Nuclear Performance and Code Review Branch
Requests for Additional Information for
TSTF-564, "Safety Limit MCPR"

1. Section 1 of TSTF-564 states that the proposed change to the minimum critical power ratio (MCPR) safety limit (SL) is not applicable to plants using AREVA fuel. This is clarified in Section 2.4 of the traveler where it is specifically stated that "the proposed change is not applicable to BWR [boiling water reactor] plants using AREVA fuel due to differences in core reload design methodology." It is not acceptable to the NRC staff to categorically exclude fuel from a specific vendor in the manner proposed, because methodologies may be changed and brought into compliance with the intent of the traveler. Instead, please provide the attributes of a core reload design methodology that are necessary for the proposed change to be applicable.

2. As discussed in 10 CFR 50.36(c)(1), plant safety limits are "limits upon important process variables that are found necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity." When the safety limits are exceeded, the reactor must be shut down to protect the integrity of these barriers and prevent uncontrolled radioactive release.

   The pressurized water reactor (PWR) departure from nucleate boiling ratio (DNBR) safety limit[1] has essentially the same basis as the proposed $MCPR_{95/95}$, in that it represents a 95/95 upper tolerance limit on the correlation used to evaluate the DNBR on the fuel in the core. This translates into a 95% probability at a 95% confidence level that the fuel will not experience departure from nucleate boiling (DNB) if the safety limit is not exceeded. The traditional BWR fuel analysis basis is different and requires that 99.9% of the fuel rods in the core are not susceptible to boiling transition.

   a. In PWR safety analyses, DNB (and, accordingly, fuel failure) is presumed if the minimum DNBR drops below the DNBR SL. Will exceedance of the $MCPR_{95/95}$ SL be similarly used as a criterion for boiling transition? If not, please discuss why it is an appropriate safety limit. Also, please justify why the MCPR operating limits based on the $MCPR_{99.9\%}$ SL are compatible with the redefined safety limit.

   b. The NRC staff reviewed current BWR MCPR SLs and found that the $SLMCPR_{95/95}$ examples provided in Table 1 of TSTF-564 are consistently lower (i.e., less conservative) than the current $SLMCPR_{99.9\%}$. Please justify why the basis for these two limits is equivalent or provide a discussion of the unnecessary conservatism included in the $MCPR_{99.9\%}$ that is not included in the $MCPR_{95/95}$.

[1] Included as SL 2.1.1.1 in the Westinghouse standard technical specifications, NUREG-1431, Volume 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12100A222).

3. The changes proposed in TSTF-564 revise the basis of the safety limit on critical power ratio such that it "ensures that there is a 95% probability at a 95% confidence level that no rods will be susceptible to transition boiling". The critical power ratio is not a measurable quantity in the plant, and must be calculated using a critical power correlation. In effect, the limit is not on the critical power ratio but on the critical power ratio calculated using a particular correlation; the limit is linked to the correlation used to generate it, and is not meaningful without it. Please revise TSTF-564 to include both the value of the revised MCPR SL and the correlation used to generate it in the TS, or provide additional justification that this is not necessary.

4. Section 2.4 of TSTF-564 discusses how to determine the $SLMCPR_{95/95}$ for cores where a mix of applicable fuel designs reside in the core, but does not provide an approach for determining the $SLMCPR_{95/95}$ for cores that contain a mix of applicable and non-applicable fuel designs. Is TSTF-564 only applicable when the core is completely loaded with applicable assemblies? If not, how is the $SLMCPR_{95/95}$ determined for cores transitioning to or from applicable fuel designs?

5. The concept presented in TSTF-564 for redefining the MCPR SL relies heavily on the experimental critical power ratio (ECPR), which is not mathematically defined in the TSTF. Please provide a mathematical definition for ECPR so consistency can be ensured in future licensing actions.

6. The NRC staff may find the need to impose safety evaluation penalties on the correlation to ensure appropriate conservatism. As discussed in Information Notice (IN) 2014-01, "Fuel Safety Limit Calculation Inputs Were Inconsistent with NRC-Approved Correlation Limit Values,"[2] the NRC staff found instances where the DNBR 95/95 correlation limit was penalized but the penalty was not appropriately fed into plant safety and operating limits. The approach used in the instances found by the NRC staff was similar to that proposed in the traveler, which uses an equation that defines the $MCPR_{95/95}$ from the ECPR mean, standard deviation, and a statistical factor that is based on the number of datapoints used to determine the ECPR statistics. How are the penalties imposed on the correlation by the NRC staff (IN 2014-01) reflected in the determination of the $MCPR_{95/95}$, the $MCPR_{99.9\%}$, and the MCPR operating limit?

7. TSTF-564 proposes that twice-burnt (or more) fuel is non-limiting with respect to MCPR. Please provide additional justification for this statement, based on theory and/or operating experience, especially for plants operating with short (i.e., one year) operating cycles or non-standard operating conditions. Please also discuss whether and how the $MCPR_{95/95}$ will be updated if a bundle assumed to be non-limiting is found to be limiting during the evaluation of the $MCPR_{99.9\%}$ in the development of the MCPR operating limit.

[2] ADAMS Accession No. ML13325A966.

8. TSTF-564 proposes to report the $SLMCPR_{95/95}$ in the TS to a precision of two digits past the decimal point using standard rounding practices. In the NRC staff's experience, the standard practice for safety limits has always been to round up due to the potential for non-conservatism in the safety limit introduced by rounding down. Is this the standard rounding practice intended in the traveler? If not, please justify.

9. The model application requests licensees discuss the fuels that are or will be in use in the reactor, and discuss which fuel type is limiting with respect to the SLMCPR consistent with the discussion in Section 2.4 of the traveler. The model application then states that SL 2.1.1.2 should be updated with values "consistent with Table 1 of TSTF-564". However, this appears to be inconsistent with the language from the text of Section 2.4 of the traveler, which states:

   > *When new fuel types are developed, the fuel vendor will describe to the NRC the derivation of the $MCPRR_{95/95}$ value for that fuel type. This description may be referenced by a licensee requesting a change to $SLMCPRR_{95/95}$.*

   Such new fuel types would not be referenced in Table 1 of the traveler and thus would constitute a variance from the model application. Please clarify if it is intended that the model application would only be applicable for the fuel types referenced in Table 1.

10. In the TSTF-564 proposed changes, the second paragraph of the "Background" section of the TS 2.1.1 Bases specifies GE and Advanced Nuclear Fuel Corporation (ANF) fuel types. In other sections of the TS Bases, revisions are made to include Westinghouse fuel. Please clarify the discrepancy.

11. TSTF-564 proposes a language change to the "Background" section of the TS 2.1.1 Bases that defines the SL as ensuring that "at least 99.9% of the fuel rods in the core are not susceptible to boiling transition" rather than "at least 99.9% of the fuel rods in the core do not experience transition boiling." What is the intent of this change, and what is the substance of the difference between these two phrases?

    Additionally, an equivalent change to similar language in the "Applicable Safety Analysis" section of the TS 2.1.1 Bases was not made. Please clarify the discrepancy.

12. In NUREG-1434, Volume 2, TS 3.2.2 Bases Reference 2 is to the "current cycle safety analysis." This is appropriate for the discussion in the bases and is applicable regardless of the fuel vendor. In NUREG-1433, Volume 2, TS 3.2.2 Bases Reference 2 is to NEDO-24011-P-A, "General Electric Standard Application for Reactor Fuel". Since discussion elsewhere in the TS Bases has been expanded to include Westinghouse fuel, it is not clear that the reference is appropriate. Please clarify.

13. Why is it appropriate to remove “SL” after MCPR in the “Applicability” section of the TS 3.2.2 Bases? With this change, when the “*[99.9%]*” is not included, the sentence becomes:

    > *Surveillance of thermal limits below 25% RTP is unnecessary due to the large inherent margin that ensures that the MCPR is not exceeded even if a limiting transient occurs.*

    This sentence does not make sense for the MCPR in general, only for a limit placed on the MCPR. Please clarify.

14. Per generic letter (GL) 88-16, which established the core operating limits report, along with subsequent NRC precedent, the methodologies for determining cycle-specific parameter limits must be included in the list of COLR references contained in TS 5.6.3.b. Given that the $MCPR_{99.9\%}$ will now be included in the COLR along with the MCPR operating limit, licensees adopting TSTF-564 must reference appropriate methodologies for the CPR correlation and $MCPR_{99.9\%}$ calculation in TS 5.6.3.b. However, this is not discussed in the traveler or model application. Why?