Enclosure 6

AREVA Report ANP-3424NP

Non-Proprietary

AREVA Responses to RAI from SCVB on MNGP EFW LAR

Revision 0

August 2015

21 pages follow

AREVA

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AREVA Inc.

ANP-3424NP
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Nature of Changes

Item	Page	Description and Justification
1.	All	This is the initial issue

Contents

Tables

Nomenclature

Acronym	Definition
$	Dollar, relative unit for reactivity
ANS	American Nuclear Society
ATWS	Anticipated Transient Without Scram
BOC	Beginning-of-Cycle
DBA	Design Basis Accident
ECCS	Emergency Core Cooling Systems
EFW	Extended Flow Window
EOC	End-of-Cycle
EPU	Extended Power Uprate
GE	General Electric
GL	Generic Letter
HPCI	High Pressure Coolant Injection
LAR	License Amendment Request
LOCA	Loss-Of-Coolant Accident
LPCI	Low Pressure Coolant Injection
MCPR	Minimum Critical Power Ratio
MELLLA+	Maximum Extended Load Line Limit Analysis Plus
MNGP	Monticello Nuclear Generating Plant
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission, U.S.
RAI	Request for Additional Information
RCIC	Reactor Core Isolation Cooling
RHR	Residual Heat Removal
SCVB	Staff in Containment and Ventilation Branch
SGTS	Standby Gas Treatment System
SRV	Safety Relief Valve

1.0 Introduction

In Reference 1, Northern States Power Company - a Minnesota corporation, doing business as Xcel Energy, submitted a license amendment request for the Monticello Nuclear Generating Plant (MNGP). The application was supplemented by Reference 2. The amendment would revise the Technical Specifications and approve certain AREVA analytical methods to support plant operation in the expanded power-flow domain described as the Extended Flow Window (EFW).

The U.S. Nuclear Regulatory Commission (NRC) staff in the Containment and Ventilation branch (SCVB) has reviewed the application and concluded that additional information is necessary to complete its review. Draft Requests for Additional Information (RAI) were provided as an attachment to Reference 3. The RAI and the AREVA responses are attached.

These responses are provided so that Xcel Energy can provide a complete set of responses to the NRC by combining the AREVA responses with the responses being prepared by Xcel Energy.

2.0 RAIs and Responses

SCVB RAI-1

In Table 2.1 Disposition of Events Summary of ANP-3295P, the licensee states that the fuel dependent characteristics void coefficient and boron worth, important to containment response, were compared for events without scram (Anticipated Transients Without Scram (ATWS)) and the analysis of record remains applicable. The licensee references Section 7.2.2 for the comparison and states that ***[[***

]]. *There is no quantifiable comparison between the fuel characteristics for GE14 fuel at Maximum Extended Load Line Limit Analysis Plus (MELLLA+) conditions and ATRIUM™ 10XM* fuel at Extended Flow Window (EFW) conditions.*

a. *Provide the comparison and justify the use of the GE14 MELLLA+ analysis as bounding.*
b. *Provide a table of the containment response limits and the GE14 and ATRIUM 10XM values.*

AREVA Response

a. The licensing basis for MNGP MELLLA+ is summarized in Section 4.1 of Reference 11. Additional information about the MNGP ATWS analyses is summarized in Reference 4. **[**

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b. The ATWS containment results for GE14 values (Reference 4) are provided in the following table together with the design limits. **[**

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Table 1 ATWS Containment Heatup Key Results

Item	Parameter	Unit	GE14 EPU Value	GE14 M+ Value	Design Limit
1	Peak Suppression Pool Temperature	°F	**[ ]**	**[ ]**	281
2	Peak Containment Pressure	psig	**[ ]**	**[ ]**	56

* ATRIUM is a trademark of AREVA Inc.

SCVB RAI-2

In Table 2.1 Disposition of Events Summary of ANP-3295P, under the comment section for ATWS, it is stated that the decay heat is used for the long-term cooling analysis and that containment heatup was dispositioned by comparing kinetics parameters for ATRIUM 10XM fuel with those for the fuel in the analysis of record. The analysis of record is based on GE14 fuel.

Provide the comparison of kinetics parameters, decay heat, and justify the use of the analysis of record for containment heatup.

AREVA Response

The fuel in the analysis of record is GE14 while the fuel in the EFW analysis is ATRIUM 10XM. **[**

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Table 2 Kinetics Parameters Comparison

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Unit of Void Coefficient is $(\Delta k/k)/(\Delta VF)$, where $\Delta k/k = (k_i-k_f)/k_i$ and $\Delta VF = VF_i - VF_f$
Unit of Boron Worth is $\Delta k/k$, where $\Delta k/k = (k_i-k_f)/k_i$
Unit of Doppler Coefficient is $(\Delta k)/(\Delta ^oF)$, where $\Delta k = (k_i-k_f)$ and $\Delta ^oF = ^oF_i - ^oF_f$

UO_2 is used in both the GE14 and ATRIUM 10XM fuel designs. **[**

] Decay heat is the heat produced by the decay of fission products which depend on the power levels at which the reactor is operated, the amount of time spent at those power levels, and the time after shutdown; **[**

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Table 3 Decay Heat Comparison

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SCVB RAI-3

In supplement ANP-3376P, Section 4.4.1, the licensee stated:

> *"The short term containment pressure depends on the break energy which is derived from the break flow rate and enthalpy. Break flow and enthalpy from a design basis break in the recirculation suction line depend on conditions inside the reactor vessel (pressure, power, feedwater temperature, etc.), but do not depend on the fuel design.*
>
> *Thus, the analysis of record for short-term containment pressure remains valid (bounding) for AREVA ATRIUM 10XM fuel operating within EFW because: (1) the analysis results do not depend on fuel design, and (2) the methodology for MNGP containment analyses is not being changed by the EFW LAR."*

The U.S. Nuclear Regulatory Commission (NRC) staff disagrees that the short-term analysis does not depend on fuel design. The staff notes that even though for the proposed fuel the decay heat is based on the same standard American Nuclear Society (ANS) 5.1-1971 as currently used, the normalized decay heat values versus time will be different and should be considered.

The short-term analysis for mass and energy (M&E) release is during the blowdown, refill, and reflood phases of loss-of-coolant accident (LOCA) which are described below:

BLOWDOWN

The period from accident initiation (when the reactor is at steady-state operation) to the time that the reactor vessel reaches initial pressure equilibrium with containment.

REFILL

The period of time when the Core Spray (CS) pumps are delivering spray water above the core and the Residual Heat Removal (RHR) pumps in the Low Pressure Coolant Injection (LPCI) mode are delivering water to the lower plenum.

REFLOOD

As the two-phase level in the core recovers and is reflooded, continued core cooling is provided by the CS pumps and RHR pumps in the LPCI mode.

The current (Extended Power Uprate (EPU) in MELLLA operating domain) short term containment analysis was performed using LAMB code for M&E release calculation and M3CPT code for containment response. During the above phases of LOCA, a significant portion of M&E release is based on the fuel related parameters which are (a) initial stored energy in the fuel, (b) the energy transferred from the fuel to the reactor coolant, and (c) the decay heat. The core stored energy should be determined consistent with the initial conditions and time in the fuel cycle life and for conservatism should be biased high by using a low value of gap (between the UO2 and the cladding) conductance. For the energy transferred to the reactor coolant, for conservatism, an upper bound gap conductance should be used during the transient to maximize the stored energy transferred to the coolant (reference 10 CFR 50 Appendix K Sections I.A.1 through I.A.3). The decay heat should be based on ANS 5.1-1971 plus 20-percent for uncertainty.

The NRC staff proposes the following options for responding to this RAI:

Option A

a. *Perform a revised licensing basis analysis for the short term pressure containment response using the currently used codes LAMB and M3CPT for the proposed fuel change and provide key inputs, assumption, description of analysis, and results (peak values and graphs).*
b. *Provide justification if conservatism in any of the inputs and assumptions is reduced.*

Option B

a. *Considering the differences in the proposed ATRIUM 10XM fuel and the current GE14 fuel (e.g., mass, material properties, core flow, decay heat, heat transfer coefficients and any other variations), justify the initial core stored energy, energy transferred to the reactor coolant, and the decay heat during the transient is bounded by the same in the current licensing basis analysis.*

   For this purpose, provide a comparison of all parameters used in the analysis with qualitative reasons justifying that the value of each parameter in the current analysis leads to a transient that will bound the same transient in the analysis for the proposed fuel.

AREVA Response

Option B will be used to respond. The following table compares the results for the MNGP short term containment analysis to the design limits. This analysis was performed by GE for MNGP based on a core of GE14 fuel and these results are reported in Reference 5 (Section 3.3.1).

Table 4 Short Term Containment Results

Parameter*	Unit	GE14 EPU Value	GE14 M+ Value	Design Limit
Drywell Peak Pressure	psig	**[ ]**	**[ ]**	56
Drywell Peak Temperature	°F	**[ ]**	**[ ]**	340**
DW-WW Peak Differential Pressure	psid	**[ ]**	**[ ]**	N/A

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10 CFR 50 Appendix K Section I.A describes the sources of heat during the LOCA. **[**

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Decay heat is principally a function of the reactor power level, the irradiation time and the time after shutdown. [

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SCVB RAI-4

Section 4.4.7 of AREVA document ANP-3376P Revision 0, "Supplement to Xcel Energy License Amendment Request for AREVA Extended Flow Window" (ADAMS accession number ML15022A162), states:

"Since the methodology for MNGP containment analyses is not being changed by the EFW LAR, the only way the change from GE14 to ATRIUM 10XM fuel could potentially impact the containment dynamic loads would be due to differences in sensible heat (short-term) and decay heat (long term)."

The staff agrees, however as stated in RAIs 3 and 7, there are differences in the short term energy release and the long term decay heat. Considering the differences, provide an evaluation of the impact on the containment dynamic loads including subcompartment pressurization loads, LOCA loads, and SRV loads and justify that the current loads bound the same in the EFW operating domain.

AREVA Response

The licensing basis for MNGP containment dynamic loads including subcompartment pressurization loads, LOCA loads, and SRV loads at MELLLA+ conditions is summarized in Sections 4.1.3 and 4.1.4 of Reference 11, which was transmitted to the NRC as Attachment 3 of Reference 12. Additional information about these MNGP containment analyses are summarized in Reference 5.

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] The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2, and RAI-3.

SCVB RAI-5

The current (EPU in MELLLA operating domain) long term analysis was performed using Super HEX (SHEX) code in which the M&E release included the stored energy in the fuel, energy transfer from the fuel to reactor coolant, and decay heat besides the sensible heat in reactor materials. Therefore, differences between these parameters for the proposed and the current fuel should be considered for the following analyses:

a. *Suppression pool temperature response*
b. *Drywell gas temperature response*
c. *Net positive suction head (NPSH) analysis*

The NRC staff proposes the following options for responding to this RAI:

Option A

a. *Revise the above (a), (b), and (c) licensing basis analyses using the currently used SHEX code for the proposed fuel change and provide key inputs, assumption, description of analysis, and results (peak values and graphs).*
b. *Provide justification if conservatism in any of the inputs and assumptions is reduced.*

Option B

a. *Considering the differences in the fuel, justify the above (a), (b), and (c) current licensing basis analyses are bounding.*
b. *For this purpose, provide a comparison of all parameters used in the analysis with qualitative reasons justifying that the value of each parameter in the current analysis leads to a transient that will bound the same transient in the analysis for the proposed fuel.*

AREVA Response

Option B will be used to respond this RAI. The licensing basis for MNGP containment system performance at MELLLA+ conditions is summarized in Section 4.1 of Reference 11. The licensing basis for MNGP containment system performance at EPU/MELLLA conditions is summarized in Section 2.6 of Reference 13, which was transmitted to the NRC as Enclosure 5 of Reference 14. Additional information about the MNGP containment analyses are summarized in Reference 15 for EPU/MELLLA and in Reference 5 for MELLLA+.

- **Suppression pool temperature response.** The long-term suppression pool temperature response for MNGP at MELLLA+ conditions is summarized in Section 4.1.2 of Reference 11. **[**

  ] The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2 and RAI-3.

- **Drywell gas temperature response**. The drywell gas temperature response for MNGP at MELLLA+ conditions is summarized in Section 4.1.1 of Reference 11. **[**

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[**]** The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2, and RAI-3.

- **NPSH analyses**. NPSH analyses for MNGP at MELLLA+ conditions are summarized in Section 3.6.2 (recirculation pumps and jet pumps), Section 3.9.3 (RCIC) and 4.2.1 (HPCI) of Reference 11. **[**

  ] The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2, and RAI-3.

SCVB RAI-6

Justify the statement that no further analysis is required for the Standby Gas Treatment System for EFW, because EFW has the same operating domain as MELLLA+. Explain all applicable assumptions.

AREVA Response

The licensing basis for MNGP MELLLA+ is summarized in Section 4.5 of Reference 11. Additional information about the MNGP analyses is summarized in Reference 16. The Standby Gas Treatment System (SGTS) is designed to maintain secondary containment at a negative pressure and to filter the exhaust air for removal of fission products potentially present during abnormal conditions. The impact of changing from GE14 fuel to ATRIUM 10XM fuel is evaluated as follows.

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Therefore; under the postulated accident conditions,

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SCVB RAI-7

Provide an evaluation of the impact on containment isolation function based on the changes in the short term pressure and temperature response due to differences in short term energy release and decay heat between the GE14 and the ATRIUM 10XM as stated in RAI-3.

AREVA Response

The licensing basis for MNGP containment isolation at MELLLA+ conditions is summarized in Section 4.1.5 of Reference 11. The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2 and RAI-3. **[**

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SCVB RAI-8

Provide an evaluation of the impact on responses to NRC Generic Letters 89-10, 89-16, 95-07, and 96-06 based on the changes in the short term pressure and temperature response due to differences in the short term energy and decay heat between the GE14 and the ATRIUM 10XM as stated in RAI-3.

AREVA Response

In the response to RAI-3 above, the differences in short-term energy and decay heat were evaluated for the two fuel designs, **[**

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SCVB RAI-9

In Section 4.5.6 of your January 9, 2015, it states that various pressures and temperatures for MELLLA+ are bounded by MELLLA.

What is the impact on the peak drywell-to-wetwell differential pressure for the EFW operating domain?

AREVA Response

Section 4.5.6 in Reference 2 addresses GL 96-06. The licensing basis for equipment operability and containment integrity during design basis accidents initiated from the MELLLA+ domain is summarized in Section 4.1.9 of Reference 11 and is based on the evaluation provided in Section 4.1.1 of Reference 11 (short term pressure and temperature response). The impact of the MELLLA+ operating domain expansion on the peak drywell-to-wetwell differential pressure for GE14 fuel was summarized in response to RAI-3. **[**

] The impact of changing from GE14 fuel to ATRIUM 10XM fuel was evaluated in response to RAI-1, RAI-2, and RAI-3.

3.0 References

1. License Amendment Request for AREVA Extended Flow Window, October 3, 2014, MNGP L-MT-14-044, (ADAMS Accession No. ML 14283A119).

2. License Amendment Request for AREVA Extended Flow Window Supplement to Respond to NRC Staff Questions (TAC No. MF5002), January 9, 2015, MNGP L-MT-14-103, (ADAMS Accession No. ML 15022A165 and ML 15022A167).

3. Monticello Nuclear Generating Plant – Draft Requests for Additional Information (SCVB) re: AREVA Extended Flow Window License Amendment Request (TAC No. MF5002), email from Terry Beltz (NRC) to Glenn Adams (Xcel Energy), June 17, 2015.

4. GEH Task Report T0902 Revision 0, MNGP MELLLA+ Anticipated Transient Without Scram, June 2009.

5. GEH Task Report T0400 Revision 0, MNGP MELLLA+ Containment System Response, January 2009.

6. ANP-3092(P) Revision 0, Monticello Thermal-Hydraulic Design Report for ATRIUM™ 10XM Fuel Assemblies, AREVA NP, July 2012.

7. License Amendment Request for Transition to AREVA ATRIUM 10XM Fuel and AREVA Safety Analysis Methodology, July 15, 2013, MNGP L-MT-13-055, (ADAMS Accession No. ML 13200A187).

8. ANP-3211(P) Revision 1, Monticello EPU LOCA Break Spectrum Analysis for ATRIUM™ 10XM Fuel, AREVA NP, July 2013.

9. ANP-3295P Revision 2, Monticello Licensing Analysis For EFW (EPU/MELLLA+), AREVA Inc, September 2014.

10. GE Report GE-NE-0000-0060-9174-R1, Containment Analysis Input Parameters (Form OPL-4A), April 19, 2007.

11. GEH Report, “Safety Analysis Report for Monticello Regarding Maximum Extended Load Line Limit Analysis Plus”, NEDC-33435P Revision 1, December 2009.

12. Letter from Xcel Energy to NRC, “License Amendment Request: Maximum Extended Load Line Limit Analysis Plus”, MNGP L-MT-10-003, January 21, 2010 (ADAMS Accession No. ML 100280558).

13. GEH Report, “Safety Analysis Report for Monticello Constant Pressure Power Uprate”, NEDC-33322P Revision 3, October 2008.

14. Letter from Xcel Energy to NRC, “License Amendment Request: Extended Power Uprate (TAC MD9990), MNGP L-MT-08-052, November 5, 2008 (ADAMS Accession No. ML 083230111).

15. Task Report T0400 Revision 3, MNGP Extended Power Uprate: Containment System Response, February 2011.

16. Task Report T0409 Revision 0, MNGP Extended Power Uprate: Standby Gas Treatment System, January 2008.