The value estimates can be looked at in terms of reduced risks (which considers the probability of ATWS). Reduced risk is defined as the product of consequences and probability of ATWS event.

Table (1) summarizes the reduced risk values and direct cost impacts of ATWS requirements for the different designers. Only alternatives (2b) and (2d) [see commission's paper] are considered in this table. Alternative (2d) is the intended final resolution of ATWS for plants that receive their operating license on or after January 1, 1984. Alternatives (2b) and (2c) would be considered for implementation on other plants licensed before January 1, 1984. Impact of alternative (2c) is less than that of alternative (2d). Impact of alternative (2a) is less than that of alternative (2b) and it is plant-specific for very early plants which are too unique in design to be classed with the remainder of the plants for generic analysis.

Summary of Uncertainties in Analyses

There are still substantial uncertainties that could be important to either the decision process or to substantiation of judgmental positions taken by the staff. These uncertainties are discussed below, categorized as to whether they are likely to affect the impact or the values.

a. Impacts

(1) Cost uncertainties for design, materials, and labor to modify a plant. At this stage there is some uncertainty as to what modifications would eventually be required, and the staff believes that in general the vendors' estimates are too high in this regard. Uncertainties in these assumptions and uncertainties in staff projections of costs may subsequently be

TABLE 1. SUMMARY DIRECT REDUCED RISK VALUE* AND DIRECT COST IMPACT OF ATWS REQUIREMENTS
1980 DOLLARS IN MILLIONS PER PLANT LIFETIME

| | Operating Plants | | Plants Under Construction (Construction Permit Issued) | | | | | | Future Plants (Construction Permit Not Issued) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fuel Load Date Before 1/1/84 | | Fuel Load Date After 1/1/84 | | | | | |
| | Alternative 2b | | Alternative 2b | | Alternative 2b | | Alternative 2d | | Alternative 2d | |
| Designer | Impacts | Values | Impacts | Values | Impacts | Values | Impacts | Values | Impacts | Values |
| Babcock & Wilcox | 2.8 | 2.2 - 8.7 | 2.0 | 2.3 - 8.6 | 2.0 | 2.3 - 8.6 | .9 | 2.3 - 8.7 | 2.5 | 4.0 - 14.9 |
| Combustion Engineering | 2.6 | 2.2 - 8.7 | 1.8 | 2.3 - 8.6 | 1.8 | 2.3 - 8.6 | 1.1 | 2.3 - 8.7 | 2.5 | 4.0 - 14.9 |
| Westinghouse | 1.7 | 4.3 - 17.4 | 1.2 | 4.6 - 17.3 | 1.2 | 4.6 - 17.3 | .6*** | - 0 | 2.0 | 4.0 - 14.9 |
| **General Electric | 3.5 | 24.0 - 60.0 | 3.2 | 24.2 - 58.8 | 3.2 | 24.2 - 58.8 | *** 7.6 | 1.4 - 3.1 | 6.7 | 22.0 - 53.2 |

*Indirect values are not included in this table. They were included in NUREG-0460, Vol. 2, App. XII and in submittal to ACRS.

**No cost was included for cleanup and downtime resulting from inadvertent actuation of poison injection system (estimated $200,000 to $8,000,000 per plant lifetime).

***These values are likely to be conservative, especially those for Westinghouse plants and for theose GE plants where the SLCS piping is not in place yet.

c. Modifications to provide mitigation of essentially all ATWS events.

d. Modifications to provide for increased prevention and for mitigation of essentially all ATWS events.

B. Discussion and Comparison of Technical Alternatives

Alternative 1. This is a "do nothing" alternative. Choosing this alternative corresponds to a conclusion that current reactor scram systems provide adequate protection from common mode failures. However, the overall risk of severe consequences summed over a long period of time and a large number of plants is too large in comparison with other sources of risk.

Alternative 2:

2a;

This alterntive includes a requirement for recirculation pump trip (RPT) for all BWRs plus supplementary equipment to increase the scram reliability (i.e., reduce the probability of an ATWS)for PWRs and BWRs. For PWRs, choosing this alternative corresponds to a conclusion that the mechanical portions of reactor scram systems have adequate protection against common mode failures, but the electrical portions need improvement. For BWRs, a similar conclusion would apply with the addition that improvements in the scram discharge volume of the BWR hydraulic drive systems are needed to reduce its common mode failure potential.

2b;

This alternative includes all the modifications of alternative 2a and adds improvements in the assurance of some ATWS mitigation capability.

2c;

This alternative includes all the modifications to provide mitigation of essentially all ATWS events.

2d;

This alternative corresponds to the final resolution (prevention and mitigation) of all ATWS events for those plants that receive their operating license on or after January 1, 1984.

C. Decision on Technical Approach

Consideration of risk leads to the conclusion that some action on ATWS must be taken. The following table shows the staff estimated probabilities of an ATWS event with the proposed changes made which are included in alternatives 2b and 2d.

| Design | Probability of ATWS Events Per Reactor-Year | | |
|---|---|---|---|
| | Current | Alternative 2b | Alternative 2d |
| Babcock & Wilcox | $8 \times 10^{-5}$ | $4 \times 10^{-5}$ | $10^{-6}$ |
| Combustion Engineering | $8 \times 10^{-5}$ | $4 \times 10^{-5}$ | $10^{-6}$ |
| Westinghouse | $8 \times 10^{-5}$ | $10^{-6}$ | $10^{-6}$ |
| General Electric | $2 \times 10^{-4}$ | $10^{-5}$ | $10^{-6}$ |

Implementing alternative 2b would decrease the ATWS risk by a factor of 20 for BWRs, a factor of 2 for CE and B & W plants, and a factor of 80 for Westinghouse plants. Going from alternative 2b to alternative 2d would decrease the ATWS risk by an additional factor of 10 for BWRs and a factor of 25 for B & W and CE plants.