3/4.2 POWER DISTRIBUTION LIMITS

BASES

The specifications of this section assure that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the 2200°F limit specified in 10 CFR 50.46.

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

This specification assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the limit specified in 10 CFR 50.46. The specification also assures that fuel rod mechanical integrity is maintained during normal and transient operations.

The peak cladding temperature (PCT) following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is dependent only secondarily on the rod-to-rod power distribution within an assembly. The peak clad temperature is calculated assuming a LHGR for the highest powered rod which is equal to or less than the design LHGR corrected for densification. This LHGR times 1.02 is used in the heatup code along with the exposure dependent steady state gap conductance and rod-to-rod local peaking factor. The Technical Specification AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) is this LHGR of the highest powered rod divided by its local peaking factor.

However, the current General Electric (GE) calculational models (SAFER/GESTR described in Reference 3), which are consistent with the requirements of Appendix K to 10 CFR 50, have established that APLHGR values are not expected to be limited by LOCA/ECCS considerations. APLHGR limits are still required, however, to assure that fuel rod mechanical integrity is maintained. They are specified for all resident fuel types in the Core Operating Limit Report based on the fuel thermal-mechanical design analysis.

The purpose of the power- and flow-dependent MAPLHGR factors specified in the CORE OPERATING LIMITS REPORT is to define operating limits at other than rated core flow and core power conditions. At less than 100% of rated flow or rated power, the required MAPLHGR is the minimum of either (a) the product of the rated MAPLHGR limit and the power-dependent MAPLHGR factor or (b) the product of the rated MAPLHGR limit and the flow-dependent MAPLHGR factor. The power- and flow-dependent MAPLHGR factors assure that the fuel remains within the fuel design basis during transients at off-rated conditions. Methodology for establishing these factors is described in Reference ~~6~~ 5.

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MINIMUM CRITICAL POWER RATIO (Continued)

The value for τ_B used in Specification 3.2.3 is 0.687 seconds which is conservative for the following reason:

For simplicity in formulating and implementing the LCO, a conservative value for $\sum_{i=1}^{n} N_i$ of 598 was used. This represents one full core data set at BOC plus one full core data set following a 120 day outage plus twelve 10% of core, 19 rods, data sets. The 12 data sets are equivalent to 24 operating months of surveillance at the increased surveillance frequency of one set per 60 days required by the action statements of Specifications 3.1.3.2 and 3.1.3.4.

That is, a cycle length was assumed which is longer than any past or contemplated refueling interval and the number of rods tested was maximized in order to simplify and conservatively reduce the criteria for the scram time at which MCPR penalization is necessary.

The purpose of the power- and flow-dependent MCPR limits specified in the CORE OPERATING LIMITS REPORT is to define operating limits at other than rated core flow and core power conditions. At a given power and flow operating condition, the required MCPR is the maximum of either the power-dependent MCPR limit or the flow-dependent MCPR limit. The required MCPR assures that the Safety Limit MCPR will not be violated. Methodology for establishing the power- and flow-dependent MCPR limits is described in Reference ~~6~~ 5.

At THERMAL POWER levels less than or equal to 25% of RATED THERMAL POWER, the reactor will be operating at minimum recirculation pump speed and the moderator void content will be very small. For all designated control rod patterns which may be employed at this point, operating plant experience indicates that the resulting MCPR value is in excess of requirements by a considerable margin. During initial start-up testing of the plant, a MCPR evaluation will be made at 25% of RATED THERMAL POWER level with minimum recirculation pump speed. The MCPR margin will thus be demonstrated such that future MCPR evaluation below this power level will be shown to be unnecessary. The daily requirement for calculating MCPR when THERMAL POWER is greater than or equal to 25% of RATED THERMAL POWER is sufficient since power distribution shifts are very slow when there have not been significant power or control rod changes. The requirement for calculating MCPR when a limiting control rod pattern is approached ensures that MCPR will be known following a change in THERMAL POWER or power shape, regardless of magnitude, that could place operation at a thermal limit.

MINIMUM CRITICAL POWER RATIO (Continued)

The value for τ_B used in Specification 3.2.3 is 0.687 seconds which is conservative for the following reason:

For simplicity in formulating and implementing the LCO, a conservative value for $\sum_{i=1}^{n} N_i$ of 598 was used. This represents one full core data set at BOC plus one full core data set following a 120 day outage plus twelve 10% of core, 19 rods, data sets. The 12 data sets are equivalent to 24 operating months of surveillance at the increased surveillance frequency of one set per 60 days required by the action statements of Specifications 3.1.3.2 and 3.1.3.4.

That is, a cycle length was assumed which is longer than any past or contemplated refueling interval and the number of rods tested was maximized in order to simplify and conservatively reduce the criteria for the scram time at which MCPR penalization is necessary.

The purpose of the power- and flow-dependent MCPR limits specified in the CORE OPERATING LIMITS REPORT is to define operating limits at other than rated core flow and core power conditions. At a given power and flow operating condition, the required MCPR is the maximum of either the power-dependent MCPR limit or the flow-dependent MCPR limit. The required MCPR assures that the Safety Limit MCPR will not be violated. Methodology for establishing the power- and flow-dependent MCPR limits is described in Reference 5.

At THERMAL POWER levels less than or equal to 25% of RATED THERMAL POWER, the reactor will be operating at minimum recirculation pump speed and the moderator void content will be very small. For all designated control rod patterns which may be employed at this point, operating plant experience indicates that the resulting MCPR value is in excess of requirements by a considerable margin. During initial start-up testing of the plant, a MCPR evaluation will be made at 25% of RATED THERMAL POWER level with minimum recirculation pump speed. The MCPR margin will thus be demonstrated such that future MCPR evaluation below this power level will be shown to be unnecessary. The daily requirement for calculating MCPR when THERMAL POWER is greater than or equal to 25% of RATED THERMAL POWER is sufficient since power distribution shifts are very slow when there have not been significant power or control rod changes. The requirement for calculating MCPR when a limiting control rod pattern is approached ensures that MCPR will be known following a change in THERMAL POWER or power shape, regardless of magnitude, that could place operation at a thermal limit.

3/4.2.4 LINEAR HEAT GENERATION RATE

The specification assures that the LINEAR HEAT GENERATION RATE (LHGR) in any rod is less than the design linear heat generation even if fuel pellet densification is postulated. The power spike penalty specified is based on the analysis presented in Section 3.2.1 of the GE topical report NEDM-10735 Supplement 6, and assumes a linearly increasing variation in axial gaps between core bottom and top and assures with a 95% confidence that no more than one fuel rod exceeds the design LINEAR HEAT GENERATION RATE due to power spiking.

References:

1. General Electric Company Analytical Model for Loss-of-Coolant Analysis in Accordance with 10 CFR 50, Appendix K, NEDO-20566A, September 1986.

2. "Qualification of the One-Dimensional Core Transient Model for Boiling Water Reactors," General Electric Company Licensing Topical Report NEDO 24154 Vols. I and II and NEDE-24154 Vol. III as supplemented by letter dated September 5, 1980, from R. H. Buchholz (GE) to P. S. Check (NRC).

3. "LaSalle County Station Units 1 and 2 SAFER/GESTR-LOCA Loss-of-Coolant Accident Analysis," General Electric Company Report NEDC-32258P, October 1993.

4. "General Electric Standard Application for Reactor Fuel," NEDE-24011-P-A (latest approved revision).

5. "ARTS Improvement Program Analysis for LaSalle County Units 1 and 2," General Electric Company Report NEDC-31531P, December 1993.

No changes to this page
Included for continuity