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NUCLEAR REGULATORY COMMISSION

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October 4, 1996

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FROM: Charles E. Rossi, Director *Charles E. Rossi*
Safety Programs Division
Office for Analysis and Evaluation
of Operational Data

SUBJECT: REPORT ON THE OPERATIONAL RELIABILITY OF THE REACTOR CORE
ISOLATION COOLING SYSTEM, 1987-1993

Attached for your information and review is the draft of the reliability report on the reactor core isolation cooling (RCIC) system. This study is part of our on-going evaluation of the reliability of risk-significant safety systems. The study provides an estimate of the associated system reliability based on actual demands between 1987 and 1993. The report also includes a comparison of the associated system reliability derived from this operating experience to values published in probabilistic risk assessments (PRAs) and independent performance evaluations (IPEs), and an evaluation of the most significant trends.

Notable findings and observations include:

- The RCIC system unreliability (including recovery) was 0.044 for short-term missions of less than 15 minutes and 0.076 for missions of 15 minutes or longer. The short term unreliability improved over the 7

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year study period but the long term unreliability remained fairly constant. The failure rate remained fairly steady while the demand rate exhibited a significant decrease. The demand rate decrease reflects the overall decrease in the annual number of reactor scrams requiring RCIC operation. No statistically significant trends were identified in the RCIC system annual failure rate or unreliability relating to plant age.

- Failures to start not associated with the injection valve were the leading contributors to the short term unreliability. These failures were primarily caused by mechanical problems with the turbine speed control which were not easily recovered by simple operator actions. For long term unreliability, failures to restart were the prime contributors. Three of the four failures during the long missions were hardware problems associated with valve cycling.
- Generally, the RCIC system unreliability estimates approximated from the PRA/IPEs were slightly lower but within the observed uncertainty intervals based on operational demands. The plants for which the IPE values were completely outside the uncertainty bounds of the operating data used turbine-driven pump failure rates that were at least an order-of-magnitude different than the average hourly rate calculated from the operating experience.
- The modeling of RCIC operation in PRA/IPEs does not appear to be consistent with the operational experience. Restarts and/or recirculation are generally either not modeled or are modeled using nominal failure probabilities associated with initial operation. Thus, care should be exercised when relying on PRA/IPE results that are significantly influenced by RCIC modeling or failure probabilities.
- The operational data contained five instances where multiple systems either failed or had the potential to fail concurrently with a RCIC failure. In two of the five instances the RCIC and high pressure coolant injection systems were affected during an unplanned demand.
- The nature of the failures experienced during actual demands was generally similar to those experienced during surveillance tests.

We intend to have a review meeting on Thursday, October 25, 1996, at 10:00 a.m. in room T4-B3 to discuss any comments or recommendations you might have before issuing the report. Please contact Dale Rasmuson (415-7571 or e-mail 'DMR') if you have any questions.

Attachment:

Reactor Core Isolation Cooling System Reliability, 1987-1993, August 1996 (INEL-95/0196)

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