ATTACHMENT (1)

SER RESTRICTIONS FOR CALVERT CLIFFS

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1.0 PURPOSE

Reference 1 submitted a license amendment request that would modify the licensing basis and the Technical Specifications to allow the use of AREVA Advanced CE-14 High Thermal Performance (HTP) fuel in the Calvert Cliffs reactors. The Nuclear Regulatory Commission (NRC) provided the preliminary results of their acceptance review and determined that the license amendment request needed to be supplemented in order for the staff to make an independent assessment regarding the acceptability of the proposed request. Specifically, the staff requested that a listing of the safety evaluation conditions, limitations and restrictions be provided, and document how compliance with each is attained and confirmed for each new methodology proposed for reference in the Core Operating Limits Report.

The following references were identified as requiring a documentation of their conditions, limitations, and restrictions:

1. ANF-88-133 (P)(A), "Qualification of Advanced Nuclear Fuels' PWR Design Methodology for Rod Burnups of 62 GWd/MTU"
2. BAW-10240(P)(A), "Incorporation of M5 Properties in Framatome ANP Approved Methods"
3. EMF-92-116(P)(A), "Generic Mechanical Design Criteria for PWR Fuel Designs"
4. EMF-92-153(P)(A), "HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel"
5. EMF-96-029(P)(A), "Reactor Analysis System for PWRs"
6. EMF-1961(P)(A), "Statistical Setpoint/Transient Methodology for Combustion Engineering Type Reactors"
7. EMF-2103(P)(A), "Realistic Large Break LOCA Methodology for Pressurized Water Reactors"
8. EMF-2310(P)(A), "SRP Chapter 15 Non-LOCA Methodology for Pressurized Water Reactors"
9. EMF-2328(P)(A), "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based"
10. XN-NF-75-32(P)(A), "Computational Procedure for Evaluating Fuel Rod Bowing"
11. XN-NF-78-44(NP)(A), "A Generic Analysis of the Control Rod Ejection Transient for Pressurized Water Reactors"
12. XN-NF-79-56(P)(A), "Gadolinia Fuel Properties for LWR Fuel Safety Evaluation"
13. XN-NF-82-06(P)(A), "Qualification of Exxon Nuclear Fuel for Extended Burnup"
14. XN-NF-82-21(P)(A), "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations"
15. XN-NF-85-92(P)(A), "Exxon Nuclear Uranium Dioxide/Gadolinia Irradiation Examination and Thermal Conductivity Results"

2.0 RESPONSES

Note that in the Safety Evaluation Report (SER) Restrictions, any references refer to those contained in the parent document. They are not repeated here. Also note that the company has had several name changes since these documents were originally issued, so that Exxon Nuclear Corporation (ENC), Siemens Power Corporation (SPC) and Framatome ANP (FANP) now refer to AREVA NP.

2.1 ANF-88-133 (P)(A) and Supplement 1, "Qualification of Advanced Nuclear Fuels' PWR Design Methodology for Rod Burnups of 62 GWd/MTU"

Purpose: Provide the design bases, analyses, and test results in support of the qualification of pressurized water reactor (PWR) fuel for extended burnups to 62 GWd/MTU rod average and submit the fuel performance code (RODEX2) for application to rod-average burnups of 62 GWd/MTU.

SER Restrictions:

1. "PNL also concludes that the application of ANF's cladding corrosion model should be limited to reactors within the coolant temperature and chemistry ranges of ANF's corrosion data."
2. "However, should ANF decide to go beyond the currently approved burnup in the future, additional data on cladding corrosion and axial growth will be required to confirm the validity of the models."

Implementation of SER Restrictions:

1. Corrosion data have been collected and verified against design predictions for each of the reactor types for which AREVA supplies fuel. Data have also been collected for a hot 16x16 Kraftwerk Union AG plant which bounds projections of corrosion for the other plant types. This information was submitted to the NRC and approved as a supplement to the PWR Generic Criteria, EMF-92-116(P)(A) [See SER Section 2.5]. These plants also cover a variety of coolant chemistry variations. A condition of the fuel contract is compliance with EPRI water chemistry guidelines.
2. The fuel currently remains with a burnup limit of 62 GWd/MTU, and this restriction is met.

2.2 BAW-10240(P)(A), Revision 0, "Incorporation of M5 Properties in Framatome ANP Approved Methods"

Purpose: To incorporate the approved M5™ cladding material properties into methodology previously reviewed and approved by the NRC for use with Zircaloy-4 cladding in support of licensing actions for Westinghouse and Combustion Engineering (CE) plants for fuel burnups to 62 GWd/MTU.

SER Restrictions:

1. "The corrosion limit, as predicted by the best estimate model, will remain below 100 microns for all locations of the fuel."
2. "All of the conditions listed in the SEs for all FANP methodologies used for M5 fuel analysis will continue to be met, except that the use of M5 cladding in addition to Zircaloy-4 cladding is now approved."
3. "All FANP methodologies will be used only within the range for which M5 data was acceptable and for which the verifications discussed in BAW-10240(P) or Reference 2 was performed."
4. "The burnup limit for this approval is 62 GWd/MTU."

Implementation of SER Restrictions:

1. The 100 microns corrosion limit is implemented into the fuel performance analysis post processing tools such that margin to 100 microns is automatically calculated. Margin to this limit is checked and reported on a cycle specific basis.
2. All modifications made to previously approved AREVA methodologies in order to analyze M5™ fuel are described within BAW-10240(P)(A). Therefore, there are no restrictions specific to CE-type M5™ fuel analysis outside of those imposed in BAW-10240(P)(A).

3. BAW-10240(P)(A) is approved for use only for M5™ properties within the range discussed and verified within BAW-10227(P)(A) [Reference 2]. Any differences are specifically discussed and approved in BAW-10240(P)(A). The approved properties, methodologies, and correlations have been incorporated into the fuel performance analysis codes and guidelines.
4. Burnup limits are included in engineering guidelines. Fuel rod performance results are automatically reported for burnups up to 62 GWd/MTU by the fuel performance code on a cycle specific basis.

2.3 EMF-92-116(P)(A), Revision 0, "Generic Mechanical Design Criteria for PWR Fuel Designs"

Purpose: Provide the generic mechanical design criteria applicable to PWR fuel.

SER Restrictions:

1. "The staff has reviewed SPC's PWR fuel mechanical design criteria described in EMF-92-116(P), and finds that the design criteria are acceptable for PWR licensing applications up to 62,000 MWd/MTU rod average burnup."
2. "For each application of the mechanical design criteria, SPC must document the design evaluation process demonstrating conformance to these criteria and submit a summary of the evaluation to the NRC staff for possible use in an audit to confirm that SPC is in compliance with these design criteria."

Implementation of SER Restrictions:

1. The design criteria are applied only up to 62 GWd/MTU. Burnup is checked and reported on a cycle specific basis to ensure that the limit is not exceeded.
2. The NRC letter from S. A. Richards to J. F. Mallay, "Siemens Power Corporation Re: Request for Concurrence on Safety Evaluation Report Clarifications (MA6160)," dated November 3, 2000, confirms that the requirement to submit a summary of the evaluation to the NRC applies only to new fuel designs. Therefore this restriction does not apply to the Calvert Cliffs fuel transition.

2.4 EMF-92-153(P)(A), Revision 1, "HTP: Departure from Nucleate Boiling Correlation for High Thermal Performance Fuel"

Purpose: The HTP departure from nucleate boiling (DNB) correlation is used in the departure from nucleate boiling ratio (DNBR) analyses of steady-state and transient events.

SER Restrictions:

1. "Based on the comparisons with the additional data, the quantitative statistical assurances continue to be met by the correlation in the regions of lower pressure, higher quality, and lower mass velocity. Therefore, the independent variables of the HTP-DNB correlation can be extended as depicted in Table 3. The HTP-DNB correlation safety limit will remain at 1.141 over these extended regions."

Table 3: Range of Independent Variables for the HTP-DNB Correlation with the Extension of the Upper Quality, Lower Mass Velocity, and Pressure Limits

Independent Variable	As Approved		Extended	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
System Pressure, psia	1775	2425	**1385**	2425
Mass Velocity, Mlb/hr-ft^2	0.936	3.573	**0.498**	3.573
Thermodynamic Quality	-0.125	0.358	-	**0.515**

2. "The necessary statistical assurances were not given for local coolant conditions where the pressure is greater than 2425 psia. Therefore, the HTP-DNB correlation's maximum pressure value must remain unchanged."
3. "Actions for analyzing the operating conditions outside of the approved ranges of the maximum pressure (2425 psia) but less than 2600 psia are stated below. Extrapolations below the minimum quality range using the process described in Reference 1 are permitted with no lower limit. Any other extrapolation requires a plant-specific review. When pressures greater than the upper pressure limit of 2425 psia but less than 2600 psia are encountered, all of the local coolant conditions are calculated at the upper pressure limit of 2425 psia using the NRC-approved thermal hydraulic code and then used in the calculation of the HTP CHF."

Implementation of SER Restrictions:

1. The operating parameters are checked on a case-by-case basis for each analysis to ensure they meet the Table 3 restrictions. These checks are documented using the standard reload process.
2. The maximum pressure value remains unchanged.
3. For operating pressures between 2425 psia and 2600 psia the XCOBRA-IIIC code automatically calculates the local conditions at 2425 psia for use in the HTP DNB calculations. These checks are performed each cycle and are documented using the standard reload process.

2.5 EMF-96-029(P)(A) Volumes 1 and 2, "Reactor Analysis System for PWRs"

Purpose: This report establishes the SAV95 code system as the current tool for performing physics calculations.

SER Restrictions:

1. "SAV95 application will be supported by additional code validation to ensure that the methodology and uncertainties are applicable:
   a. For designs differing from the Westinghouse reactors with 157 fuel assemblies with either 15x15 or 17x17 fuel rod arrays, and CE reactors with 217 fuel assemblies with 14x14 fuel rod arrays,
   b. When using incore monitoring systems differing from the INPAX-W and INPAX-2 systems contained in this safety evaluation when SPC provides input from SAV95."
2. "Modifications to the code and methodology will be validated using the criteria approved in EMF-96-029(P)."
3. "The validation will be maintained by SPC and be available for NRC audit."

Implementation of SER Restrictions:

1. The Calvert Cliffs units are CE reactors with 217 assemblies with 14x14 fuel rod arrays, utilizing INPAX-2; therefore, this requirement is directly met.
2. There are no code or methodology modifications expected for Calvert Cliffs.
3. Any future code or methodology modifications would be validated as required.

2.6 EMF-1961(P)(A) Revision 0, "Statistical Setpoint/Transient Methodology for Combustion Engineering Type Reactors"

Purpose: This topical report defines the setpoint methodology for CE designed reactors.

SER Restrictions:

1. "This methodology is approved only for CE type reactors which use protection systems as described in the topical report."
2. "The methodology includes a statistical treatment of specific variables in the analysis; therefore, if additional variables are treated statistically SPC should re-evaluate the methodology and document the changes in the treatment of the variables. The documentation will be maintained by SPC and will be available for NRC audit."

Implementation of SER Restrictions:

1. The Calvert Cliffs Units are CE-type reactors and have protection system functions identical to those discussed in the topical report (i.e., CE designed analog protection system).
2. There will be no changes to the statistical treatment of specific variables for the Calvert Cliffs setpoint analyses. Therefore, this restriction does not apply to the Calvert Cliffs fuel transition.

2.7 EMF-2103(P)(A), Revision 0, "Realistic Large Break LOCA Methodology for Pressurized Water Reactors"

Purpose: Provide an analysis of loss-of-coolant accident (LOCA) event using a realistic model for PWRs of the Westinghouse 3 and 4 loop and CE 2x4 designs. Describe the S-RELAP5 analysis code.

SER Restrictions:

1. "A CCFL violation warning will be added to alert the analyst to CCFL violation in the downcomer should such occur."
2. "Framatome ANP has agreed that it is not to use nodalization with hot leg to downcomer nozzle gaps."
3. "If Framatome ANP applies the RLBLOCA methodology to plants using a higher planar linear heat generation rate (PLHGR) than used in the current analysis, or if the methodology is to be applied to an end-of-life analysis for which the pin pressure is significantly higher, then the need for a blowdown clad rupture model will be reevaluated. The evaluation may be based on relevant engineering experience and should be documented in either the RLBLOCA guideline or plant specific calculation file."
4. "Slot breaks on the top of the pipe have not been evaluated. These breaks could cause the loop seals to refill during late reflood and the core to uncover again. These break locations are an oxidation concern as opposed to a PCT concern since the top of the core can remain uncovered for extended periods of time. Should an analysis be performed for a plant with loop seals with bottom elevations

that are below the top elevation of the core, Framatome ANP will evaluate the effect of the deep loop seal on the slot breaks. The evaluation may be based on relevant engineering experience and should be documented in either the RLBLOCA guideline or plant-specific calculation file."

5. "The model applies to 3 and 4 loop Westinghouse- and CE-designed nuclear steam systems."
6. "The model applies to bottom reflood plants only (cold side injection into the cold legs at the reactor coolant discharge piping)."
7. "The model is valid as long as blowdown quench does not occur. If blowdown quench occurs, additional justification for the blowdown heat transfer model and uncertainty are needed or the calculation is corrected. A blowdown quench is characterized by a temperature reduction of the peak cladding temperature (PCT) node to saturation temperature during the blowdown period."
8. "The reflood model applies to bottom-up quench behavior. If a top-down quench occurs, the model is to be justified or corrected to remove top quench. A top-down quench is characterized by the quench front moving from the top to the bottom of the hot assembly."
9. "The model does not determine whether Criterion 5 of 10 CFR 50.46, long term cooling, has been satisfied. This will be determined by each applicant or licensee as part of its application of this methodology."
10. "Specific guidelines must be used to develop the plant-specific nodalization. Deviations from the reference plant must be addressed."
11. "A table that contains the plant-specific parameters and the range of the values considered for the selected parameter during the topical report approval process must be provided. When plant-specific parameters are outside the range used in demonstrating acceptable code performance, the licensee or applicant will submit sensitivity studies to show the effects of that deviation."
12. "The licensee or applicant using the approved methodology must submit the results of the plant-specific analyses, including the calculated worst break size, PCT, and local and total oxidation."
13. "The licensee or applicant wishing to apply Framatome ANP realistic large break loss-of-coolant accident (RLBLOCA) methodology to M5 clad fuel must request an exemption for its use until the planned rulemaking to modify 10 CFR 50.46(a)(i) to include M5 cladding material has been completed."
14. "When a license amendment is necessary in order to use the S-RELAP5-based RLBLOCA methodology, the individual licensee or applicant must provide justification for the specific application of the code which is expected to include:

    - Nodalization: Specific guidelines used to develop the plant-specific nodalization. Deviations from the reference plant must be addressed.
    - Chosen Parameters and Conservative Nature of Input Parameters: A table that contains the plant-specific parameters and the plant-specific parameters and the range of the values considered for the selected parameters during the topical report approval process. When plant-specific parameters are outside the range used in demonstrating acceptable code performance, the licensee or applicant will submit sensitivity studies to show the effects of that deviation.
    - Calculated Results: The licensee or applicant using the approved methodology must submit the results of the plant-specific analyses, including the calculated worst break size, PCT, and local and total oxidation."

Implementation of SER Restrictions (Reference 1, Enclosure 1, Table 3-4):

1. There was no significant occurrence of CCFL violation in the downcomer for this analysis. Violations of CCFL were noted in a statistically insignificant number of time steps.
2. Hot leg nozzle gaps were not modeled.
3. The PLHGR for Calvert Cliffs is lower than that used in the development of EMF-2103(P)(A). An end-of-life calculation was not performed; thus, the need for a blowdown cladding rupture model was not re-evaluated.
4. For Calvert Cliffs, the elevation of the cross-over piping top (ID) relative to the cold leg center line is -55 inches, and the elevation of the top of the active core relative to the cold leg center line is -66.925 inches. Therefore, no evaluation is required
5. The plant is a CE-designed 2X4 loop plant.
6. The plant is a bottom reflood plant.
7. The limiting case did not show any evidence of a blowdown quench.
8. Core quench initiated at the bottom of the core and proceeded upward.
9. Long-term cooling is determined by the licensee as part of the application of this methodology.
10. The nodalization in the plant model is consistent with the CE-designed 2X4 loop model, which was included in the guideline that was submitted to the NRC for review with EMF-2103 (P) (A). See Reference 1, Enclosure 1 for the following: Figure 3-1 shows the loop noding used in this analysis. (Note only Loop 1 is shown in the figure; Loops 2, 3, and 4 are identical to loop 1, except that only Loop 1 contains the pressurizer and the break.) Figure 3-2 shows the steam generator model. Figures 3-3, 3-4, and 3-5 show the reactor vessel noding diagrams.
11. The correlations of interest are the set of heat transfer correlations as described in EMF-2103(P) (A). See Reference 1, Enclosure 1 for the following: Table 3-7 presents the summary of the full range of applicability for the important heat transfer correlations, as well as the ranges calculated in the limiting case of this analysis. Calculated values for other parameters of interest are also provided. It is confirmed that the plant-specific parameters fall within the methodology's range of applicability.
12. Analysis results are discussed in Reference 1, Enclosure 1, Section 3.5.
13. The realistic large break LOCA analysis was for M5™ clad fuel and the plant has requested an exemption for operation with M5™ clad fuel (Reference 1, Enclosure 3).
14. The required elements are contained in Reference 1, Enclosure 1.

2.8 EMF-2310(P)(A), Revision 1, "SRP Chapter 15 Non-LOCA Methodology for Pressurized Water Reactors"

Purpose: Provide a PWR non-LOCA transient analysis methodology based on the S-RELAP5 systems analysis code and the XCOBRA-IIIC thermal-hydraulics code for predicting the event-specific minimum DNBR that applies to Westinghouse and CE PWRs with AREVA NP fuel.

SER Restrictions:

1. "The staff also notes, however, that a generic topical report describing a code such as S-RELAP5 cannot provide full justification for each specific individual plant application. The individual applicant must still provide justification for the specific application of the code which is expected to

include as a minimum, the nodalization, defense of the chosen parameters, any needed sensitivity studies, justification for the conservative nature of the input parameters, and calculated results."

For the boron dilution event, " FANP review of the specific application of the EMF-2310(P) methodology must be performed to ensure the situation warrants use of the complete mixing assumption."

2. "The following values and assumptions, as delineated in SRP Section 15.4.6, are considered acceptable, and should be evaluated if appropriate:"

   a. "For analyses during power operation, the initial power level is rated output (licensed core thermal power) plus an allowance of 2 percent, or justified amount, to account for power-measurement uncertainty."

   b. "The boron dilution is assumed to occur at the maximum possible rate."

   c. "The core burnup and corresponding boron concentration are selected to yield the most limiting combination of moderator temperature coefficient, void coefficient, Doppler coefficient, axial power profile, and radial power distribution."

   d. "All fuel assemblies are installed in the core."

   e. "A conservatively low value is assumed for the reactor coolant volume."

   f. "For analyses during refueling, all control rods are withdrawn from the core."

   g. "For analyses during power operation, the minimum shutdown margin allowed by the technical specifications is assumed to exist prior to the initiation of boron dilution."

   h. "For each event analyzed, a conservatively high reactivity addition rate is assumed taking into account the effect of increasing boron worth with dilution."

   i. "Conservative scram characteristics are assumed, i.e., maximum delay time with the most reactive rod held out of the core."

Implementation of SER Restrictions: Each of these SER restrictions are addressed through the AREVA work flow process. Specifically, for each non-LOCA transient event analysis, the nodalization, chosen parameters, conservative input and sensitivity studies are reviewed for applicability to the fuel transition in compliance with the SER Restrictions 1 and 2 above.

1. The S-RELAP5 model nodalizes the primary and secondary sides into control volumes representing reasonable homogenous regions, interconnected by flow paths, or "junctions". The reactor vessel, Reactor Coolant System piping and steam generator nodalization diagrams are shown in the Calvert Cliffs sample application (Reference 1, Enclosure 1). The analyses are based on a Calvert Cliffs plant specific model.

   In general, the plant nodalization is defined to be consistent wherever possible for different plant types. Calvert Cliffs is a CE 2x4 plant. The S-RELAP5 model used for the Calvert Cliffs analysis is based on the sample problem in EMF-2310(P)(A), which is for a CE 2x4 plant, with some modifications to account for plant-specific geometry.

   The steam generator secondary and steam line models are nodalized slightly different between the current model for Calvert Cliffs and the EMF-2310(P)(A) sample problem model, namely, the steam generator downcomer and boiler regions in the current model each contain one fewer node. Although the number of nodes decreased by one in each of these regions, the characteristics of the steam generator, specifically the volume distribution in the downcomer and the heat transfer to the

boiler region, are more accurately captured. The overall effect of these changes on the analysis is negligible. Also, the main feedwater and auxiliary feedwater connections to the steam generator downcomer are one node lower than the sample problem, to match the Calvert Cliffs plant geometry.

Other plant-specific differences include the number and location of the main steam safety valves, the geometry of the pressurizer surge line, the pressurizer power-operator relief valve design and additional nodes for the steam generator tubes.

The parameters and equipment states are chosen to provide a conservative estimate of the calculated parameter that will be compared to the respective acceptance criteria. The biasing and assumptions for key input parameters are consistent with the approved EMF-2310(P)(A) methodology. These key inputs are event-specific. The process of defining the biasing and assumptions for key input parameters are consistent with the EMF-2310(P)(A) sample problem.

Each event is controlled primarily by key parameters. Those parameters are well understood and well behaved for the spectrum of analyses performed in S-RELAP5. The S-RELAP5 code assessments in EMF-2310(P)(A) validate the model relative to these controlling parameters. Thus, no additional model sensitivity studies are needed for this application.

The biasing of input parameters is chosen to produce a conservative estimate of the calculated parameter that will be compared to the respective acceptance criteria. Review of the input parameter biasing is performed to determine if input parameter sensitivity studies are needed on an event-specific basis.

2. The Boron Dilution event analysis is performed each reload through the AREVA work flow process with values and assumptions consistent with SER Restriction 2 listed above, and is available for NRC audit.

2.9 EMF-2328(P)(A), Revision 0, "PWR Small Break LOCA Evaluation Model, S-RELAP5 Based"

Purpose: Provide PWR small break LOCA evaluation methodology based on S-RELAP5 that applies to Westinghouse and CE PWRs with AREVA NP fuel.

SER Restrictions:

"That while it has been shown in Reference 53 that the thermal-hydraulic phenomena observed for breaks up to 10 percent of the cold leg flow area are the same, if the code is used for break sizes larger than 10 percent of the cold leg flow area additional assessments must be performed to ensure that the code is predicting the important phenomena which may occur."

Implementation of SER Restrictions:

Small break LOCA analyses performed with S-RELAP5 cover a break spectrum with an upper break size limited through the AREVA NP work flow process to no more that 10% of the cold leg flow area.

2.10 XN-NF-75-32(P)(A) Supplements 1, 2, 3, and 4, "Computational Procedure for Evaluating Fuel Rod Bowing"

Purpose: Provides an empirical method for determining fuel rod bow.

SER Restrictions:

1. "This acceptability is limited to the fuel designs, exposures and conditions stated in the licensing topical report supplements and supporting documentation. It is based, in part, on the Exxon gap closure representation and the specific assumptions made in formulating this methodology." … "The acceptance is not applicable to fuel designs which exhibit a greater propensity for bowing than that given in data from which the models reviewed were developed."
2. "Offsetting margins that are used must be documented in the bases to the technical specifications and any remanent penalties must be accommodated into the technical specifications."
3. "When the supplements are referenced, the reference must include both the proprietary and non-proprietary versions."

Implementation of SER Restrictions:

1. The application of the rod bow model to higher burnup and other fuel designs was approved in ANF-88-133(P)(A).
2. Generic and/or plant specific margins are not used to offset rod bow DNBR penalties. Rod bow DNBR penalties are evaluated on a cycle specific basis and applied in the DNB evaluation of limiting transient events and also in the cycle specific setpoint verification. These analyses are performed each cycle and are documented in the standard reload process.
3. The proprietary version of the supplements will be referenced in the plant Core Operating Limits Report as they contain all of the information necessary to perform a complete review.

2.11 XN-NF-78-44(NP)(A), Revision 0, "A Generic Analysis of the Control Rod Ejection Transient for Pressurized Water Reactors"

Purpose: This report establishes the method for analyzing deposited enthalpy in the fuel during the rod ejection event.

SER Restrictions:

"The methodology report does not discuss the calculation of DNB which is generally used to determine the number of fuel rods which experience clad failure. Therefore, the determination of clad failure should be performed on a case-by-case basis."

Implementation of SER Restrictions:

Departure from nucleate boiling analysis for the rod ejection event will be performed specifically for Calvert Cliffs, as noted in Reference 1, Attachment 4, Section 6.3.13.

2.12 XN-NF-79-56(P)(A), Revision 1 and Supplement 1, "Gadolinia Fuel Properties for LWR Fuel Safety Evaluation"

Purpose: To justify Gadolinia fuel properties for up to 5 wt% Gadolinia loading in uranium dioxide fuel.

SER Restrictions:

"Nonetheless, to the extent that the gadolinia-bearing fuel pins do not appear to be limiting factors in accident and related safety analyses, the database is adequate to permit the insertion of up to 5 wt% Gd_2O_3 in ENC fuel with the proviso that further examinations, includes destructive PIE, will be performed to augment the database."

Implementation of SER Restrictions:

The 5 wt% restriction no longer applicable. The limit was raised to 8 wt% in XN-NF-85-92(P)(A). Additional data was gathered on Gadolinia rods from Prairie Island, Tihange, and other reactors and provided to the NRC in a letter from R. A. Copeland (Siemens Nuclear Power) to R. C. Jones (NRC), "Gadolinia Bearing Fuel Rod Design Methodology," dated May 13, 1992.

2.13 XN-NF-82-06(P)(A) Revision 1 and Supplements 2, 4 and 5, "Qualification of Exxon Nuclear Fuel for Extended Burnup"

Purpose: Provide the design bases, analyses, and test results in support of the qualification of PWR fuel for extended burnups.

SER Restriction:

"If a plant depressurization accident were to occur involving ENC fuel at extended burnup levels, the licensee must address the extent of possible hydride reorientation in their fuel cladding before further irradiation of this fuel is allowed, see Section 2.0(h). This requirement is only in effect following a plant depressurization accident."

Implementation of SER Restriction:

The customer would notify AREVA in the event of an accident. Evaluation requirements would be determined on a case by case basis. They may include a review of stresses and temperatures during the accident with reference to internal pressure above system pressure criteria as discussed in Section 2.0(h) of XN-NF-82-06 (P)(A).

2.14 XN-NF-82-21(P)(A), Revision 1, "Application of Exxon Nuclear Company PWR Thermal Margin Methodology to Mixed Core Configurations"

Purpose: This topical report defines the mixed-core methodology for DNB analyses.

SER Restrictions:

1. "The staff has concluded that the thermal-hydraulic design methodology presented in XN-NF-82-21(P), Revision 1 is acceptable for performing steady-state core thermal-hydraulic calculations when the proper method of storing crossflow boundary conditions is used."
2. "In addition, an adjustment of 2% on the minimum DNBR must be included for mixed cores containing hydraulically different fuel assemblies."

Implementation of SER Restrictions:

1. Boundary conditions are properly stored between the 1st and 2nd pass of the XCOBRA-IIIC model as approved in XN-NF-75-21 (P)(A), Revision 2.
2. The 2% adjustment is applied to mixed cores containing hydraulically different fuel assemblies at Calvert Cliffs. Application of the 2% mixed core adjustment is governed by analysis guidelines and is discussed in Reference 1, Section 4.2.

2.15 XN-NF-85-92(P)(A), Revision 0, "Exxon Nuclear Uranium Dioxide/Gadolinia Irradiation Examination and Thermal Conductivity Results"

Purpose: To justify Gadolinia fuel properties for up to 8 wt% Gadolinia loading in uranium dioxide fuel.

SER Restrictions:

1. "Because of different data acquired at different gadolinia concentrations, e.g., thermal conductivity acquired at 12 w/o, fissions gas release at 8 w/o, we limit the approval of XN-NF-85-92 to the lower concentration of 8 w/o gadolinia."
2. "Based on ENC test results and the commitment to an in-reactor irradiation program to confirm that UO2 fission gas release model is adequate for gadolinia/UO2 fuel, we conclude that the gadolinia fuel properties are acceptable for licensing applications up to 8 w/o gadolinia concentration."

Implementation of SER Restrictions:

1. The restriction on 8 wt% Gadolinia is implemented in engineering guidelines.
2. In-reactor fission gas release test results were provided to the NRC in a letter from R. A. Copeland (Siemens Nuclear Power) to R. C. Jones (NRC), "Gadolinia Bearing Fuel Rod Design Methodology," dated May 13, 1992.

3.0 REFERENCES

1. Letter from T. E. Trepanier (CCNPP) to Document Control Desk (NRC), dated November 23, 2009, License Amendment Request – Transition from Westinghouse Nuclear Fuel to AREVA Nuclear Fuel