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2CAN010206

January 31, 2002

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

SUBJECT: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Revision to Peak Linear Heat Rate Safety Limit;
Technical Specification 2.1.1.2.

REFERENCES:

1. Entergy letter dated December 19, 2000, Technical Specification Change Request, "Application for License Amendment to Increase Authorized Power Level (2CAN120001)
2. Issuance of Amendment No. 138 to Facility Operating License No. NPF-6 - Arkansas Nuclear One, Unit No. 2 (TAC No. M84098) dated July 22, 1992 (2CNA109205)

Dear Sir or Madam:

Pursuant to 10CFR50.90, Entergy Operations, Inc. (Entergy) hereby requests the following amendment for Arkansas Nuclear One, Unit 2 (ANO-2). This submittal requests a change to Technical Specification (TS) Safety Limit 2.1.1.2, "Peak Linear Heat Rate" (PLHR). This change will replace the PLHR Safety Limit with a Peak Fuel Centerline Temperature Safety Limit. The associated TS Bases changes are also being provided to appropriately reflect the proposed new Safety Limit.

It was recently determined that the current Safety Limit does not clearly conform to 10CFR50.36(c)(1)(ii)(A). The current PLHR Safety Limit of 21 kW/ft adequately addresses normal steady state operations but may be momentarily exceeded during two anticipated operational occurrences (AOOs). This is acceptable per NUREG-0800, "Standard Review Plan" and the current ANO-2 TS 2.1 Bases because the fuel centerline melting temperature limit is not exceeded. A change to the Safety Limit is needed to more clearly conform to 10CFR50.36. The proposed change will replace the current Peak Linear Heat Rate Safety Limit with a Peak Fuel Centerline Temperature. The proposed approach contained in Attachment 1 has been discussed with the NRC staff.

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This Operating License Amendment request is being submitted on an exigent basis. This application is considered exigent since the 10CFR50.36 interpretation to change the ANO-2 Safety Limit for conformance to 10CFR50.36 was only recently identified by the NRC. Entergy has worked expeditiously to submit the needed TS change. This change should be approved before the ANO-2 Power Uprate License Amendment Requests (Reference 1) which has been requested for the April 2002 refueling outage. Entergy requests approval of the proposed amendment prior to March 15, 2001. Once approved, the amendment shall be implemented within 30 days.

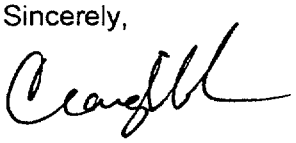
The proposed change has been evaluated in accordance with 10CFR50.91(a)(1) using criteria in 10CFR50.92(c) and it has been determined that this change involves no significant hazards considerations. The proposed change does not include any new commitments.

If you have any questions or require additional information, please contact Steve Bennett at 479-858-4626.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on January 31, 2002 .

Sincerely,



CGA/sab

Attachments:
1. Analysis of Proposed Technical Specification Change
2. Proposed Technical Specification Changes (mark-up)
3. Changes to TS Bases pages (mark-up)

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**Attachment 1**

**2CAN010206**

**Analysis of Proposed Technical Specification Change**

**Analysis of Proposed Technical Specification Change
Regarding Peak Fuel Centerline Temperature**

## 1.0 DESCRIPTION

This letter is a request to amend Operating License NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2). The proposed change will replace the Peak Linear Heat Rate (PLHR) Safety Limit with a Peak Fuel Centerline Temperature Safety Limit. This change is necessary to more clearly conform with 10CFR50.36(c)(1)(ii)(A), which requires that Limiting Safety System Settings prevent a Safety Limit from being exceeded during normal operations and Anticipated Operational Occurrences.

## 2.0 PROPOSED CHANGE

Replace Technical Specification (TS) Safety Limit 2.1.1.2, "Peak Linear Heat Rate" with a "Peak Fuel Centerline Temperature" Safety Limit. Attachment 2 contains the marked-up TS pages reflecting the proposed change.

The Bases for Technical Specification 2.1.1 and 2.2.1 are being revised accordingly to reflect the new Peak Fuel Centerline Temperature Safety Limit and provide a reference to the approved Topical Reports for determining the Peak Fuel Centerline Temperature Safety Limit. Attachment 3 contains the marked-up TS Bases pages.

This change deviates from NUREG-1432[1] in that it proposes to replace the PLHR Safety Limit with the Peak Fuel Centerline Temperature Safety Limit. This deviation from NUREG-1432 is necessary to adequately address Anticipated Operational Occurrences (AOOs). However, the change is consistent with the Westinghouse and B&W improved standard TSs as discussed in Section 6.0.

## 3.0 BACKGROUND

During the review of the Waterford 3 Appendix K Margin Recover Power Uprate request the NRC staff recognized that the Peak Linear Heat Rate Safety Limit of 21 kW/ft would be exceeded for an Anticipated Operational Occurrence (AOO). In-accordance-with 10CFR50.36(c)(1)(ii)(A), Limiting Safety System Settings must be chosen such that automatic action will prevent a SL from being exceeded. This is applicable during steady state operations and AOOs. Therefore, conformance with 10CFR50.36 is not clearly demonstrated. A similar condition exists with the ANO-2 TSs.

The current steady state limit of 21 kW/ft is momentarily exceeded during two AOOs, however; the peak fuel centerline temperature does not exceed the melting point. These AOOs are the control element assembly withdrawal events from subcritical and at hot zero power conditions. The analysis for the events resulting in the 21 kW/ft limit being exceeded, has been previously reviewed and found to be acceptable by the NRC staff (Reference 2). This approved change is discussed in the ANO-2 TS 2.1 Bases as part of Operating License Amendment 138.

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[1] NUREG-1432, "Standard Technical Specifications, Combustion Engineering Plants," Revision 2

## 4.0 TECHNICAL ANALYSIS

The intent of the PLHR SL is to prevent the fuel centerline temperature from reaching the melting point, which conservatively assures that there will be no breach in cladding integrity. The current 21 kW/ft limit was chosen because it is the highest steady state linear heat rate at which the fuel can operate without causing the centerline temperature to reach the melting point. This limit adequately addresses steady state operation except for the two subject AOOs. In these cases, the AOO analyses show that PLHR exceeds 21 kW/ft for a short duration, however, the peak fuel centerline temperature melting point is not approached or exceeded. A better way to represent the Safety Limit peak fuel centerline temperature.

In accordance with 10CFR50, Appendix A, "General Design Criteria" (GDC) 10, "Reactor Design" and 20, "Protection Systems Functions," the acceptance criteria for normal operation and AOOs is that the Specified Acceptable Fuel Design Limits (SAFDLs) not be exceeded. The SAFDL of interest, in this case, is the Peak Fuel Centerline Temperature limit. This SAFDL is discussed in detail in SRP Section 4.2[2], which states:

> *(II)(A)(2)(e) "Overheating of Fuel Pellets: It has also been traditional practice to assume that failure will occur if centerline melting takes place. ... For normal operation and anticipated operational occurrences, centerline melting is not permitted. ... The centerline melting criterion was established to assure that axial or radial relocation of molten fuel would neither allow molten fuel to come into contact with the cladding nor produce local hot spots. The assumption that centerline melting results in fuel failure is conservative."*

Additionally, ANO-2 Safety Analysis Report (SAR) Section 4.4.1.1.A, states:

> *"The peak temperature of the fuel shall be less than the melting point ... during steady-state operation and anticipated operation and anticipated operational occurrences."*

Therefore, a more representative Safety Limit would be one that is based upon the peak fuel centerline temperature. A peak fuel centerline temperature Safety Limit would address both normal operation and AOOs. A peak fuel centerline temperature Safety Limit would be consistent with 10CFR50 Appendix A, the SRP, the ANO-2 licensing basis, and 10CFR50.36.

The melting point of the fuel is dependent on fuel burnup and the amount and type of burnable poison used in the fuel. The design melting point of new fuel with no burnable poison is 5080°F. The melting point is adjusted downward from this temperature depending on the amount of burnup and amount and type of burnable poison in the fuel. The adjustment for burnup of 58°F per 10,000 MWD/MTU is consistent with standard TSs as discussed in Section 6.0 of this attachment. The 58°F per 10,000 MWD/MTU was accepted by the NRC in Topical Report CEN-386-P-A[3]. The burnable poison adjustments are determined in-accordance-with CENPD-275-P, Revision 1-P-A [4] for fuels containing gadolinium and CENPD-382-P-A[5] for fuels

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[2] NUREG-0800, Standard Review Plan, Section 4.2, Fuel System Design," Rev. 2, July 1981.
[3] CEN-386-P-A, "Verification of the Acceptability of a 1-Pin Burnup Limit of 60 MWD/kgU for Combustion Engineering 16x16 PWR Fuel," August 1992
[4] CENPD-275-1-P, Revision 1-P-A, CE Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers, May 1988

containing erbium absorbers. The current ANO-2 core contains fuel having only gadolinium, however, beginning in Cycle 16 (spring 2002) ANO-2 will begin using cores containing erbium. The specific formula for adjustment to these burnable poisons is considered to be proprietary information and therefore can not be included in the TS. The mode of applicability and actions required if the limit is exceeded would be the same as they are for the current PLHR Safety Limit. However, for completeness the references to CENPD-275-P and CENPD-382-P-A are being referenced in TS 2.1.

Therefore, a peak fuel centerline temperature SL of less than 5080°F (decreasing by 58°F per 10,000 MWD/MTU for burnup and adjusting for burnable poisons per CENPD-275-P, Revision 1-P-A and CENPD-382-P-A) is more appropriate than the current PLHR SL. The peak fuel centerline temperature SL will:

- address both normal operations and AOOs,
- be consistent with 10CFR50 Appendix A criteria,
- be consistent with SAFDLs,
- be consistent with SRP acceptance criteria,
- be consistent with the ANO-2 licensing basis,
- be determined using NRC approved methodologies, and
- clearly conform to 10CFR50.36(c)(1)(ii)(A).

## 5.0 REGULATORY ANALYSIS

### 5.1 Applicable Regulatory Requirements/Criteria

The proposed changes have been evaluated to determine whether applicable regulations and requirements continue to be met.

The proposed change is already consistent with the current ANO-2 TS Bases and the Safety Analysis Report. The SAR will only require a change to indicate that the Safety Limit for fuel temperature is fuel centerline melt and not linear heat rate.

Entergy has determined that the proposed changes do not require any exemptions or relief from regulatory requirements, other than the TS, and do not affect conformance with any GDC differently than described in the SAR. The approval of this change will clearly establish conformance with 10CFR50.36.

### 5.2 No Significant Hazards Consideration

The proposed change will revise the Arkansas Nuclear One, Unit (ANO-2) Operating License to replace the Peak Linear Heat Rate Safety Limit, Technical Specification 2.1.1.2, with a Peak Fuel Centerline Temperature Safety Limit of less than 5080°F (decreasing by 58°F per 10,000 MWD/MTU for burnup and adjusting for burnable poisons per CENPD-275-P, Revision 1-P-A and CENPD-382-P-A. This change is necessary to more clearly conform with 10CFR50.36(c)(1)(ii)(A), which requires that Limiting Safety System Settings prevent a Safety

[5] CENPD-382-P-A, Methodology for Core Designs Containing Erbium Burnable Absorbers, August 1993

Limit from being exceeded during normal operations and Anticipated Operational Occurrences (AOOs.)

Entergy Operations, Inc. has evaluated whether or not a significant hazards consideration is involved with the proposed amendment(s) by focusing on the three standards set forth in 10CFR50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The proposed change does not require any physical change to any plant systems, structures, or components nor does it require any change in systems or plant operations. The proposed change does not require any change in safety analysis methods or results. The change to establish the peak fuel centerline temperature as the Safety Limit is consistent with the licensing basis of ANO-2 for ensuring that the fuel design limits are met. Operations and analysis will continue to be in-accordance-with the ANO-2 licensing basis. The peak fuel centerline temperature is the basis for protecting the fuel and is consistent with safety analysis.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The accident analysis in Chapter 15 of the ANO-2 Safety Analysis Report (SAR) where the peak linear heat rate may exceed the limiting safety system setpoint of 21 kw/ft is the control element assembly withdrawal at subcritical conditions and at hot zero power. The analysis for these anticipated operational occurrences (AOOs) indicates that the peak fuel centerline temperature is not approached or exceeded. The existing safety analysis, which is unchanged, does not affect any accident initiators that would create a new accident.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No.

The proposed change does not require any change in safety analysis methods or results. Therefore, by changing the Safety Limit from peak linear heat rate to peak fuel centerline temperature the margin as established in the ANO-2 technical specifications and SAR are unchanged.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment(s) present no significant hazards consideration under the standards set forth in 10CFR50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

5.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10CFR51.22(c)(9). Therefore, pursuant to 10CFR51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

## 6.0 PRECEDENCE

The "Peak Fuel Centerline Temperature Safety Limit" proposed for ANO-2 is consistent with the "Peak Fuel Centerline Temperature" and "Maximum Local Fuel Pin Centerline Temperature" Safety Limits contained in the Standard Technical Specifications (STS) for Westinghouse[6] and Babcock & Wilcox[7] (B&W) plants, respectively. The STS for Westinghouse and B&W contain a formula for decreasing the melting point as a function of burnup. The proposed Safety Limit for ANO-2 does not contain a similar formula but instead states that the limit is "decreasing by 58°F per 10,000 MWD/MTU for burnup and adjusting for burnable poisons per CENPD-275-P, Revision 1-P-A and CENPD-382-P-A." This is acceptable because the portion of the adjustment formula accounting for burnable poison is proprietary and can not be placed in the TS. CENPD-275-P and CENPD-382-P-A are NRC approved methodologies.

[6] NUREG-1431, Standard Technical Specifications Westinghouse Plants, Revision 2
[7] NUREG-1430, Standard Technical Specifications Babcock and Wilcox Plants, Revision 2

**Attachment 2**

**2CAN010206**

**Proposed Technical Specification Changes (mark-up)**

## 2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

### 2.1 SAFETY LIMITS

### 2.1.1 REACTOR CORE

DNBR

2.1.1.1 The DNBR of the reactor core shall be maintained ≥ 1.25.

APPLICABILITY: MODES 1 and 2.

ACTION:

Whenever the DNBR of the reactor core has decreased to less than 1.25, be in HOT STANDBY within 1 hour.

~~PEAK LINEAR HEAT RATE~~

~~2.1.1.2 The peak linear heat rate (adjusted for fuel rod dynamics) of the fuel shall be maintained ≤ 21.0 kw/ft.~~

~~APPLICABILITY: MODES 1 and 2.~~

~~ACTION:~~

~~Whenever the peak linear heat rate (adjusted for fuel rod dynamics) of the fuel has exceeded 21.0 kw/ft, be in HOT STANDBY within 1 hour.~~

PEAK FUEL CENTERLINE TEMPERATURE

2.1.1.2 The peak fuel centerline temperature shall be maintained < 5080°F (decreasing by 58°F per 10,000 MWD/MTU for burnup and adjusting for burnable poisons per CENPD-275-P, Revision 1-P-A and CENPD-382-P-A).

APPLICABILITY: MODES 1 and 2.

ACTION:

Whenever the peak fuel centerline temperature has equaled or exceeded 5080°F (decreasing by 58°F per 10,000 MWD/MTU for burnup and adjusting for burnable poisons per CENPD-275-P, Revision 1-P-A and CENPD-382-P-A), be in HOT STANDBY within 1 hour.

**Attachment 3**

**2CAN010206**

**Changes to Technical Specification Bases Pages**

2.1.1 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

BASES

2.1.1 REACTOR CORE

The restrictions of these safety limits prevent overheating of the fuel cladding and possible cladding perforation which would result in the release of fission products to the reactor coolant. Overheating of the fuel cladding is prevented by (1) restricting fuel operation to within the nucleate boiling regime where the heat transfer coefficient is large and the cladding surface temperature is slightly above the coolant saturation temperature, and (2) maintaining the dynamically adjusted peak linear heat rate of the fuel at or less than 21 kw/ft which will not cause fuel centerline melting in any fuel rod.

First, by operating within the nucleate boiling regime of heat transfer, the heat transfer coefficient is large enough so that the maximum clad surface temperature is only slightly greater than the coolant saturation temperature. The upper boundary of the nucleate boiling regime is termed "departure from nucleate boiling" (DNB). At this point, there is a sharp reduction of the heat transfer coefficient, which would result in higher cladding temperatures and the possibility of cladding failure.

Correlations predict DNB and the location of DNB for axially uniform and non-uniform heat flux distributions. The local DNB ratio (DNBR), defined as the ratio of the predicted DNB heat flux at a particular core location to the actual heat flux at that location, is indicative of the margin to DNB. The minimum value of DNBR during normal operational occurrences is limited to 1.25 for the CE-1 correlation and is established as a Safety Limit.

Second, operation with a peak linear heat rate ~~below that which~~ ≤ 21 kw/ft setpoint will ~~would cause~~ ensure that the peak fuel centerline ~~melting~~ temperature safety limit ~~maintains~~ protects fuel rod and cladding integrity. Above this peak linear heat rate level (i.e., with some melting in the center), fuel rod integrity would be maintained only if the design and operating conditions are appropriate throughout the life of the fuel rods. Volume changes which accompany the solid to liquid phase change are significant and require accommodation. Another consideration involves the redistribution of the fuel which depends on the extent of the melting and the physical state of the fuel rod at the time of melting. Because of the above factors, the steady state value of the peak linear heat rate which would not cause fuel centerline melting is established as a Limiting Safety System Setting~~Limit~~. To account for fuel rod dynamics (lags), the directly indicated linear heat rate is dynamically adjusted.

TS 2.1.1.2 establishes a peak fuel centerline temperature of 5080° with adjustments for burnup and burnable poison. An adjustment for burnup of 58°F per 10,000 MWD/MTU has been established in NRC approved Topical Report CEN-386-P-A, "Verification of the Acceptability of a 1-Pin Burnup Limit of 60 MWD/kgU for Combustion Engineering 16x16 PWR Fuel," August 1992. Adjustments for burnable poisons are established based on NRC approved Topical Reports CENPD-275-P, "Revision 1-P-A, CE Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers", May 1988 and CENPD-382-P-A, "Methodology for Core Designs Containing Erbium Burnable Absorbers", August 1993.

A steady state peak linear heat rate of 21 kw/ft has been established as the Limiting Safety System Setting ~~Limit~~ to prevent fuel centerline melting during normal operation. Following design basis anticipated operational occurrences, the transient linear heat rate may exceed 21 kw/ft as long as the fuel centerline melt temperature is not exceeded.

SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

BASES

Steam Generator Level-Low

The Steam Generator Level-Low trip provides protection against a loss of feedwater flow incident and assures that the design pressure of the Reactor Coolant System will not be exceeded due to loss of the steam generator heat sink. This specified setpoint provides allowance that there will be sufficient water inventory in the steam generator at the time of the trip to provide sufficient margin before emergency feedwater is required.

Local Power Density-High

The Local Power Density-High trip is provided to prevent the linear heat rate (kw/ft) in the limiting fuel rod in the core from exceeding the fuel design limit in the event of any anticipated operational occurrence. The local power density is calculated in the reactor protective system utilizing the following information:

a. Nuclear flux power and axial power distribution from the excore flux monitoring system;

b. Radial peaking factors from the position measurement for the CEAs;

c. ΔT power from reactor coolant temperatures and coolant flow measurements.

The local power density (LPD), the trip variable, calculated by the CPC incorporates uncertainties and dynamic compensation routines. These uncertainties and dynamic compensation routines ensure that a reactor trip occurs when the actual core peak LPD is sufficiently less than the fuel design limit such that the increase in actual core peak LPD after the trip will not result in a violation of the ~~peak LPD~~ fuel centerline temperature Safety Limit. CPC uncertainties related to peak LPD are the same types used for DNBR
calculation. Dynamic compensation for peak LPD is provided for the effects of core fuel centerline temperature delays (relative to changes in power density), sensor time delays, and protection system equipment time delays.