Industry/TSTF Standard Technical Specification Change Traveler

Revision to Peak Linear Heat Rate Safety Limit

NUREGs Affected: ☐ 1430 ☐ 1431 ☑ 1432 ☐ 1433 ☐ 1434

Classification: 1) Technical Change Recommended for CLIIP?: Yes

Priority 2)Medium

Simple or Complex Change: Complex

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1.0 DESCRIPTION

This Traveler is a request to amend NUREG 1432, Revision 2, Revised Standard Technical Specifications for Combustion Engineering Plants. The proposed change will replace the Peak Linear Heat Rate (PLHR) Safety Limit (SL) with a Peak Fuel Centerline Temperature (PFCT) SL. This change is being undertaken to satisfy a Nuclear Regulatory Commission (NRC) request that the SL more clearly conform with 10 CFR 50.36(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

The proposed change replaces Technical Specification (TS) Safety Limit 2.1.1.2, "Peak Linear Heat Rate" with a "Peak Fuel Centerline Temperature" Safety Limit. This change is applicable to both analog and digital plants within the Combustion Engineering (CE) fleet. The Bases associated with this specification is also proposed for revision to reflect the new PFCT SL and provide a reference to the approved Topical Reports for determining the PFCT SL.

This change modifies NUREG-1432, Revision 2 in that it proposes to replace the PLHR SL with the PFCT SL. This change 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 review of the Waterford Steam Electric Station, Unit 3 10 CFR 50, Appendix K Margin Recovery Power Uprate request the NRC staff recognized that the PLHR SL of 21 kW/ft would be exceeded for an Anticipated Operational Occurrence (AOO). In accordance with 10 CFR 50.36(c)(1)(ii)(A), Limiting Safety System Settings must be chosen such that automatic action will prevent a SL from being exceeded. This assessment is applicable during steady state operations and AOOs. Therefore, conformance with 10 CFR 50.36 was not being clearly demonstrated. A similar condition exists for other plants within the CE fleet.

The current steady state limit of 21 kW/ft is exceeded during two AOOs. However; the corresponding PFCT does not exceed the melting point during these events. The affected AOOs are the Control Element Assembly Withdrawal Events from both Subcritical and at Low Power Startup conditions. The analysis for these events results in the 21 kW/ft limit being exceeded, although this had been previously reviewed and found to be acceptable by the NRC staff (Reference 1) for at least two plants.

4.0 TECHNICAL ANALYSIS

The intent of the PLHR SL is to prevent the Fuel Centerline Temperature (FTC) from exceeding the melting point, which conservatively assures that there will be no breach in cladding integrity. The current 21 KW/ft limit was historically chosen as a conservative limit at which the fuel can operate without causing the FTC to exceed the melting point and is a parameter that can be monitored directly by the operators in the Control Room.

For the two AOOs identified above, calculations have shown that fuel centerline temperature remains below the melt temperature at linear heat rates of 21 Kw/ft. While the AOO analyses show that the peak linear heat rate may exceed 21 Kw/ft, the fuel centerline temperature does not exceed the melt temperature, thereby fully satisfying the intent of the Safety Limit.

In accordance with 10 CFR 50, Appendix A, "General Design Criteria" (GDC) 10, "Reactor Design" and GDC 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 PFCT limit. This SAFDL is discussed in detail in SRP Section 4.2 (Reference 3), 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."*

Therefore, a more representative SL would be one that is based upon the Peak Fuel Centerline Temperature. A PFCT SL would address both normal operation and AOOs. A PFCT SL would also be consistent with 10 CFR 50 Appendix A, the SRP, and 10 CFR 50.36.
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 unirradiated fuel containing 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] (Reference 4). The burnable poison adjustments are determined in-accordance-with [CENPD-275-P, Revision 1-P-A] (Reference 5) for fuels containing gadolinium and [CENPD-382-P-A] (Reference 6) for fuels containing erbium absorbers. The specific formula for adjustment to these burnable poisons is considered to be proprietary information and therefore can not be included in this application. The mode of applicability and actions required if the limit is exceeded would be the same as they are for the current PLHR SL. References to [CENPD-275-P and CENPD-382-P-A] are proposed for inclusion in the TS 2.1.1 Bases.

Therefore, a PFCT SL of less than [5080°F decreasing by 58ºF 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, from a verbatim compliance perspective, than the current PLHR based SL. The PFCT SL will:

- address both normal operations and AOOs,
- be consistent with 10 CFR 50 Appendix A criteria,
- be consistent with SAFDLs,
- be consistent with SRP acceptance criteria,
- be consistent with current licensing basis for individual CE plants,
- be determined using NRC approved methodologies, and
- clearly conform to 10 CFR 50.36(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 changes do not require any exemptions or relief from regulatory requirements, other than the TS, and do not affect conformance with any GDC. The approval of this change will clearly establish conformance with 10 CFR 50.36.

5.2 No Significant Hazards Consideration

The proposed change will revise NUREG 1432, Revision 2, Revised Standard Technical Specifications for Combustion Engineering Plants, to replace the Peak Linear Heat Rate (PLHR) Safety Limit (SL), Technical Specification (TS) 2.1.1.2, with a Peak Fuel Centerline Temperature (PFCT) SL of [5080ºF] or less decreasing by [58ºF 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 10 CFR 50.36(c)(1)(ii)(A), which requires that Limiting Safety System Settings prevent a SL from being exceeded during normal operations and Anticipated Operational Occurrences (AOOs).

The proposed change has been evaluated as to whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, “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 PFCT as the SL is consistent with the Standard Review Plan (SRP) for ensuring that the fuel design limits are met. Operations and analysis will continue to be in compliance with NRC regulations. The PFCT is the basis for protecting the fuel and is consistent with the analogous TS wording for Westinghouse and Babcock & Wilcox (B&W) designed plants.

   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 analyses indicate that the peak linear heat rate may exceed the Limiting Safety System Setpoint of 21 kw/ft during Control Element Assembly Withdrawal Events at Subcritical and Hot Zero Power conditions. The analyses for these AOOs indicate that the PFCT is not approached or exceeded. The existing analyses remain unchanged and do 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 accident analysis methods or results. Therefore, by changing the SL from PLHR to Peak Fuel Centerline Temperature, the margin as established in the current license basis remains unchanged.

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

Based on the above, the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(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 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 PRECEDENCE

The proposed "PFCT SL" 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 (Reference 7) and B&W (Reference 8) plants, respectively. The STS for Westinghouse and B&W contain a formula for decreasing the melting point as a function of burnup. The proposed SL for CE plants 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, Rev. 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 NUREG. [CENPD-275-P and CENPD-382-P-A] are NRC approved methodologies.

7.0 REFERENCES

1. 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 and Waterford Steam Electric Station, Unit 3, Cycle 2 Safety Evaluation Report, Section 5.4, dated January 16, 1987

2. NUREG-0800, Standard Review Plan, Section 15.4.1, "Uncontrolled Control Rod Assembly Withdrawal From A Subcritical or Low Power Startup Condition," Rev. 2, July 1981

3. NUREG-0800, Standard Review Plan, Section 4.2, "Fuel System Design," Rev. 2, July 1981

4. [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]

5. [CENPD-275-1-P, Revision 1-P-A, "CE Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers," May 1988]

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

7. NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Revision 2

8. NUREG-1430, "Standard Technical Specifications Babcock and Wilcox Plants," Revision 2.

Revision History

OG Revision 0 **Revision Status: Active** **Next Action: NRC**

Revision Proposed by: ANO

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 17-Jun-02

Owners Group Comments
(No Comments)

Owners Group Resolution: Approved Date: 19-Jul-02

TSTF Review Information

TSTF Received Date: 19-Jul-02 Date Distributed for Review 19-Jul-02

OG Review Completed: ☐ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 30-Jul-02

NRC Review Information

NRC Received Date: 07-Aug-02

Affected Technical Specifications

SL 2.1	Safety Limits (analog)
SL 2.1	Safety Limits (digital)
SL 2.1 Bases	Safety Limits (analog)
SL 2.1 Bases	Safety Limits (digital)
Ref. 2.1 Bases	Safety Limits (analog)
Ref. 2.1 Bases	Safety Limits (digital)

2.0 SAFETY LIMITS (SLs) (Analog)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 In MODES 1 and 2, the combination of THERMAL POWER, pressurizer pressure, and the highest operating loop cold leg coolant temperature shall not exceed the limits shown in Figure 2.1.1-1.

2.1.1.2 In MODES 1 and 2, the peak ~~linear heat rate~~fuel centerline temperature ~~(LHR)~~ shall be ~~<~~≤ [~~21.0~~5080]~~°F-kW/ft, decreasing by [58°F per 10,000 MWD/MTU] and adjusted for burnable poison in accordance with NRC approved methodologies~~.

2.1.2 Reactor Coolant System Pressure SL

In MODES 1, 2, 3, 4, and 5, the RCS pressure shall be maintained ≤ [2750] psia.

2.2 SAFETY LIMIT VIOLATIONS

2.2.1 If SL 2.1.1 is violated, restore compliance and be in MODE 3 within 1 hour.

2.2.2 If SL 2.1.2 is violated:

2.2.2.1 In MODE 1 or 2, restore compliance and be in MODE 3 within 1 hour.

2.2.2.2 In MODES 3, 4, or 5, restore compliance within 5 minutes.

2.0 SAFETY LIMITS (SLs) (Digital)

2.1 SLs

2.1.1 Reactor Core SLs

2.1.1.1 In MODES 1 and 2, departure from nucleate boiling ratio (DNBR) shall be maintained at ≥ [1.19].

2.1.1.2 In MODES 1 and 2, the peak ~~linear heat rate~~fuel centerline temperature ~~(LHR)~~ shall be maintained at ~~<~~≤ [~~21.0~~5080]~~°F/kW/ft~~, decreasing by [58°F per 10,000 MWD/MTU] and adjusted for burnable poison in accordance with NRC approved methodologies.

2.1.2 Reactor Coolant System Pressure SL

In MODES 1, 2, 3, 4, and 5, the RCS pressure shall be maintained at ≤ [2750] psia.

2.2 SAFETY LIMIT VIOLATIONS

2.2.1 If SL 2.1.1.1 or SL 2.1.1.2 is violated, restore compliance and be in MODE 3 within 1 hour.

2.2.2 If SL 2.1.2 is violated:

2.2.2.1 In MODE 1 or 2, restore compliance and be in MODE 3 within 1 hour.

2.2.2.2 In MODES 3, 4, or 5, restore compliance within 5 minutes.

BASES

APPLICABLE SAFETY ANALYSES (continued)

conditions of the safety analyses (as indicated in the FSAR, Ref. 2) provide more restrictive limits to ensure that the SLs are not exceeded.

SAFETY LIMITS

The curves provided in Figure B 2.1.1-1 show the loci of points of THERMAL POWER, pressurizer pressure, and highest operating loop cold leg temperature, for which the minimum DNBR is not less than the safety analysis limit.

SL 2.1.1.2 ensures that fuel centerline temperature remains below the fuel melting temperature of [5080] °F with adjustments for burnup and burnable poison. An adjustment of [58°F per 10,000 MWD/MTU] has been established in [Topical Report CEN-386-P-A] (Ref. 3) and adjustments for burnable poisons are established based on [Topical Reports CENPD-275-P] (Ref. 4) and [CENPD-382-P-A] (Ref.5).

APPLICABILITY

SL 2.1.1 only applies in MODES 1 and 2 because these are the only MODES in which the reactor is critical. Automatic protection functions are required to be OPERABLE during MODES 1 and 2 to ensure operation within the reactor core SLs. The steam generator safety valves or automatic protection actions serve to prevent RCS heatup to the reactor core SL conditions or to initiate a reactor trip function, which forces the unit into MODE 3. Setpoints for the reactor trip functions are specified in LCO 3.3.1.

In MODES 3, 4, 5, and 6, Applicability is not required, since the reactor is not generating significant THERMAL POWER.

SAFETY LIMIT VIOLATIONS

The following SL violation responses are applicable to the reactor core SLs.

2.2.1

If SL 2.1.1 is violated, the requirement to go to MODE 3 places the unit in a MODE in which this SL is not applicable.

The allowed Completion Time of 1 hour recognizes the importance of bringing the unit to a MODE of operation where this SL is not applicable and reduces the probability of fuel damage.

BASES

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, 1998.

2. FSAR, Section [ ].

3. [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.]

4. [Topical Report CENPD-275-P, Revision 1-P-A, "CE Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers," May 1988.]

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

BASES

APPLICABLE SAFETY ANALYSES (continued)

The SL represents a design requirement for establishing the protection system trip setpoints identified previously. LCO 3.2.1, "Linear Heat Rate (LHR)," and LCO 3.2.4, "Departure From Nucleate Boiling Ratio (DNBR)," or the assumed initial conditions of the safety analyses (as indicated in the FSAR, Ref. 2) provide more restrictive limits to ensure that the SLs are not exceeded.

SAFETY LIMITS

SL 2.1.1.1 and SL 2.1.1.2 ensure that the minimum DNBR is not less than the safety analyses limit and that fuel centerline temperature remains below melting.

The minimum value of the DNBR during normal operation and design basis AOOs is limited to [1.19], based on a statistical combination of CE-1 CHF correlation and engineering factor uncertainties, and is established as an SL. Additional factors such as rod bow and spacer grid size and placement will determine the limiting safety system settings required to ensure that the SL is maintained.

~~Maintaining the dynamically adjusted peak LHR to $\leq$ 21 kW/ft~~SL 2.1.1.2 ensures that fuel centerline ~~temperature remains below the fuel~~ melt ~~temperature of [5080] °F will not occur~~ during normal operating conditions or design AOOs ~~with adjustments for burnup and burnable poison. An adjustment of [58°F per 10,000 MWD/MTU] has been established in [Topical Report CEN-386-P-A] (Ref. 3) and adjustments for burnable poisons are established based on [Topical Reports CENPD-275-P] (Ref. 4) and [CENPD-382-P-A] (Ref.5)~~.

APPLICABILITY

SL 2.1.1.1 and SL 2.1.1.2 only apply in MODES 1 and 2 because these are the only MODES in which the reactor is critical. Automatic protection functions are required to be OPERABLE during MODES 1 and 2 to ensure operation within the reactor core SLs. The steam generator safety valves or automatic protection actions serve to prevent RCS heatup to the reactor core SL conditions or to initiate a reactor trip function, which forces the unit into MODE 3. Setpoints for the reactor trip functions are specified in LCO 3.3.1.

In MODES 3, 4, 5, and 6, Applicability is not required, since the reactor is not generating significant THERMAL POWER.

BASES

SAFETY LIMIT VIOLATIONS

The following violation responses are applicable to the reactor core SLs. If SL 2.1.1.1 or SL 2.1.1.2 is violated, the requirement to go to MODE 3 places the unit in a MODE in which this SL is not applicable.

The allowed Completion Time of 1 hour recognizes the importance of bringing the unit to a MODE where this SL is not applicable and reduces the probability of fuel damage.

REFERENCES

1. 10 CFR 50, Appendix A, GDC 10, 1988.

2. FSAR, Section [ ].

~~4.~~ 3. [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.]

4. [Topical Report CENPD-275-P, Revision 1-P-A, "CE Methodology for Core Designs Containing Gadolinia-Urania Burnable Absorbers," May 1988.]

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