UNITED STATES
NUCLEAR REGULATORY COMMISSION
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1986

MEMORANDUM FOR: O. Parr, Chief
Plant Electrical, Instrumentation
and Control Systems Branch, DPWRL-B

FROM: Frank J. Congel, Chief
Reliability & Risk Assessment Branch, DSRO

SUBJECT: RRAB INPUT TO DPWRL-B's REGULATORY DECISION ON EFW SYSTEM BACKFIT AT OCONEE SITE

REFERENCE: Memorandum from D. M. Crutchfield, DPWL-B to B. Sheron, DSRO, dated January 7, 1986 Regarding Regulatory Analysis for Plant Specific Backfit of Oconee

The above reference identified the need for a regulatory analysis of the emergency feed-water (EFW) system at Oconee nuclear units. Enclosed is our evaluation of the Safety Issue discussed in the above reference. Our preliminary evaluation indicates that the upper bound estimate of the cost of any proposed EFW System fix should not exceed $600,000, based on a $1000/person-rem criteria. We suggest that any proposed fix of the EFW system could consider the plant improvements which have been previously implemented by the licensee, Duke Power Company.

If you need further information regarding risk perspective, E. Chelliah could be contacted at x28338.

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As stated

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ENCLOSURE

RRAB INPUT TO DPWRL-B'S REGULATORY DECISION ON

EFW SYSTEM BACKFIT AT OCONEE SITE

REFERENCE: Memorandum from D. M. Crutchfiled, DPWL-B to B. Sheron, DSRO, dated January 7, 1986 Regarding Regulatory Analysis for Plant Specific backfit of Oconee

The above reference identified the need for a regulatory analysis of the emergency feed-water (EFW) system at the Oconee nuclear units. Basically, staff's review of the licensee, Duke Power Company (DPC), response to generic letter 81-14 concerning seismic qualification of the EFW system indicates that a safe shutdown earthquake (SSE) of 0.1g magnitude could cause a pipe rupture of the non-seismic condenser circulation water (CCW) system; the resulting flood in the turbine building could result in the loss of all three trains of the EFW System. When the above adverse systems interaction is compounded by a postulated single active failure in the standby shutdown facility (SSF) system, the decay heat removal capability through the steam generators could be lost. The staff believes that DPC should correct the above postulated scenario.

Because the original licensing basis for Oconee nuclear units did not require regulatory compliance with general design criteria GDC-2 and GDC-34 for the EFW system, staff considers the above postulated safety issue resolution a backfit for Oconee. Thus, the above reference requested DSRO staff to perform an initial cost/benefit analysis in order to establish an upper bound on cost of the desired backfit that could be justified as a realistic safety improvement

at the Oconee site. The purpose of this memorandum is to a provide risk perspective regarding seismic core damage sequences including the postulated accident scenario indicated in the above reference and to provide an upper bound estimate of the dollar worth of safety improvement that could be realized from the seismic safety issue discussed in the above reference.

Our preliminary review of Oconee Probabilistic Risk Assessment (PRA) indicates that the total mean core damage frequency estimate is about 3E-4 per reactor year. The core damage frequency is dominated by various internal flooding events (not seismically induced) at the turbine building. The frequency contribution of seismic events of various magnitudes ranging from 0.01g to 0.6g to the total core damage is about 6E-5 per reactor year. The above estimate has a very large uncertainty (a frequency range of 1.0E-7 to 1.0E-4 per reactor year). The Oconee PRA has identified three dominant structural failure modes which contribute to the total seismic sequence frequency of 6E-5 per reactor year. These failure modes are: (1) the collapse of auxiliary building (AB) internal massonry walls causing loss of the high pressure injection [HPI] and EFW system and system components; (2) collapse of the blockwalls in the blockhouse through which all 4.16KV emergency buses pass; and (3) rupture of the condenser and failure of CCW pipes connected to the condenser which cause a large flood in the TB, resulting in the loss of three EFW trains and HPI pumps in AB. The median fragility estimate of the condenser and connected CCW piping is about 0.21g with a considerable uncertainty bound which is about Br=Bv=0.14. Thus, a postulated SSE could cause CCW pipe failure which could in turn cause a large flood resulting in failure of three trains of the EFW System. The postulated SSE, in combination with a single failure in

SSF System or a failure of stuck open safety relief valve in the reactor primary system could cause core damage. The mean frequency of the above core damage sequence is estimated to be less than 2E-5 per reactor year.

The Oconee containment is a large dry containment. The Oconee PRA predicts that the seismic capacity of the Oconee containment is about 2g (Median) with an uncertainty bound about Br=0.26 and Bv=0.29. Because of the larger capacity of the containment, we believe that a seismic event of SSE magnitude will not cause a containment gross failure. However, postulated core damage due to the TB flooding sequence could cause a delayed containment failure due to late overpressure buildup inside the containment. The overpressure buildup could be due to the production of non-condensible gases with no containment heat removal at about 12 hours after the onset of core damage. Thus the release estimates from the seismically induced flooding sequence are estimated to be similar to the release estimates of a release category 4 as defined in the Oconee PRA. If a conditional probability of 0.9 for the containment overpressure failure mode and a conditional whole body dose with a maximum estimate of 1.0E+6 per event are assumed, then the risk estimate of the postulated SSE induced flooding sequence could not be more than about 18 person rem per reactor year. There could also be about 0.1 probability that the containment may not fail with core damage, but release could occur through containment leakage. The conditional release through a leakage type failure mode is similar to a release category 5 as defined in the Oconee PRA, which results in an estimated conditional whole body dose of not more than 1.0 E+4 person rem per event. The risk estimate due to the leakage failure mode is then less than one person-rem per reactor year. Therefore, the total risk

estimate of the SSE induced flooding sequence should not to exceed about 18 person-rem per reactor year. If the Commission's proposed safety goal of $1000 per person-rem for the benefit/cost guidance is applied and a reactor life of 30 years is assumed, then the postulated SSE induced flooding sequence could have a maximum risk worth of about $540,000.

It is very important to note that the above risk worth estimate of $540,000 is more likely an upperbound estimate. This is primarily because of the use of the Reactor Safety Study (RSS) type source term methods in estimating Oconee releases. The staff believes that the use of RSS-type source term methods could yield a somewhat higher risk estimate for sequences involving late containment failures. Also, the frequency estimate of an SSE induced flooding sequence is a little higher than the realistic estimate. The higher estimate of sequence frequency is primarily due to the inclusion of CCW structural failure contribution beyond the seismic intensity of 0.2g and up to 0.6g. However, the failure contributor beyond 0.2g is not expected to be significantly higher. At this time, we do not know the nature of EFW System and/or CCW System backfit and therefore, do not know the potential risk reduction of the backfit. However, we suggest that the maximum risk worth estimate of $540,000 due to the SSE induced flood sequence could be considered as an additional basis that the staff can reassess the need for any kind of backfit to the EFW System at Oconee. It is also very important to note that DPC has already implemented many plant fixes to mitigate the TB flood and its impact on safety systems including EFW System pumps; therefore DPC has reduced the overall flood sequence frequency substantially.