various aspects of MELLLA+ operating domain expansion, including changes to the P/F map, changes to important setpoints, changes to plant procedures, and startup test procedures. The classroom training may be combined with simulator training for normal operational sequences unique to operation in the MELLLA+ domain. The plant dynamics do not change substantially for operation in the MELLLA+ domain. Enhanced training on ATWS event mitigation in the MELLLA+ domain, FW pump trip transient, and RPT transient will be conducted.

The licensee concluded that the evaluation of the NMP2 operator training and human factors is consistent with the guidance presented in the MELLLA+ LTR and meets current industry standards.

The discussion of the NRC staff SE for "Operator Training and Human Factors," is provided in the SE Section 3.4.7.

<u>SAR Section 10.7, "Plant Life"</u>

<u>SAR Section 10.7.1, "Irradiated Assisted Stress Corrosion Cracking"</u>

The licensee states:

With regard to IASCC, the MELLLA+ LTR states that the longevity of most equipment is not affected by the MELLLA+ operating domain expansion. The peak fluence experienced by the reactor internals may increase, representing a minor increase in the potential for IASCC. Therefore, the current inspection strategy for the reactor internal components is adequate to manage any potential effects of MELLLA+.

Section 3.2.1 provides an evaluation of the change in fluence experienced by the reactor internals. The change in fluence is minor,

> resulting in an insignificant change in the potential for IASCC. Therefore, the current inspection strategy based on the BWRVIP-76 is sufficient to address the small increase in fluence.
>
> Fluence calculations performed at MELLLA+ conditions as required by MELLLA+ LTR SER Limitation and Condition 12.22 indicate that only the top guide and shroud exceed the 5E20 n/cm 2 threshold value for IASCC. The core plate fluence was calculated to be 5.95E20 n/cm 2, however, while this value is slightly above the IASCC threshold, it is actually a decrease from the permitted CLTP value, thus it has no effect. In-core instrumentation dry tubes and guide tubes are included in the evaluation due to an existing identification as being susceptible to IASCC in BWRVIP-47.
>
> The increase in fluence due to MELLLA+ does cause an increased potential for IASCC. However, the inspection strategies and inspections recommended by BWRVIP-25, 26, 47, and 76, respectively) are based on component configuration and field experience and this inspection program is considered adequate to address the increase in potential for IASCC in the top guide, shroud, and in core instrumentation dry tubes and guide tubes.
>
> The BWRVIP evaluated the failure modes and effects of reactor vessel internals and published the results in BWRVIP-06. This evaluation for the shroud concluded that the inspections and evaluations performed in response to Generic Letter (GL) 94-03 provided conservative assurance that the shroud is able to perform its safety function. The inspections of the shroud and top guide are conducted using the guidance of BWRVIP-26, 76, and 183. These guidelines in the areas of detection, inspection, repair or mitigation ensure the long-term function of these components.

SAR Section 10.9, "Emergency and Abnormal Operating Procedures"

EOPs and AOPs can be affected by the MELLLA+ operating domain expansion.

SAR Section 10.9.1, "Emergency Operating Procedures"

The licensee states:

> The EOPs include variables and limit curves, which define conditions where operator actions are indicated. The EOPs remain symptom-based, and thus the operator actions remain unchanged. Therefore, the MELLLA+ operating domain expansion is not expected to affect the NMP2 EOPs. In accordance with MELLLA+ LTR SER, Limitation and Condition 12.23.4, the EOPs will be reviewed for any effect and revised as necessary prior to implementation of MELLLA+ operating domain expansion. Any changes identified to the EOPs will be included in the

operator training to be conducted prior to implementation of MELLLA+. The ATWS calculation performed for MELLLA+ was based on the NMP2 operator actions from the EOPs.

SAR Section 10.9.2, "Abnormal Operating Procedures"

The licensee refers to NMP2 AOPs as special operating procedures (SOPs). SOPs include event based operator actions. No significant SOP revisions are expected as a result of the MELLLA+ operating domain expansion. However, the SOPs will be reviewed for any effect and revised as necessary prior to implementation of the MELLLA+ operating domain expansion. Any changes identified to the SOPs will be included in the operator training to be conducted prior to implementation of the MELLLA+.

3.4 NRC Staff Evaluations of Various Topics – Licensee's Plant Specific Evaluations

The following Sections provide the NRC staff evaluation of various topics, including the topics for which the licensee submitted the plant-specific dispositions discussed in Section 3.3 of this SE.

3.4.1 SAR Section 2.0, "Reactor Core and Fuel Performance"

As noted above, even though the licensee concluded that the topics in this section met the generic disposition of the MELLLA+ LTR, the NRC staff performed a review to confirm these conclusions. The NRC staff used RS-001, "Review Standard for Extended Power Uprates," as a reference in conducting the MELLLA+ review. Although MELLLA+ is not a power uprate, and RS-001 guidance is not wholly applicable, RS-001 provides a reasonable framework for review of this application. The NRC staff recognizes that there are sections in RS-001 that are unnecessary for the MELLLA+ application review. The following review areas were evaluated for the proposed extension of the operating domain:

1. Fuel System Design (Reviewed in SE Section 3.4)
2. Nuclear Design (Reviewed in SE Section 3.4)
3. Thermal and Hydraulic Design (Reviewed in SE Section 3.4)
4. Emergency Systems (Reviewed in SE Section 3.4)
5. Accident and Transient Analyses (Reviewed in SE Sections 3.4)

The NRC staff was assisted in their review by staff from Oak Ridge National Laboratory (ORNL).

3.4.1.1 Fuel System Design

Regulatory Evaluation

The fuel system consists of arrays of fuel rods, burnable poison rods, spacer grids and springs, end plates, channel boxes, and reactivity control rods. The NRC staff reviewed the fuel system to ensure that:

1. The fuel system is not damaged as a result of normal operation and AOOs,

2. Fuel system damage is never so severe as to prevent control rod insertion when it is required,

3. The number of fuel rod failures is not underestimated for postulated accidents, and

4. Coolability is always maintained.

The NRC staff's review covered fuel system damage mechanisms, limiting values for important parameters, and performance of the fuel system during normal operation, AOOs, and postulated accidents. The NRC's acceptance criteria are based on:

1. 10 CFR 50.46, insofar as it establishes standards for the calculation of emergency core cooling system (ECCS) performance and acceptance criteria for that calculated performance;

2. GDC 10, insofar as it requires that the reactor core be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs;

3. GDC 27, insofar as it requires that the reactivity control systems be designed to have a combined capability, in conjunction with poison addition by the ECCS, of reliably controlling reactivity changes under postulated accident conditions, with appropriate margin for stuck rods, to assure the capability to cool the core is maintained; and
4. GDC 35, insofar as it requires that a system to provide abundant emergency core cooling be provided to transfer heat from the reactor core following any LOCA. Specific review criteria are contained in SRP Section 4.2 and other guidance provided in Matrix 8 of RS-001 (Revision 5).

Technical Evaluation

The NRC staff has reviewed the impact on the fuel system of the proposed MELLLA+ operating domain extension based on the licensee-provided analyses for normal operation, AOOs, infrequent and special events. The complete staff evaluation of these results is documented in Section 3.1.5. As seen in that evaluation, operation at the lower MELLLA+ flows has no impact on transient response because all events analyzed are limiting at the 105% core flow conditions. The licensee analyses demonstrate that with the proposed NMP2 MELLLA+ set points, fuel damage is not expected for any AOO or the analyzed infrequent or special events, and core coolability is always maintained. Thus, the NRC staff concludes that the impact on fuel of operation with the more restrictive set points at the lower MELLLA+ flows is minimal.

Conclusions

The NRC staff has reviewed the licensee's analyses related to the effects of the proposed operating domain extension on the fuel system design of the fuel assemblies, control systems, and reactor core. The staff concludes that the licensee has adequately accounted for the effects of the proposed operating domain extension on the fuel system and demonstrated that: (1) the fuel system will not be likely to be damaged as a result of normal operation and AOOs, (2) the fuel system damage, should it happen, is not likely to be so severe as to prevent control rod insertion when it is required, (3) the number of fuel rod failures has not been underestimated for postulated accidents, and (4) coolability is likely to be maintained. Based on this, the NRC staff concludes that the fuel system and associated analyses will continue to meet the requirements of 10 CFR 50.46, GDC 10, GDC 27, and GDC 35 following implementation of the proposed operating domain extension. Therefore, the NRC staff finds the proposed operating domain extension acceptable with respect to the fuel system design.

3.4.1.2 Nuclear Design

Regulatory Evaluation

The NRC staff reviewed the nuclear design of the fuel assemblies, control systems, and reactor core to ensure that fuel design limits will not be exceeded during normal operation and anticipated operational transients, and that the effects of postulated reactivity accidents will not cause significant damage to the RCPB or impair the capability to cool the core. The NRC staff's review covered core power distribution, reactivity coefficients, reactivity control requirements and control provisions, control rod patterns and reactivity worths, criticality, burn up, and vessel irradiation. The NRC's acceptance criteria are based on:

1. GDC 10, insofar as it requires that the reactor core be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any condition of normal operation, including the effects of AOOs;
2. GDC 11, insofar as it requires that the reactor core be designed so that the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity;
3. GDC 12, insofar as it requires that the reactor core be designed to assure that power oscillations, which can result in conditions exceeding SAFDLs, are not possible or can be reliably and readily detected and suppressed;
4. GDC 13, insofar as it requires that instrumentation and controls be provided to monitor variables and systems affecting the fission process over anticipated ranges for normal operation, AOOs and accident conditions, and to maintain the variables and systems within prescribed operating ranges;
5. GDC 20, insofar as it requires that the protection system be designed to initiate the reactivity control systems automatically to assure that acceptable fuel design limits are

not exceeded as a result of AOOs and to automatically initiate operation of systems and components important to safety under accident conditions;

6. GDC 25, insofar as it requires that the protection system be designed to assure that SAFDLs are not exceeded for any single malfunction of the reactivity control systems;

7. GDC 26, insofar as it requires that two independent reactivity control systems be provided, with both systems capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes;

8. GDC 27, insofar as it requires that the reactivity control systems be designed to have a combined capability, in conjunction with poison addition by the ECCS, of reliably controlling reactivity changes under postulated accident conditions, with appropriate margin for stuck rods, to assure the capability to cool the core is maintained; and

9. GDC 28, insofar as it requires that the reactivity control systems be designed to assure that the effects of postulated reactivity accidents can neither result in damage to the RCPB greater than limited local yielding, nor disturb the core, its support structures, or other reactor vessel internals so as to significantly impair the capability to cool the core. Specific review criteria are contained in SRP Section 4.3 and other guidance provided in Matrix 8 of RS-001.

Technical Evaluation

Operating Limits

GDC 10 specifies the requirements for core operating limits. GDC 10 is met by operating the plant within established operating limits. The OLMCPR and the MAPLHGR limit are designed to protect the fuel during normal operation, as well as during anticipated transients, from exceeding SAFDLs.

The NRC staff reviewed the design changes between the NMP2 EPU core design and a reference MELLLA+ core design in terms of its impact on compliance with GDC 10. The staff notes that the core and fuel design remain unchanged, and a full load of GE14 fuel is used.

The SLMCPR is calculated based on the actual core loading pattern for each reload core, and the results are reported in the SRLR. In the event that the cycle-specific SLMCPR is not bounded by the current NMP2 TS value, NMP2 must implement a license amendment to change the TS. As required by the MELLLA+ SER, the SLMCPR is calculated at different operating conditions for every reload core. The specified conditions include: 100%CLTP/105% CF, 100% OLTP/100% CF, 100% OLTP/85% Flow, and 77.6% CLTP/55% CF. The calculated SLMCPR values include the adders required by the Methods SER (NEDC-33173P and NEDC-33173P-A) for operation in the MELLLA+ domain (see response to RAI-2 dated May 14, 2014, for more details).

For the current Cycle-15 with GE14 fuel, the calculated SLMCPR is 1.07. For MELLLA+ operation, the licensee will increase the TLO SLMCPR to 1.09 as indicated in the SRLR. The two-loop value is increased by 0.02 primarily due to condition 12.6 in the SER which requires the application of the SLO core flow uncertainty to the TLO calculation. The licensee proposed changes to TS 2.1.1.2 by increasing the SLMCPR for two recirculation loops in operation from 1.07 to 1.09.

The OLMCPR is calculated by adding the change in MCPR due to the limiting AOO event to the SLMCPR. The OLMCPR for NMP2 is determined on a cycle-specific basis from the results of the reload transient analysis, which are documented in the SRLR. The final value of the OLMCPR is documented in the Core Operating Limits Report (COLR). Based on the generic results documented in the MELLLA+ SER, and the reference transient analyses documented in Section 9 of the NMP2 SAR, the AOO delta MCPR is not impacted significantly by MELLLA+ operation because the limiting events occur at the 105% core flow condition, which would have been analyzed should MELLLA+ not be implemented. In NMP2, the OLMCPR is impacted mostly by the changes imposed by the MELLLA+ SER on the calculation of SLMCPR (i.e., using SLO uncertainties plus adders) which is approximately 0.04 larger in MELLLA+ than under EPU conditions).

The LHGR and MAPLHGR operating limits are calculated for each reload fuel bundle design. The limits are documented in the cycle-specific COLR.

Section 4.3 of the NMP2 SAR and the response to RAI-15 (dated May 9, 2011, 2014) presents results for a LOCA analysis at different initial conditions. **[[**

]]

<u>Monitoring and Control</u>

GDC 13 specifies the requirements for instrumentation to monitor variables affecting the fission process. Maneuvering within the MELLLA+ operating domain is performed by either controlling the recirculation flow, or moving control rods. GDC 13 requires that instrumentation be provided to ensure that the operation is within prescribed operating ranges.

The design changes to incorporate MELLLA+ do not include any changes to the neutron monitoring system (NMS) or the flow instrumentation. Nevertheless, the NRC staff reviewed the effects of operation in the expanded domain on instrumentation performance and, therefore, the adequacy of the NMS to meet the requirements of GDC 13.

MELLLA+ LTR SER Limitation and Condition 12.15, bypass voiding above the D-level is addressed in SAR section 5.1.5. [[

]].

Reactivity Control

GDC 20, 25, 26, 27 and 28 specify the requirements for the reactivity control systems.

Power control is achieved in the expanded operating domain by controlling core reactivity with control blades as well as recirculation flow.

GDC 20 and 25 are met by the reactor protection system and the scram function of the control rod system. These are unaffected by the implementation of the MELLLA+ domain.

GDC 26 and 27 are met by the control rod system and the SLC system. These systems are unaffected by the implementation of the MELLLA+ domain.

The staff determined that compliance with GDC 28 is assured by demonstrating acceptable radiological consequences and barrier integrity during postulated control rod drop accidents. The most limiting conditions occur during low power operation and are therefore unaffected by the MELLLA+ implementation.

Conclusions – Nuclear Design

The NRC staff has reviewed the licensee's analyses related to the effect of the proposed operating domain extension on the nuclear design of the fuel assemblies, control systems, and reactor core. The staff concludes that the licensee has adequately accounted for the effects of the proposed operating domain extension on the nuclear design and has demonstrated that the fuel design limits will not be exceeded during normal or anticipated operational transients, and that the effects of postulated reactivity accidents will not cause significant damage to the RCPB or impair the capability to cool the core. Based on this evaluation and in coordination with the reviews of the fuel system design, thermal and hydraulic design, and transient and accident analyses; the staff concludes that the nuclear design of the fuel assemblies, control systems, and reactor core will continue to meet the applicable requirements of GDCs 10, 11, 12, 13, 20, 25, 26, 27, and 28. Therefore, the NRC staff finds the proposed operating domain extension acceptable with respect to the nuclear design.

3.4.1.3 Thermal and Hydraulic Design

Regulatory Evaluation

The NRC staff reviewed the thermal and hydraulic design of the core and the RCS to confirm that the design:

1. Has been accomplished using acceptable analytical methods,
2. Is equivalent to or a justified extrapolation from proven designs,
3. Provides acceptable margins of safety from conditions which would lead to fuel damage during normal reactor operation and AOOs, and
4. Is not susceptible to thermal-hydraulic instability.

The review also covered hydraulic loads on the core and RCS components during normal operation and DBA conditions and core thermal-hydraulic stability under normal operation and ATWS events. The NRC's acceptance criteria are based on:

1. GDC 10, insofar as it requires that the reactor core be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs; and

2. GDC 12, insofar as it requires that the reactor core and associated coolant, control, and protection systems be designed to assure that power oscillations, which can result in conditions exceeding SAFDLs, are not possible or can reliably and readily be detected and suppressed. Specific review criteria are contained in SRP, Section 4.4, and other guidance provided in Matrix 8 of RS-001.

Technical Evaluation

Analytical Methods

The NRC staff has reviewed the analytical methods utilized by the licensee. A comprehensive list of the codes used to support the analyses is documented in Table 1-1 of the NMP2 SAR. As described in the footnotes to Table 1-1, not all codes used have an explicit staff SER associated with them; however, sufficient regulatory basis is provided for their use. The following exceptions are noted:

1. The ISCOR code does not have an explicitly approved SER; however, the approval SER for NEDE-24011-P, Rev-0, mentions a "digital computer code" that is and acceptable method. GEH states (Note 1 of SAR Table 1-1) that the digital computer code referred in the NEDE-24011-P/Rev 0 SER is indeed ISCOR.

2. A similar situation occurs with STEMP code, which is used to calculate the suppression pool temperature using basic energy conservation equations. STEMP was referenced in the approval of NEDE-24222.

3. The LAMB code is explicitly approved for use in ECCS-LOCA applications, but it is not explicitly approved for use in reactor internal pressure differences and containment

response; however, this is simply an extension of the approved use, and the models used are those of the approved ECCS-LOCA application.

4. TRACG04 code is currently approved for use in DSS-CD and ATWS overpressure analysis, and has been used for ATWS best-estimate calculations; however, the licensing basis ATWS analyses are based on ODYN.
5. Following approval of Amendment 26 of GESTAR II, GEH implemented TGBLA06 and PANAC11 codes.

Thus, the NRC staff concludes that all the methods used in the NMP2 SAR are either approved or an acceptable extension of the use of an approved code.

Equivalency to Proven Designs

The proposed MELLLA+ operating domain is similar in design to the P/F operating domain currently in use by NMP2. The primary difference is the higher P/F ratio in the MELLLA+ corner, which results in higher operating void fraction and higher operating power when the recirculation pumps are tripped, which affect ATWS performance.

Steady State Operation

Table 2 and Table 3 show a summary of the NMP2 steady state operating conditions (extracted from Tables 1-2 and 1-3 of the NMP2 SAR).

Table-2. NMP2 Operating Conditions

Parameter	MELLLA 100% CLTP, 99% CF	MELLLA+ 100% CLTP, 85% CF	MELLLA+ 77.6% CLTP, 55% CF
Thermal Power (MWt)	3988	3988	3,095
Dome Pressure (psia)	1035	1035	1,011
Steam Flow Rate (Mlbm/hr)	17.636	17.633	13.115
FW Flow Rate (Mlbm/hr)	17.604	17.601	13.083
FW Temperature (°F)	440.5	440.5	411.4
CF (Mlbm/hr)	107.4	92.2	59.7
Core Inlet Enthalpy (BTU/lbm)	528.7	525.2	511.4
Core Pressure Drop (psi)	25.0	20.2	10.7
Core Average Void Fraction	0.504	0.531	0.532
Average Core Exit Void Fraction	0.723	0.755	0.766

Table-3. NMP2 P/F Ratios

Operating Domain	Point on P/F Map	Core Thermal Power (MWt /%CLTP)	CF (Mlbm/hr/% Rated)	P/F Ratio (MWt / Mlbm/hr)
Current Operating Domain 100% RCF	E	3988/100	108.5 / 100	36.76
Current Operating Domain 99% RCF	D	3988/100	107.4/99%	37.13
MELLLA+ Operating Domain 85% RCF	N	3988 / 100.0	92.2 / 85.0	43.24
MELLLA+ Operating Domain 55% RCF	M	3,095 / 77.6	59.7/ 55.0	51.86

As seen in

Table-3, the power density at Point M (55% flow, see SAR Figure-1) is 51.86 MW/Mlbm/hr, which is greater than the action threshold of 50 MW/Mlbm/hr set by Limitation 9.3 of the Methods LTR and associated SERs (NEDC-33173-P and NEDC-33173P-A). During the evaluation of the Methods LTR, the staff reviewed power distribution uncertainties up to P/F ratios of 42 MW/Mlbm/hr, and found that an uncertainty of 0.02 should be added to the SLMCPR to cover operation up to 50 MW/Mlbm/hr (Figure-2). The reason for this limitation is that insufficient data was available to judge power distribution uncertainties at the higher void fraction levels. Extremely high void fractions result in increased errors in cross section generation, and challenge some of the assumptions used in modern nodal neutronic methods because of the harder neutron spectrum.

For operation at P/F ratio greater than 50 (for example, at point M in Figure-2), the staff SER required a case-specific evaluation to ensure that the particular plant is not an outlier and has unusual uncertainty values. The staff also required an additional penalty on the SLMCPR by using SLO uncertainties even though SLO operation is not allowed under MELLLA+. This restriction applies to the region in Figure-2 above the 50 MW/Mlbm/hr line, which is a very small area around point M. The staff reviewed on a plant-specific basis the power distribution uncertainties for NMP2. This review was based on a comparison of TIP data provided by the licensee against PANACEA calculated power distributions.

Following the guidelines from Methods Limitation 9.3, the staff has reviewed on a plant-specific basis the power distribution uncertainties for NMP2. This review was based on a comparison of TIP data provided by the licensee against PANACEA calculated power distributions. The TIP data encompasses three cycles from 5/2010 through 7/2014. Figure-3 shows the locations in the P/F map where TIP measurements were performed in NMP2 for the last three cycles 13-15). Analyses of these data show that the power distribution RMS error is between 3% and 7%, depending on the type of uncertainty. A more complete evaluation of the data is provided in Appendix A, RAI-1 evaluation of this SE. The TIP data was provided in the RAI-1 response.

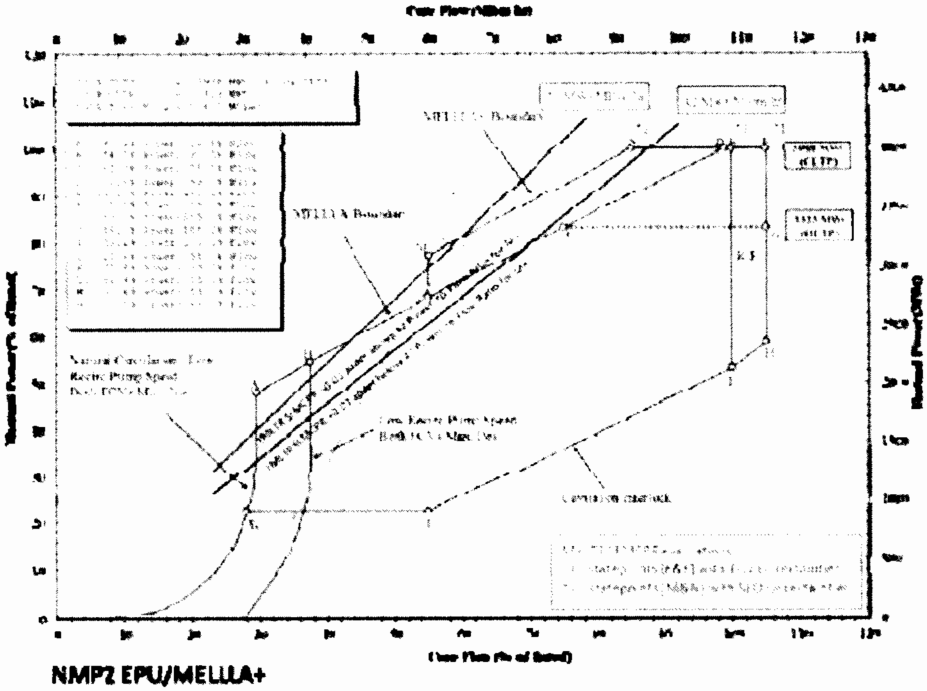

Figure-2. Illustration of P/F ratio requirements from Limitation 9.3

In addition to the 42 and 50 P/F lines (red lines), Figure-2 shows the line in the P/F map where the exit void fraction in the bypass region is supposed to be <5% (orange line) based on conservative ISCOR calculations. Bypass void fractions can affect the calibration of LPRM or TIP detectors because they are typically calibrated at full power where there is no bypass flow. The MELLLA+ SER requires that the bypass void fraction be lower than 5% to prevent this de-calibration issue. The calculation shown in Figure-2 confirms that bypass voiding is only a potential problem in NMP2 in a small area around point M (55% flow); however: (1) the void fraction is not higher than 5% at the LPRM location because it is lower than the TIP exit, and (2) NMP2 has committed (Division of Safety Systems, Reactor Systems Branch (SRXB) (2) RAI-1 response dated March 10, 2014), to avoid taking TIP measurements around point M. Therefore, the staff concludes that bypass voiding is not an issue for NMP2 operation in the MELLLA+ domain.

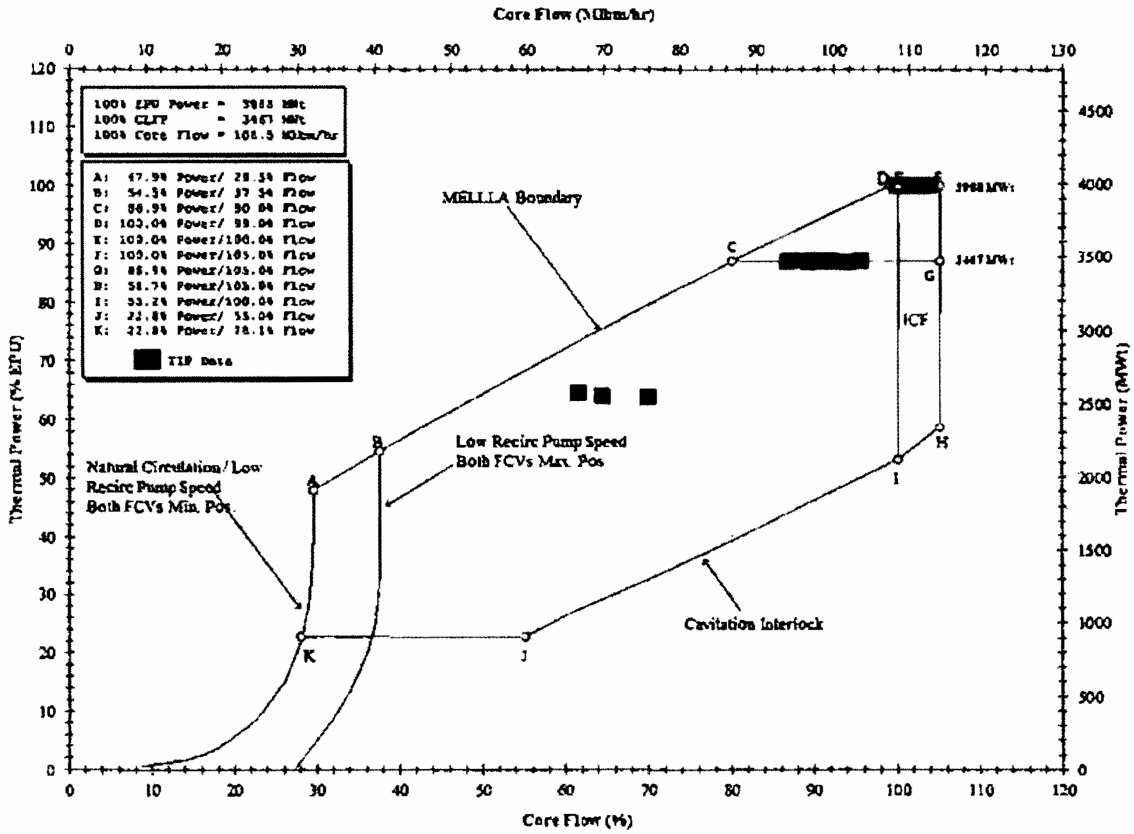

Figure-3. Location in power to flow map of available TIP data in Nine Mile Point 2

<u>Transient Response</u>

The licensee has provided analyses for normal operation, AOOs, transient and special events. The complete staff evaluation of these results is documented in Sections 3.4.9 and 3.4.10 of this SE. As seen in that evaluation, operation at lower core flows in the MELLLA+ domain has no impact on transient response, and the limiting initiating conditions are always at 105% core flow. Calculations (see Table 9-1 of the NMP2 SAR) show that the limiting AOO is the LRNBP. For this case, the AOO delta-CPR is 0.30 when initiating from the 105% flow conditions and 0.26 when initiating from 85% flow condition. Thus, no reduction of operating margin is required when operating in MELLLA+.

The OLMCPR steady state limits are calculated on a cycle specific basis to maintain the same margin to the SLMCPR during transients. The transient delta-CPR, which defines the OLMCPR, is calculated for all transients affected by the MELLLA extension. In this way, the limiting transient event initiating from inside the MELLLA+ region has the same margin to the SLMCPR than before the MELLLA+ domain was implemented.

Stability

NMP2 will implement the DSS-CD solution consistent with the MELLLA+ LTR. DSS-CD implementation includes any limitations and conditions in the applicable DSS-CD SER. NMP2 has a full-core load of GE14 fuel; therefore, the transition from Option III to DSS-CD does not require any special analyses because they are covered by the DSS-CD LTR results.

[[

]] The calculations documented in Table 2-5 of the NMP2 SAR confirm that these IMCPR values are acceptable because they follow the approved procedure established in the DSS-CD SER and **[[**
]]

In the response to RAI-4 (Division of Risk Assessment, PRA Operations and Human Factors Branch (APHB) Response dated October 10, 2014), the licensee provided the preliminary NMP2 BSP regions. Proposed Technical Specifications have been provided to implement the change from Option III to DSS-CD. The specifications follow the standard industry practice and require restoration of the primary DSS-CD instrumentation if both OPRM and Automatic Backup Stability Protection (ABSP) functions are inoperable. Also, within 90 days, a special report should be provided with a plan for restoration of the primary stability licensing option. ABSP provides acceptable stability protection while the primary DSS-CD option is declared inoperable, although it does not replace it, and long term operation without the OPRM operation enabled is not expected. The proposed changes to TSs to implement DSS-CD are acceptable.

Conclusions – Thermal Hydraulic Design

The NRC staff has reviewed the licensee's analyses related to the effects of the proposed operating domain extension on the thermal and hydraulic design of the core and the RCS. The staff concludes that the licensee has adequately accounted for the effects of the proposed MELLLA+ operating domain extension on the thermal and hydraulic design and demonstrated that the design: (1) has been accomplished using acceptable analytical methods, (2) is equivalent to proven designs, (3) provides acceptable margins of safety from conditions that would lead to fuel damage during normal reactor operation and AOOs, and (4) is not susceptible to thermal-hydraulic instability. The staff further concludes that the licensee has adequately accounted for the effects of the proposed MELLLA+ operating domain extension on the hydraulic loads on the core and RCS components. Based on this, the NRC staff concludes that the thermal and hydraulic design will continue to meet the requirements of GDCs 10 and 12 following implementation of the proposed operating domain extension. Therefore, the NRC staff finds the proposed operating domain extension acceptable with respect to thermal and hydraulic design.

3.4.2 SAR Section 4.0, "Engineered Safety Features"

Introduction

The licensee's letter, dated November 1, 2013 (ML13316B113), contains the proprietary version of the SAR for NMP2 MELLLA+. The SE, herein, provides the staff review of the following sections of SAR:

- Section 4.1 Containment System Performance
- Section 4.2.6 ECCS Net Positive Suction Head
- Section 4.4 Main Control Room Atmosphere Control System
- Section 4.5 Standby Gas Treatment System
- Section 4.7 Post-LOCA Combustible Gas Control System

Regulatory Evaluation

The NRC staff acceptance criteria are based on the following "General Design Criteria GDC for Nuclear Power Plants" in Appendix A to 10 CFR, Part 50:

1. GDC 4, "Environmental and Dynamic Effects Design Bases," insofar as it requires that Structures, Systems, and Components SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents and that such SSCs be protected against dynamic effects.

2. GDC 16, "Containment Design," insofar as it requires that the containment and associated systems be designed to establish an essentially leak tight barrier against the uncontrolled release of radioactivity to the environment, and to assure that the containment design conditions important to safety are not exceeded as long as postulated accident conditions require.

3. GDC 19, "Control Room," insofar as it requires that adequate radiation protection be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent, to any part of the body, for the duration of the accident.

4. GDC 38, "Containment Heat Removal," insofar as it requires that a Containment Heat Removal System (CHRS) be provided and that its function shall be to rapidly reduce the containment pressure and temperature following a LOCA and maintain them at acceptably low levels.

5. GDC 41, "Containment Atmosphere Cleanup," insofar as it requires systems to: (1) control fission products, hydrogen, oxygen and other substances which may be released into the reactor containment; (2) reduce the concentration and quality of fission products released to the environment following postulated accidents; and (3) control the concentration of hydrogen or oxygen and other substances in the containment

atmosphere following postulated accidents to assure that containment integrity is maintained.

6. GDC 50, "Containment Design Basis," insofar as it requires that the containment and its associated heat removal systems be designed so that the containment structure can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated temperature and pressure conditions resulting from any LOCA.

7. In 10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors," insofar as it requires that plants be provided with the capability of controlling combustible gas concentrations in the containment atmosphere.

Technical Evaluation

NMP2 is a BWR (BWR-5) with a Mark II pressure suppression type primary containment. The primary containment structure for NMP2 consists of the drywell, the pressure suppression chamber that stores a large volume of water, and the drywell floor, which separates the drywell and suppression chamber. The drywell is a steel lined concrete vessel in the shape of a portion of a cone, closed by a dome with a torispherical head. The pressure suppression chamber is a cylindrical stainless-steel clad, steel lined, reinforced concrete vessel, located below the drywell. The primary containment structure houses the Reactor Vessel (RV), the reactor recirculation system, and other branch connections of the RCPB. The primary containment design features include the down comers between the drywell and suppression chamber, containment isolation valves, vacuum breakers, and the RHR system for containment heat removal.

The scope of evaluations required to support the expansion of the core flow operating domain to the MELLLA+ boundary is contained in the LTR NEDC-33006P-A, "Maximum Extended Load Line Limit Analysis Plus (MELLLA+)," referred to as the MELLLA+ LTR. Attachment 10 to the licensee's letter dated November 1, 2013, provides a disposition of the MELLLA+ LTR subjects applied to NMP2, including performance of plant and confirmation of the applicability of generic assessments contained in MELLLA+ LTR to support a MELLLA+ operating domain expansion. NRC has previously reviewed the MELLLA+ LTR and provided a SE in NEDC-33306P-A. The following plant specific SE of the NMP2 MELLLA+ is based on a review of the MELLLA+ LAR dated November 1, 2013, and the NRC staff evaluation in NEDC-33006P-A.

Containment Pressure and Temperature Response Analysis

The licensee used LAMB computer code for the short term Mass and Energy (M&E) release analysis and M3CPT computer code for the short term containment pressure and temperature response analysis for the proposed EPU MELLLA+ operating domain which are the same as those used in the current analysis.

Short-Term LOCA Analysis for Drywell Pressure Response (SAR Section 4.1.1)

In NEDC-33576NP, Section 4.1.1, the licensee stated that the NMP2 short-term RSLB containment temperature and pressure responses are affected by the change in enthalpy as a result of MELLLA+ operating domain expansion. There are two peak pressures for NMP2, the first occurring approximately at 25 seconds end of initial reactor vessel inventory blowdown and the second peak occurring at approximately 150 seconds end of blowdown phase. As stated by the licensee in the EPU application the NMP2 containment design has a vent area to break area ratio that is at least 20% larger than other Mark II plants which tends to reduce the first peak, while it is also among the Mark II plants with a relatively large drywell to wetwell volume ratio that increase the second peak due to increased transfer of non-condensable gas from drywell to wetwell. In NEDC-33576NP, Revison 0, Section 4.1.1, the licensee noted that the first peak is lower than the second peak by approximately 0.5 psi for EPU. The licensee further stated that the extended short-term analysis is not sensitive to the subtle initial changes in vessel mass and energy associated with operation at various points in the operating domain. Due to the extended time frame until Drywell (DW) reaches the second peak pressure conditions, it is recognized that the minor variability in the initial reactor vessel inventory energy associated with various points in the operating range would have a negligible effect in comparison to the overall mass and energy contributions to the DW at the time of the second peak. Therefore, the effect of MELLLA+ is assessed from the results of the standard short-term analysis using more detailed LAMB break flow model, which captures the subcooling effect when operating in MELLLA+ operating domain. The licensee analyzed several short-term cases for MELLLA+ statepoints and compared results to EPU short-term results. The results show that EPU short-term peak pressure bounds the MELLLA+ peak pressure. The peak DW-to-wetwell differential pressures for operation in the MELLLA+ operating domain are bounded by those previously reported for the EPU operation. In NEDC-33576NP, Revison 0, Section 4.1.1, the licensee concluded that:

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The NRC staff concurs with the licensee's evaluation because the licensee used the same methodology as in the current licensing basis analysis.

<u>Short-Term LOCA Analysis for Drywell Gas Temperature Response (SAR Section 4.1.1)</u>

The licensee stated that short-term containment temperature response for the DBA LOCA is affected by the change in enthalpy of the break fluid in the MELLLA+ operating domain.

The licensee previously applied for NMP2 EPU (NMP2 LAR dated May 27, 2009) and obtained the NRC approval to implement the EPU (NMP2 Amendment No. 140 dated December 22, 2011 – ML113300041). The non-proprietary version of the licensee SAR for the EPU application is contained in ADAMS under Accession No. ML113560333. As stated in Section 6.2.1.1.6 of the USAR, the basis for the original selection of a design temperature was a bounding combination of reactor vessel pressure and drywell pressure that produces a maximum calculated superheated gas temperature that can be caused by a blowdown of steam to the drywell during a small break LOCA. As stated Section 6.2.1.1.3 of the USAR under the item "Drywell Environmental Design Temperature Considerations," conservatively neglecting passive heat sinks, a combination of RCS pressure of approximately 470 pounds per square inch absolute (psia) and drywell pressure of 50.2 psia resulted in a drywell temperature of 325.8°F. Based on the conservative analysis, a drywell design temperature of 340°F was selected for NMP2. Both the USAR (Section 2.6.3.1.1 of NEDO-33351, Rev. 0) and the EPU application state that the bounding conditions are derived independent of the initial reactor power and; therefore, the EPU has no effect on the peak drywell design temperature. As stated in Table 2.6-1 of NEDO-33351, Revision 0, the short term RSLB analysis at EPU results in a maximum drywell temperature of 279.7°F. In Section 4.1.1 of NRC Order EA-13-109, the licensee stated that the short-term RSLB analyses cases at MELLLA+ demonstrate that the peak DW temperatures are bounded by the EPU result of 279.7°F, indicating a significant margin between the design and calculated temperature values.

The NRC staff finds that the licensee's evaluation is acceptable.

<u>Long-Term Suppression Pool Temperature Response (SAR Section 4.1.1.1)</u>

Section 4.1.1.1 of NRC Order EA-13-109 states:

> **[[**
>
> **]]**

The licensee confirmed that the sensible and decay heat under EPU conditions do not increase as a result MELLLA+ operating domain expansion and, therefore, no further evaluation of this topic is required.

The NRC staff finds that the licensee's evaluation is acceptable.

<u>Containment Dynamic Loads (SAR Section 4.1.2)</u>

Consistent with MELLLA+ LTR, the licensee performed an evaluation to determine the effect of MELLLA+ on the LOCA containment dynamic loads. The LOCA dynamic loads include vent clearing jet loads, pool swell, condensation oscillation (CO), and chugging. The licensee used the results from **[[** **]]** The licensee stated that the results of the **[[** **]]** LOCA containment dynamic loads evaluation demonstrate that existing vent clearing jet loads, pool swell, CO, and chugging load definitions remain bounding for operation in the MELLLA+ operating domain and, therefore, the LOCA containment dynamic loads are not affected by the MELLLA+ operating domain expansion. The NRC staff finds that the licensee's evaluation is acceptable.

<u>Safety/Relief Valve SRV Loads (SAR Section 4.1.2.3 and Section 4.1.2.4)</u>

The SRV loads are affected by the SRV setpoints, sensible and decay heat. In NEDC-33576NP, Sections 4.1.2.3 and 4.1.2.4, the licensee provided an evaluation of NMP2 specific piping SRV loads and containment dynamic loads due to SRV discharge. **[[**

]] The licensee confirmed that operation in MELLLA+ operating will not change decay heat or the SRV set points (Section 4.1.2.3 of NEDC-33576NP) and, therefore, the NRC staff finds that the licensee's conclusion is acceptable. No further evaluation of these topics is required.

Sub-compartment Pressurization (SAR Section 4.1.2.2)

In Section 4.1.2.2 of NEDC-33576NP, the licensee addressed subcompartment pressurization and the associated loads. The licensee stated that break flow rates for liquid line breaks such as FW and recirculation line breaks for the MELLLA+ expanded operating domain are bounded by the break flow rates for the current licensed operating domain.

The licensee stated that NMP2-specific annulus subcompartment pressurization for MELLLA+ operating domain is bound by the current licensed operating domain (Section 4.1.2.2.1, NEDC-33576NP).

The licensee stated that NMP2-specific DW head subcompartment pressurization for MELLLA+ operating domain is bound by the current licensed operating domain (Section 4.1.2.2.2, NEDC-33576NP).

The licensee stated that NMP2-specific annulus biological shield wall subcompartment pressurization for MELLLA+ operating domain is bound by the current licensed operating domain (Section 4.1.2.2.3, NEDC-33576NP).

The NRC staff finds the licensee's evaluation to be acceptable because the subcompartment pressurization under MELLLA+ operating domain for all the pertinent cases were found to be bounded by the current operating domain.

Post-LOCA Combustible Gas Control System (SAR Section 4.7)

In NEDC-33576NP, Section 4.7, the licensee provided evaluation of the post-LOCA combustible gas control system. The NRC revised 10 CFR 50.44, "Combustible gas control for nuclear power reactors" in September 2003. The revised rule eliminated the requirements for hydrogen recombiners and relaxed the requirements for hydrogen and oxygen monitoring in containment. The revised 10 CFR 50.44 no longer defines a design-basis LOCA hydrogen release, and eliminates requirements for hydrogen control systems to mitigate such a release. The NMP2 has nitrogen inerted containment. The licensee stated that NMP2 has adopted the revised rule per license amendment number 124 issued in April 2008; however, has chosen to leave the recombiners in place and remain functional. The licensee also stated that MELLLA+ operating expansion has no effect on the design of these systems or on the ability of these systems to perform their intended functions. Based on the consideration that this system is no longer required to be maintained as a post-LOCA combustible gas control system, the licensee concluded that no further evaluation is necessary for MELLLA+ operating domain expansion. The NRC staff finds the licensee's evaluation to be acceptable.

Emergency Core Cooling System (ECCS) and Containment Heat Removal (CHR) Pumps Net Positive Suction Head (NPSH) (SAR Section 4.2.6)

In NEDC-33576NP, Section 4.2.6, the licensee provided the evaluation of the NPSH for the ECCS and CHR pumps. In addition, the NPSH for the RCIC was provided in Section 3.9.3 of NEDC-33576NP.

The ECCS and CHR pumps are the RHR and CS pumps. During the EPU reviews by the NRC staff, the licensee provided NPSH evaluations for the RHR and CS pumps (Section 3.4.4 of the NMP2 Draft SE). A brief summary of which follows:

> NMP2 follows RG 1.1, which prohibits reliance on CAP for assuring adequate NPSH.
>
> NPSH evaluations were performed for different scenarios of operation of the ECCS and containment heat removal pumps, RHR (also operating in LPCI mode), LPCS, and HPCS.
>
> The scenarios of operation included DBA-LOCA, Alternate Shutdown Cooling ASDC, Appendix R fire, ATWS, and Station Blackout recovery period.
>
> The evaluations included the impact of uncertainties and maximum erosion zone, as specified in the draft guidance for the use of CAP in determining the NPSH margin. Based on the evaluations, the licensee has determined that the ECCS and CHR pumps meet the guidance in SECY-11-0014, without taking credit of CAP.

The NRC has found the licensee's NPSH evaluation for EPU acceptable.

In SAR Section 4.2.6 of NEDC-33576NP, the licensee stated the following:

> The MELLLA+ operating domain expansion does not result in an increase in the heat addition to the suppression pool following LOCA, SBO, or Appendix R event. **[[**
>
> **]]**
>
> There are no physical changes in the piping or system arrangement. There is no change in the operator actions to throttle the RHR and CS pumps.
>
> All criteria related to ECCS-NPSH **[[**
> **]]** are met, and no further evaluation is required.
>
> Suppression pool temperature following an ATWS event is bounded by the EPU ATWS. As shown in Table 9.4 of NEDC-33576P, Revision 0, **[[**

]]

The NPSH evaluations performed for EPU will bound the operation of the ECCS and CHR pumps under MELLLA+ operating domain.

Based on the information provided by the licensee, the NRC staff concludes that the NPSH evaluations for the ECCS and CHR pumps under MELLLA+ operating domain satisfy the NRC staff guidance.

The purpose of the RCIC pump is to provide coolant to the reactor pressure vessel so that the core is not uncovered during an SBO or a loss of feedwater (LOFW) event. The RCIC system is designed with the capability to take suction from either the condensate storage tank or the suppression pool. This feature allows switching the suction from the suppression pool to the CST, when suppression pool temperatures becomes greater than the operational limit of the RCIC pump, as could occur during ATWS. As stated in Section 5.4.6.2.3 of the USAR, the limiting operating condition in terms of NPSH, when taking suction from the suppression pool in combination with maximum suppression pool temperature of 170°F, results in a NPSH margin (i.e. available NPSH greater than required NPSH) of approximately 5.5 feet.

[[
]] the NPSH available for the RCIC pump [[

]]. In Section 3.9.3 of NEDC-33576P, Revision 0, the licensee has confirmed that these parameters are unchanged for the proposed MELLLA+ operating domain. The licensee further stated that the NPSH required by the RCIC pump [[
]]. Also, the MELLLA+ suppression pool temperature following an ATWS is bounded by EPU.

The NRC staff concurs with the licensee's conclusion that RCIC NPSH evaluation under the EPU bounds the operation of the RCIC pump under the MELLLA+ operating domain.

Main Control Room Atmosphere Control System (SAR Section 4.4)

The MCR Atmosphere Control System is described in the NMP2 USAR Section 6.7, "Main Control Room, Emergency Filtration Train Building and Technical Support Center Habitability". In NEDC-33576NP, Section 4.4, the licensee provided evaluation of the Main Control Room Atmosphere Control System. The licensee stated that there is no change in the NMP2 source term or release rates as a result of MELLLA+ operating domain expansion and, therefore, no further evaluation of the MCR Atmosphere Control System is required.

The licensee stated the following in its evaluation:

> [[ ]] there is no change in the NMP2 source term or release rates as a result of MELLLA+ operating domain expansion. [[
>
>]]

The NRC staff finds the licensee's conclusion to be acceptable and that no further evaluation of the MCR atmosphere control system is required.

<u>Standby Gas Treatment System (SAR Section 4.5)</u>

In Section 4.5 of NEDC-33576NP, the licensee provided an evaluation of the SGTS. The licensee stated that the SGTS maintains the secondary containment at a negative pressure and filters the exhaust air by removing fission products potentially present during abnormal conditions. The licensee further stated that the design flow capacity of the NMP2 SGTS is selected to maintain the secondary containment at the required negative pressure to minimize the potential for exfiltration of air from reactor building and by limiting the release of unfiltered airborne particulates and halogens, the SGTS limits off-site dose following postulated design basis accidents (DBA). The core fission product inventory is not changed by the MELLLA+ operating domain expansion, and reactor coolant activity levels are defined by TS which also remain unchanged. Therefore, there is no change to the SGTS adsorber iodine loading, decay heat rates, or iodine removal efficiency.

The licensee's evaluation for SAR Section 4.5.1, "Flow Capacity" states that:

> [[ ]] the design flow capacity of the NMP2 SGTS was selected to maintain the secondary containment at the required negative pressure to mionimize the potential for exfiltration of air from the reactor building. [[
>
>]] and no further evaluation is required.

The licensee's evaluation for SAR Section 4.5.2, "Iodine Removal Capability" states that:

> [[ ]] the core fission product inventory is not changed by the MELLLA+ operating domain expansion, and coolant activity levels are defined by TS and do not change, so no change occurs in the SGTS adsorber iodine loading, decay heat rates, or iodine removal efficiency. [[
>]]

Based on the information provided, the licensee's conclusion that no further evaluation of the SGTS is required is acceptable to the NRC staff.

Containment Isolation (SAR Section 4.1.3)

The containment isolation system is affected by the containment pressure and temperature response under design basis accident conditions.

As stated in Section 4.1.3 of NEDC-33576P, Revision 0:

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Therefore, the NRC staff finds the licensee's conclusion that no containment isolation system evaluations are required for NMP2 to be acceptable.

Generic Letter 89-10 (SAR Section 4.1.4)

The response to Generic Letter (GL) 89-10 Supplement 3, "Consideration of the Results of NRC-Sponsored Tests of Motor-Operated Valves" is affected by the containment pressure and temperature under design basis accident conditions.

As stated in Section 4.1.4 of NEDC-33576P, Revison 0:

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Therefore, the NRC staff finds the licensee's conclusion that a separate plant-specific GL 89-10 MOV program evaluation for MELLLA+ operating domain is not required for NMP2 is acceptable.

Generic Letter 89-16 (SAR Section 4.1.5)

GL 89-16 is only applicable to BWR Mark I containments. It is not applicable to NMP2 because it has a BWR Mark II containment. Therefore, the NRC staff concurs with the licensee's conclusion that operation in MELLLA+ operating domain for NMP2 has no impact due to GL 89-16. However, in response to Fukushima Dai-ichi accident, the NRC has issued Order EA-13-109, requiring both BWR Mark I and Mark II containments to install a reliable hardened containment vents capable of operation under severe accident conditions. NMPNS is in the process of submitting implementation plans for NMP2 to comply with the Order. The NRC staff is reviewing those plans including compliance with all technical requirements contained in the Order and in the ISG (Interim Staff Guidance JLD-ISG-2013-02, Revision 0) associated with the Order. The staff review of licensee submittal for NMP2 to comply with Order EA-13-109 is independent of the MELLLA+ operating domain review.

Generic Letter 95-07 (SAR Section 4.1.6)

The response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," would be affected by the containment pressure and temperature under design basis accident conditions.

As stated in Section 4.1.6 of NEDC-33576P, Revision 0:

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Therefore, the NRC staff finds the licensee's conclusion that no GL 95-07 evaluation is required for MELLLA+ operating domain for NMP2 is acceptable.

Generic Letter 96-06 (SAR Section 4.1.7)

The response to GL 96-06, "Assurance of Equipment Operability and Containment Integrity during Design-Basis Accident Conditions," would be affected by the containment pressure and temperature under design basis accident conditions.

As stated in Section 4.1.7 of NEDC-33576P, Revision 0:

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Therefore, the NRC staff finds the licensee's conclusion that no GL 96-06 evaluation is required for MELLLA+ operating domain for NMP2 is acceptable.

Conclusions – SAR Section 4.0, Containment System Performance

The NRC staff has reviewed the licensee's assessment of the topics addressed in this SE and concludes that they are adequately addressed for NMP2 in the EPU MELLLA+ operating domain. The NRC staff also concludes that NMP2 will continue to meet the requirements of GDCs 4, 16, 19, 38, 41, and 50 following implementation of the proposed MELLLA+ operating domain under EPU conditions.

3.4.3 SAR Section 5.0, "Instrumentation and Controls"

Regulatory Evaluation

The regulatory requirements and guidance which the NRC staff considered in its review of the application, are as follows:

1. SRP, NUREG 0800, Chapter 7, Branch Technical Position 7-19, Revision 6, "Guidance for evaluation of Diversity and Defense-In-Depth in Digital Computer-Based Instrumentation and Control Systems."

2. 10 CFR Part 50 establishes the fundamental regulatory requirements with respect to the domestic licensing of nuclear production and utilization facilities. Specifically, Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 provides, in part, the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety.

3. GDC 1,"Quality standards and records," requires structures, systems, and components important to safety to be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

4. GDC 10, "Reactor design," requires the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

5. GDC 12, "Suppression of reactor power oscillations," requires the reactor core and associated coolant, control, and protection systems to be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

6. GDC 13, "Instrumentation and control," requires that instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to

assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

7. GDC 20, "Protective system functions," requires the protection system be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety.

8. GDC 21, "Protection system reliability and testability," requires that the system be designed for high functional reliability and in service testability, with redundancy and independence sufficient to preclude loss of the protection function from a single failure and preservation of minimum redundancy despite removal from service of any component or channel.

9. GDC 22, "Protection system independence," requires that the system be designed so that natural phenomena, operating, maintenance, testing and postulated accident conditions do not result in loss of the protection function.

10. GDC 23, "Protection system failure modes," requires that the system be designed to fail to a safe state in the event of conditions such as disconnection, loss of energy, or postulated adverse environments.

11. GDC 24, "Separation of protection and control systems," requires that interconnection of the protection and control systems be limited to assure safety in case of failure or removal from service of common components.

12. GDC 25, "Protection system requirements for reactivity control malfunctions," requires that the protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems.

13. GDC 29, "Protection against anticipated operational occurrences," requires that protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.

14. 10 CFR 50.36 – "Technical specifications," states, "Each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section." Specifically, 10 CFR 50.36(c)(2)(ii) sets forth four criteria to be used in determining whether a limiting condition for operation is required to be included in the technical specification TS.

15. 10 CFR 50.55a(h) requires that the protection systems meet Institute of Electrical and Electronics Engineers (IEEE) 279. Section 4.2 of IEEE 279-1971 discusses the general

functional requirement for protection systems to assure they satisfy the single failure criterion.

The NRC SRM on SECY 93-087, dated July 21, 1993, describes the position of NRC regarding Diversity and Defense-In-Depth (D3). This SRM states that applicants using digital or computer based technology shall assess the D3 of the proposed instrumentation and control system to demonstrate that vulnerabilities to common mode failures have been adequately addressed. The SRM also states: "in performing the assessment, the vendor or applicant shall analyze each postulated common-mode failure for each event that is evaluated in the accident analysis section of the safety analysis report SAR using best estimate methods. The vendor or applicant shall demonstrate adequate diversity within the design for each of these events."

Technical Evaluation

The OPRM performs a Period Based Algorithm (PBA) reactor trip safety function which is credited in the NMP2 UFSAR, Chapter 7.6.1.4.3, "Average Power Range Monitor Subsystem," for mitigation of a plant instability event. The OPRM also performs two other algorithms: Amplitude Based Algorithm, and Growth Based Algorithm which are not credited safety functions but are included as defense-in-depth features. The PBA function is used to demonstrate protection of the minimum critical power ratio safety limit for anticipated reactor instabilities. A failure of the Nuclear Measurement Analysis and Control (NUMAC) OPRM or APRM could disable the automatic safety trip function performed by the DSS-CD algorithms. The NMP2 NUMAC system includes a means of providing ABSP in the event that the primary means of stability protection DSS-CD becomes inoperable; however, the NRC staff notes that use of common software for both primary DSS-CD and backup ABSP stability protection can lead to a condition where both of these automatic functions would become disabled due to a postulated software defect that could be triggered to result in a common-cause failure (CCF) of the OPRM reactor trip safety function.

If the OPRM system is inoperable and the ABSP function performed by the APRM either cannot be implemented or is also inoperable, manual BSP becomes the licensed stability solution. The NMP2 P/F graph contains regions of operation that are defined by a BSP boundary. With the BSP boundary being the credited stability solution, the reactor power is reduced below the BSP line. When the plant is operating in manual BSP mode, if conditions result in operation inside the BSP Scram Region (Region I), administrative actions require initiation of a manual scram. This is described in Section 7 and in the TS changes documented in the approved DSS-CD Licensing Topical Report NEDC-33075P-A, Revision 6 (ADAMS Accession Number ML080310402).

Because of the potential for loss of both primary and backup automatic protection functions, the licensee performed a D3 analysis which considered the effects of a postulated software common cause failure CCF of the NUMAC Power Range Neutron Monitoring (PRNM) APRM/OPRM system in conjunction with the plant instability events described in the NMP2 UFSAR. The results of this analysis were provided in the document titled "Response to Request for Supplemental Information" (ADAMS Accession No. ML14054A138). This analysis identified Manual Operator Actions as a diverse means of maintaining plant safety if the automatic trip functions performed by the DSS-CD algorithms and the ABSP become unavailable due to a postulated common-mode failure of the NUMAC PRNM system.

The D3 analysis identified that the postulated CCF in the PRNM system results in the [[

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This immediate action is uncomplicated and is completed by rotating the reactor mode switch to the shutdown position at panel 603 in the MCR. In the event that the mode switch did not result in an immediate actuation of a reactor scram, operators would simultaneously depress the two reactor scram push buttons at panel 603. Confirmation that the manual scram is successful is unambiguous and provided by the control rod display on panel 603 within a few seconds. Further confirmation is provided by information available on the plant process computer. The NRC staff confirmed that the systems used for initiation of the manual scram and for confirmation that the scram was successful do not rely on digital or software based technologies. The staff determined these systems would therefore not be affected by a postulated software CCF that renders the automatic protection functions inoperable.

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]] The NRC staff confirmed the systems used for controlling core flow, reactor power and manual scram do not rely on digital or software based technologies. The NRC staff determined these systems would, therefore, not be affected by a postulated software CCF of the PRNMS that renders the automatic protection functions inoperable.

In its previous evaluation of BSP protection (ADAMS Accession Number ML080310402), the NRC staff concluded the proposed BSP methodology is an acceptable solution because it provides sufficient protection against plant SLMCPR violations commensurate with the probability of an instability event in the short period of time they are active. This evaluation further concludes the manual control measures needed to support BSP protection are sufficiently diverse from the digital PRNMS NUMAC systems and, therefore, provide an acceptable means of diverse protection for the DSS-CD safety function.

Conclusion – SAR Section 5.0, "Instrumentation and Control"

The NRC staff determined that the proposed license amendment to revise NMP2 Operating License and TSs allowing the plant operation in the MELLLA+ domain with BSP provides reasonable assurance of adequate protection of public health, safety, and security based on the evaluation in Section 3.0, which applies current and applicable regulatory evaluation criteria that is identified in Section 2.0. The NRC staff also determined manual control measures needed to support BSP protection are sufficiently diverse from the digital PRNMS NUMAC systems and therefore provide an acceptable means of diverse protection for the DSS-CD safety function. On this basis, the staff finds the proposed license amendment to be acceptable.

3.4.4 SAR Section 8.0, "Radwaste Systems and Radiation Sources"

Regulatory Evaluation

The NRC staff conducted its review in this area to ascertain what overall effects the proposed expanded operating domain, identified as MELLLA+, will have on both occupational and public radiation doses or the licensee's ability to maintain doses within the applicable regulatory limits and ALARA. The staff's review included an evaluation of any increases in radiation sources and how this may affect plant area dose rates, plant radiation zones, and plant area accessibility. The staff evaluated how personnel doses needed to access plant vital areas following an accident are affected. The staff also considered the effects of the proposed MELLLA+ on plant effluent levels and radioactive waste generation, and the impact that any increase in these may have on offsite radiation doses to any member of the public. The NRC's acceptance criteria for occupational and public radiation doses are based on 10 CFR Part 20, 10 CFR 50.67, 10 CFR Part 50, Appendix I, and Appendix A, GDC 19. Specific review criteria are contained in NUREG 0800, SRP Chapters 11 and 12, and NUREG-0737, Item II.B.2.

Technical Evaluation

Source Terms

Fission Products

The MELLLA+ operating domain expansion does not involve a change in the current licensed maximum reactor thermal power nor the maximum rated reactor steam flow. During power operation, the radiation sources in the core are directly related to the fission rate. These radiation sources include radiation from the fission process, accumulated fission products, and neutron activation of reactor components. Since the fission rate in the core is directly related to the power output, there is no impact on these radiation sources from operating in the MELLLA+ operating domain.

Activation of Coolant and Corrosion Products

In addition to the radioactive materials in the core, normal power operation results in radioactive materials in the reactor coolant. These sources include small amounts of fission products released into the reactor coolant system, activation of impurities in the water, or as in the case of Nitrogen-16 (N-16) the activation of the reactor coolant itself. The radioactive sources in the reactor coolant exist as dissolved noble gasses, soluble, or insoluble suspensions. The production of the reactor coolant sources is also directly related to reactor power. Therefore, the concentration of these sources in the reactor coolant is not expected to be significantly impacted by operation in the MELLLA+ domain.

Post-Shutdown Radiation Levels

The post-operation radiation sources in the core are primarily the result of accumulated fission products, which in turn is a function of the recent integrated power history of the core. Since the maximum operating power is unchanged, the maximum integrated power of a core is unchanged. Therefore, the shutdown radiation sources in the reactor core and the maximum source term available for release during an accident are unchanged.

Radioactivity Transport:

The moisture content of the MS leaving the vessel may increase while operating near the minimum CF in the MELLLA+ operating domain. The amount of liquid water carried in the steam is called moisture carryover (MCO) and can have a negative effect on turbine performance. Higher MCO will also result in an increase in the soluble and non-soluble radioactive species in the reactor water being transported from the reactor vessel to the turbine and secondary side of the plant. The NMP2 MCO will be monitored and controlled to < 0.25 wt. % within the analytical assumption of 0.35 wt. % used in the determination of radiation levels. The effect of increased MCO on plant operation has been analyzed to verify acceptable steam separator-dryer performance under MELLLA+ operating conditions for a maximum moisture content of 0.25 wt. %. MCO is monitored during operation to ensure adequate operating limitations are implemented as required to maintain MCO within analyzed conditions. The amount of time NMP2 is operated with higher than the original design moisture content (0.10 wt. %) is minimized by operations. MCO monitoring periodicity is based upon results of startup testing, operating experience, control rod pattern and time in core life.

Radioactive Waste and Offsite Radiation Exposures:

Liquid and Solid Waste Management

The largest source of liquid and wet solid waste is from the backwash of the condensate demineralizers. Although the volume of waste generated is not expected to increase, potentially higher MCO in the reactor steam could result in slightly higher loading on the condensate demineralizers. However, due to the very small increase in reactor MCO reaching the condenser, the filter backwash frequency and volume are not changed. Additionally, because the RWCU system is not affected by operation in the MELLLA+ operating domain, the RWCU filter demineralizer backwash frequency is not changed. Therefore, the NRC staff has determined the NMP2 waste volumes will not be affected by operation in the MELLLA+ operating domain.

Plant Gaseous Emissions

As mentioned above, operating in the MELLLA+ domain expansion does not involve a change in the current licensed maximum reactor thermal power nor the maximum rated reactor steam flow. Therefore, the production of and the effluent release of radioactive noble gases is unchanged. Similarly, the production of hydrogen and oxygen from radiolytic decomposition of water in the reactor core is unchanged. Therefore, there is no impact on the hydrogen recombiner in the gaseous effluent processing (augmented off-gas) system.

The small increase in MCO from periodically operating at or near the MELLLA+ minimum CF rate results in a small increase in soluble radioactive iodine and particulates in airborne releases. However, these increases are within the current licensing basis. The licensee has stated that current administrative controls are adequate to limit offsite releases such that doses to the public remain a small percentage of the 10 CFR 50, Appendix I, design objectives and remain within the applicable regulatory guidance of 10 CFR 20.

Radiation Levels

Protection Design Features and Onsite Radiation Exposures

The production of radioactive materials in the reactor as a result of normal power operations is directly proportional to the reactor power history. The concentrations of fission products, actinides, and corrosion and wear products in the reactor coolant are proportional to their production rate in the reactor (i.e., proportional to reactor power) and the integrity of the reactor fuel. Neither of these processes is affected by operations in the MELLLA+ CF region. Therefore, there should be no increase in the direct radiation levels inside or outside containment that would impact the plant radiation shielding design or onsite radiation exposures.

Post-Accident Radiation Levels

Post-accident radiation levels depend primarily upon the core inventory of fission products and TS levels of radionuclides in the coolant. The post-accident source term is similarly dependent on the maximum licensed power. Since there is no change to the maximum licensed power, operations in the MELLLA+ domain has no impact on the in-plant radiological hazards during an accident or on the licensee's assessment of vital area access per NUREG 0737, Item II.B.2.

Operational Radiation Protection Programs

The small increase in MCO from periodically operating at or near the MELLLA+ minimum CF rate may increase the deposition of non-volatile fission products, actinides and corrosion and wear products from the reactor coolant onto the wetted surfaces of the turbine, condensate and FW systems. Although the MCO is expected to be within the current amount allowed, the corresponding increase in dose rates associated with these deposited materials may be an additional source of occupational exposure during the repair and maintenance of these systems.

However, the current ALARA program practices at NMP2 (i.e., work planning, source term minimization, etc.), coupled with existing radiation exposure procedural controls, will be able to compensate for any small increases in dose rates associated with MELLLA+ operations. Therefore, the increased radiation sources resulting from the proposed MELLLA+, as discussed above, will not adversely impact the licensees ability to maintain occupational and public radiation doses resulting from plant operation to within the applicable limits in 10 CFR 20 and ALARA.

Conclusion

The staff has reviewed the licensee's assessment of the effects of the proposed MELLLA+ on radiation source terms and plant radiation levels. The NRC staff concludes that the licensee has taken the necessary steps to ensure that any increases in radiation doses will be maintained ALARA. The staff further concludes that the proposed MELLLA+ meets the requirements of 10 CFR 20 and 10 CFR 50, Appendix I. Therefore, the NRC staff finds the licensee's proposed MELLLA + acceptable with respect to radiation protection and ensuring that public and occupational radiation exposures will be maintained ALARA.

3.4.5 SAR Section 9.0, "Radiation Protection and Consequences"

Regulatory Evaluation

This SE input addresses the impact of the proposed changes on previously analyzed design basis accident DBA radiological consequences. The criteria for which the staff based its acceptance are the accident dose requirements in 10 CFR 50.67, "Accident source term." Additional criteria for which the staff based its acceptance were the accident specific design criteria provided in RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."

Technical Evaluation

NMP2 is currently licensed to operate in the MELLLA domain. The NMP2 LAR requests operation in the MELLLA+ domain, which expands the operating boundary without changing the maximum licensed core power, core flow, or the current vessel dome pressure. Furthermore, the magnitude of the potential radiological consequences depends on the quantity of fission products released to the environment, the atmospheric dispersion factors, and the dose exposure pathways. The core inventory source term, atmospheric dispersion factors, and the dose exposure pathways do not change because of operation in the MELLLA+ domain.

The licensee has evaluated the impact of the MELLLA+ operating domain expansion on the radiological consequences of DBAs in Section 9.2 of Attachments 8 and 10 of the licensee's LAR.

DBAs Evaluated Generically

As summarized in a table in SAR Section 9.2 of Attachments 8 and 10 of the LAR, the licensee has evaluated the impact of the MELLLA+ operating domain expansion on the radiological consequences of DBAs. The radiological consequences of DBAs were evaluated to determine off-site doses as well as control room operator doses. Neither, core inventory sources terms or TS RCS source terms change because of MELLLA+. There is no change in NMP2 licensed core power, decay heat, pressure, or steam flow as a result of the MELLLA+ operating range expansion.

The CRDA, ILBA, MSLBA (Outside Containment), LOCA (Inside Containment), Large Line Break (Feedwater or Reactor Water Cleanup), Liquid Radwaste Tank Failure, Fuel Handling Accident, Offgas System Failure, and Cask Drop were resolved generically in NEDO 33006P-A. The licensee confirmed these generic evaluations were applicable to the NMP2 application.

The NRC staff confirmed that there are no changes to the relevant NMP2 licensing basis related to licensed core power, decay heat, pressure, or steam flow as a result of the MELLLA+ operating range expansion. Furthermore, the magnitude of the potential radiological consequences depends on the quantity of fission products released to the environment, the atmospheric dispersion factors, and the dose exposure pathways. The currently licensed quantity of fission products, atmospheric dispersion factors, and the dose exposure pathways do not change as a result of operating in the MELLLA+ operating domain.

<u>DBA Evaluated on a Plant-Specific Basis</u>

NEDO 33006P-A indicates that a plant-specific evaluation of the MELLLA+ impact on the liquid radwaste tank failure analysis should be performed. As provided in Section 9.2.1.6 of Attachments 8 and 10 of the licensee's LAR, the radiological consequence of the Liquid Radwaste Tank Failure Accident was evaluated specifically for NMP2. The NMP2 evaluation concludes that the liquid radwaste tank failure accident does not present a radiological concern at NMP2 for operation in the MELLLA+ operating domain and meets all regulatory requirements.

From Section 15.7.3 of the NMP2 UFSAR, the liquid radwaste tank failure accident postulated by NUREG-0800 is that an unspecified event causes the release of the contents of the tank or component containing the largest inventory of radionuclides in the liquid radwaste system that is most easily transported to groundwater. Although the volume of waste generated is not expected to increase, potentially higher moisture carry over in the reactor steam would result in a slightly higher loading on the condensate demineralizers. Because the higher moisture content will occur infrequently, the MELLLA+ operating domain expansion will not cause the condensate demineralizer backwash frequency to be changed significantly. As discussed in Section 8.4, the moisture content of the main steam leaving the vessel may increase at certain times while operating in the MELLLA+ operating domain. However, the NMP2 moisture carry over will be monitored and controlled to ≤ 0.25 wt. %, which is within the analytical assumption of 0.35 wt. % used in the determination of normal operation radiation levels. The radionuclide inventory in the radwaste tanks, adjusted for higher moisture carry over, is bounded by the inventory used in the liquid radwaste tank failure analysis currently presented in the NMP2 UFSAR. Therefore, the dose calculation described in the UFSAR for the liquid release pathway of a liquid radwaste tank failure remains bounding. Therefore, NMP2 meets the NEDO 33006P-A disposition for the liquid radwaste tank failure.

The NRC staff reviewed the dose consequences of the licensee's proposed changes. Since there are no major modifications to plant equipment, no increases in the design basis operating pressure, power, radiological source terms, steam flow rate, or FW flow rate, the staff finds that NMP2s DBA dose consequence evaluation is reasonable and that the dose consequences of DBAs will not be increased by the proposed expansion of the P/F map to MELLLA+.

Conclusion – SAR Section 9.0, Reactor Safety Performance Evaluations

Since NMP2 MELLLA+ operation is bounded by the existing analyses in the approved NEDO 33006P-A and NMP2 UFSAR, and the radiological dose consequences for all accidents remain below the design criteria specified in 10 CFR 50.67, "Accident source term," and the accident specific design criteria outlined in RG 1.183, the NRC staff concludes that the implementation of MELLLA+ at NMP2 is acceptable.

3.4.6 SAR Section 10.5, "Probabilistic Risk Assessment"

The NRC staff has reviewed NMP2 LAR and determined that it was not risk-informed[1], but did include Attachment 4 which provided risk insights related to the implementation of MELLLA+. Specifically, the licensee augmented the generic risk discussion contained in GE Licensing Topical Report (LTR), NEDO-33006P, Revision 2, with plant-specific information on initiating event frequencies, component reliability, operator response, success criteria, external events, shutdown risk, and PRA quality. The licensee reported an increase in CDF of 1×10^{-8}/year and an increase in LERF of 3×10^{-9}/year primarily due to slight changes to human error probabilities associated with ATWS sequences.

Consistent with the NRC's guidance on non-risk-informed LARs (SRP Chapter 19, Appendix D), the staff reviewed Attachment 4 to determine whether "special circumstances" were present (i.e., a risk increase exceeding the RG 1.174 acceptance guidelines) that would warrant a more detailed risk evaluation. Based on the risk information provided by the licensee, the staff concluded that the expected increase in risk associated with implementation of MELLLA+ at NMP2 would be well within the risk acceptance guidelines delineated by RG 1.174. In fact, sensitivity studies provided by the licensee demonstrated that even with more conservative assumptions, the calculated increase in CDF and LERF would remain several orders of magnitude below these guidelines. Therefore, the NRC staff's review did not identify any "special circumstances" that would warrant an in-depth PRA review.

3.4.7 SAR Section 10.6, "Operator Training and Human Factors"

Regulatory Evaluation

The regulatory requirements and guidance which the NRC staff considered in its review of the LAR are as follows:

1. 10 CFR 50.120, "Training and qualification of nuclear power plant personnel"

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[1] Review Standard-001 defines a "risk-informed" LAR as one that requests relaxation of deterministic requirements based in part on risk arguments.

2. 10 CFR 50.59, “Changes, tests, and experiments”

3. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition:” Chapter 18, provides review guidance for “Human Factors Engineering.”

4. NUREG-1764, “Guidance for the Review of Changes to Human Actions,” In accordance with the generic risk categories established in Appendix A to NUREG-1764, Table A.1, Generic BWR Human Actions That Are Risk-Important, the NRC staff performed its review using a Level II medium or moderate risk.

5. NUREG-0711, “Human Factors Engineering Program Review Model,” Revision 2.

Technical Evaluation

Description of Operator Actions Added/Changed/Deleted

The licensee, in response to the NRC staff's RAI (licensee submission dated October 10, 2014, ADAMS Accession No. ML14288A241), has stated that no additional operator manual actions will be added, deleted, or changed; but will reclassify two current operator actions as *Time Critical Operator Actions*: (1) Operators insert manual scram within 20 seconds of initiation of the event, and (2) Water level reduction begins within 270 seconds of initiation of the event specifically, the dual recirculation pump trip event, to address ATWSI assumptions. These actions have been validated and the results have been reviewed by both the licensee and NRC staff. The change to risk is small and is not expected to create additional burden, therefore, the staff finds this to be acceptable.

The licensee has stated that while the operator responses to anticipated occurrences, accidents, and special events for EPU remain unchanged, there will be a reduction in the time for operator actions during an ATWS event. According to the licensee's calculations, the reduction in time available for these actions was negligible and within the margin of uncertainty. The NRC staff has reviewed the reduction in the time and also finds it to be negligible. The staff has determined that there is not a significant effect on risk, and finds this reduction in time to be acceptable.

Operating Experience Review

While the industry's adoption of the MELLLA+ design is relatively recent, the staff confirmed that the licensee has reviewed the appropriate documents that provide for an adequate operating experience. These include approved GE-Hitachi Nuclear Energy Americas Licensing Topical Reports and their associated SER, and a previously submitted MELLLA+ LAR and its associated RAIs for NMP2. Additionally, the licensee states they will continue to monitor MELLLA+ operations and take appropriate actions as applicable. The staff reviewed the licensee's Operating Experience Review (OER) process and finds it to be acceptable.

Probabilistic Risk Assessment and Human Reliability Analyses

The licensee has provided a list of changes that will be required with the implementation of MELLLA+ and states that the changes will have no direct impact on the PRA models or human reliability analyses as a result of those changes. Consistent with the NRC's guidance on non-risk-informed LARs (SRP Chapter 19, Appendix D) as discussed in the Section 3.4.5 of this SE, the NRC staff agrees and concludes that an in-depth PRA review would not be necessary. Therefore, no PRA or HRA [Human Reliability Analysis] insights are available or necessary.

Human-System Interface Design

The Human System Interface (HSI) design changes as listed by the licensee are appropriate by its implementation. The licensee states there will be no major plant hardware modifications, no upgrade from analog to digital, and no changes to the MCR controls, displays or alarms. The main change will be to the operating P/F map and to a small number of instrument setpoints, all of which are considered inconsequential. The change will be made to a computer display and a hardcopy of the P/F map will be available in the MCR for control room operators.

Additionally, because there will be no changes to the Safety Parameter Display System, the NRC staff finds this to be acceptable.

Procedure Design

As a consequence of implementing the MELLLA+ amendment, the licensee will make changes to their procedures. The procedure changes do not affect EOPs or SAMGs. The licensee has submitted a complete list of the specific procedure changes in their response to RAIs. The staff's review of the associated changes finds them to be appropriate and, therefore, the staff finds this to be acceptable.

Training Program Design

The training required for the implementation of the MELLLA+ design is considered to be minimal. The operator training on the simulator training will be completed prior to expansion of the plant operation in MELLLA+ domain. Classroom training will also be conducted and may be combined with simulator training. The licensee will update the associated training documents as needed. Just-in-time-training will be conducted as a part of implementation of the MELLLA+ amendment for start-up testing program and contingencies.

In addition, no additional staffing is required nor are there new operator actions. The new time critical operator actions can be met without procedure or training changes, and are part of the current ATWS EOPs, therefore, the staff finds this to be acceptable.

Human Factors Verification and Validation (V&V)

The licensee provided data for the operator manual actions per administrative procedure OP-AA-102-106, Operator Response Time Program, specifically for a dual recirculation pump trip during an ATWSI event. Additionally, the NRC staff was able to observe an NMP crew run several simulator scenarios at both 100% power and 85% recirculation flow during the audit.

The process for maintaining operator response times was discussed between the licensee and the NRC audit team during the audit. The licensee's MELLLA+ implementation plan and the NMP2 USAR will require that the operator response times are maintained. Any changes will be identified, reviewed, evaluated, and reported under 10 CFR 50.59. The staff has reviewed the data and observed that the operators can reliably complete the actions in the reduced time and, therefore, finds this to be acceptable.

Conclusion – SAR Section 10.6, "Operator Training and Human Factors"

Based on the above discussion, the NRC staff finds that the licensee has provided sufficient and adequate information in the LAR, response to RAIs, and through the audit that the expansion into the MELLLA+ operating domain for NMP2 will not compromise public health and safety, and that the changes will be in compliance with regulations. The staff also confirmed that the licensee will continue to monitor MELLLA+ operations and take appropriate actions as necessary.

3.4.8 Emergency Systems

3.4.8.1 Control Rod Drive System

Regulatory Evaluation

The NRC staff's review covered the functional performance of the control rod drive system (CRDS) to confirm that the system can affect a safe shutdown, respond within acceptable limits during AOOs, and prevent or mitigate the consequences of postulated accidents. The review also covered the CRDS cooling system to ensure that it will continue to meet its design requirements. The NRC's acceptance criteria are based on:

1. GDC 4, insofar as it requires that SSCs important to safety be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

2. GDC 23, insofar as it requires that the protection system be designed to fail into a safe state.

3. GDC 25, insofar as it requires that the protection system be designed to assure that SAFDLs are not exceeded for any single malfunction of the reactivity control systems.

4. GDC 26, insofar as it requires that two independent reactivity control systems be provided, with both systems capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes.

5. GDC 27, insofar as it requires that the reactivity control systems be designed to have a combined capability, in conjunction with poison addition by the ECCS, of reliably controlling reactivity changes under postulated accident conditions, with appropriate margin for stuck rods, to assure the capability to cool the core is maintained.

6. GDC 28, insofar as it requires that the reactivity control systems be designed to assure that the effects of postulated reactivity accidents can neither result in damage to the RCPB greater than limited local yielding, nor disturb the core, its support structures, or other reactor vessel internals so as to significantly impair the capability to cool the core;

7. GDC 29, insofar as it requires that the protection and reactivity control systems be designed to assure an extremely high probability of accomplishing their safety functions in event of AOOs; and

8. 10 CFR 50.62(c)(3), insofar as it requires that all BWRs have an alternate rod injection (ARI) system diverse from the reactor trip system, and that the ARI system have redundant scram air header exhaust valves. Specific review criteria are contained in SRP Section 4.6.

Technical Evaluation and Conclusion

The control rod design has not been modified relative to the baseline. The NRC staff determined that the regulatory requirements in GDCs 4, 23, 25, 26, 27, 28, 29, and 10 CFR 50.62(c)(3) continue to be satisfied by the design.

3.4.8.2 Overpressure Protection for the RCPB During Power Operation

Regulatory Evaluation

Overpressure protection for the RCPB during power operation is provided by relief and safety valves and the reactor protection system. The NRC staff's review covered relief and safety valves on the main steam lines and piping from these valves to the suppression pool. The NRC's acceptance criteria are based on:

1. GDC 15, insofar as it requires that the RCS and associated auxiliary, control, and protection systems be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs.

2. GDC 31, insofar as it requires that the RCPB be designed with sufficient margin to assure that it behaves in a nonbrittle manner and that the probability of rapidly propagating fracture is minimized. Specific review criteria are contained in SRP Section 5.2.2.

Technical Evaluation and Conclusion

The licensee has evaluated the impact of the proposed operating domain extension on overpressure protection. The evaluation is documented in Section 3.1.2 of the NMP2 SAR. The reactor pressure remains unchanged; therefore, the steam flow during normal operation or through a relief valve or break remains unchanged.

For NMP2, the limiting overpressure event is the MSIV followed by High-Flux Scram. Analyses in Section 3.1.2 of the NMP2 SAR indicate that the peak vessel pressure remains unchanged, and it is below the ASME, Section III, limit of 1,375 psig limit.

There is no change in the overpressure relief capacity. The NRC staff determined that the requirements of GDCs 15 and 31 continue to be met.

3.4.8.3 Reactor Core Isolation Cooling

Regulatory Evaluation

The RCIC system serves as a standby source of cooling water to provide a limited decay heat removal capability whenever the main FW system is isolated from the reactor vessel. In addition, the RCIC system may provide decay heat removal necessary for coping with a station blackout. The water supply for the RCIC system comes from the condensate storage tank, with a secondary supply from the suppression pool. The NRC staff's review covered the effect of the proposed MELLLA+ on the functional capability of the system. The NRC's acceptance criteria are based on:

1. GDC 4, insofar as it requires that SSCs important to safety be protected against dynamic effects;

2. GDC 5, insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be demonstrated that sharing will not impair its ability to perform its safety function;

3. GDC 29, insofar as it requires that the protection and reactivity control systems be designed to assure an extremely high probability of accomplishing their safety functions in event of AOOs;

4. GDC 33, insofar as it requires that a system to provide reactor coolant makeup for protection against small breaks in the RCPB be provided so the fuel design limits are not exceeded;

5. GDC 34, insofar as it requires that a residual heat removal system be provided to transfer fission product decay heat and other residual heat from the reactor core at a rate such that SAFDLs and the design conditions of the RCPB are not exceeded;

6. GDC 54, insofar as it requires that piping systems penetrating containment be designed with the capability to periodically test the operability of the isolation valves to determine if valve leakage is within acceptable limits; and

7. 10 CFR 50.63, insofar as it requires that the plant withstand and recover from an SBO of a specified duration. Specific review criteria are contained in SRP Section 5.4.6.

Technical Evaluation and Conclusion

The RCIC design has not been modified relative to the baseline and the expanded operating domain does not have an impact on the gross thermal power. Thus, the NRC staff determined that the requirements of GDCs 4, 5, 29, 33, 34, 54, and 10 CFR 50.63 continues to be satisfied.

3.4.8.4 Residual Heat Removal System

Regulatory Evaluation

The RHR system is used to cool down the RCS following shutdown. The RHR system is typically a low pressure system which takes over the shutdown cooling function when the RCS temperature is reduced. The NRC staff's review covered the effect of the proposed MELLLA+ on the functional capability of the RHR system to cool the RCS following shutdown and provide decay heat removal. The NRC's acceptance criteria are based on:

1. GDC 4, insofar as it requires that SSCs important to safety be protected against dynamic effects.
2. GDC 5, insofar as it requires that SSCs important to safety not be shared among nuclear power units unless it can be shown that sharing will not significantly impair their ability to perform their safety functions.
3. GDC 34, which specifies requirements for an RHR system. Specific review criteria are contained in SRP Section 5.4.7 and other guidance provided in Matrix 8 of RS-001.

Technical Evaluation and Conclusion

The RHR system design has not been modified relative to the baseline, and the expanded operating domain does not have an impact on the decay heat. Thus, the NRC staff detrmined that the the requirements of GDCs 4, 5, 19, and 34 continue to be satisfied.

3.4.8.5 Standby Liquid Control System

Regulatory Evaluation

The SLCS provides backup capability for reactivity control independent of the control rod system. The SLCS functions by injecting a boron solution into the reactor to affect shutdown. The NRC staff's review covered the effect of the proposed on the functional capability of the system to deliver the required amount of boron solution into the reactor. The NRC's acceptance criteria are based on:

1. GDC 26, insofar as it requires that two independent reactivity control systems of different design principles be provided, and that one of the systems be capable of holding the reactor subcritical in the cold condition;

2. GDC 27, insofar as it requires that the reactivity control systems have a combined capability, in conjunction with poison addition by the ECCS, to reliably control reactivity changes under postulated accident conditions; and

3. 10 CFR 50.62(c)(4), insofar as it requires that the SLCS be capable of reliably injecting a borated water solution into the reactor pressure vessel at a boron concentration, boron enrichment, and flow rate that provides a set level of reactivity control. Specific review criteria are contained in SRP Section 9.3.5 and other guidance provided in Matrix 8 of RS-001.

Technical Evaluation

The Hot Shutdown Boron Weight (HSBW) is calculated on generic basis for each fuel line (e.g., GE14 in the case of NMP2). The HSBW is confirmed effective on plant- and cycle-specific basis with ODYN and TRACG ATWS calculations. Section 9.3.1 of the NMP2 SAR documents these calculations. Both the licensing bases and the best-estimate ATWS calculations show that the generic HSBW is effective to shut down the NMP2 core under MELLLA+ initial conditions.
The Boron-10 enrichment of the SLCS has been increased from 25% to 92%. With this change, the time to inject the HSBW and place the reactor in hot shutdown has been decreased significantly. The effectiveness of the new enrichment on SLCS performance was apparent during a staff audit in the NMP2 simulator of November 20, 2014. The enrichment change positively enhances the safety of NMP2.

In NMP2, SLCS is automatically started during ATWS. Because the peak pressure during ATWS has increased, the licensee has increased the SLCS pump discharge pressure in the TS from 1,327 psig to 1,335 psig. The minimum reactor pressure, just prior to the time when SLCS initiates, remains low enough to ensure relief valve closure prior to the analyzed SLCS initiation in the event of an early initiation of the SLCS during the initial ATWS. The NRC staff detrmined that TS SR 3.1.7.7 which changes the acceptance criterion for the SLCS pump discharge from 1,327 psig to 1,335 psig is acceptable.

Conclusions

The NRC staff has reviewed the licensee's analyses related to the effects of the proposed operating domain extension on the functional design of the SLCS. The regulatory requirements in GDC 4, 23, 25, 26, 27, 28, 29, and 10 CFR 50.62(c)(3) continue to be satisfied by the design. The Boron-10 enrichment has been increased, slight ATWS peak reactor pressure increase has been incorporated in TS, and the SLCS boron inventory shutdown margin has been evaluated for the initial core in the NMP2 SAR. The licensee has adequately accounted for the effects of the proposed operating domain extension on the system and demonstrated that the system will continue to provide the function of reactivity control independent of the control rod system following implementation of the proposed operating domain extension. Based on this, the NRC staff concludes that the SLCS will continue to meet the requirements of GDCs 26 and 27, and 10 CFR 50.62(c)(4) following implementation of the proposed operating domain extension. Therefore, the NRC staff finds the proposed operating domain extension to be acceptable with respect to the SLCS.

3.4.9 SAR Section 9.1, "Anticipated Operation Occurrences"

See Section 3.3.7 of this SE.

3.4.10 SAR Section 9.3, "Special Events"

The evaluation of MELLLA+ impact on special events is documented in Section 9.3 of the SAR. Station blackout was evaluated generically in the MELLLA+ SER and the conclusions have been confirmed for NMP2. The remaining special events are ATWS events, including ATWSI.

Regulatory Evaluation

ATWS is defined as an AOO followed by the failure of the reactor protection system specified in GDC 20. The regulation at 10 CFR 50.62 requires that:

1. Each BWR must have an ARI system that is designed to perform its function in a reliable manner and be independent from the existing reactor trip system from sensor output to the final actuation device.
2. Each BWR must have a standby liquid control system (SLCS) with the capability of injecting into the reactor vessel a borated water solution with reactivity control at least equivalent to the control obtained by injecting 86 gpm of a 13 wt. % sodium pentaborate decahydrate solution at the natural Boron-10 isotope abundance into a 251-inch inside diameter reactor vessel. The system initiation must be automatic.
3. Each BWR must have equipment to trip the reactor coolant recirculation pumps automatically under conditions indicative of an ATWS.

The NRC staff's review was conducted to ensure that: (1) the above requirements are met; (2) sufficient margin is available in the set point for the SLCS pump discharge relief valve such that SLCS operability is not affected by the proposed MELLLA+; and (3) operator actions specified in the plant's EOPs are consistent with the generic emergency procedure guidelines/severe accident guidelines (EPGs/SAGs), insofar as they apply to the plant design. In addition, the NRC staff reviewed the licensee's ATWS analysis to ensure that: (1) the peak vessel bottom pressure is less than the ASME Service Level C limit of 1,500 psig; (2) the peak clad temperature is within the 10 CFR 50.46 limit of 2,200°F; (3) the peak suppression pool temperature is less than the design limit; and (4) the peak containment pressure is less than the containment design pressure. The NRC staff also evaluated the potential for thermal-hydraulic instability in conjunction with ATWS events using the methods and criteria approved by the NRC staff. For this analysis, the NRC staff reviewed the limiting event determination, the sequence of events, the analytical model and its applicability, the values of parameters used in the analytical model, and the results of the analyses.

Technical Evaluation

Anticipated Transients Without Scram:

The licensee reviewed the anticipated transients without scram (ATWS) in the NMP2 SAR. The licensee provided additional information in response to RAIs SRXB 2-9 to 13. Based on this evaluation, the licensee concluded that the ATWS logic and set points remain unchanged for the proposed operating domain extension; therefore, the limiting ATWS events are specified in the MELLLA+ SER:

1. MSIV closure (MSIVC)
2. Pressure regulator failure open (PRFO)

For NMP2, the LOOP event does not result in a reduction of RHR capability relative to MSIVC and PRFO and it was not analyzed, which the NRC staff finds to be acceptable.

Two analysis methods are used: (1) the licensing methodology, which uses ODYN, and (2) a best-estimate methodology, which uses TRACG04 with input data from TGBLA06/PANAC11. As required by the MELLLA+ SER limitation, the NMP2 SAR lists the key operator actions credited, which include:

1. FW flow reduction starts in less than 60 seconds depending on the transient because of automated actions.
2. Automated SLCS initiation occurs at approximately 150 seconds, which is approximately 75 seconds after the boron injection initiation temperature is reached in the suppression pool.
3. Initiation of RHR within 1,080 seconds of event initiation.

For the licensing basis calculation ODYN, the water level is controlled to five feet above the top of active fuel, and the suppression pool is allowed to heat up even after the heat capacity temperature limit HCTL is reached. This is consistent with the approved ODYN licensing procedure.

With those assumptions, the peak vessel pressure is calculated by ODYN to reach 1,372 psig as given Table 9-4 of the SAR, which is well below the 1,500 psig ASME Service Level C limit. The calculations also show that MELLLA+ operation has a negligible effect on PCT and clad oxidation because the peak channel power and limits remain unchanged. Note that the more accurate TRACG ATWS analysis calculates a peak pressure of 1,226 psig, which is well below the 1500 psig ASME Service Level C limit.

The ODYN calculation indicates that, without depressurization, the suppression pool temperature would reach a temperature of 160°F which is below the containment temperature limit of 190°F. [[

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The MELLLA+ SER allows for two options with respect to the best-estimate ATWS calculation:

(1) Perform a best-estimate TRACG04 calculation modelling the depressurization; or

(2) Increase the Boron-10 (B-10) enrichment so that the SLCS shutdown occurs earlier and the integrated load to containment is maintained under MELLLA+. NMP2 has opted for Option 2 and has increased the Boron-10 enrichment in the SLCS from 25% to 92%.

The MELLLA+ SER allows for two options with respect to the best-estimate ATWS calculation: (1) perform a best-estimate TRACG04 calculation modelling the depressurization; or (2) increase the B-10 enrichment so that the SLCS shutdown occurs earlier and the integrated load to containment is maintained under MELLLA+. NMP2 has opted for Option 2 and has increased the B-10 enrichment in the SLCS from 25% to 92%. The staff concludes that the B-10 increase to 92% limits the integrated heat load to containment to a value lower than the original design. Therefore, the Option-1 best-estimate ATWS calculation is not required for NMP2.

Section 9.3.1 of the NMP2 SAR presents the results of the ODYN ATWS analyses. For all cases analyzed, the NRC staff finds the ATWS acceptance criteria are satisfied.

<u>ATWSI</u>:

In addition, the licensee has evaluated stability during ATWS events and the results are documented in Section 9.3.3 of the NMP2 SAR. The results of the ATWSI analysis show that the mitigation actions in the NMP2 EOP procedures flow runback to uncover the spargers are effective in the MELLLA+ operating domain. The TRACG04 calculations indicate that all applicable fuel limits are satisfied during this relatively small oscillation. The highest PCT during the most limiting ATWSI event is calculated at 912°F as shown in SAR Table 9-9, which is significantly lower than the criterion of 2,200°F.

As part of the response to RAI-12, the licensee submitted a comparison of calculated PCT versus minimum stable film boiling temperature (Tmin) during an ATWSI calculation, PCT and Tmin are on the left axis of Figure-4 and core flow is on the right axis of Figure-4. Beginning of Cycle (BOC) conditions are presented with a two reactor recirculation pump (2RPT) transient and failure to scram. As seen in Figure-4, sufficient margin exists to Tmin; therefore, the TRACG04 quench model has no impact on the calculations as shown in Figure-5 where the quench model is disabled with little or no impact on the PCT values.

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Figure-4. Tmin, PCT, and flow rate for BOC 2RPT ATWS

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Figure-5. PCT during ATWSI with and without TRACG-04 quench model enabled

Based on the above data, the NRC staff concludes that the automated ATWS mitigation features (i.e., FW flow runback and automatic SLCS injection) are adequate to mitigate the ATWSI oscillations. The NRC staff finds the calculations indicate that ATWS acceptance criteria are satisfied even in the presence of unstable power oscillations.

Timing of Operator Actions for Critical Events

NMP2 has a modern BWR control system and many of the critical actions that are manual in other reactors have been automated in NMP2. For example, following detection of ATWS (high ATWS pressure setpoint is reached and APRM power is >4%), the NMP2 control system takes the following automated actions:

1. Recirculation pump trip occurs immediately.

2. FW flow runback occurs with a 25 second delay.

3. SLC boron injection occurs with a 98 second delay.

Thus, only two critical actions are required of the operators in NMP2:

1. Place the reactor switch in shutdown mode. The required timing is < 20 seconds.

2. Terminate and prevent injection. The required timing is < 270 seconds.

Prior to the staff audit on the NMP2 simulator, the validation occurred when NMP2 tested four of their operating crews to determine the actual timing of all the critical operator actions. The following results were obtained:

1. Critical Action: Place Reactor Switch in Shutdown Mode. Five different ATWS scenarios were considered: Turbine Trip (TT) without Bypass (TTNBP), 2RPT, Pressure Regulator Failed, MSIV Closure, and LOOP. The average time to completion was 8.49 seconds. The timing spread was between 5 seconds fastest event and 16 seconds slowest event. All tested operating crews succeeded in completing the critical action in less than the required 20 seconds.

2. Critical Action: Terminate and Prevent Injection. For this critical action, a single initiating event was used, 2RPT. The average operator time to terminate and prevent was 193 seconds. The timing spread was between 150 and 232 seconds, which is faster than the required 270 seconds.

Based on the above results, the NRC staff concludes that the NMP2 operators have demonstrated proficiency in executing, with conservative timing, the critical actions that are assumed in the safety analysis.

Conclusions

The NRC staff has reviewed the information submitted by the licensee related to ATWS and concludes that the licensee has adequately accounted for the effects of the proposed operating domain extension on ATWS. The NRC staff concludes that the licensee has demonstrated that ARI, SLCS, and FW runback systems have been installed; and that they will continue to meet the requirements of 10 CFR 50.62 and the analysis acceptance criteria following implementation of the proposed operating domain extension. Therefore, the NRC staff finds the proposed operating domain extension to be acceptable with respect to ATWS.

3.5 Limitations of Applicable SERs

The NMP2 SAR (NEDC-33576NP) appendices summarize the disposition of the limitations in the applicable SERs, including:

1. The Methods SER, NEDC-33173P-A

2. The MELLLA+ SER, NEDC-33006P-A, Rev. 3

3. The DSS-CD SER, NEDC-33075P-A

Note that, in prior MELLLA+ applications, a fourth appendix was included to account for one limitation of the TRACG application for DSS-CD; however, the new Revision 7 of the DSS-CD SER incorporates the TRACG application and the old limitation no longer applies.

3.5.1 Methods LTR NEDC-33173P-A, Rev. 3 Limitations

Appendix A summarizes the disposition of limitations in the Methods SER, NEDC-33173P and NEDC-33173P-A. The licensee states that the following Methods SER limitations do not apply to NMP2:

- 9.2, 3D Monicore – Because the limitation is applicable only to TGBLA04/PANAC10 applications.

- 9.4, SLMCPR 1 – Superseded by Rev. 4 of NEDC-33173P.

- 9.13, Application of 10wt. % Gd – Because NMP2 MELLLA+ uses less than 10% Gd.

- 9.14, Part 21 Evaluation of GESTR-M Fuel Temperature Calculation – Because NMP2 has a PRIME T-M and PRIME fuel temperature basis.

- 9.15, 9.16, Void Reactivity-1 and 2, and 9.20, Void-Quality Correlation – The NMP2 MELLLA+ SAR ATWS licensing basis is not based on TRACG for: (1) the void reactivity coefficient bias and uncertainties relative to lattice designs; (2) the void coefficient biases and uncertainties for known dependencies; and (3) the Void-Quality Correlation. The NMP2 MELLLA+ SAR analysis uses ODYN as the licensing basis code, and as such, this limitation and condition is not applicable to the NMP2 MELLLA+ SAR. For calculations other than ATWS, the NMP2 MELLLA+ SAR calculations use TRACG04/PANAC11 void reactivity coefficients bias and uncertainties that are applicable to the GE14 lattice designs loaded in the core as approved in Supplement 3 to NEDE-32906P, "Migration to TRACG04/PANAC11 from TRACG02/PANAC10."

- 9.18, DSS-CD Uncertainties – Per NEDC-33173P-A, 5% OPRM and 2% APRM uncertainty does not apply because the "50/20" treatment of uncertainties for DSS/CD is sufficiently conservative.

- 9.21, Mixed Core Method – Because NMP2 MELLLA+ is not based on a mixed core.

- 9.22, Mixed Core Method – Because GE14 is an approved fuel line in the methods SER.

- 9.23, MELLLA+ Eigenvalue – GEH has a standing commitment to submit eigenvalue and power distribution tracking data following implementation of MELLLA+. This limitation cannot be satisfied prior to implementation and is, thus, not applicable to the NMP2 SAR.

The disposition of the limitations applicable to NMP2 is summarized on a table in Appendix A of the NMP2 SAR and discussed in more detail in the body of the report. These limitations and their resolution are:

- 9.1, TGBLA/PANAC Version – TGBLA06/PANAC11 methods are used.

- 9.3, P/F Ratio – The NMP2 MELLLA+ power density is 51.86 MWt/Mlbm/hr, which exceeds the 50 MWt/Mlbm/hr limit. Staff resolution of this limitation involves two steps: (1) additional uncertainty is applied to the SLMCPR calculation by using the SLO flow uncertainties, and (2) plant-specific power distribution uncertainties have been evaluated based on NMP2 TIP measurements.

- 9.5, SLMCPR 2 – The original condition has been superseded by the staff SER for NEDC-33173P, Revision 4, dated November 2012. The conclusion of this SER stated that the original SLMCPR adders in the Methods SER are no longer applicable. Using the Rev. 4 methodology, a 0.02 value shall be added to the cycle-specific SLMCPR value for P/F ratios above 42 MWt/Mlbm/hr.

    - The Rev. 4 methodology does not change the SLO uncertainty penalty for conditions above 50 MWt/Mlbm/hr. In MELLLA+, SLO uncertainties are used to determine the acceptable SLMCPR, this is equivalent to 0.02 and hence is acceptable.

- 9.6, R-Factor – The R-factors are consistent with the axial void profiles expected in NMP2.

- 9.7, ECCS-LOCA – The NMP2 ECCS LOCA analyses include an evaluation for top-peaked and mid-peaked axial power profiles.

- 9.8, ECCS-LOCA – NMP2 ECCS LOCA calculations have been performed at the MELLLA+ corner 100% CLTP 85% Flow and demonstrated compliance with limits.

- 9.9, Transient LHGR 1 and 9.10, Transient LHGR 2 – The SRLR was submitted to the staff for review for the first cycle application. For the equilibrium MELLLA+ core the LHGR and AOOs have been evaluated in Section 9 of the NMP2 SAR. T-M limits are satisfied with the proposed operating margins for the equilibrium core.

- 9.11, Transient LHGR 3 – The results in Section 9 of the NMP2 SAR demonstrate a 10% margin to T-M limits.

- 9.12, LHGR and Exposure Qualification

- 9.17, Steady–State 5% Bypass Voiding – Bypass voiding is conservatively estimated at slightly over 5% at the top of the TIP instrument in a small region of the MELLLA+ region the 55% core flow point. NMP2 has committed to not use TIP data from this region to adjust LPRMs. The region is small and highly unlikely that TIPs will be collected there because equilibrium Xenon is required.

- 9.19, Void-Quality Correlation 1 – The 0.01 OLMCPR penalty has been applied.

- 9.23, MELLLA+ Eigenvalue Tracking - By letter dated November 1, 2013, the licensee has committed to track the eigenvalue.

- 9.24, Plant-Specific Application – The bundle power, operating LHGR and MCPR have been provided for the equilibrium GE14 MELLLA+ NMP2 cycle. The NRC staff finds that all limits are satisfied.

3.5.2 MELLLA+ LTR NEDC-33006P-A Limitations

Appendix B of the NMP2 SAR summarizes the disposition of limitations in the MELLLA+ SER, NEDC-33006P-A, Rev. 3. The licensee states that the following Methods SER limitations do not apply to NMP2:

- 12.3d, e, f, 12.23.6, and 12.23.7 – Because NMP2 uses a full core load of GE14, which is an approved product line for MELLLA+.
- 12.10c, ECCS-LOCA Off rated Multiplier – Because NMP2 MELLLA+ takes credit for off-rated limits at minimum core flow state point; therefore, core monitoring is required per limitation 12.10.d.

- 12-20, Generic ATWS Instability – Because NMP2 does not use the generic ATWS/Stability analysis and has performed a plant-specific ATWS Instability evaluation.

The disposition of the limitations applicable to NMP2 is summarized on a table in the NMP2 SAR appendix and discussed in more detail in the body of the report. These limitations and their resolution are:

- 12.1, GEXL-PLUS – GEXL-Plus applicability has been confirmed in Section 1.1.3 and 2.6.4 of the NMP2 SAR.

- 12.2, Related LTRs – The limitations from NEDC-33173PA, and NEDC-33075PA are specifically addressed in Appendices A and C of the NMP2 SAR.

- 12.3, Concurrent Changes -

    - 12.3a – As addressed in Section 1.1.2 of the NMP2 SAR, concurrent changes have been taken into account in the evaluation.

    - 12.3b – As addressed in Section 1.1.1 of the NMP2 SAR, all generic dispositions have been reviewed for applicability.

    - 12.3c – As addressed in Section 1.1.1 of the NMP2 SAR, generic bounding sensitivities have been reviewed for applicability.

    - 12.3g – DSS-CD will be employed in NMP2 to address possible instabilities. DSS-CD has been approved for MELLLA+ applications.

- 12.4, Reload Analysis Submittal – The NMP2 application has provided the plant-specific thermal limits and transient assessment in the SRLR for Cycle-15 and future values will be reported in the COLR.

- 12.5, Operating Flexibility –

    - 12.5a – SLO operation is not allowed in MELLLA+. The NMP2 TS have been updated.

    - 12.5b – NMP2 Licensing Condition 7 requires FW temperature to operate within 20°F of the nominal value, which satisfies the SER requirement.

    - 12.5c – The licensee has committed to provide the P/F map in the COLR.

- 12.6, SLMCPR State points and CF Uncertainty – The licensee has evaluated the SLMCPR at off-nominal conditions, including the 55% flow state point, and has reported it in the SRLR.
- 12.7, Stability – The DSS-CD automated backup stability option will be implemented in NMP2.

- 12.8, Fluence Methodology and Fracture Toughness – The change of vessel effective full power years is estimated to be less than 1% under MELLLA+ conditions. The staff was unable to confirm that the fluence calculation was done with acceptable approaches. Thus, the NRC staff prepared an RAI requesting the licensee to provide a RG 1.190 compliant disposition of neutron fluence calculations that is in accordance with the MELLLA+ topical report. The licensee in its RAI response, dated February 18, 2015, stated that an NRC-approved method, NEDO-32983-A, Revision 2, "General Electric

Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluations" (ML072480121), was used to evaluate the MELLLA+ conditions for neutron fluence. The NRC staff determined that the licensee is not changing the current licensing basis for neutron fluence calculations by using NEDO-32983-A, Revision 2. The licensee is using NEDO-32983-A, Revision 2, to evaluate the current neutron fluence calculations for MELLLA+ conditions. Based on these considerations, the NRC staff has determined the licensee has adequately clarified that the neutron fluence calculations are in line with RG 1.190 and in accordance with the MELLLA+ topical report.

- 12.9, Reactor Coolant Pressure Boundary –

  In the discussion of Section 3.5.1.3, of the NMP2 SAR in Section 3.2.2 of this SE, it was pointed out that the licensee has stated that the MELLLA+ does not affect the maximum operating temperature, pressure, or flow rate of high pressure core spray, low pressure core spray, RHR/low pressure coolant injection, SLCS, and other RCPB piping systems. The piping systems are within the design values used for worst case conditions. Their susceptibility to erosion/corrosion does not increase under the MELLLA+ program.

  Also, in the discussion of Section 3.5.1.4, of the NMP2 SAR in Section 3.2.2 of this SE, it was pointed out that the licensee has stated that Category A material is defined as the piping material that is resistant to intergranular stress corrosion cracking (IGSCC). The "Other Than Category "A" material" is defined as the piping material that is not resistant to IGSCC. These definitions are discussed in Generic Letter 88-01.

  For the Other Than Category A materials, the licensee has various inspection programs to monitor their degradation: (1) The licensee has the inservice inspection program that examines Other Than Category A welds in accordance with the ASME Code, Section XI, IWB-2500, (2) NMP2 has implemented an NRC-approved risk-informed inpsection program which focuses on the examinations based on degradation mechanisms such as the piping material that is susceptible to IGSCC, (3) NMP2 implements an augmented IGSCC inspection program in accordance with GL 88-01, NUREG-0313 and BRWVIP-75, and (4) NMP2 also follows the ASME Code, Section XI, Appendix VIII for the performance demonstration for ultrasonic examination which provides rigor in the volumetric examinations of material.
  As for the Category A material, the licensee follows the required examinations in accordance with the ASME Code, Section XI, IWB-2500.

  As stated above, MELLLA+ will not significantly affect the operating conditions of the RCPB systems. The likelihood of the degradation in RCPB resulting from MELLLA+ is small. In addition, the licensee has implemented various inspection programs to monitor the potential degradation of the RCPB materials periodically. Therefore, the NRC staff finds that the structural integrity of the RCPB material will be satisfactorily maintained under MELLLA+.

- 12.10, ECCS-LOCA Off-rated Multiplier –

    - 12.10a – NMP2 specific Appendix K ECCS LOCA calculations were provided in the NMP2 SAR. The PCT results are determined to be bound by the high-flow PCT values.

- 12.10b, and d – NMP2 has committed that every future cycle reload will contain confirmation that cycle-specific off-rated thermal limits applied at the 55% CF state points are consistent with those assumed for the NMP2 plant-specific ECCS-LOCA analyses.

- 12.11, ECCS-LOCA Axial Power Distribution Evaluation – Top peaked and mid-peaked power shapes have been used for the LOCA analyses.

- 12.12, ECCS LOCA Reporting –

    - 12.12a and b – Both, the nominal and the Appendix K LOCA results have been reported in the NMP2 SAR. The current uncertainty method was used.

- 12.13, Small Break LOCA and 12.14, Break Spectrums – Small breaks and large breaks were analyzed. **[[**
]] The ECCS-LOCA analyses were performed for all state points in the upper boundary of the expanded operating domain. The LOCA evaluation verified that the expected PCT throughout the MELLLA+ domain would be bounded by he reported PCT at higher flow.

- 12.15, Bypass Voiding Above the D Level – Bypass voiding is conservatively estimated at slightly over 5% at the top of the TIP instrument in a small region of the MELLLA+ region the 55% core flow point. NMP2 has committed to not use TIP data from this region to adjust LPRMs. The region is small and highly unlikely that TIPs will be collected there because equilibrium xenon is required.

- 12.16, RWE – A plant-specific RWE analysis was performed using PANACEA to confirm the validity of the RBM set points.
- 12.17, ATWS LOOP – ATWS calculations were performed in Section 9.3.1 of the NMP2 SAR using the licensing basis (ODYN) and a best-estimate code (TRACG).

- 12.18, ATWS TRACG –

    - 12.18a, b, and c – TRACG ATWS calculations were performed to demonstrate compliance with ATWS criteria because: (1) the licensing bases ODYN calculation showed that HCTL limit would be reached, and (2) the licensee also opted to increase the Boron-10 enrichment.

    - 12.18d – The NMP2 TS LCOs will implement the limitation of no FW Heaters out of service in the MELLLA+ region, and it is implemented with the 20 degree operating envelope. An evaluation has been made on the NMP2 SAR about the number of SRV's that must be available.

- 12.18e and f – the key assumptions used for the ATWS analyses and the treatment of uncertainties are documented in Section 9.3.1 of the NMP2 SAR.

- 12.19, Plant Specific ATWS Instability – The licensee has provided a best-estimate ATWS/Stability calculation using TRACG04 to demonstrate compliance with limits.

- 12.21, Individual Plant Examination – A plant-specific probabilistic risk assessment was included in Section 10.5 of the NMP2 SAR. Based on these analyses, the licensee concludes that the risk increase lies in within Region III i.e., changes that represent very small risk changes.

- 12.22, IASCC – Fluence calculations indicate that the top guide and shroud exceed the 5E20 n/cm^2 threshold. The inspection strategies in place are considered sufficient.

- 12.23, Limitations from the ATWS RAI Evaluations –

    - 12.23.2 – The ATWS calculations key parameters were provided.

    - 12.23.3 – The SRV tolerances were included in the ATWS analyses.

    - 12.23.4 – The EOP procedures were reviewed and sensitivity analyses were performed for different water level control strategies. The EOPs require the operator to lower level to TAF (unless the transient terminates early) and control within a band between the minimum steam cooling water level and 2 feet below the spargers. A wide band is necessary because manual level control during an ATWS cannot be accomplished accurately. The sensitivity calculations indicate that the EOP strategy is adequate to satisfy the ATWS criteria.

    - 12.23.5 – The NMP2 MELLLA+ power density at the full power-minimum flow state point is 43.24 MW/Mlbm/hr, which does not exceed the 52.5 MW/Mlbm/hr limit.

    - 12.23.8 – The ATWS calculations accounted for all NMP2 specific features.

    - 12.23.9 – The plant-specific ATWS calculations accounted for the physical limitations of ECCS systems used (RCIC in the NMP2 case).

    - 12.23.10 – The containment pressure calculated by ODYN ATWS analysis during MELLLA+ condition shows a decrease in peak containment pressure from 7 psig to 6.5 psig (NEDC-33576P, Revision 0), Table 9-4, NEDC-33576, NMP2 SAR), which is under the containment limit of 45 psig for NMP2. All safety grade equipment will function under this containment overpressure conditions.

  - 12.23.11 – The HCTL values used for ATWS calculations are the nominal vales. They are a function of vessel pressure and suppression pool water level.

- 12.24, Limitations from Fuel Dependent Analyses RAI Evaluations –

  - 12.24.1 – The TRACG NMP2-specific calculations model the water rod flow explicitly.

  - 12.24.2 – The core exit void fraction is presented in Table 1-2 of the NMP2 SAR for a MELLLA, and MELLLA+. The highest void fraction under MELLLA+ corresponds to the low flow point 77.6% CLTP, 55% Flow and has a value of 77%, compared to 72% for the nominal MELLLA condition 100% CLTP, 100% Flow.

3.5.3 NEDC-33075P-A Limitations

Appendix C of the SAR summarizes the disposition of limitations in the DSS-CD LTR, NEDC-33075P-A, Rev. 8. The disposition of the limitations applicable to NMP2 is summarized on a table in Appendix C of the NMP2 SAR and discussed in more detail in the body of the report. These limitations and their resolution are:

- 5.1, LTS Platform – DSS-CD will be implemented in the already approved GE Option III platform.
- 5.2, DSS-CD Set-Point – The DSS-CD CDA set point calculation followed the procedure outlined in the DSS-CD LTR NEDC-33075P-A, Revision 8.
- 5.3, DSS-CD Parameters – The values of the fixed and adjustable parameters are established by GEH and will be documented in a DSS-CD Settings Report.
- 5.4, DSS-CD Trip Function – V&V of the DSS-CD trip function code was performed for transportability considerations.

It must be noted that the previous version of DSS-CD LTR, NEDC-33075PA, Revision 6, relied on a separate LTR, NEDE-33147P-A, Revisions 4 and 8, for the TRACG04 application. When Revision 7 of the DSS-CD LTR was issued, it incorporated the TRACG04 application and the limitations of that LTR are no longer applicable.

The NRC staff concurs with the licensee evaluation of the above limitations in the listed SERs.

3.6 Use of TRACG

The NRC staff has reviewed the TRACG code models and concludes that TRACG calculations of ATWSI for NMP2 with possible rewetting and quenching is sufficient to provide reasonable assurance of compliance with the applicable ATWS regulatory criteria; namely demonstrating that core coolability is maintained during ATWSI events. The staff's review considered plant-specific information (e.g., EOPs), specific aspects of TRACG code use as it was applied in the context of the NMP2 ATWSI analysis provided by the licensee (e.g., updates to the quench model, revision to the Tmin correlation in TRACG, etc.), and justification of the applicability of experimental data. The current review does not constitute a generic review and approval of the TRACG method.

With the automated ATWS actions (25 seconds to initiate FW flow reduction and 98 seconds to inject SLCS) TRACG04 calculations show that post-CHF Tmin conditions are not reached during ATWSI event and these models are not relied upon to demonstrate acceptable criteria in NMP2.

The NRC staff concludes that, with the automated FW runback initiated within approximately 25 seconds, post-CHF Tmin conditions are not reached during ATWSI events, and the TRACG04 Tmin and quench models are not relied upon to demonstrate acceptable criteria in NMP2. Nevertheless, the staff has reviewed the TRACG code models and concluded that TRACG calculations of ATWSI for NMP2 with possible rewetting and quenching is sufficient to provide reasonable assurance of compliance with the applicable ATWS regulatory criteria; namely demonstrating that core coolability is maintained during ATWSI events. The staff review considered plant-specific information (e.g., EOPs and automated actions), specific aspects of TRACG code use as it was applied in the context of the NMP2 ATWSI analysis provided by the licensee (e.g., updates to the quench model, revision to the Tmin correlation in TRACG, etc.), and justification of the applicability of experimental data. The current review, however, does not constitute a generic review and approval of the TRACG method.

4.0 OPERATING LICENSE AND TECHNICAL SPECIFICATION CHANGES

4.1 Technical Specification Changes

The licensee submitted revised changes to the NMP2 TSs (response dated June 13, 2014) to support its MELLLA+ LAR. The proposed TS changes are primarily associated with implementation of the DSS-CD long term stability solution and described in NEDC-33075P-A, Section 8.0, "Effect of Technical Specifications." The NRC staff's review of the proposed changes is discussed below.

The existing NMP2 License Condition 7 restricts operation with FW heating to within 20° of the design FW temperature which satisfies MELLLA+ LTR SER Limitation and Condition 12.5.b.

TS SL 2.1.1.1 Reactor Core Safety Limits – SLMCPR is increased from 1.07 to 1.09. The two-loop value is increased by 0.02 primarily due to condition 12.6 in the MELLLA+ SER which requires the application of the SLO core flow uncertainty to the TLO calculation. This change is acceptable as discussed in Sections 3.1.2 and 3.1.3 of this SER.

TS SR 3.1.7.7 – SLCS Pump Test – The licensee proposed to revise the SLCS pump discharge pressure from 1,327 psig to 1,335 psig. Because the peak pressure during ATWS has increased, the licensee has increased the SLCS pump discharge pressure in the TS from 1,327 psig to 1,335 psig. The licensee evaluated inadvertent lifting of the SLCS pump discharge relief valve and relief valve set point drift and confirmed that there is sufficient margin (176 psig). Since there is sufficient margin between the operating pressure and the relief valve set point, the NRC staff determined that the requested change is acceptable.

TS 3.3.1.1, RPS Instrumentation, Conditions J, and K and new Condition L – The licensee revised this section in response to RAI STSB-1 in letter dated May 14, 2014.

The licensee proposed to revise the TS 3.3.1.1 action statements for Conditions F and G, and to insert new Conditions J and K to support implementation of the Backup Stability Protection BSP requirements in the event that the DSS-CD is inoperable. The NRC staff finds the proposed changes are consistent with the requirements specified in Section 8.0 of the DSS-CD LTR (NEDE-33075P-A Revision 7).

TS Section 3.3.1.1.13, RPS Instrumentation, Surveillance Requirement SR – Editorial error in Note 3 (i.e., ORRM) is changed to OPRM. The NRC staff finds this action to be acceptable.

TS Section 3.3.1.1.16, RPS Instrumentation, Surveillance Requirement SR

The licensee proposed to delete SR 3.3.1.1.16. The surveillance is no longer required and eliminates unnecessary actions. The NRC staff finds the proposed changes are consistent with the requirements specified in Section 8.0 of the DSS-CD LTR. Therefore, the NRC staff finds these actions to be acceptable.

TS Section 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1, Function 2 b

The licensee proposed to revise the allowable value for Function 2.b, "Flow Biased Simulated Thermal Power – Upscale" from 0.55W+ 60.5% RTP and 115.5% to 0.61W + 63.4% RTP and 115.5%. The basis for the allowable value set point is discussed in the SAR (NEDC-33576NP), Section 5.3.1, and "APRM Flow-Biased Scram." The proposed change is also consistent with the requirements specified in Section 8.0 of the DSS-CD LTR (NEDC-33075P-A, Rev. 8). Based on the above, the NRC staff finds the change to be acceptable.

TS Section 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1, Function 2 b, new Note e

The licensee proposed to add new Note e to require resetting the allowable value set point for the APRM Flow Biased Simulated Thermal Power STP – High when the OPRM is inoperable. New Note e will read as follows:

> With OPRM Upscale function 2.e inoperable, reset the APRM-STP High Scram set point to the values defined by the COLR to implement the Automated BSP Scram Region in accordance with Action F. 2.1 of this Specification.

The proposed change is consistent with the requirements specified in Section 8.0 of the DSS-CD LTR (NEDC-33075P-A, Rev. 8). Therefore, the NRC staff finds the change to be acceptable.

TS Section 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1, Function 2 e

The licensee proposed to change the value in the APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS column from Mode-1 to 18%. This change is consistent with the plant specific analyses and the NRC staff finds it to be acceptable. The staff finds the proposed change in the allowable value from "As specified in the COLR" TO "NA" is acceptable since it complies with the DSS-CD LTR.

TS Section 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1, Function 2 e, new Note f

The licensee proposed to add a new note for Function 2.e-OPRM – Upscale to denote that following implementation of DSS-CD, DSS-CD is not required to be armed while in the DSS-CD Armed Region during the first reactor start-up and during the first controlled shutdown that passes completely through the DSS-CD Armed Region. However, DSS-CD is considered operable and capable of automatically arming for operation at recirculation flow rates above the DSS-CD Armed Region.

DSS-CD is armed and working throughout each cycle except during the first ascension to power startup and the first shutdown. These are the two times when there may be spurious SCRAMS if the solution parameters are not tuned properly. For the first startup and shutdown, the licensees still have BSP available. During startup and shutdown, the plant operates outside the MELLLA+ region; and therefore the NRC staff finds the proposed new Note f is acceptable.

TS Section 3.4.1, Recirculation Loops Operating

The licensee revised this section in response to RAI STSB-2 in letter dated May 14, 2014.

The licensee proposed to modify LCO 3.4.1 for one recirculation loop operation. The proposed change further defines requirements while in single loop operation, and restricts single-loop operation in the MELLLA+ operating domain. Operation in the MELLLA+ domain is not analyzed for single-loop operation.

LCO 3.4.1 will be revised as highlighted in **BOLD** to read as follows;

LCO 3.4.1 two recirculation loops with matched flows shall be in operation; or

One recirculation loop shall be in operation **provided the plant is not operating in the MELLLA or MELLLA+ domain defined in the COLR and provided** the following limits **are** applied when the associated LCO is applicable.

As discussed in Section 3.6.3 of the SAR (NEDC-33006P-A, Rev. 3), single-loop operation is not allowed in the MELLLA+ operating domain. The proposed modification to LCO 3.4.1 recognizes that one recirculation loop may be in operation provided the plant is not operating in the MELLLA+ operating domain as defined in the COLR. The NRC staff has reviewed the proposed change and finds it acceptable.

TS Section 3.4.1, Recirculation Loops Operating, Condition B

The licensee proposes to add required action B.2 to identify that intentional operation in the MELLLA domain or MELLLA+ domain as defined in the COLR is prohibited when a recirculation loop is declared "not in operation" due to a recirculation loop flow mismatch not within limits.

MELLLA+ is not analyzed for single loop operation and this restriction complies with the Section 8 of the DSS-CD LTR (NEDC-33075P-A, Rev. 8) and hence the NRC staff finds it to be acceptable.

TS Section 5.6.5, Core Operating Limits Report COLR

The licensee proposed to replace the reference to "Reactor Protection System Instrumentation set point for the OPRM-Upsale Function Allowable Value for Specification 3.3.1.1" with a reference to "The Manual Backup Stability Protection BSP Scram Region (Region I), the Manual BSP Controlled Entry Region, (Region II), the modified APRM Flow Biased Simulated Thermal Power – High trip function (Function 2.e), automated BSP Scram Region, and the BSP Boundary for Specification 3.3.1.1."

The proposed changes are consistent with the requirements specified in Section 8.0 of the DSS-CD LTR (NEDC-33075P-A, Rev. 8). The changes will ensure that applicable thermal limits continue to be met and reflect NRC-approved analytical methodologies. Therefore, the NRC staff finds the changes to be acceptable.

TS Section 5.6.8, OPRM Report New

The licensee proposed to add a new item to Section 5.6, "OPRM Report" to read as follows:

> 5.6.7 OPRM Report
>
> When a report is required by Required Action F.2 of LCO 3.3.1.1, "RPS Instrumentation," a report shall be submitted within 90 days of entering CONDITION F. The report shall outline the pre-planned means to provide backup stability protection, the cause of the inoperability, and the plans and schedule for restoring the required instrumentation channels to OPERABLE status.

The change is consistent with the requirements specified in Section 8.0 of the DSS-CD LTR (NEDC-33075P-A, Rev. 8), and conforms to the content and structure of structure of the TSs as described in NUREG-1433. Therefore, the NRC staff finds the changes to be acceptable.

4.2 Regulatory Commitments

By letter dated November 1, 2013, the licensee made the following regulatory commitments:

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	**CONTINUING COMPLIANCE**	
(1) The fuel and cycle-dependent analyses, including the plant-specific thermal limits assessment, will be submitted for NRC staff confirmation by supplementing the initial MELLLA+ Safety Analysis Report (SAR) in accordance with Limitation and Condition 12.4 of the MELLLA+ Licensing Topical Report (LTR) Safety Evaluation Report (SER). Specifically, CENG will provide the cycle specific Supplemental Reload Licensing Report (SRLR) and Fuel Bundle Information Report (FBIR), which includes the supplemental information to satisfy MELLLA+ LTR SER Limitation and Condition 12.4. (2) Nine Mile Point Nuclear Station, LLC (NMPNS) will provide a cyclespecific core design loading map along with a summary of differences between the reference design described in the MELLLA+ SAR and the cyclespecific core design. This summary will include differences in the energy requirements, average enrichment, and analytical inputs, a cyclespecific thermal limits assessment, and the actual reload analysis results. Additionally, the Supplemental Reload Licensing Report, which includes the cycle specific core map, will be provided. Submittal of the cycle-specific design will satisfy the NRC request made at the MELLLA+ LAR pre-meeting on March 13, 2013.			February 28, 2014

COMMITMENT	TYPE (Check one) ONE-TIME ACTION	 CONTINUING COMPLIANCE	SCHEDULED COMPLETION DATE (If Required)
(3) If NMP2 is the first plant-specific implementation of MELLLA+, then the cycle-specific eigenvalue tracking data will be evaluated and submitted to NRC to establish the performance of nuclear methods under the operation of the new operating domain. The following data will be analyzed: • Hot critical eigenvalue, • Cold critical eigenvalue, • Nodal power distribution (measured and calculated traversing incore probe (TIP) comparison), • " Bundle power distribution (measured and calculated TIP comparison), • Thermal margin, • Core flow and pressure drop uncertainties, and • The MCPR Importance Parameter (MWP) Criterion (i.e., determine if core and fuel design selected is expected to produce a plant response outside the prior experience base).			June 30, 2016

The NRC staff notes that Commitments 1 and 2 have been completed by the licensee's submissions dated February 25, 2014. The NRC staff does not depend on these commitments to make a safety determination. Further, the NRC staff concludes that reasonable controls for the implementation and subsequent evaluation of proposed changes pertaining to the above regulatory commitments are best provided by the licensee's administrative processes, including its commitment management program. None of the above regulatory commitments warrant the creation of regulatory requirements (items requiring prior NRC approval of subsequent changes).

4.3 Conclusion – NRC Staff's Technical Evaluation

The NRC staff has reviewed the proposed NMP2 operating domain extension (MELLLA+) documented in the NMP2 LAR, as supplemented, in particular, the SAR NEDC-33576P, Revision 0. The staff has also reviewed the licensee's analyses related to the effect of the proposed extension on the nuclear design of the fuel assemblies, control systems, and reactor core. The expansion of the NMP2 operating domain by lowering the flow at high reactor power without additional limitations would reduce the safety margin. However the NRC staff finds that the measures proposed by the licensee for NMP2 in the SAR are adequate to satisfy the regulatory criteria. The following measures are proposed to maintain the same safety margin under MELLLA+ than under the current licensed conditions:

1. FW temperature must be maintained within a range of 20°F, which satisfies the requirement of the MELLLA+ SER to avoid FW heater out of service in MELLLA+ conditions. The existing NMP2 License Condition 7 restricts FW operation to within 20°F of the design FW temperature which satisfies MELLLA+ SER Limitation and Condition 12.5b.

2. Single Loop Operation (SLO) is not allowed in the MELLLA+ domain.

3. The isotopic enrichment of Boron-10 in the SLCS has been increased from 25% to 92% to achieve a lower integrated heat load to containment during ATWS under MELLLA+ conditions. Note that the Boron-10 enrichment increase has already been approved in a separate license amendment request and it is implemented in Cycle-15. In addition, pump discharge pressure for the SLC System pump will be increased to accommodate larger transient over-pressure.

4. To provide additional protection against spurious, noise-induced scrams on the DSS-CD system, [[

   ]]

5. With the automated FW runback initiated within approximately 25 seconds, TRACG04 calculations show that post-CHF Tmin conditions are not reached during ATWSI events; therefore the TRACG04 Tmin and quench models are not relied upon to demonstrate acceptable criteria in NMP2, which is acceptable.

6. Typically, the limiting AOOs result in larger delta-CPR when initiated at nominal conditions than when initiated at lower flows inside the MELLLA+ domain. This is the case in NMP2 and the MELLLA+ operating domain expansion does not significantly change the operating limit because the largest delta CPR values occur at the 105% core flow conditions. Note that changes to the SLMCPR, including uncertainty penalties, do propagate to the OLMCPR and the final OLMCPR increases.

Critical operator actions have been assumed to occur consistent with the ATWS analysis. The NMP2 control system automatically performs actions that are typically accomplished by operators in other plants. Specifically, the NMP2 control system initiates a feedwater runback within 25 seconds of ATWS detection, and SLC boron injection within 98 seconds. Critical operator actions in NMP2 are: (1) place the reactor switch in shutdown mode, and (2) terminate and prevent injection. Through training exercises on the simulator (Report on Site Audit of

November 20, 2014), dated January 16, 2015 (ADAMS Accession No. ML14363A090) (Non-Public), the NMP2 operators have demonstrated their proficiency in executing the two critical actions, with conservative timing, that are assumed in the safety analysis.

The NRC staff determined that the licensee has adequately accounted for the effects of the proposed MELLLA+ operating domain extension on the nuclear design and demonstrated that the fuel design limits will not be exceeded during normal or anticipated operational transients, and demonstrated that the effects of postulated reactivity accidents will not cause significant damage to the pressure vessel or impair the capability to cool the core.

4.4 Recommended Areas for Testing and Inspection

As described above, the NRC staff conducted an extensive review of the licensee's test and inspection plans and analyses related to the proposed MELLLA+ implementation and concluded that they are acceptable. The NRC staff's review identified the following areas for consideration by the NRC inspection staff during the licensee's implementation of the proposed MELLLA+ (See Section SAR 10.4 for additional details):

- Steam Separator-Dryer Performance
- Average Power Range Monitor Calibration
- Core Performance
- Pressure Regulator
- Water Level Setpoint Changes
- Neutron Flux Noise Surveillance

These areas are recommended based on the licensee submission dated November 1, 2013 (NEDC-33576P, Revision 0), for the proposed testing for implementation of MELLLA+ at the NMP2 site, the extent and unique nature of changes necessary to implement the proposed MELLLA+ domain, and new conditions of operation necessary for operation in the proposed MELLLA+ domain. They do not constitute inspection requirements but are intended to give inspectors insight into important bases for approval of the MELLLA+ LAR.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the New York State official was notified of the proposed issuance of the amendment. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration in the *Federal Register* on August 5, 2014, (79 FR 45491), and there has been no public comment on the finding. Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

7.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

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Date: September 2, 2015

<u>APPENDICES</u>:
Appendix-A. Request for Additional Information Evaluation
Appendix-B. List of Acronyms

APPENDIX A

REQUEST FOR ADDITIONAL INFORMATION EVALUATION

This appendix provides a summary of the evaluation of the Licensee's responses dated September 15, 2014, ADAMS Accession No. ML14266A190) to the staff requests for additional information (RAI).

RAI-1 Power density > 50 MEGAWATT THERMAL/Mlbm/hr

The Methods safety evaluation report (SER) states, "Plant-specific EPU and expanded operating domain applications will confirm that the core thermal power to core flow ratio will not exceed 50 MWt/Mlbm/hr at any statepoint in the allowed operating domain. For plants that exceed the P/F value of 50 MWt/Mlbm/hr, the application will provide power distribution assessment to establish that neutronic methods axial and nodal power distribution uncertainties have not increased." The power distribution root mean squared, RMS, data provided to support the Methods SER (SER Figure 3-4) ranged from [[ ]], and an extrapolation to [50 MWt/Mlbm/hr] was allowed based on the Safety Limit Minimum Critical Power Ratio (SLMCPR) adders.

The statement in Section 2.2.5 of the Safety Analysis Report (SAR): "The incorporation of this limitation duplicates the intent of the Methods SER..." does not seem to be justified by the SER language and intent.

Since NMP2 power density is 51.86 MWt/Mlbm/hr (>50), provide a power distribution assessment to establish that neutronic methods axial and nodal power distribution uncertainties have not increased.

Resolution:

In the response (GE-PPO-IGYEF-KGI-742, NMP2L2556, dated Sept 15, 2014), the Licensee described the "additional conservatism" as the use of the more conservative SLO flow uncertainties to calculate the SLMCPR. For the first NMP2 MELLLA+ implementation (Cycle 15), the SLO uncertainty is estimated to be equivalent to a penalty of 0.02 (TLO SLMCPR is 1.07, but NMP2 use the SLO SLMCPR value of 1.09 in the MELLLA+ region), which is a significant penalty.

The licensee provided comparisons of TIP data versus PANACEA calculations that show that, in spite of the large power density, the power distribution uncertainties in NMP2 are within acceptable limits. The TIP comparison with calculations indicate that for the typical condition, the power distribution uncertainty is between 3% and 7%, depending on the type of uncertainty (see Table 4). Table 4 shows that NMP2 is not an outlier plant when compared to the rest of the fleet. Note that these uncertainties are the ones that have been measured during pre-MELLLA+ operation in NMP2 (up to 38.5 MW/Mlb/hr) and their impact on the SLMCPR is already reflected in the current values. The expectation is that an increase from 38 to 50 MWt/Mlb/hr would increase these uncertainties by a relatively small amount, which should be covered by the 0.02 SLMCPR penalty.

This RAI issue is resolved.

Table 4. Average TIP-PANACEA uncertainties showing that NMP2 is not at outlier

	TIP Type	Radial TIP RMS	Axial TIP RMS	Nodal TIP RMS
Plant A	**Neutron**	[[ ]]	[[ ]]	[[ ]]
NMP2	**Neutron**	[[ ]]	[[ ]]	[[ ]]
Plant C	**Gamma**	[[ ]]	[[ ]]	[[ ]]
Plant D	**Gamma**	[[ ]]	[[ ]]	[[ ]]

<u>RAI-2 Safety Limit Minimum Critical Power Ratio (SLMCPR) Adders</u>

Section 2.2.1 "Safety Limit Minimum Critical Power Ratio" states that "a +0.02 SLMCPR adder will be added to the cycle-specific SLMCPR."

1. *Provide a list of SLMCPR adders in MELLLA+ with respect to Original Licensed Thermal Power (OLTP) conditions.*

2. *Specify which adders is part of the Extended Power Uprate (EPU), and which is MELLLA+ specific.*

3. *In addition, the Methods SER specifies a SLMCPR adder of 0.03. Please explain the difference between the 0.03 and 0.02 values.*

<u>Resolution</u>:

The SLMCPR adders for NMP2 were provided.

For pre-MELLLA+ cycles, NMP2 used Rev. 3 of the Methods LTR (NEDC-33173PA [Ref. 8]) as their licensing basis. Rev. 3 Required a 0.02 SLMCPR adder for operation up to EPU conditions, or a 0.03 adder for operation inside the MELLLA+ domain.

Revision 3 of the Methods SER has now been replaced by Rev. 4, which is the licensing basis for the NMP2 MELLLA+ application. Rev. 4 has replaced the Rev. 3 SLMCPR adders. Rev. 4 adders are based on the power density, not the region of operation. For operation with power density lower than 42 MW/Mlb/h, Rev. 4 applies a 0.01 SLMCPR adder. For power densities greater than 42 MW/Mlb/h, Rev. 4 applies 0.02.

The NMP2 MELLLA+ application conservatively uses a 0.02 SLMCPR adder in the complete operating domain (even for power densities lower than 42 MWt/Mlb/m) which is an acceptable application of the limitations and conditions of the currently applicable Methods SER (i.e., Rev. 4).

This RAI issue is resolved.

RAI-3 Void Fraction

Figures 2-2 through 2-5 of the SAR show an unusual behavior towards the end of cycle in NMP2 (significant increase in flow and reduction in void past 16.5 GWD/ST).

1. *Is this behavior caused by an end of cycle (EOC) stretch with increased core flow (ICF)?*

2. *The hot power bundle flow (Fig 2-2) increases by -25% whereas the increased core flow has a maximum value of 5% (Fig 1-1). Please explain the unusual NMP2 behavior in Figs 2-2 through 2-5.*

Resolution:

The behavior referred to by the RAI is caused by elevated core flows on the approach to end of cycle as the flow is increased from 85% to 105%.

This RAI issue is resolved.

RAI-4 Backup Stability Solution

Section 2.4.3 Backup Stability Protection (BSP) describes that the Detect and Suppress Solution - Confirmation Density (DSS-CD) licensing topical report (LTR) provides two options: (1) BSP manual regions and (2) BSP implemented with average power range monitor (APRM) flow bias scram. This section of the NMP2 SAR appears to be a summary of the DSS-CD LTR, but it is not clear which of the two options will be implemented by NMP2.

1. *Which option will NMP2 use for the first MELLLA+ cycle?*
2. *Provide the BSP regions for the NMP2 equilibrium cycle.*

Resolution:

A description of the backup solutions was provided along with the exclusion regions calculated for NMP2.

This RAI issue is resolved.

RAI-5 Reactor Core Isolation Cooling (RCIC)

Section 3.9.3 "[RCIC] Net Positive Suction Head" states that "For ATWS (Section 9.3) and fire protection (Section 6.7), operation of the RCIC system at suppression pool temperatures greater than the operational limit may be accomplished by using the condensate storage tank (CST) volume as the source of water."

1. *Is the CST available for RCIC even under containment isolation conditions?*
2. *If the suppression pool temperature reaches the operational limit, what indication/training does the operator have to switch from suppression pool to CST inlet?*

Resolution:

The information was provided. The RCIC system suction is normally aligned to the condensate storage tank.

This RAI issue is resolved.

RAI-6 Anticipated Operational Occurrence (AOO) Impact Of Flow

On a separate MELLLA+ submittal, data was provided to justify that AOOs have smaller change in minimum critical power ratio (ΔMCPR) at 80% core flow than at 105% core flow. The argument presented in the past is a shift in power towards the bottom as the voids increase for the 80% flow case, which results in increased control rod performance that offsets the higher void reactivity coefficients at higher void levels.

NMP2 uses a core flow window from 85% to 105%. Provide the initial axial power shapes for the events in Table 9-1 of the SAR at 85% and 105% flow.

Resolution:

The power shapes requested in the RAI were provided. They confirm that the more favorable response at the lower flow (85%) condition is probably a consequence of more bottom peaked power shapes that make control rods more responsive (affect power earlier).

This RAI issue is resolved.

RAI-7 Bi-Stable Flow

Is NMP2 susceptible to bi-stable flow in the recirculation loops? If so, what is the maximum achievable recirculation flow used in normal operation to minimize bi-stable flow concerns?

Resolution:

NMP2 is susceptible to bi-stable flow. At NMP2 the magnitude of the bi-stable flow condition is reduced as the recirculation flow control valve position is increased. Thus, no maximum recirculation flow limit is required.

This RAI issue is resolved.

RAI-8 Plant Design Parameters

1. Provide plant design parameters relevant to the ATWS calculations in Section 9 of the SAR. Specifically: turbine bypass capacity, sources of high-pressure injection and their operability issues (e.g., steam is lost after isolation…), sources of low-pressure injection and their operability issues (e.g. CST pumps…).

2. Provide vessel component elevations in units comparable to the ones used for water level in the Section 9 figures (include separators, feedwater spargers, nominal level, level setpoints for actuations, top of active fuel...).

Resolution:

The information requested in the RAI was provided.

This RAI issue is resolved.

RAI-9 ATWS Sequence of Events

Provide tables of the assumed sequence of events for the ODYN computer code licensing calculation, the ATWS/Stability calculation, and the ATWS/Stability/Reactor Pump Trip (RPT) calculation

Resolution:

The sequence of events assumed for the ODYN and ATWSI calculations were provided. [[

]]

This RAI issue is resolved.

RAI-10 ATWS Water Level Strategy

1. *Provide a detailed description of what water level control strategy (with emphasis on timing) was used for each ATWS calculation.*

2. *Describe the sources of water used to control the level. For the equipment used, describe automated actions (i.e., loss of extraction steam), and assumptions about operability (i.e., residual steam volume, if used) after the Main Steam Isolation Valve isolation occurs.*

Resolution:

The water level strategy for ATWS was provided.

This RAI issue is resolved.

RAI-11 Detailed Plots

The neutron flux provided for the ATWSI (RPT) calculation is core-average. Provide additional plots with hot channel powers at symmetric core locations showing the amplitude of the regional oscillations for the ATWSI calculation.

Resolution:

The information was provided showing the hot channel out of phase oscillation.

This RAI issue is resolved.

RAI-12 Peak Cladding Temperature

1. *Section 9.3.3 of the SAR specifies that the minimum stable film boiling temperature (T_{min}) correlation used is Shumway with clean Zirconium (Zr) credit (i.e., no Zr oxide) and no void credit. Is the TRACG quench model activated for these calculations or for the ATWS/Instability/RPT transient?*

2. *The ATWS/Instability/RPT calculation (Fig 9-12) shows a PCT heatup at ~140 sec when the power oscillations initiate. The PCT recovers and the rods seem to rewet at ~300 sec when the oscillations are mitigated by the flow/reduction. What mechanism allows for heatup and rewet?*

3. *Provide plots similar to Figure 9-12 that shows PCT superimposed with the calculated T_{min} value.*

4. *Provide tables showing the calculated margin between PCT and T_{min} for Figure 9-12.*

Resolution:

The information was provided. **[[**

]] The figures in the

RAI response **[[**

]] The data provided confirms that the

ATWSI calculations are acceptable.

This RAI issue is resolved.

RAI-13 Turbine Trip Events

Results for turbine trip without bypass (TTNBP) during an AWTS-I event are not included in the SAR. Provide results for TTNBP in the MELLLA+ operating domain.

Resolution:

The TTNBP data was provided in the RAI response.

This RAI issue is resolved.

RAI-14 Steam Dryer Structural Integrity

1. *Are the boundary conditions used in Acoustic Circuit Model, ACM, affected by MELLLA+ flow? Is there any impact on reactor water level and boundary conditions for annular region between dryer skirt and separator stand pipes, and annular region between reactor pressure vessel wall and dryer skirt? Is there any impact on dryer pressure loading used and on dryer structural analysis?*
2. *Are steam dryer stresses evaluated for EPU conditions bounding for plant operation at EPU conditions combined with MELLLA+ conditions?*
3. *Section 3.3.4 "Steam Line Moisture Performance Specification" states, "This increase resulted in a MCO value above the original moisture performance specification of 0.10 wt. %." ... "The amount of time NMP2 is operated with higher than the original design moisture content (0.10 wt. %) is minimized by operations" ... "the NMP2 moisture carryover, MCO, will be monitored and controlled to < 0.25 wt. %". Provide a summary explanation of:*
   a. *What analyses were performed to determine the 0.25% permissible limit?*
   b. *What analyses were performed to determine the original 0.1% moisture carryover, MCO, under MELLLA+ conditions?*
   c. *What plant operations are used in NMP2 to minimize the moisture carryover, MCO?*
   d. *Provide a short physical explanation of what causes the increased moisture carryover, MCO, at lower flow. Is this mechanism predicted using an experimental correlation or a first principle analytical tool?*
   e. *How is the MCO monitored during operation? What is the typical surveillance period?*

Resolution:

In response to the NRC RAI on steam dryer acceptability for the combined MELLLA+ and EPU Conditions, and on the effect of increased moisture carryover (MCO) on Main Steam Line (MSL) components, the licensee provided the response to RAI-14, which included a summary of its evaluations. On the topic of steam dryer acceptability, the evaluations considered the effect of MELLLA+ conditions on MCO, acoustic boundary conditions, steam dryer loads, and steam dryer stresses. The licensee stated that operation at MELLLA+ core flow conditions increases MCO and affects the steam quality. A bounding MCO value of 0.35 wt. percent was used for steam dryer evaluations. The lower core flow conditions at MELLLA+ affect the acoustic boundary conditions for the Acoustic Circuit Model steam/froth interface under the dryer, and steam/water interface in the annular region between the dryer skirt and reactor vessel wall. The licensee also evaluated the steam dryer stresses for the combined EPU and MELLLA+ flow conditions comparing them with the acceptance criteria in the ASME B&PV Code 2007, Subsection NG. To address questions on the effect of increased MCO, the licensee provided clarification based on the analyses performed to determine the original and updated MCO limits, and described how the MCO will be monitored and minimized in operation.

NRC Staff Evaluation

The NRC staff reviewed the licensee's steam dryer evaluations. The licensee conservatively used a high bounding MCO of 0.35 wt. % for the steam exiting the reactor pressure vessel. It is noted that wet steam increases acoustic damping and therefore damps acoustic oscillations. The increased moisture content at the vessel outlet increases the steam density slightly. The effect of slight changes in acoustic properties corresponding to MELLLA+ conditions is insignificant on the acoustic pressure loads on the steam dryer.

The NRC staff notes that the steam dryer loads associated with MELLLA+ conditions for deadweight, reactor internal pressure differences, seismic, and SRV loads remain the same or are bounded by those considered in the EPU evaluation. Therefore, the structural integrity results of the EPU evaluation remain applicable for MELLLA+ as well as for normal, upset, emergency, and faulted conditions. The EPU acoustic steam dryer loads are established based on measured data from the Main Steam Line strain gages. This data has established that these loads are bounded by the steam line flow velocity squared relationship. The minor change in steam density has negligible effect on the acoustic speed as well as on the steam dryer acoustic loads. Further, NMP2 uses recirculation flow control at constant recirculation pump speed to achieve 85 percent core flow for MELLLA+ extended operation and recirculation pump vane passing frequency (VPF) remains unchanged from EPU conditions. Therefore, the VPF loads for MELLLA+ remain the same as for EPU.

The NRC staff also reviewed the licensee's steam line moisture performance specifications, which increases the permissible limit of the MCO in steam leaving the Reactor Pressure Vessel (RPV) from 0.10 wt. % to 0.25 wt. %. By remaining below this MCO permissible limit, the MCO values at the Outboard Main Steam Isolation Valves, which were identified by the licensee to be the limiting MSL components, will remain below their maximum allowable MCO of 0.50 wt. %. It is noted that based on current predictions, the MELLLA+ MCO average levels leaving the RPV in operation are expected to remain below the current 0.07 wt. % alert levels defined in the NMP procedure. Based on this plant-specific analysis, and the small expected increase in the average MCO levels in the MSL, the licensee has demonstrated reasonable assurance that MSL components will not experience accelerated degradation as a result of the increased moisture content in the steam.

Conclusion

The NRC reviewed the licensee's input regarding steam dryer acoustic boundary conditions, pressure loading, and steam dryer stresses for the combined MELLLA+ and EPU conditions and finds them acceptable because the stresses in the steam dryer meet the acceptance criteria for the flow induced vibration stress limit (13600 psi endurance limit for high cycle fatigue based on ASME Code 2007, Subsection NG). The NRC staff also reviewed the licensee's steam line moisture performance specifications and finds them acceptable because the MCO will be monitored and controlled to provide reasonable assurance that MSL components will not experience accelerated degradation due to increased moisture content in the steam.

The NRC staff concludes that the proposed license amendment to operate NMP2 at EPU conditions combined with MELLLA+ for the steam dryer is acceptable (a) with respect to potential adverse flow effects for high cycle fatigue, (b) as well as to withstand the ASME normal, upset, emergency, and faulted load combinations. The NRC staff also concludes that the steam dryer will maintain its structural integrity for the combined EPU and MELLLA+ flow conditions. Furthermore, the NRC staff concludes that the MSL components will not experience accelerated degradation due to increases in moisture carryover.

Requested information was provided, this RAI issue is resolved.

RAI-15 Large Break and Small Break LOCA

1. *Section 4.3.1 Break Spectrum Response and Limiting Single Failure states, "A number of small break sizes were evaluated at the rated EPU power/MELLLA+ flow domain to determine the worst case small break." Provide a list of cases evaluated and indicate the limiting case.*

2. *The Small-Break LOCA results in Section 4.3.3 show the top-peaked axial power shape is limiting compared to the mid-peaked power shape. Why is Small-Break LOCA top-peak limited?*

3. *The results for Large-Break LOCA in Section 4.3.2 show the mid-peaked axial power shape being limiting. Why is Large-Break LOCA mid-peak limited?*

4. *In Section 4.3.2, explain the following regarding its results:*

a. The MELLLA+ LTR requires Small- and Large-Break LOCA analyses to include top-peaked and mid-peaked power shape in establishing the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) and determining the PCT. Explain why only mid-peaked axial power shape is analyzed at 100% power and 100% flow.

b. Explain why the mid-peaked axial power shape is limiting in terms of the PCT.

c. What is the difference between mid-peak and top-peak values for the 1st peak results?

d. Explain why the first peak is lower than the second peak for the mid-peaked axial power shape calculation in the Appendix K PCT analyses.

e. Explain why no data is shown for the Nominal PCT cases.

f. Please provide a plot of PCT versus time for Large-Break LOCA top- and mid-peaked axial power shape cases.

Resolution:

Requested information was provided. SER Section 3.1.2 includes resolution of the issues identified.

RAI-16 OPRM Armed Region

The generic MELLLA+ flow domain is 80% - 100% flow at 100% power. NMP2 chose a different flow domain of 85% - 100% flow at 100% power. The generic Oscillation Power Range Monitor (OPRM) armed region value for the DSS-CD is 75% flow. Please explain why the generic value for the armed region for the DSS-CD was not adjusted commensurate with the adjustments to the generic flow domain? Please provide the criteria and methodologies used to set the OPRM armed region.

Resolution:

The information was provided. The 75 percent flow limit is a generic value based on engineering experience.

This RAI issue is resolved.

RAI-17 Simulator Update

1. Describe any modifications to the training status of the key operator actions credited in the TRACG ATWSI analysis.

Resolution:

Appropriate modifications necessary to the training program related to key operator actions were implemented by the licensee.

This RAI issue is resolved.

RAI-18 Core Design

1. *Please verify that the document from James J. Stanley to the NRC dated February 25, 2014, "License Amendment Request Pursuant to 10 CFR 50.90: Maximum extended Load Line Limit Analysis Plus - Core Reload and Safety Limit Supplemental Information" is the final supplemental reload licensing report (SRLR) for NMP2 MELLLA+ operating Cycle 15. If the document is not a final SRLR, when will the final SRLR be available to support NMP2 MELLLA+ operation?*
2. *When will the final Core Operating Limits Report be available to support NMP2 MELLLA+ operation?*
3. *Table 2-1 and Figures 2-1 through 2-6 of the SAR indicate the core design and fuel monitoring parameters for each exposure statepoint. Table 2-1 shows the peak nodal exposures ranging from 38.849 to 56.660 GWd/ST (52.003 GWd/ST for NMP2 MELLLA+) and Figures 2-1 through 2-6 show cycle exposure only up to 18 GWd/ST.*
    a. *Why do the figures show the data only up to 18 GWd/ST?*
    b. *Provide values for maximum bundle power, flow for peak bundle, exit void fraction for peak power bundle, maximum channel exit void fraction, core average exit void fraction, and peak LHGR at peak nodal exposure.*
4. *Please provide a detailed description and basis as to why the operational conditions for NMP2 in the MELLLA+ operating domain are within expected parameters based on the data shown in Figures 2-7 through 2-17.*

Resolution:

The information was provided.

This RAI issue is resolved.

RAI-19 Standby Liquid Control System

1. *Provide rationale to revise the acceptance criterion in Surveillance Requirement 3.1.7.7 from a discharge pressure of ≥ 1,327 pounds per square inch gauge (psig) to ≥ 1,335 psig.*

Resolution:

The information was provided. SER Section 3.1.4.5 includes discussion of this issue. This RAI issue is resolved.

RAI-20 Cycle Specific Safety Limits

1. *It appears that both Figure 1 of Attachment 11 to the SAR and Figure 1 of the February 25, 2014, SRLR show the same core loading pattern. Please verify that Figure 1 in both documents is the same final core loading pattern. If they are not the same final core loading pattern, explain what they represent.*

2. *Figure 3 in Attachment 11 of the SAR shows Monte Carlo trials for the SLMCPR value through all of the uncertainty subroutines. Are there any Part 21 reports associated with SLMCPR?*

3. *Table 3 of Attachment 11 shows that the Final Estimated SLMCPR for a state-point at 100% power and 85% flow is [[ ]]. The Calculated Monte Carlo SLMCPR is [[ ]]. Explain why the 0.02 adder for MELLLA+ operation was applied to the Calculated Monte Carlo SLMCPR and not the Final Estimated SLMCPR.*

4. *Was the STERN test data used to improve the non-power distribution uncertainties shown in Table 4 in Attachment 11? If so, explain how the data was used. If not, explain why?*

Resolution:

The information was provided.

This RAI issue is resolved.

RAI-21 Technical Specifications

Please identify which version of GESTAR is used for TS 5.6.5.b.1.

Resolution:

The May 2012 version is used.

RAI-22 Limiting Events Analyzed in ATWS versus ATWSI

1. *For NMP2, the limiting ATWS events analyzed were initiated from 100% current licensed thermal power, CLTP, and 85% rated core flow at beginning of cycle, BOC, and EOC exposure conditions. Why is peak reactivity exposure not analyzed as a limiting event for ATWS?*

Resolution:

[[

]]

RAI-23 ATWS Analysis Results

Table 9-4 shows the key results of the ATWS analyses. Footnote 2 of Table 9-4 states "Coolable core geometry is ensured by meeting the 2200°F PCT and 17% local cladding oxidation acceptance criteria of 10 CFR 50.46." No calculation was performed for peak local cladding oxidation. Verify that the peak local cladding oxidation is insignificant under NMP2 MELLLA+ operation.

Resolution:

[[ ]] Since this is less than the acceptance criterion of 2200°F, this is acceptable.

Fluence RAI-1:

By application dated November 21, 2012, NMPNS requested changes to the facility Technical Specifications as necessary to implement a Pressure Temperature Limits Report (PTLR) using a plant-specific method performed by MPM Technologies, Inc. (MPM). This application was approved by the NRC staff in its safety evaluation, "Nine Mile Point Nuclear Station, Unit No. 2 - Issuance of Amendment Regarding Relocation of Pressure and Temperature Limit Curves to the Pressure and Temperature Limits Report," dated May 29, 2014 (ML14057A554).

Fluence is identified in the MELLLA+ topical report as an item to be dispositioned. NEDC-33576NP, Safety Analysis Report for Nine Mile Point Unit 2 Maximum Extended Load Line Limit Analysis Plus (ML13316B109) attached with the application states that MELLLA+ flux is calculated using the GEH flux evaluation methodology contained in NEDO-32983-A, Revision 2, "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluations," (ML072480121).

A clarification call on Tuesday, December 16, 2014, took place to discuss the NMP2 MELLLA+ GEH method for fluence evaluation. The licensee stated, in part, that the PTLR approved by the NRC staff uses the MPM plant-specific calculation and that the fluence evaluation for MELLLA+ conditions was performed using the GEH method contained in NEDO-32983-A, Revision 2. The final outcome of this call was for the licensee to submit the neutron fluence calculation notes and data for MELLLA+ conditions for audit.

The NRC staff audited the provided material from the licensee for neutron fluence calculations using the GEH method. While auditing the provided calculations, the NRC staff observed that the fluence estimation and flux/fluence data documented in the plant-specific MPM method are used as the basis for all pre-EPU cycles. The NRC staff also observed that the fluence estimation is based on a combination of (1) End-of-Cycle (EOC) 10 fluence at 14.08 Effective Full Power Years (EFPY) documented in the plant-specific MPM method, (2) Cycle 10 flux derived from 22-EFPY fluence and EOC 10 fluence in the plant-specific MPM method, and (3) [MELLLA+] flux calculated in this task.

The combination of multiple fluence methods is not in accordance with Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." Nor is it, in the staff's view, accordant with NEDO-32983-A, Revision 2, since the NEDO document is limited only to GEH's calculational approach, and it does not provide for fluence inputs from other methods. Furthermore, the NRC did not identify any information in the [MELLLA+] SAR justifying the combination of multiple fluence methods.

The NRC staff requests the licensee to provide a RG 1.190 compliant disposition of fluence calculations that is in accordance with the MELLLA+ topical report. Alternatively, provide a comparison of EPU flux and MELLLA+ flux to show that the effects of MELLLA+ operation are appropriately addressed. Provide information to show that (1) the comparative flux evaluation is conservative relative to recent plant operation, (2) the comparative flux evaluation is based on RG 1.190-adherent transport methods, and (3) the comparative flux evaluation accounts for the increased coolant void conditions associated with MELLLA+ operation.

Resolution:
The licensee submitted its response by letter dated February 18, 2015. The NRC staff reviewed the response and found it acceptable.

APPENDIX B

LIST OF ACRONYMS

Acronym	Definition
ABSP	Automatic Backup Stability Protection
ADAMS	Agencywide Documents Access And Management System
ADS	Automatic Depressurization System
APHB	Division of Risk Assessment, PRA Operations and Human Factors Branch
AL	Analytical Limit
ALARA	As Low As Is Reasonably Achievable
ANSI	American National Standards Institute
AOO	Anticipated Operating Procedures
AOP	Abnormal Operating Procedures
AP	Annulus Pressurization
APRM	Average Power Range Monitor
ARI	Alternate Rod Injection
ARS	Amplified Response Spectra
ART	Adjusted Reference Temperature
ASDC	Alternate Shutdown Cooling
ASME	American Society Of Mechanical Engineers
AST	Alternate Source Term
ATWS	Anticipated Transients Without Scram
ATWSI	Anticipated Transients Without Scram - Core Instability
AV	Allowable Value
AV	Air Volume
BOC	Beginning of cycle?
BOP	Balance Of Plant
BSP	Backup Stability Protection
BSW	Biological Shield Wall
BWR	Boiling-Water Reactor
BWRVIP	Boiling-Water Reactor Vessel And Internals Project
CAP	Containment Accident Pressure
CCF	Common-Cause Failure
CDF	Core Damage Frequency
CENG	Constellation Energy Nuclear Group, Llc
CF	Core Flow
CFR	*Code Of Federal Regulations*
CHF	Critical Heat Flux
CHR	Containment Heat Removal
CLOD	Current Licensed Operating Domain
CLTP	Current Licensed Thermal Power
CO	Condensation Oscillation
COLR	Core Operating Limits Report
CRD	Control Rod Drive
CRDA	Control Rod Drop Accident
CRDS	Control Rod Drive System
CRGT	Control Rod Guide Tube
CS	Core Spray

Acronym	Definition
CST	Condensate Storage Tank
DBA	Design Basis Accident
DBA-LOCA PCT	Design Basis Accident Loss-Of-Coolant Accident Peak Cladding Temperature
DFFR	Dynamic Forcing Functions Report
DSS-CD	Detect And Suppress Solution - Confirmation Density
DW	Drywell
ECCS	Emergency Cooling System
EFPY	Effective Full Power Years
EGC	Exelon Generation Company, Llc
EOP	Emergency Operating Procedures
EPG/SAG	Emergency Procedure Guidelines/Severe Accident Guidelines
EPRI	Electric Power Research Institute
EPU	Extended Power Uprate
EQ	Environmental Qualification
FAC	Flowaccelerated Corrosion
FCV	Flow Control Valve
FHA	Fuel Handling Accident
FIV	Flow-Induced Vibration
FR	*Federal Register*
FW	Feedwater
FWCF	Feedwater Controller Failure (Maximum Demand)
GDC	General Design Criteria
GEH	GE-Hitachi Nuclear Energy Americas LLC
GESTAR	General Electric Standard Application for Reactor Fuel
GL	Generic Letter
HPCI	High Pressure Coolant Injection
HPCS	High Pressure Core Spray
HRA	Human Reliability Analyses
HSBW	Hot Shutdown Boron Weight
his	Human System Interface
ICF	Increased Core Flow
ID	Internal Diameter
IASCCC	Irradiated Assisted Stress Ccorrosion Cracking
IEEE	Individual Plant Examination of External Events
IGSCC	Intergranular Stress Corrosion Cracking
ILBA	Instrument Line Break Accident
IMCPR	Initial MCPR (Minimum Critical Power Ratio)
IRM	Intermediate Range Monitor
LAR	License Amendment Request
LCO	Limiting Condition For Operation
LCS	Leakage Control System
LERF	Large Early Release Frequency
LFWH	Loss of Feedwater Handling
LHGR	Linear Heat Generation Rate
$LHGRFAC_f$	LHGR Flow Factor
LOCA	Loss-Of-Coolant Accident
LOOP	Loss-Of-Off-Site Power

Acronym	Definition
LOWF	Loss of Feedwater
LPCI	Low Pressure Coolant Injection
LPCS	Low Pressure Core Spray
LPRM	Local Power Range Monitor
LRNBP	Load Rejection Without Bypass
LTR	Licensing Topical Report
LWR	Light-Water Reactor
M+LTR	Mellla+ Licensing Topical Report Nedc-330006p-A
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCO	Moisture Carryover
MCPR	Minimum Critical Power Ratio
$MCPR_f$	MCPR Flow Factor
$MCPR_p$	MCPF Power Factor
MCR	Main Control Room
M & E	Mass and Energy
MELB	Moderate Energy Line Break
MELLLA+	Maximum Extended Load Line Limit Analysis Plus
MOV	Motor-Operated Valve
MPC	Maximum Permissible Concentration
MS	Main Steam
MSIV	Main Steam Isolation Valve
MSIVC	Main Steam Isolation Valve Closure
MSIVF	Main Steam Isolation Valve Closure With Scram On High Flux
MSL	Main Steam Line
MSLBA	Main Steam Line Break Accident
MWt	Megawatts Thermal
NMP1	Nine Mile Point Nuclear Station, Unit 1
NMP2	Nine Mile Point Nuclear Station, Unit 2
NMPNS	Nine Mile Point Nuclear Station
NMS	Neutron Monitoring System
NPSH	Net Positive Sunction Head
NRC	U.S. Nuclear Regulatory Commission
NTSP	Normal Trip Setpoints
NUMAC	Nuclear Measurement Analysis And Control
ODYN	N/A - Computer Code
OER	Operating Experience Review
OLMCPR	Operating Limit Minimum Critical Power Ratio
OLTP	Original Licensed Thermal Power
OPRM	Oscillation Power Range Monitor
ORNL	Oak Ridge National Laboratory
P/F	Power Flow
PBA	Period Based Algorithm
PCT	Peak Cladding Temperature
PDI	Performance Demonstration Initiative
PRA	Probabilistic Risk Assessment
PRFO	Pressure Regulator Failure Open
PRNM	Power Range Neutron Monitoring
psig	Pounds Per Square Inch Gauge

Acronym	Definition
RAI	Request For Additional Information
RBM	Rod Block Monitors
RCF	Rated Core Flow
RCIC	Reactor Core Isolation Cooling
RCPB	Reactor Coolant Pressure Boundary
RCS	Reactor Coolant System
rem	Roentgen Equivalent Man
RG	Regulatory Guide
RHR	Residual Heat Removal
RIPDS	Reactor Internal Pressure Difference
RIS	Regulatory Issue Summary
RPS	Reactor Protection System
RPV	Residual Heat Removal
RRS	Reactor Recirculation System
RS	Review Standard (Rs-001)
RSLB	Recirculation Suction Line Break
RTP	Rated Thermal Power
RV	Reactor Vessel
RWCU	Reactor Water Cleanup
RWE	Rod Withdrawal Error
RWM	Rod Worth Minimizer
S_{AD}	Amplitute Discriminator Set Point
SAFDL	Specified Acceptable Fuel Design Limits
SAR	Safety Analysis Report
SBO	Station Blackout
SC	Safety Communication
SDC	Shutdown Cooling
SE	Safety Evaluations
SER	Safety Evaluation Report
SGTS	Standby Gas Treatment System
SL	Safety Limit
SLCS	Standby Liquid Control System
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single-Loop Operation
SLS	Standby Liquid Control System
SOP	Special Operating Procedures
SP	Suppression Pool
SR	Surveillance Requirements
SRLR	Supplemental Reload Licensing Topical Report
SRM	Source Range Monitor
SRM	Staff Requirements Memorandum
SRO	Strong Rod Out
SRP	Standard Review Plan
SRV	Safety Relief Valve
SRXB	Division of Safety Systems, Reactor Systems Branch
SSC	Structures, Systems, And Components
SSE	Safe Shutdown Earthquate
STP	Simulated Thermal Power

Acronym	Definition
TAF	Top Of Active Fuel
TGBLA/PANAC	N/A - Computer Code
TIPs	Traversing Incore Probes
TLO	Two Loop Operation
T-M	Thermal-Mechanical
Tmin	Minimum stable film boiling temperature
TS	Technical Specification
TSTF	Technical Specification Task Force
TSV	Turbine Stop Valve
TT	Turbine Trip
TTBNP	Turbine Trip Without Bypass
UFSAR	Updated Final Safety Analysis Report
USAR	Updated Safety Analysis Report
USE	Upper Shelf Energy
V&V	Verification and Validation