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C0400-11

Docket Nos.: 50-315
50-316

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

Donald C. Cook Nuclear Power Plant, Units 1 and 2
RESPONSE TO UNRESOLVED ITEM 50-315/99033-02, 50-316/99033-02

On February 18, 2000, the U.S. Nuclear Regulatory Commission (NRC) issued Inspection Report (IR) 50-315(316)/99033. This IR contained unresolved item (URI) 50-315/99033-02; 50-316/99033-02 and requested that Indiana Michigan Power Company (I&M) provide a response to this URI. The letter transmitting the IR stated that the criteria used in the Emergency Operating Procedures (EOPs) for determining whether the reactor was shut down and whether boration was necessary did not appear to be supported by analyses, and a technical justification was requested.

On March 27, 2000, and April 5, 2000, we contacted Mr. Anton Vegel of your staff and received an extension to our response to this URI.

This letter transmits I&M's technical justification for the shutdown and boration criteria used in the EOPs. The attachment to this letter contains a detailed discussion of I&M's technical justification.

There are no commitments made in this response. Actions discussed in this submittal represent intended or planned actions by Indiana Michigan Power Company. They are provided to the NRC for information and are not regulatory commitments.

IE01

Should you have any questions, please contact me at 616-466-2698.

Sincerely,

Robert C. Godley
Regulatory Affairs Director

/dms

Attachment

c: J. E. Dyer
MDEQ – DW & RPD, w/o attachment
NRC Resident Inspector
R. Whale, w/o attachment

ATTACHMENT TO C0400-11

Reply To Unresolved Item 50-315/99033-02; 50-316/99033-02
Donald C. Cook Nuclear Plant Unit 2

Restatement of IR 99033 Section O3.1.b.5 and the Unresolved Item:

"By Information Change Package 00344, design engineering communicated the value of 10 steps out as an acceptable value for determining whether control rods are sufficiently inserted to not require boration. The specific application was the shutdown criteria used in emergency operating procedures (EOPs) such as 02-OHP 4023.ES-0.1, Reactor Trip Response. Procedure ES-0.1 required operators to verify all control rods (other than control rod H-8) were inserted to less than 10 steps out prior to proceeding without borating (indication for control rod H-8 is discussed in Section O8.9). The inspectors noted that, theoretically, all control rods could be stuck out at nine steps and boration would not be required by the procedure. The analysis performed to support the 10 step criteria was described in calculation FA-99-03, Stuck Control Rods Near Reactor Core Bottom, Shutdown Margin, and Emergency Boration. Calculation FA-99-03 determined, deterministically, that the reactor would be shutdown with adequate margin if all control rods were stuck out at seven steps. Additionally, calculation FA-99-03 determined that if eight control rods were stuck out at 22 steps and the remaining control rods were fully inserted, the reactor would also be shutdown with adequate margin. The inspectors noted that the criteria of 10 steps appeared to be non-conservative with respect to the analysis which supported the value of the seven steps. Calculation FA-99-03 stated that due to the uncertainties associated with rod position indication, if all control rods were stuck at 8 steps, the probability that at least one rod would show 11 steps or more was greater than 99.9%. The calculation assumed that the rod indication had a normal distribution with a three-step standard deviation from actual position. The inspectors questioned the appropriateness of relying upon statistical variations in rod position indication (i.e., the probability that the indication would not accurately reflect actual rod position) for supporting a criteria which was in the non-conservative direction with respect to the analyzed value. This issue is an unresolved item (URI) pending review of the licensee's justification. (URI 50-315/99033-02; 50-316/99033-02(DRS))"

Background

In accordance with the design and licensing basis, the shutdown margin (SDM) analysis for D. C. Cook Nuclear Plant (CNP) ensures that the reactor will remain shutdown under all conditions with the highest worth control rod fully withdrawn. However, as a conservative measure, the reactor trip response procedures direct the operators to borate if any control rod is not fully inserted. This action provides an additional measure of SDM above that required by the design and licensing basis.

Following a reactor trip, the individual rod position indicators (IRPIs) frequently indicate multiple rods a few steps withdrawn, even when the rods are fully inserted[1]. This is due to an

[1] Based on historic performance of rod drop testing at Cook.

inherent inaccuracy associated with the analog IRPI system. This inaccuracy is reflected in the technical specifications, which specify the maximum allowable misalignment of the rod group step counter position. Although borating when any control rod is verified not to be fully inserted is conservative with respect to the SDM analysis, it is not desirable to borate after every reactor trip when all control rods are fully inserted. Thus, this inherent inaccuracy must be taken into account in the boration instructions provided to the operators.

The analysis that was performed to determine the boration guidance provided in the reactor trip response procedures evaluated a number of scenarios well in excess of the requirements of the CNP design and licensing basis. The analysis determined that all control rods could be stuck at seven steps and the SDM would still be bounded by the design basis analysis, which assumes one control rod is fully withdrawn. As many as eight rods could be stuck as high as twenty-two steps and still be bounded by the SDM analysis. And for the unlikely situations where the number of stuck rods is greater than eight, there is a sufficiently high probability that the IRPI system will identify at least one rod above ten steps.

In the past, operators would rely on the rod bottom lights (which come on at twenty steps) to confirm full rod insertion. The reactor trip response procedures were revised to ensure IRPI inaccuracy is consistently applied to maintain a conservative margin to the design basis SDM. In light of the analysis results, and since the IRPI system indicates rod position in five step increments, ten steps was chosen as a conservative determination point for identifying a control rod as not fully inserted, which would result in emergency boration.

Analysis/Technical Justification

In the case of Unit 2, the operations head procedure directs the operator to: "Check All Control Rods Inserted" and "If rod H8 is NOT less than 35 steps OR any other control rod is NOT less than 10 steps, THEN borate 150 ppm for each rod NOT inserted:...." The Unit 1 procedure provides essentially the same guidance and incorporates the same Unit 2 assumptions, assertions and positions.

This procedural guidance is supported by an engineering calculation (FA-99-03) performed by the Fuel, Safety & Analysis Department. The purpose of the calculation was to demonstrate that the subject procedures provided adequate shutdown margin following a reactor trip. The approach was to evaluate conservatively the viability of the procedure in the face of hypothetical, post-trip rod positions in excess of the licensing basis. A variety of non-credible scenarios involving postulated stuck rod cluster control assemblies (RCCAs) near the bottom of the core following a reactor trip were examined. The measure of acceptability was a demonstration that technical specifications SDM requirements would continue to be met with a high degree of confidence for each of the analyzed scenarios which are outside of the plant's licensing basis. More specifically, the calculation shows that at least a single RCCA out of 53, which is postulated to be stuck above seven steps, will indicate greater than 10 steps on the IRPIs and boration would be initiated. Borating in accordance with the EOPs and the core design which

accounts for the worth of the most reactive rod is conservative with respect to our SDM requirements and ensures the reactor will remain shutdown.

The analysis has two parts. First, a deterministic conservative calculation demonstrated that all 53 rods could be stuck in old fuel at seven steps without compromising SDM. Although this scenario is outside of CNP's licensing basis, it is being used to assure that the shutdown margin will be preserved under any circumstances. Though the SDM calculations assume the highest worth rod stuck out, we direct boration upon identification of any rod stuck out. For the first part of the calculation the following conservatisms were used:

- This calculation was performed assuming that the emergency boration will start when the first rod is identified as being stuck out. Therefore, the worth of one fully stuck out rod may be used to offset the worth of several rods near the bottom of the core.

- The lowest worth of the fully stuck out rod for both units in all past cycles was used. The worth of the rod was taken at burnup when it was the lowest. (For this calculation the low value for the fully stuck out rod is conservative as it minimizes SDM).

- The worth of the rods near the bottom of the core was taken for the unit and the cycle where it was maximum. Unit 2 designs had low enriched axial blankets, therefore, the worth of the rods at the bottom of the core was relatively low. Therefore, Unit 1 data was used for conservatism.

- In addition to assuming that rods might stick only in old fuel, half of the rods were assumed to be stuck in fresh fuel where the worth of rods at the core bottom is higher than in old fuel. This is because fresh fuel has short burnable absorbers which increases the relative reactivity of the bottom of the fuel assembly with respect to the center of the fuel assembly. This increases the conservatism of the calculation and maximizes the worth of stuck rods.

- The distribution of burnable absorbers may be axially asymmetric. Therefore, for additional conservatism, the worth of the rods stuck at the bottom of the core was obtained from Unit 1 Cycle 15 design. The data was taken at the beginning of cycle. This cycle had burnable absorbers offset to the top of the core. This further increased the worth of the rods stuck at the bottom of the core.

The second part of calculation FA-99-03 was a probabilistic evaluation which conservatively modeled the behavior of the IRPIs and demonstrated with 99.98% confidence that, in the unlikely event that all rods stick at greater than seven steps, at least one IRPI will indicate greater than ten steps and the operator will initiate emergency boration. This act of boration for one rod will satisfy the SDM requirements. For the second part of the calculation the following conservatisms were used.

- The procedure reviewed by the Nuclear Regulatory Commission directed boration if any rod is indicated at 10 steps or more. The calculation assumed emergency boration only if rods are indicated greater than 10 steps. Hence, the boration criteria in the procedure are more conservative than the criteria assumed in the calculation.

- The assumed value of sigma (standard deviation) for IRPIs is an important consideration. It directly affects the probability that rods stuck near the bottom of the core will have an IRPI value greater than 10 steps. An assumed sigma that minimizes the likelihood of an IRPI value greater than 10 steps also minimizes the probability of operator boration. It would be expected that ±12 steps are equivalent to 2 sigma or 3 sigma. In either case, however, sigma would then range from 6 to 4 steps respectively. Selection of either 4 or 6 steps, in comparison to 3 steps, as representative of sigma would imply a higher likelihood of IRPI indications greater than 10 steps. For the purpose of this calculation this would be non-conservative. The calculation conservatively assumed that the IRPI uncertainty of ±12 steps was equivalent to 4 sigma, hence sigma equals 3 steps. The 3 steps were used in the probability calculation. This calculation showed that the probability for one IRPI to indicate more than 10 steps is equal to 99.989%.

For situations when all rods stick at seven steps or fewer, the available allowance in the SDM analysis for one rod completely stuck out is sufficient to preserve the shutdown margin. For situations when all rods stick at positions eight to ten steps, there is a high probability that the IRPI system will identify at least one rod as stuck at ten steps or more and emergency boration will commence.

Additional Information

A survey was conducted of Westinghouse plants with analog IRPIs. This survey was conducted by telephone with utility reactor engineers and core analysis personnel. While the information is believed accurate, it has not been validated to the individual plant's core analysis. The survey showed that out of 24 units, only 3 verify higher shutdown margins available for IRPI inaccuracies, and thus have an approach that is clearly more conservative than CNP.

Summary/Conclusion

In summary, Indiana Michigan Power Company (I&M's) position regarding this issue is:

- The current CNP EOPs require boration for the first stuck rod which is indicated to be at ten steps or more. A conservative statistical analysis demonstrates with 99.98% confidence that the subject EOPs will direct the operators to begin emergency boration whenever necessary following a reactor trip. A case in which all rods are postulated to stick off the bottom of the core without emergency boration being required by EOP direction is not credible.
- The post-trip rod position instrument inaccuracy exists at 24 Westinghouse units with analog IRPI in the United States. Thus, this is not a CNP site specific issue.

- While consideration of multiple stuck rods is beyond CNP's licensing basis, prudent actions have been taken to address this issue.

I&M maintains that correct analytical techniques and conservative assumptions have been used for evaluating potential IRPI uncertainties, and that current EOPs provide conservative operator action for identification and boration of stuck rods assuring compliance with post-trip technical specification SDM requirements.