Staff Reports to The President's Commission on The Accident at Three Mile Island

Technical Assessment Task Force Reports

Note: This is a historical document. The conditions and situations described here are those that existed in 1979, which differ significantly from the nuclear industry and its regulators of today.

Index of Reports:

TMI Reports (home)
Commission Report

Tech. Assessment Task Force Vol. I

Task Force Staff
Reports Summary
Sequence of Events

Technical Staff Analysis Reports Summary

WASH 1400

Back Next

WASH 1400 (The Rasmussen Report) was published in 1975. It was intended to estimate the probabilities of occurrences of accidents involving radioactivity release and to assess the risk of such accidents relative to other risks. The study involves (1) a list of potential accidents in nuclear reactors, (2) estimation of the likelihood of accidents resulting in radioactivity release, (3) estimation of health effects associated with each accident, and (4) comparison of nuclear accident risk with other accident risks. The study determined that the nuclear accident risk was small - almost negligible compared with more common risks.

The WASH 1400 risk assessment was subsequently reviewed by a Risk Assessment Review Group in 1977 (the Lewis Report) that concluded that "they were unable to determine whether the absolute probabilities of accident sequences in WASH 1400 are high or low, but believes that the error bounds on those estimates are, in general, greatly understated." They went on however to say:

> WASH-1400 was largely successful in at least three ways: in making the study of reactor safety more rational, in establishing the topology of many accident sequences, and in delineating procedures through which

quantitative estimates of the risk can be derived for those sequences for which a data base exists.

Despite its shortcomings, WASH-1400 provides at this time the most complete single picture of accident probabilities associated with nuclear reactors. The fault tree/event tree approach coupled with an adequate data base is the best available tool with which to quantify these probabilities.

WASH-1400 made clear the importance to reactor safety discussions of accident consequences other than early fatalities.

The NRC accepted the findings of the Risk Assessment Review Group and issued a statement which said in part:

> The Commission accepts the Review Group Report's conclusion that absolute values of the risks presented by WASH-1400 should not be used uncritically either in the regulatory process or for public policy purposes and has taken and will continue to take steps to

assure that any such use in the past will be corrected as appropriate. In particular, in light of the Review Group conclusions on accident probabilities the Commission does not regard as reliable the Reactor Safety Study's numerical estimate of the overall risk of reactor accident.

With respect to the component parts of the study, the Commission expects the staff to make use of them as appropriate, that is, where the data base is adequate and analytical techniques permit. Taking due account of the reservations expressed in the Review Group Report and in its presentation

> to the Commission, the Commission supports the extended use of probabilistic risk assessment in regulator decisionmaking (sic).

It is important to note that the Risk Assessment Review Group, while critizing (sic) the risk assessment of WASH 1400 per se, commended the description of accident sequences and the "fault tree/ event tree" approach as an analytic tool for quantifying probabilities of accidents.

The failure of a pressurizer relief valve to close is discussed in WASH 1400 and its likelihood was predicted on the basis of actual experience with relief valves. WASH 1400 goes on to state that normal response to this failure is actuation of emergency core cooling to avoid excessive loss of water from the reactor. It states that failure to remove heat from the core could lead to core meltdown or damage and that operator action is required to prevent meltdown. (In TMI-2 the operators turned off the emergency core cooling system.)

Although the absolute risk assessment of WASH 1400 was questioned, the message that the reactor accident risk is dominated by the small- break loss-of-coolant accident and by transients initiated accidents is quite clear and was not contested. Thus, emphasis should have been given in reactor research, design considerations, operator training, and safety procedures to the amelioration of these events. This does not seem to be the case. NRC and the industry are still focusing on the "design basis (large) accidents" that admittedly have great consequence but low probability

of occurrence.

LESSONS THAT SHOULD HAVE BEEN LEARNED FROM WASH 1400

WASH 1400 contains three important messages. These involve expected frequency of accidents, methods for improving reactor safety, and the most likely types of accidents. Perhaps it is a fault of the report that these messages were not emphasized, because the conclusions most often associated with WASH 1400 -- reactors are safe -- receives the primary emphasis in the report. Perhaps it is the fault of the NRC that more effort was dedicated to criticize, WASH 1400 then was applied to understand its messages. In fact, WASH 1400 predicted that accidents could happen although most would present little or no public hazard. One message of WASH 1400 is that while nuclear accident risk is small compared to other societal risks, accidents similar to Three Mile Island should have been expected. These accidents were not emphasized in WASH 1400, because they do not contribute as significantly to risk as the more severe core melt accidents (See Rasmussen deposition, Sept. 15 1979, pp. 35-36).

The WASH 1400 study, in using the "event tree" and "fault tree" methodologies, borrowed from the aerospace industry, actually revealed a "weak link" in the safety of the Surry reactor. This led directly to a change in inspection procedures at Surry and reduced the probability of one major risk contributing accident (see Rasmussen deposition, Sept. 15, 1979 pp. 26-29) by a factor of 20 (p. 63, Main Report). Thus, another message of WASH 1400 is that application of these methods to analysis of a specific reactor should be used to reveal "weak links" in safety.

Recently, NRC officials have endorsed a plan to apply WASH 1400 techniques to the

analysis of other existing reactors for this purpose (see Levine deposition, Sept. 15, 1979, pp. 25-26). Since the accident at Three Mile Island, NRC has applied reliability analysis to the study of auxiliary feedwater availability in all U.S. commercial reactors.

Reactor safety research, both before and after WASH 1400 was published, has concentrated on the double ended pipe break, or large loss- of-coolant accident. Safety systems were designed specifically to accommodate this accident. Yet, the WASH 1400 results published in 1975 indicated that reactor accident risk is dominated by small-break loss- of-coolant accidents and transient initiated accidents, like Three Mile Island. A third message of WASH 1400 is the relative efforts in reactor safety research for large loss-of-coolant accidents, and transient initiated accidents should be consistent with priorities suggested by their relative risk contributions. Generally, NRC has based priorities on "good engineering judgment" (see Rasmussen deposition, Sept. 15, 1979, pp. 56-57), although the Lewis Report and the NRC commissioners have recently endorsed the use of WASH 1400 techniques to carry out more effectively the licensing. In fact, the NRC staff has successfully applied the techniques to prioritize safety issues, overpressurizing of vessels, and optimization of inspection time intervals (see Rasmussen deposition, Sept. 15. 1979, pp. 58-59).

It should be noted with regard to small-break loss-of-coolant accidents (LOCAs) that it was thought by NRC that safety systems designed to accommodate large LOCAs would necessarily be adequate to deal with small LOCAs (see Budnitz deposition, Aug. 27, 1979, pp. 28-30). It should have been clear from WASH 1400 treatment of PORV transient- initiated LOCAs that such was not the case.

Instead, WASH 1400 was taken by NRC as an affirmation of their good regulatory work (see Budnitz deposition, Aug. 27, 1979 pp. 33).

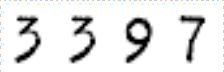
Further, procedural considerations inhibit the application of WASH 1400 techniques. It is very difficult to apply properly the techniques, and few people are trained or experienced in such work (see Levine deposition, Sept. 15, 1979 pp. 20-21). Also, the criticisms of WASH 1400 techniques by NRC Commissioners left the NRC staff unmotivated to develop ways to apply the techniques. Since the Lewis Report and the Three Mile Island accident, this trend appears to be reversing.

TMI-2 AND WASH 1400 RISK ASSESSMENT

If WASH 1400 predictions of the best estimate probabilities are valid, there was a 13 percent chance of having an accident at the time of TMI-2. Further, there was an 80 percent chance that the accident would occur in a PWR rather than a BWR. The WASH 1400 upper bound probabilities yield a predicted 80 percent chance of having an accident after 400 reactor-years of operations of nuclear power systems in the United States. The TMI-2 occurrence is therefore within the bounds of the WASH 1400 predictions.

Fault tree analysis techniques of the WASH 1400 type are extremely valuable to determine where effort can best be put to insure reduction of failure rates of critical elements of existing plants and proposed new designs as rapidly as experience and technology permit.

Back Next



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e-mail | interesting links