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MEMORANDUM FOR: R. J. Mattson, Director
Division of Systems Safety
Office of Nuclear Reactor Regulation

FROM: R. Bernero, Director
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Office of Nuclear Regulatory Research

SUBJECT: CRYSTAL RIVER IREP STUDY AND INTERIM CRITERIA FOR ACTION

As you are aware from our recent discussions the Crystal River IREP study is nearing completion. The internal peer review by NRC staff members and the plant owner's representatives has been conducted. We have many comments from the NRC staff and expect many from the owner shortly. Our best estimate is that it will take another 2 months to obtain all the comments, deal with them, and complete the report. As we approach the publication of this report we are conscious of the commitment to provide general and plant specific recommendations based on the knowledge gained in this reliability evaluation of the plant.

Based on what we see so far in the Crystal River 3 study, major immediate corrective action does not appear to be required. The present prediction of the likelihood of severe core damage is approximately 3×10^{-4}/yr. This does not significantly exceed the range of values for other LWRs we have examined. We believe the SMI analysis of Crystal River 3 is conservative in many respects, although potential accident sequences which were not analyzed may counter-balance this apparent conservatism. I should also note that the societal risk of Crystal River 3 is held down by the very small population around the site.

Based on the IREP study we make the following recommendations:

1. Ensure that the licensee's voluntary action to eliminate the AC power dependency in the steam-driven emergency feedwater train is properly implemented.

2. Verify the existence of or add to the technical specifications a limiting condition for operation that requires prompt shutdown if the steam-driven emergency feedwater pump train and the electric-motor-driven emergency feedwater pump train are both inoperative.

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3. Verify the adequacy of the licensee's procedures regarding the checking of check valve position for those valves whose failure would cause a LOCA that blows down outside containment and require appropriate testing in the Technical Specifications.

4. The common DC power dependency between one diesel and the emergency feedwater system turbine admission valve should be eliminated. We note, however, that one of the suggestions made by our contractor (to power the admission valve from both DC trains) may not be desirable since it may compromise DC power redundancy. An EFS turbine steam admission valve that fails open upon loss of DC power may be appropriate.

5. Additional investigation of the diesel-generator failure history is recommended (see the memorandum on this subject from G. Edison to D. Eisenhut and N. Moseley dated July 2, 1980).

6. We recommend operator training and procedure review based on the IREP sequences. It is our understanding that this is now underway.. The adequacy of this training and procedure review should be ascertained. As is true in most nuclear power plants, human-related errors are an important contributor to the risk.

7. The decay heat closed cycle cooling water system (DHCCCS) has two trains which are completely redundant. This system provides component cooling to several engineered safety features. Thus, a single failure would disable not only one train of DHCCCS but also one train of multiple engineered safety features. It may be prudent to modify the DHCCCS to include one or more properly engineered cross-over points to reduce this common coupling of multiple systems.

8. Review the steam line rupture matrix circuitry for actuation or failure modes which might disable both trains of emergency feedwater. Many of the B&W plants have systems such as this one; we are about to look at another in the Arkansas 1 IREP study. It may be appropriate to conduct a risk tradeoff study of these systems to see if they do indeed reduce overall risk.

9. Consider the possibility of further modifications to the Emergency Feedwater System. The Crystal River 3 plant has a two pump EFS arrangement. With action on items 1, 2, 4 and 8 above the Crystal River 3 EFS is not notably unreliable. However, here, as well as in other EFS studies we find inherent limitations in the two pump configuration.

Implicit in our recommendations is a standard for corrective action related to the probability of a serious accident. The standard we have in mind in making these Crystal River recommendations is:

$P_{CD} > 1 \times 10^{-2}$/yr: fix in days

1×10^{-2}/yr > $P_{CD} > 1 \times 10^{-4}$/yr: fix in years

1×10^{-4}/yr > $P_{CD} > 1 \times 10^{-5}$/yr: consider fixing

$P_{CD} > 1 \times 10^{-5}$/yr: acceptable where P_{CD} is the probability of severe core damage.

The attached memorandum from Frank Rowsome gives some perspective to this interim standard for the probability of severe core damage. It provides some interesting insights not only on individual failure probabilities but the combined probabilities for the population of existing reactors. It certainly suggests that we should proceed with IREP and NRUP promptly.

I would not consider the severe core damage probability standard defined above as a sharply defined standard ready for formal adoption. I believe it is useful as a priority guide until we have better developed standards which will relate public health risks back to core damage probabilities.

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Enclosure: Memo dtd 7/11/80
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