From: "Daflucas, Ronda" <rdafluc@entergy.com>
To: "Rick Ennis" <RXE@nrc.gov>
Date: 8/10/05 11:03AM
Subject: DRAFT response RAI SRXB-A-17

Rick - Provided is an attachment to support discussion with the NRR reviewer, George Thomas. Would you please provide to the reviewer and request his availability for a call with VY?

Thank you,

Ronda Daflucas

<<SRXB-17 Revised-050810 LTG.doc>>

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NRC RAI SRXB-17

In Supplement 4, Attachment 5, Matrix 8, page 13, note for SE Section 2.8.5.4.1, there is an explanation for uncontrolled control rod withdrawal from a subcritical or low power startup condition. In this explanatory section, this event is considered as an accident and a fuel enthalpy of 170 calories/gram is given as the acceptance criterion. However, in SRP Section 15.4.1, this event is considered as a transient, not as an accident, and hence specified acceptable fuel design limit criteria is applied. Why is this event considered as an accident rather than a transient?

Proposed New Response

The transient thermal limits are established such that no fuel damage is to occur during the most severe abnormal operating transient. Fuel damage is defined as perforation of the cladding that permits release of fission products. Fuel damage can occur due to two primary mechanisms: (1) severe overheating of the fuel cladding caused by inadequate cooling, and (2) fracture of the fuel cladding due to stresses which may be induced by the relative expansion of the fuel pellet inside the cladding.

To achieve severe overheating of the cladding due to inadequate cooling, it would be necessary to generate more thermal power (heat) in the fuel than can be adequately transferred through the cladding to the coolant. Transients that can cause this type of behavior, typically occur during higher power operation. Operation within the Operating Limit Maximum Critical Power Ratio (OLMCPR) protects against this.

At lower power, rapid fission gas generation and pellet expansion induced cladding stresses are a concern. In order to protect against events of this type, including the Continuous Rod Withdrawal during Startup transient, a criterion was developed that limited peak fuel enthalpy below the cladding stress failure limit.

For the Continuous Rod Withdrawal during Reactor Startup transient, NEDO-23842 (Ref. 1) establishes a peak fuel enthalpy licensing basis criterion of 170 cal/gm that shall not be exceeded. This criterion was adopted from NEDO 10527 (Ref. 2), which states that this value is the fuel cladding failure threshold. This criterion is widely used by operating BWRS, and its use has been accepted by NRC. In fact, NUREG 1433 (Ref. 3) Section B3.3.1.1 states "to demonstrate the capability of the IRM System to mitigate control rod withdrawal events, generic analyses have been performed (Ref. 4) to evaluate the consequences of control rod withdrawal events during startup that are mitigated only by the IRM." The "(Ref. 4)" from this section of NUREG 1433 is NEDO-23842 (Ref. 1).

VYNPS Updated Final Safety Analysis Report (UFSAR) (Ref. 5) Section 14.5.3.2, "Continuous Rod Withdrawal during Reactor Startup," states that the peak fuel enthalpies resulting from this event are less than 60 cal/gm, which is significantly less that the licensing basis limit of 170 cal/gm. As such, this is VYNPS' current licensing basis for this event, and it is not being changed for EPU. Because this event is considered a non-limiting transient, it is not required to be analyzed for EPU per NEDO-33004-A (Ref. 6), as approved by the NRC in a safety evaluation dated March 31, 2003. However, VYNPS did perform an evaluation of the Continuous Rod Withdrawal during Reactor Startup transient for EPU.

For EPU by itself, peak fuel enthalpy is not expected to increase. However, indirectly, EPU fuel and core designs may lead to higher rod worth and, therefore, higher peak fuel enthalpy at low power. It was conservatively assumed that a 20% increase in rated power would increase peak fuel enthalpy at low power by 20%, resulting in a peak fuel enthalpy for the Continuous Rod Withdrawal during Reactor Startup of 72 cal/gm, still far below the peak fuel enthalpy limit of 170 cal/gm.

References:

1. NEDO-23842, R.C. Stirn & J.F. Klapproth, "Continuous Control Rod Withdrawal Transient in the Startup Range," April, 18, 1978

2. NEDO-10527, C.J. Paone, R.C. Stirn, & J.A. Woolley, "Rod Drop Accident Analysis for Large Boiling Water Reactors," March 1972

3. NUREG-1433, Revision 3.0, "Standard Technical Specifications General Electric Plants, BWR/4," June 2004

4. NEDO-23842, R.C. Stirn & J.F. Klapproth, "Continuous Control Rod Withdrawal Transient in the Startup Range," April, 18, 1978 (same as Ref. 1)

5. Updated Final Safety Analysis Report (UFSAR), Vermont Yankee Nuclear Power Station, Revision 19

6. NEDO-33004-A, Revision 4, "Licensing Topical Report, Constant Pressure Power Uprate," July 2003