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2CAN100402

October 14, 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Supplement to Amendment Request
For License Amendment in Support of Cycle 18 Core Reload
Arkansas Nuclear One, Unit 2
Docket No. 50-368
License No. NPF-6

REFERENCES: 1. Entergy letter to the NRC dated July 8, 2004, "Supplemental Letter to License Amendment Request to Support Cycle 18 Core Reload" (2CAN070402)

Dear Sir or Madam:

By letter (Reference 1), Entergy Operations, Inc. (Entergy) proposed a change to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TSs) to support the cycle 18 core reload.

On August 23, 2004, Entergy received four questions which were determined to need formal response. Entergy's response is contained in Attachment 1.

There are no technical changes proposed. The original no significant hazards consideration included in Reference 1 is not affected by any information contained in the supplemental letter. There are new and revised commitments contained in this letter.

If you have any questions or require additional information, please contact Dana Millar at 601-368-5445.

I declare under penalty of perjury that the foregoing is true and correct. Executed on October 14, 2004.

Sincerely,

JSF/DM

Attachments:
1. Response to Request for Additional Information
2. Revised Markup of Technical Specification Pages
3. List of Regulatory Commitments

A001

cc: Dr. Bruce S. Mallett
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U. S. Nuclear Regulatory Commission
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Attachment 1

To

2CAN100402

Response to Request for Additional Information

Response to Request for Additional Information Related to License Amendment in Support of Cycle 18 Core Reload

Question 1:

Enclosure 1 to 2CAN070402 provided supplemental information to demonstrate the applicability of the Westinghouse nuclear physics code package to ANO-2. Figures 2.3-9 through 2.3-20 provide comparisons between plant measurements and the ANC code predictions of ANO-2 [Arkansas Nuclear One, Unit 2] Cycles 15 and 16 radial assembly average power and radial peaking factor (Fr) distributions. These comparisons, however, show large differences between the measured and predicted values for some assemblies. For example, in Figure 2.3-12, assembly R-10 for cycle 16 has a difference of 8.3 % in the measured and predicted radial assembly average power; and Figure 2.3-18, the difference in the Fr for assembly L-14 is 8.7%. Also, the comparison of the Cycle 15 and 16 boron letdown measurements and predictions (in Table 2.3-1) demonstrate large differences on a percentage basis in critical boron concentration at the end of cycle although the mean difference between the measured and predicted boron concentration for both cycles is only 21 ppm with a standard deviation of 6 ppm.

Provide justification for concluding the applicability the Westinghouse nuclear physics package to ANO-2 in light of these large differences between the measured and the predicted values.

Response 1:

The specific assembly locations cited in the question are core periphery locations whose assembly powers are significantly below core average power. In these instances, small absolute differences in power can become large percent differences. The basis of Westinghouse's neutronic code topical reports has been based on absolute difference (calculated to measured) not percent difference. The assembly absolute power differences and radial power distribution standard deviations as calculated by ANC are within Westinghouse's experience base as documented in previous topical reports, e.g. the INCA/CECOR topical report (CENPD-153-P Revision 1-P-A).

In Figure 2.3-18, for example, the maximum error for potential limiting assemblies (i.e. those having an assembly power within 10% of the peak assembly power) is 2.3%, which is well within the uncertainty allowance on assembly power of 4.24% used in the safety analysis. When expressed on an absolute normalized power unit basis the maximum error in Figure 2.3-18 is 0.07 power units, which represents 5% of the peak assembly power in the core.

In the current style of low leakage core designs employed at ANO-2, the peripheral assemblies are not limiting. With respect to the radial peaking factor (Fr) distributions, the value of importance to the safety analyses is the core maximum value.

With regard to the critical boron concentration differences, it should be noted that percentage difference is not always a suitable indicator of the predictive capability of a code. The relevant units for characterizing the predicted error in critical boron are expressed in terms of absolute ppm since this is proportional to the reactivity difference between the calculated and measured core state points. The maximum difference in critical boron shown on Table 2.3-1 is 32 ppm, which translates into a maximum reactivity difference for these cycles of 0.30% dk. The mean difference in ppm for all data points in Table 2.3-1 is 21 ppm, which translates to a mean reactivity difference of 0.19% dk. Both of these differences are well within the uncertainty allowance of 0.35% dk used in the safety analysis. Appropriate biases and uncertainties are applied when using ANC to account for the observed (measured to predicted) differences in reactivity (critical boron concentration).

Question 2:

The staff included several conditions in its acceptance of CENPD-404-P-A for licensing application. Condition 4 stated that until data are available demonstrating the performance of ZIRLO cladding in CENP designed plants, the fuel duty will be limited for each CENP designed plant with some provision for adequate margin to account for variations in core design (e.g., cycle length, plant operating conditions, etc.). The licensee's response to Condition 4 (on page 8 of Attachment 1 to 2CAN070402) indicated that the maximum modified fuel duty index (mFDI) calculated based on actual 16x16 CE-designed fuel is approximately 590; and the mFDI values of 652 and 712, which are 110% (for the majority of ZIRLO clad fuel pins) and 120% (for a fraction of ZIRLO clad fuel pins in a limited number of assemblies) of 590, respectively, will be used as upper design limits for the ANO-2 fuel to provide margin to account for core design variations. The response (and repeated in Entergy's Regulatory Commitments provided in Attachment 3 to 2CAN070402) further states that if the mFDI and measured oxide thickness correlate as expected or is conservative relative to predictions, ANO-2 will no longer restrict the mFDI except as required to meet the 100 micron oxide limit.

(A) *Explain how the maximum mFDI value of 590 is calculated and why this is the adequate nominal fuel duty limit. The response should include: (1) the values and the source of data regarding the time averaged oxide layer surface temperature (T_{avg}), total irradiation time (Hrs), and total mass evaporation (Mt) used to calculate the maximum mFDI value (see the mFDI formula described in Equation 3-2 of CENPD-404) of 590; and (2) ZIRLO oxide measurements as a function of mFDI from CE fuel designs (e.g., lead test assemblies, fuel batches, etc.) to demonstrate the relative corrosion rate of ZIRLO in a CE fuel design and adequacy of the mFDI limit of 590.*

(B) *Explain how the 110% and 120% mFDI multipliers are obtained to provide adequate margin for variations in core design, and how they will be applied to the ANO-2 fuel, i.e., which fuel pins are subject to which mFDI limit values.*

(C) *The margin provision stated in Condition 4 is intended to account for core design variations to further restrict the fuel duty limit until data are available demonstrating the performance of ZIRLO cladding. Explain why increasing, rather than reducing, the fuel duty limit with the 110% and 120% multipliers, respectively, is not contrary to the intent of Condition 4.*

(D) *Explain what is meant by the "as expected" correlation between mFDI and measured oxide thickness. Provide the correlation, with basis, used to judge if the measured oxide thickness is as expected or conservative.*

(E) *The licensee indicated that if the mFDI and measured oxide thickness correlate as expected, then ANO-2 will no longer restrict the mFDI except as required to meet the 100 oxide limit. Please clarify whether the licensee intends to lift the restriction on fuel duty without the NRC's evaluation of the licensee submittal of the appropriate ZIRLO corrosion data from CE fuel design.*

Response 2(A):

During NRC review of the ZIRLO™ topical report, the NRC stated that until data are available demonstrating the performance of ZIRLO™ cladding in Combustion Engineering (CE) designed plants, the fuel duty will be limited for each CE designed plant with some provision for adequate margin to account for variations in core design (e.g., cycle length, plant operating conditions, etc.). At the NRC's request the maximum fuel duty was estimated based on past operating experience for CE 16x16 plants using the methodology described in Section 3 of CENPD-404-P-A. This maximum mFDI was estimated to be about 590. To account for variations in core design the NRC and Westinghouse reached an agreement that the mFDI could deviate up to 110% of the maximum mFDI based on past operating experience for a majority of ZIRLO™ clad fuel pins and 120% of the maximum for a fraction of core pins. These temporary restrictions are clearly below the ZIRLO™ database maximum mFDI (~900) for Westinghouse plants as shown in Figure 3.4-2 in CENPD-404-P-A. After it is confirmed that the corrosion data for ZIRLO™ cladding in CE plants demonstrates a similar behavior to corrosion data in the Westinghouse ZIRLO™ database the fuel duty restriction will be lifted and the only limit will be the best estimate maximum oxide thickness of 100 microns.

The lead 16x16 CE fuel design plants for ZIRLO™ implementation are Arizona Public Services (APS) Palo Verde Nuclear Generating Station Units 1, 2 and 3 (PVNGS). An mFDI of about 600 was determined to be applicable for the 16x16 CE fuel design and has been approved by the NRC for the PVNGS units[1]. APS committed to restrict the mFDI of each ZIRLO™ clad fuel pin to 110 percent of the maximum fuel pin value previously experienced and up to 120 percent of the maximum fuel pin value previously experienced for fuel pins in a limited number of assemblies (4-8). APS further committed to ensure that the baseline mFDI would remain unchanged during the process of collecting additional data to support increasing the mFDI and that this restriction would be lifted only after consultation with the NRC and the data will be shared with the NRC. The results of the measurements used to demonstrate that the oxide thicknesses are in good agreement with the predicted are expected to be available in the Summer of 2005.

Response 2(B):

The 110% and 120% multipliers were determined based on expected deviations in core design which may occur in the future as part of the fuel management process for CE plants. These values were agreed upon with the NRC during the review of the APS ZIRLO™ implementation amendment. Until ZIRLO™ corrosion data is obtained for CE plants, Westinghouse or the licensee will demonstrate by analysis that the mFDI will be less than the 110% and 120% restrictions.

All ZIRLO™-clad fuel pins are subject to the 110% mFDI multipliers, but a fraction of these pins, in a limited number of assemblies, are permitted to have values up to the 120% multiplier. Since these target values are defined by operations constrained by experience, rather than physical or regulatory limits, there is no exact number associated with the number of rods above the 110% threshold. Judgment will be applied to the design evaluation to ensure that the intent of the SER condition is not being challenged.

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[1] Letter, J. Donohew (NRC) to G. R. Overbeck (APS), "Subject: Palo Verde Nuclear Generating Station, Units 1, 2, and 3 - Issuance of Amendments Re: Technical Specification 5.6.5b, Core Operating Limits Report (COLR) and Use of ZIRLO™ Cladding Material (TAC Nos. MB3373, MB3374, And MB3375)", March 12, 2002

Response 2(C):

It is recognized that the maximum mFDI for CE plants is near 600 and for Westinghouse plants about 900. To account for expected changes in cycle length, uprated cores, batch size, etc., the fuel duty could increase slightly. The NRC allowed Westinghouse/licensees to have some flexibility in core design so these multipliers were greater than 100% however the allowable mFDI is still well below the 900 value from Westinghouse ZIRLO™ database and the predicted best estimate maximum oxide thickness shall always be less than 100 microns.

Response 2(D):

The response to Condition 4 actually says "If the mFDI and measured oxide thickness correlate as expected." This means the corrosion data for ZIRLO™ cladding in CE plants will be compared to the Westinghouse ZIRLO™ corrosion database to determine if a similar behavior exists. The statement simply reflects the degree of confidence that Westinghouse has in obtaining consistent results for CE fuel designs. That is, it is expected that the corrosion behavior of ZIRLO™ in CE plants will be similar to that observed in Westinghouse plants. Once ZIRLO™ corrosion data is available for CE plants then this data will be compared to the Westinghouse ZIRLO™ database.

Response 2(E):

ANO-2 will lift the restriction on fuel duty if the ZIRLO™ corrosion behavior in CE plants is similar to or conservative relative to the Westinghouse ZIRLO™ corrosion data. Entergy intends to lift this restriction, without an NRC evaluation, for the ANO-2 plant based on the NRC's actions relative to lifting the restriction for the lead 16x16 plant (PVNGS) for ZIRLO™ implementation. Entergy will document its action via 10 CFR 50.59.

Question 3:

In the list of the analytical methods specified in TS 6.9.5.1, Item 10 is listed as "Implementation of Zirconium Diboride Burnable Absorber Coating in CE Nuclear Power Fuel Assembly Design," WCAP-16045-P-A.

Is the topical report number WCAP-16045 a typographic error with the correct number being WCAP-16072?

Response 3:

Item 10 should reference WCAP-16072. Attachment 2 includes a new markup of the affected Technical Specification (TS) page.

Question 4:

Attachment 3 to 2CAN070402 provides a list of regulatory commitments by Entergy.

(A) The fourth commitment item states that hot full power (HFP) MTC test within seven days of reaching the highest RCS soluble boron concentration conditions predicted during full power operation will be performed.

This commitment appears to be incomplete without stating the objective of the test. Should the commitment be augmented to include "... be performed to confirm that the peak positive HFP MTC is within the TS limits at the peak boron concentration"?

(B) Commitment Item 5 states that Entergy will "provide the necessary information from the HFP test at peak boron concentration conditions to Westinghouse."

Should the commitment be augmented to include "... to Westinghouse for its submittal to NRC"?

(C) Item 7 states that "in the event of a Condition III or IV event at ANO-2, an evaluation of fuel structural integrity with respect to radial hydriding will be performed prior to power ascension."

Should the commitment be augmented to include "... to ensure that hydrides have not precipitated in the radial direction"?

Response 4(A):

No. The test will be performed at the peak boron concentration and will not be performed to satisfy a TS surveillance requirement. The possibility of peak soluble boron concentration occurring after beginning of cycle (BOC) due to rapid depletion of zirconium diboride (ZrB_2) (boron run-up) was the subject of extensive discussion during the review of WCAP-16072, as indicated below:

- Item 11 in Appendix A and Appendix B,
- Item 3 in Appendix E and Appendix F,
- SER Section 3.3 under Core Physics,
- SER Section 4.0 Conditions and Limitations, Item 3,
- SER Resolution of Comments on Draft Safety Evaluation for Topical Report WCAP-16072-P, Revision 00, "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs", Item 10, and
- SER Resolution of Comments on Draft Safety Evaluation for Topical Report WCAP-16072-P, Revision 00, "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs", Item 13.

In the response to one NRC request for additional information (RAI) on this topic (Item 3 in Appendix F), Westinghouse identified a recommendation to allow an adjustment, based on predictions, to be applied to the BOC surveillance, consistent with past practices. In discussions with the NRC on April 21 and April 22, 2004 (as indicated in SER Resolution of Comments, Items 10 and 13), Westinghouse came to understand that the reviewer's underlying concern was related to the fact that the affected plants for the initial implementation (Calvert Cliffs Unit 2 and ANO-2) were simultaneously transitioning to the ZrB_2 burnable absorbers and to the ALPHA-PARAGON-ANC (APA) Physics code suite. The reviewer indicated some uncertainty in applying a method for TS compliance confirmation based on prediction without a base point for demonstrating the adequacy of the predictive tool (ANC) for this type of application. As a result, the following clarification was added to item 3 of SER Section 4.0 (contrast with the wording in SER Section 3.3):

> "This direct measurement is only required for the first application of ZrB_2 IFBA in a CE 14x14 or 16x16 fuel assembly design"

The first applications of ZrB_2 burnable absorbers and the APA Physics suite for CE plants is planned for Calvert Cliffs Unit 2 Cycle 16 and ANO-2 Cycle 18, whose start-up schedules are approximately the same in the Spring of 2005. In subsequent discussions with the affected utilities and the NRC, it was recommended that the one-time surveillance be performed for ANO-2, independent of exact timing to reach the peak soluble boron concentration. This recommendation was based on the preliminary design results for both plants which indicated little or no boron run-up for the Calvert Cliffs Unit 2 Cycle 16 implementation, significantly limiting the value of a test at that unit given the basis for the SER condition.

Response 4(B):

The commitment will be augmented to state that Westinghouse will submit the results to the NRC. Attachment 3 includes a revised list of commitments.

Response 4(C):

The commitment will not be augmented. This commitment refers only to an actual Condition III or Condition IV occurrence at the plant that could potentially result in fuel damage, and would not allow for an immediate plant restart. The evaluation would likely be similar to the information provided in RAI response in Items 6 of Appendix H of WCAP-16072-P-A, relying on the fact that the conditions necessary to allow radial hydriding would not have existed, and therefore the possibility of radial hydriding need not be considered further. Since this condition applies to an actual event and not to licensing calculations for this event, such evaluation would be based on best estimate assumptions and/or known plant conditions.

Attachment 2

To

2CAN100402

Revised Markup of Technical Specification Pages

~~10) "Calculative Methods for the CE Small Break LOCA Evaluation Model," CENPD-137, Supplement 2-P-A, dated April, 1998 (Methodology for Specification 3.1.1.4 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).~~

~~11~~6) "CESEC-Digital Simulation of a Combustion Engineering Nuclear Steam Supply System~~,~~" ~~December 1981~~ (Methodology for Specifications 3.1.1.1 and 3.1.1.2 for Shutdown Margin, 3.1.1.4 for MTC, 3.1.3.1 for CEA Position, 3.1.3.6 for Regulating CEA and Group P Insertion Limits, and 3.2.4.b for DNBR Margin).

~~12~~7) "Technical Manual for the CENTS Code," CENPD 282-P-A~~, February 1991~~ (Methodology for Specifications 3.1.1.1 and 3.1.1.2 for Shutdown Margin, 3.1.1.4 for MTC, 3.1.3.1 for CEA Position, 3.1.3.6 for Regulating and Group P Insertion Limits, and 3.2.4.b for DNBR Margin.

~~13) Letter: O.D. Parr (NRC) to F.M. Stern (CE), dated June 13, 1975 (NRC Staff Review of the Combustion Engineering ECCS Evaluation Model). NRC approval for 6.9.5.1.4, 6.9.5.1.5, and 6.9.5.1.8 methodologies.~~

~~14) Letter: O.D. Parr (NRC) to A.E. Scherer (CE), dated December 9, 1975 (NRC Staff Review of the Proposed Combustion Engineering ECCS Evaluation Model changes). NRC approval for 6.9.5.1.6 methodology.~~

~~15) Letter: K. Kniel (NRC) to A.E. Scherer (CE), dated September 27, 1977 (Evaluation of Topical Reports CENPD-133, Supplement 3-P and CENPD-137, Supplement 1-P). NRC approval for 6.9.5.1.9 methodology.~~

~~16) Letter: 2CNA038403, dated March 20, 1984, J.R. Miller (NRC) to J.M. Griffin (AP&L), "CESEC Code Verification." NRC approval for 6.9.5.1.11 methodology.~~

~~17) "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model," CENPD-132-P, Supplement 4-P-A, Revision 1 (Methodology for Specification 3.1.1.4 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).~~

8) "Implementation of ZIRLO Material Cladding in CE Nuclear Power Fuel Assembly Designs," CENPD-404-P-A (modifies CENPD-132-P and CENPD-137-P as methodology for Specification 3.1.1.4 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).

9) "Qualification of the Two-Dimensional Transport Code PARAGON," WCAP-16045-P-A (may be used as a replacement for the PHOENIX-P lattice code as the methodology for Specifications 3.1.1.1 and 3.1.1.2 for Shutdown Margins, 3.1.1.4 for MTC, 3.1.3.6 for Regulating and Group P CEA Insertion Limits, and 3.2.4.b for DNBR Margin).

10) "Implementation of Zirconium Diboride Burnable Absorber Coatings in CE Nuclear Power Fuel Assembly Designs," WCAP-16072-P-A (Methodology for Specification 3.1.1.4 for MTC, 3.2.1 for Linear Heat Rate, 3.2.3 for Azimuthal Power Tilt, and 3.2.7 for ASI).

6.9.5.2 The core operating limits shall be determined so that all applicable limits (e.g. fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

6.9.5.3 The CORE OPERATING LIMITS REPORT, including any mid-cycle revisions or supplements thereto, shall be provided upon issuance to the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

Attachment 3

To

2CAN100402

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
The cycle specific COLR will contain the complete identification of each of the TS referenced topical reports used to prepare the COLR (i.e., report number, title, revision, date, and any supplements).		x	
The upper design limits for ANO-2 fuel will be limited to mFDI values of 652 for the majority of the fuel assemblies and 712 for a fraction of the fuel pins in a limited number of assemblies (no more than eight fuel assemblies). If the mFDI and measured oxide thickness correlate as expected or is conservative relative to predictions, mFDI will no longer be restricted except as required to meet the 100 micron oxide limit.		x	
Cycle specific evaluations will be used to verify that required power margins in the axial cutback regions are maintained within the safety analysis limitations.		x	
Hot full power (HFP) MTC test within seven days of reaching the highest RCS soluble boron concentration predicted during full power operation will be performed.	x		
Provide the necessary information from the HFP test at peak boron concentration conditions to Westinghouse for its submittal to NRC.	x		
Plant procedures will be modified as needed to reflect the calculated peak HFP MTC along with ZrB2 IFBAs distinctive trend in RCS critical boron concentration.		x	
In the event of a Condition III or IV event at ANO-2, an evaluation of fuel structural integrity with respect to radial hydriding will be performed prior to power ascension.		x	
Analyses, as part of the ANO-2 reload efforts, will be performed in support of the generic implementation of ZrB2 fuel to ensure that cladding bursts are precluded for Conditions I, II, III and IV events.		x	
Prior to the use of ZrB2 burnable absorber coatings, the fuel design will be analyzed with applicable NRC staff approved codes and methods.		x	
ANO-2 will lift the restriction on fuel duty if the ZIRLO™ corrosion behavior in CE plants is similar to or conservative relative to the Westinghouse ZIRLO™ corrosion data. Entergy will document its action via 10 CFR 50.59.	x		