For PDR
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April 9, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

MEMORANDUM FOR: Robert B. Minogue, Director
Office of Nuclear Regulatory Research

FROM: Frank H. Rowsome, Deputy Director
Division of Systems and Reliability Research
Office of Nuclear Regulatory Research

SUBJECT: TECHNICAL ISSUES IN COMMISSIONER AHEARNE'S QUERY OF MARCH 24, 1981, ENTITLED, "ROLES OF COMPONENT/HARDWARE BEHAVIOR IN ACCIDENT SEQUENCES"

The subject letter cites a number of examples in which the treatment of accident process phenomenology and the consequent equipment challenges or failures are afforded rather simplistic or presumptuous treatment in our IREP studies. Many of these are an expected consequence of the scope and objectives of IREP. A few are deficiencies even within the terms of IREP objectives.

IREP is intended as a model of a "quick and dirty" survey of the susceptibility of a plant to core melt accidents that could be performed by licensees quickly and without great cost. Many of the refinements we would like to see in state-of-the-art risk assessments are deliberately sacrificed to minimize the skills and man-hour requirements for such studies. The IREP program is predicated on our belief that it is preferable to survey many plants quickly than a few plants thoroughly. There are several reasons we believe extensive application is better than intensive application:

(1) Many reactor owners/operators will be directly involved in a widespread IREP program. This would not be the case if a few licensees hired consultants to do massive PRA studies. We believe the widespread owner involvement is an intrinsic benefit.

(2) Many of the safety weaknesses responsible for the historical close calls were unique to the subject plant or to a few similar plants. Intensive studies of a few plants could miss such weaknesses in design or operation of individual plants.

(3) IREP should serve as a building block for more intensive, subsequent PRA refinements. The investment of resources in IREP should not be lost if and when follow-up studies are done. Thus we can think of IREP/NREP as the first phase of a more thorough, intensive application of probabilistic safety analysis.

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The simplifications in IREP adopted to minimize the resource requirements (analyst skills and time) include the omission of thermal hydraulic analysis of core uncovery, containment challenge analysis, and consequence analysis. In the Commissioner's first example, the accident sequence TMLB' entails the failure of all bulk AC power supplies. There is no core cooling, and no containment heat removal. We know that the containment pressure will rise until the rise is limited by containment failure. We can infer from previous studies the time of and pressure at failure within a factor of 2 or so. It is out of scope for IREP to calculate the details of containment atmosphere response or of containment failure, as this is not relevant to the goal of identifying how the plant might get in this fix and roughly estimating its likelihood. It would be interesting, though peripheral to IREP objectives, to calculate the time and pressure at failure of the containment and to determine the isotopic release. This can be done later if desired. IREP will give a cursory, qualitative treatment of the possibility that AC power might be restored before core damage or in the interval after the core is lost but before the containment bursts on overpressure. Repair of faulted equipment will be addressed in IREP accident analysis, although not in the initial screening of accident sequence likelihood used to sort important accident scenarios from the less important ones.

Commissioner Ahearne's second example entails reactor vessel rupture due to thermal shock. There will be a niche in the event tree analysis in IREP appropriate to reactor vessel rupture but the analysis of the structural mechanisms and likelihood are outside IREP scope. That, too, can be added later.

The third example involves ATWS. The treatment of scram failure in the IREP BWR studies include the explicit consideration of whether or not HPCI, RCIC, SLC, etc. function, and likelihoods are developed for each variant sequence, but not a consequence analysis. In the PWR analysis of scram failure, the effects of the reactor coolant pressure spike are not being modeled. We will instruct the IREP teams to make sure that their event trees can accommodate each of the possible outcomes of the pressure spike, in order to preserve the applicability of the IREP building block concept. IREP teams are not, however, expected to calculate the pressure spike or the likelihood of the several kinds of failure it might cause.

The Commissioner's letter suggests that the phenomenological analyses that are missing from IREP would improve its value as a source of technical and regulatory insights. This is unquestionably true. Such complementary, phenomenological analyses can be done as a follow-up. It will be essential to do this in the applications of PRA to rulemakings and regulatory guide development such as the degraded core, minimum engineered safety feature, and emergency planning rules. Some of this supporting phenomenological analysis is already being done under the Severe Accident Sequence Analysis program or the work under the SAPMR decision unit in DAE (nee RSR).

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Nonetheless, the coordination between DSRR and RSR has not been as good as it should become. We need to develop a mechanism to fold our PRA-based needs for input from DAE into their hopper along with outside user needs. Bob Bernero and I will work with Sam and Charlie to work out the details.

/s/

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