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

JUN 11 1981

MEMORANDUM FOR: Carlyle Michelson, Director
Office for Analysis and Evaluation of Operational Data

FROM: Harold L. Ornstein
Office for Analysis and Evaluation of Operational Data

SUBJECT: RES COMMENTS ON AEOD REPORT: SAFETY CONCERNS ASSOCIATED WITH PIPE BREAKS IN THE BWR SCRAM SYSTEM, MARCH 1981

In response to your request for comments on the subject memorandum, I noted the following:

It is gratifying to know that regardless of the disagreements on the probability numbers, RES supports our conclusion that the BWR scram system does not appear to explicitly satisfy the isolation valve redundancy requirements called for in GDC 54 and 55 and that something has to be done on this problem. However, I do not agree with the rationale that was used to pare down the probabilistic estimates of core uncovery. I believe that there are several shortcomings in RES's analysis as listed below:

1. Regarding operator actions, it should be realized for the accident under consideration, contrary to the Browns Ferry fire, the operators may not have access to locations in the plant at which corrective or mitigating actions could be taken. Also, it is not clear that any licensee has qualified equipment and emergency procedures in place which would enable their operators to provide emergency makeup water during the postulated accident.

2. Regarding the Sandia electrical insulation tests, it appears that the testing was conducted in a manner which is not prototypic of what would happen to the electrical equipment outside containment during the postulated accident. The situation which would occur during the postulated accident is one in which cold equipment (below the saturation temperature of the entering steam) would act as condensation surfaces with water droplets or films forming on it. The resulting failure rates would most probably be much greater than those estimated from the Sandia tests.

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More importantly, it is noted that the referenced Sandia Report (NUREG/CR-1682, Electrical Insulators in a Reactor Environment) shows that failure probabilities increase with increasing temperatures. (Table 3 from that report is shown below.)

Breakdown Statistics for Terminal Blocks
(480 Volts, 100% rel. Humidity, 5 hours exposure)

Temperature	Number of Experiments		Breakdowns	Probability
163°C = 325°F (Commercial Tests)	Protected*	28	4	.14
	Open	20	6	.30
	Overall	48	10	.21
86°C = 186°F (Three Mile Island 2)	Protected*	112	1	.009
	Open	315	22	.07
	Overall	427	23	.054
43°C = 110°F (Laboratory)	Protected*	42	0	$<10^{-3}$
	Open	170	2(+4 multiples)	.012
	Overall	212	2	.009
Room Temp.				$\sim 10^{-5}$

*6 mm weephole

It should be noted that this table represents an "optimistic" case which does not consider mechanical failures associated with rapid thermal expansion (page 10 of the Sandia report) or the affect of dirt (another factor of 2). From the aforementioned table, one finds that for high temperatures an optimistic failure probability for protected terminal blocks may be as high as 0.14, whereas unprotected terminal blocks may have failure probabilities of 0.3. These aspects of the Sandia report are not presented in RES's May 22 memo. Because electrical equipment failure

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probabilities are highly dependent upon temperature (terminal block failure probabilities of 10^{-5} to .3 with an error band as high as 2 when taking cleanliness into account), I suggest that prior to assigning failure probabilities to the electrical equipment* affected by the SDV piping failure outside containment, specific room configurations, specific equipment, and the resulting local temperature and moisture profiles must be considered.

3. It is my understanding that the quality, quality assurance, engineering analysis, fabrication techniques, in-service inspection, corrosion protection, etc., associated with the piping which is postulated to fail is inferior to that of the associated reactor cooling system piping. Therefore, I question whether the numbers used for the initiating pipe failure probability are too low (perhaps a factor of ten). Note that this rationale was used by WASH-1400 in concluding that the failure probability of the RPV was 10^{-7}/yr, even though general vessel failure data predicts a probability of 10^{-6}/yr. Analysis, QA requirements, testing, etc., are thought to give us a factor of ten improvement; therefore, the probability used for a reactor vessel failure is 10^{-7}/yr.

4. I believe that caution should be used in applying the favorable BWR scram discharge piping experience data which has been accrued, e.g., 3900 successful dynamic challenges was translated to a failure rate of 8×10^{-4}/scram loading with a 95% confidence (chi-square). However, I can similarly show that given 3000 successful reactor years of operation prior to the TMI-2 accident (world's LWR experience), the accident rate is about 10×10^{-4}/reactor year with a 95% confidence (chi-square). These numbers are not all that consoling -- when one observes that the TMI-2 accident did happen.

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*Electrical equipment failures should not be limited to just terminal blocks.

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