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PROBABILISTIC METHODS IN REACTOR LICENSING

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by
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designers can, with proper care, use these techniques in evaluating the reliability of various design configurations of safety systems. However, in the design stage generally only component failure, and perhaps some human error, contributions can be included in a fault tree. This generates a value that might be termed the "design-base" unavailability. The "operation-based" unavailability, i.e., that which is actually achieved in plant operation, may be significantly higher because of human errors and common cause failures which are not included in fault trees constructed at the design stage. Even though such hardware fault trees are incomplete, they are of utility in identifying component problems and in comparing different system designs. However, to the extent that variations in design can be influenced by different contributions from human errors, testing, maintenance, and common cause failures, care must be exercised in the conclusions drawn from such efforts.

It is also clear that WASH-1400 techniques can be used to supplement safety evaluations. But we see no need for, or safety benefit to be derived from, the complete risk and reliability analyses of entire applications for nuclear power plant licenses. It is our view that safety decision-making is a complex matter and should not lightly be changed, especially where a good safety record has been achieved as is so far true for nuclear power plants. I will talk more about this later.

Acceptable Levels of Risk

There is some existing opinion that it is necessary to define an acceptable level of safety for nuclear power plants and then to determine whether each plant meets that standard. While it would certainly be useful to have acceptable levels of safety established and, although others have done and are now doing some work of this type, we are not aware of any large scale technology in the U.S. where such determinations have been made; nor are we aware of successful schemes to allocate the overall risk among the various elements in a particular endeavor. It seems that the quantitative determination of acceptable levels of risk on a broadly socially acceptable basis for any endeavor will be a formidable task. Although we feel that WASH-1400 made a first step in quantitative risk assessment, the quantification of benefits and the comparison of risks and benefits in commensurate terms appear to be extraordinarily difficult and will require many years of research.

We have received letters in the past year from the Natural Resources Defense Council and EPA strongly suggesting that we develop criteria for acceptable levels of risk. We have had meetings with EPA and we have agreed that such work would be useful, but that it would involve a long-term program. So we are now committed to working in this area and are in the process of formulating a program.

Our thinking in this area is preliminary and we are certainly open to suggestions as to how to proceed in this endeavor. I have so far only discussed the difficulties in doing such work as it relates to a long-term program that would involve the quantification of benefits and the quantitative comparison of benefits and risks. A shorter-term approach is possible if the scope of activity is limited to cover only the generation of electric power. This approach would not require quantification of the benefits of electric power or the quantitative balancing of its benefits and risks. It is clear, then, that a balancing of costs and risks (not just accident risks, but all the risks associated with each fuel cycle) involved in the various ways of generating power can be done; in fa t much of the work has already been done.

There will be difficulties associated with this short-term approach. In making the risk comparisons, the nuclear reactor accident risk portion of the nuclear fuel cycle risks would be derived from WASH-1400. Thus, a question already raised will again come to the fore--to what extent should WASH-1400 be used for policy making? Although this is not an important question now, since WASH-1400 results are not being used in policy making, the quantitative comparison of electric power generating risks will involve the use of WASH-1400 in just that way. And, of course, the real question that remains unresolved in the minds of some is how good are the WASH-1400 estimations of risk. Another question will relate to how satisfied such organizations as NRDC, EPA, and others will be without an absolute quantification of benefits and risks. Without knowing the answers to these questions, perhaps we should follow two approaches, both the long-term and short-term, and then reexamine the situation after further development takes place.

Certainly, for now, it seems that for either approach we will have to do more work to gain broader acceptance of WASH-1400 probability predictions. This will likely involve the further clarification of perhaps a dozen or so issues and perhaps even some changes in our predictions in order to settle the matter and make its use in these assessments acceptable.

Utilization of Reactor Safety Study Techniques

As I stated earlier, it is now clear that the safety review of nuclear power plants can be assisted by the engineering insights and techniques developed in WASH-1400. One of the most useful applications of WASH-1400 techniques is the analysis of postulated accident sequences to determine whether they would have contributed to the core melt probability predicted in WASH-1400. Although care is necessary to ensure the validity of such comparisons among different plants, it has been found that much useful work can be done in this area. For instance, as an example of a practical utilization, an analysis was performed by the Nuclear Regulatory Commission to investigate the risk from seismically-induced fires. The question was