Addendum to Technical Evaluation Report:

Fort St. Vrain Nuclear Generating Station
Docket 50-267

REVIEW OF PROPOSED TECHNICAL SPECIFICATION CHANGE:

CORE INLET VALVES/MINIMUM HELIUM FLOW AND MAXIMUM CORE REGION TEMPERATURE RISE (L.C.O. 4.1.9)

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Project: Selected Reactor Operating Issues-
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*(Note: Original TER was submitted under A9351)

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INTRODUCTION

The original ORNL Technical Evaluation Report[1] (TER) recommended that a means for computing the bulk core temperature and its rate of rise (toward the 760 F limit imposed) should be specified in the Tech Specs. Public Service Company of Colorado (PSC) has resubmitted the proposed Tech Spec change (P-87124), incorporating new definitions of calculated bulk core temperature (Sect. 2.23) and means for calculating it following long periods of interruption of all primary coolant flow in a shutdown (Sect. 4.0.4.).

COMMENTS

1. In general, we determined that the method presented for ensuring that the bulk core temperature does not exceed 760 F is straight forward and conservative.

2. The decay heat curves (Fig. 4.0-1) are consistent with the FSAR values (Fig. D.1-9), and the superpositioning scheme for compiling an effective total decay heat power is valid. The method and curve values for various shorter-term power histories and shutdowns were spot checked using a digital filtering scheme developed for the ORECA code[2], and were found to be valid and conservative.

3. The decay heat energy requirement curve (Fig. 4.0-2) was also checked using FSAR specific heat relations and found to be valid and conservative.

4. There are several compounded conservatisms that make this procedure an "ultra-safe" one: 1) The 760 F upper limit for bulk core temperature is a conservative limit. No damage of any type would be expected at this temperature. 2) The adiabatic core assumption is very conservative. ORECA code runs predicted that, for slow heat-ups, the actual rates would be several times lower as the bulk temperature approached 760 F. 3) Ignoring the reflector heat capacity for slow heat-ups adds about another factor of two conservatism. 4) Subsequent reduction in afterheat power after the start of the outage is ignored.

5. The one factor in this calculation that may not be conservative is the FSAR decay heat curve. Comparisons with a later afterheat study by GA published as LTR-4A[3] show that for long shutdown times, the FSAR values become more non-conservative for longer times (30% low at 100 days, 70% low at 1000 days). Considering all the other conservátism's built in, however, especially for slow heat-ups characteristic of long shutdowns, the net result would be conservative.

6. There are also few clarifications that should be made in the Plant procedures:
   1) The instructions for computing decay heat power don't say how far back in power history the calculation should go. It is noted (p.4.0-6) that 1000 days is an upper limit (built-in assumption of 100% power operation preceeding that), but it is not specified, and the example in Fig. 4.0-1 doesn't suggest, that one needs to go back 1000 days. The actual amount of time that should be considered is a function of operating history, and naturally the further back, the less precise the historical record needs to be. We would suggest that for "active" operating periods, the previous one-year history should be entered, with the year before that put in as a single average. A trial-and-error scheme (adding more and more history until there is no more significant afterheat added) would be the most satisfactory.
   2) The instructions don't specify how the initial value of bulk core temperature is measured. Presumably, it would be from an average of core outlet temperature readings while there is forced cooling. This would be a conservative measure.
   3) It should be made clear to the operators that the "power history" used in the decay heat calculation is "thermal", not "electrical" power.

REFERENCES

1. Letter to Mr. R. O. Williams, Jr., (PSC) from Kenneth L. Heitner, NRC FSV Project Manager, "Fort St. Vrain Technical Specification LCO 4.1.9," (Dec. 5, 1986).

2. S. J. Ball et al, High-Temperature Gas-Cooled Reactor Safety Studies for the Division of Reactor Safety Research, Quarterly Progress Report for October 1-December 31, 1981 ORNL/TM-8260, (May 1982).

3. R. E. Sund, Afterheat Calculations for HTGR, General Atomic Company Report GA-LTR-4A (July 1974).