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SUBJECT: Expresses appreciation for opportunity to review & comment on staff accident precursor analysis of Oconee Unit 2 HPI line crack.

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February 24, 1998

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Comments On Preliminary Accident Sequence Precursor Analysis of Operational Event At Oconee Nuclear Station, Unit 2 (LER No. 270/97-001)

The subject report was provided to Duke Energy Corporation (Duke) in a letter from the staff dated January 26, 1998. Duke appreciates the opportunity to review and comment on the staff's accident precursor analysis of the Oconee Unit 2 HPI line crack that occurred on April 21, 1997. As discussed below, Duke believes that the value assigned to the conditional probability of a small break LOCA is not appropriate, and that the failure probability of the HPI system to respond to the HPI line break which is used in this preliminary analysis is conservative compared to the plant specific reliability estimate.

Conditional Small Break LOCA Probability

While the Swedish (SKI) piping failure database provides a source of information on the frequency of piping failures, it is not reasonable to extrapolate this generic data beyond an estimate of the frequency of events. This small group of events (13 leakage events and no ruptures) is inadequate to make a statistical inference of the conditional probability of pipe rupture. Assigning the value of 0.053 for the rupture probability for the Oconee leakage event based on no ruptures in 13 events is not reasonable in a best estimate analysis process. This approach also ignores the phenomenological aspects of crack growth from thermal cycling and the physical attributes of the piping. For example, the analysis does not consider that the piping material is a highly ductile austenitic stainless steel. Piping stress analysis of the failed Oconee piping material concluded that even with the existing crack, the HPI line had enough remaining strength to

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provide a factor of safety greater than 2 under design basis event loads.

As discussed in several communications with the NRC (References 1, 2, 3, 4, and 5), Duke performed extensive metallurgical examination of the failed piping section and determined that the leaking weld crack had propagated over a long period of time, believed to be greater than 2 years. The primary initiator of the crack was high cycle/low amplitude stresses consistent with thermal cycling in the weld region. This type of crack grows very slowly at specific times when temperature and flow variations occur in the reactor coolant system or the HPI makeup flow. After the onset of the initial leak (2.36 gpm) in the April 21, 1997, Oconee Unit 2 event, the leakage rate increased gradually over the next 19 hours, peaking at 12 gpm. It is felt that the increase in RCS leakage rate between initial discovery and unit shutdown was not due to additional growth of the crack itself. It is more plausible that the gradual increase in leakage rate was caused by the erosion of material within the opened crack or other undetermined mechanisms. Without substantial additional growth of the crack or a substantial external load (much greater than DBA conditions), it is highly improbable that a catastrophic rupture (small break LOCA) could occur.

Duke's conclusion from these examinations and analysis is that the probability of complete rupture of this line was still very small. This type of event is not well suited for accident sequence precursor (ASP) analysis given the current state of materials engineering and operational experience, and the extrapolation necessary to obtain a conditional probability of the initiating event.

HPI System Failure Probability

Duke's review of the preliminary ASP basic event probabilities showed that most of the values were consistent with Duke PRA analyses, with the important exceptions of HPI-MDP-CF-START (common cause failure of Motor-Driven HPI pumps B and C to Start) and HPI-XHE-XM-PMPB (Operators Fail to Align HPI Pump B to Loop B). Duke believes that the values for these events are overly conservative and should be lowered.

In the case of a common cause failure of HPI pumps B and C to start, the ASP assessment value of 6.3E-04 is a factor of 5 higher than the most recent Duke analysis (Reference 6).

This value is also high relative to the ASP failure probability assigned for individual HPI pump train failure (3.9E-03). Generally, common cause start failure probabilities should not exceed 10% of the single train start failure probability unless a detailed plant specific common cause assessment is performed to support using a higher common cause value.

Event HPI-XHE-XM-PMPB models the failure of operators to align HPI Pump B to RCS Loop B by opening motor operated valve HP-409. This action is proceduralized in the Oconee Emergency Operating Procedure (EOP)(EP/2/A/1800/01) under Enclosure 505 "ES Actuation" Steps 2.3 and 2.4. In these steps, operators verify that the minimum injection flow required for each header is met and that HPI pump runout limits are not exceeded. If the required HPI flow to header "B" is not met, operators are directed to open HP-409. Operators receive extensive training on this enclosure and specifically on HPI line break events. Failure to perform this clear and straightforward action was quantified at 1.0E-03 in the Oconee IPE and was verified in more recent analysis (References 7 and 8). The value used in the ASP preliminary analysis is an order of magnitude higher and is considered to be overly conservative.

The question of whether or not the conditional core damage probability of this event is less than the precursor threshold (10^{-6}) depends primarily on the value assigned to the conditional probability that the leakage event would have progressed to a small break event. Duke believes it is very difficult to select a specific value for this probability. Since it is very difficult to assign a number to such a "precursor to a small break LOCA initiating event", Duke suggests that this event be treated as a "potentially significant event considered impractical to analyze."

Again, Duke thanks the staff for the opportunity to review and comment on this report. Please address any questions to Dr. P. M. Abraham at (704) 382-4520.

Very Truly Yours,

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References

1) J. W. Hampton, Letter to USNRC, dated May 2, 1997, "Justification for Continued Operation of Oconee Unit 1 Based On Oconee Unit 2 HPI Line Leak."

2) J. W. Hampton, Letter to USNRC, dated May 9, 1997, "Response to Request for Additional Information on the High Pressure Injection (HPI) System."

3) J. W. Hampton, Letter to USNRC, dated May 13, 1997, "Response to Request for Additional Information on the High Pressure Injection (HPI) System."

4) J. W. Hampton, Letter to USNRC, dated May 19, 1997, "Justification for Continued Operation of Oconee Unit 1 Based On Oconee Unit 2 HPI Line Leak - Supplemental Information."

5) J. W. Hampton, Letter to USNRC, dated May 22, 1997, "Justification for Continued Operation of Oconee Unit 1 Based On Oconee Unit 2 HPI Line Leak - Supplemental Information."

6) Oconee Nuclear Station HPI Reliability Study, Duke Power Company, December 1997.

7) Oconee Nuclear Station IPE Submittal Report, Duke Power Company, 1989.

8) Oconee Nuclear Station PRA Revision 2 Summary Report, Duke Power Company, December 1996.