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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JAN 15 1986

MEMORANDUM FOR: Hugh L. Thompson, Jr., Director
Division of PWR Licensing-A, NRR

FROM: Themis P. Speis, Director
Division of Safety Review and Oversight

SUBJECT: SAFETY EVALUATION REPORT RELATED TO THE LCO RELAXATION PROGRAM FOR THE BYRON GENERATING STATION (TAC NO. M57242)

We have completed our review of the probabilistic risk analysis (WCAP-10526) submitted by Commonwealth Edison in support of their proposal to increase the Allowed Outage Times (AOTs) from 3 days to 7 days for nine safety related systems in the Byron plant. This Safety Evaluation Report provides our risk perspective of the proposal, and is submitted as supporting information for decision making by NRC. In brief, the results of our review are:

- Flagged a significant plant vulnerability in connection with Byron Unit 1 operating with its two-pump essential service water (ESW) system without established cross-tie capability for ESW backup from Unit 2; interim resolution of this problem, pending completion of Unit 2, was obtained by Commonwealth Edison's commitment of December 6, 1986 to make at least one ESW pump from Unit 2 available for Unit 1 prior to the operational restart of Unit 1; and

- Support a decision to permit the proposed increase in AOT for six safety related systems in the Byron plant.

- Support denial of the proposed increase in AOT for the essential service water system, diesel generators, and the auxiliary feedwater system.

The Applicant's submittal was reviewed by the Reliability and Risk Assessment Branch with technical assistance by the Brookhaven National Laboratory (BNL). The Applicant's risk analysis utilized various PRA models and data developed for the Zion Probabilistic Safety Study, the rationale for this being the general similarity in the design and operation of the Zion and Byron plants.

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Our review approach involved the following considerations:

(a) Single Unit Operation: The review was performed in the context of the existing operational status at Byron, i.e., operation of Unit 1 only, with no established capability for inter-unit sharing of the essential water system. This is of consequence in regard to the assessment of risk posed by the Byron 1 two-pump ESWS, which, in the absence of the potential backup capability that could be provided by the Unit 2 ESW pumps, can fail with a frequency of about 9×10^{-4} per year. Failure of this vital support system fails important safety functions, including the cooling of the reactor coolant pump (RCP) seals, which can lead (with an assumed probability of 0.5) to a non-recoverable seal LOCA. Thus, the Loss-of-ESW initiating event by itself is estimated to provide a direct contribution to core melt frequency of about 5×10^{-4}/year. In this connection, the large difference in Byron 1 core melt frequency results obtained between BNL and the Applicant's study is principally due to the fact that this accident initiator was not considered in WCAP-10526. Estimates of the core melt frequency when a Unit 2 ESW pump is available to Unit 1 are presented later.

(b) Risk Index The Applicant's study presented the impact of the proposed change in AOTs in terms of changes in offsite health risks. The staff analysis used core melt frequency as a risk measure, because it is more directly related to changes in AOT, and because, in general, the core melt frequency is the limiting constraint to the proposed numerical guidelines of the NRC safety goal.

(c) System-Specific AOT Risk Impact: The Applicant's results apply to the case where the AOT change is applied to all nine proposed systems at the same time. This does not yield information on the relative risk impact posed by each of the various systems. The BNL analysis examined the effect of an AOT change on individual systems as well as on the proposed group of nine systems.

(d) Sensitivity Approach: The Applicant's AOT analysis was based on Bayesian-estimated values of the frequency and duration of maintenance events. The relevant data base, both generic and plant specific, is of meager proportions. In the BNL analysis, uncertainties related to frequency and duration were addressed using a sensitivity approach in which the core melt frequency was linearly related to the mean maintenance duration time (Tm) for the systems of interest. The analysis covered the Tm range from 19 hours (estimated to be the mean maintenance duration time for the current 3-day AOT technical specification) to the full 7-day period of 168 hours.

The interim BNL results indicated the Byron 1 baseline core melt frequency for the existing 3-day AOT condition to be about $1x10^{-3}$/year, the main contribution to this arising from the vulnerability posed by the Byron two-pump ESWS with no backup. Discussion of these results in meetings with the Applicant at NRC on December 3 and 6, 1985 focused on the question of the expected reduction in core melt frequency that could be obtained if: (a) revisions were made in three calculational factors affecting the calculated annual frequency for loss of the Unit 1 ESW system and (b) one of the two Unit-2 ESW pumps were to be made available as additional emergency backup to the two-pump system in Unit 1.

The net result of revising the three factors under (a) above, was an approximate one-third reduction in the initiating event frequency for loss of ESW in Byron 1 (from about $1.5x10^{-3}$/year to about $9.5x10^{-4}$/year; see Appendix 1, Enclosure), with the net overall core melt frequency for Byron 1 with 2 ESW pumps reduced from about $1x10^{-3}$/year to about $7x10^{-4}$/year. (These estimates do not include a possible contribution due to common cause failures between the ESW pumps).

This estimated core melt frequency of $7x10^{-4}$/year for the Byron 1 two-pump ESW is high. However, with the availability of a Unit-2 ESW pump (as committed to by Commonwealth Edison on December 6, 1985) the initiating event frequency for loss of ESW is reduced by a factor of about 25, while the Byron core melt frequency point-estimate is reduced to nearly $2x10^{-4}$/year.

As discussed more fully in the Enclosure, the core melt frequency results obtained with the mean maintenance duration time increased to a full 7 days indicate the Byron 1 risk impact for the two-ESW pump configuration to be unacceptably high for the AOT increase applied to the ESWS, appreciably high for the DG and AFW system, and of little significance for the other six proposed systems. While this conclusion clearly holds for Tm=168 hours, we believe the conclusion also holds for reduced values of Tm comparable with Zion plant experience.

For the 3-pump ESW configuration, we believe the risk impact associated with increasing the AOT for the ESWS would still be too high. As indicated in the Enclosure, the primary reason for this is attributed to the sensitivity of the loss of ESW initiating event frequency to maintenance. Accordingly, a relatively high rate of increase in core melt frequency is estimated to be obtained for the 3-pump case, amounting to approximately $1x10^{-6}$/year for each additional hour of maintenance.

In conclusion, the results of the staff's probabilistic risk evaluation of the Byron AOT proposal would (a) support relaxation of the 3-day AOT for the following systems: charging pumps, safety injection pumps, RHR pumps, fan coolers, containment spray pumps, and component cooling water pumps; (b) not support relaxation of the 3-day AOT for the following systems: essential water system, diesel generators, and auxiliary feedwater pumps.

Finally, it is important to point out that the risk perspective obtained in our evaluation is dependent, in particular, on the assumptions of frequency and maintenance outage times provided in the Applicant's submittal. The technical specifications set forth for Byron 1 provide, in general, no control on the frequency of maintenance events, and, therefore, on the cumulative outage times for the various systems. At the least, reasonable prudency would appear to warrant self-monitoring actions by the utility to obtain trending information on the frequency of maintenance events, especially for the risk important ESW and DG support systems, and the two-pump AFW system.

Themis P. Speis, Director
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Enclosure: As stated

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