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Dr. Paul Boehnert
Staff Engineer
Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards
Room 1044B
1717 H Street NW
Washington, D.C. 20555

Dear Paul:

Attached are my comments on the Utility Group's response to the NRC proposal for reducing the risk of ATWS sequences. I look forward to meeting you on October 1 at the ACRS meeting.

Sincerely,

Chuck Mueller

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Comments on Utility Response Re ATWS

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We have broken this review into three sections, Overview, Specific Comments, and General Conclusions.

Overview of Comments

The twofold thrust of the Utility Group's response is first that the Utility Rule should be adopted by the NRC as the solution to ATWS and second that the two NRC Rules are clearly not acceptable solutions.

To demonstrate its case the Utility Group puts forth four major arguments:

1) ATWS is an acceptable risk now and that Utility Rule improvements will improve an already acceptable safety posture.
2) The Utility Rule is more cost-effective than the NRC Rules.
3) Only the Utility Rule is consistent with current policies.
4) The record and notice for the NRC Rules are inadequate.

In the letter to the Secretary of the NRC by the Counsel to the Utility Group the latter three arguments are cited as the three "reasons" the NRC should adopt the Utility Rule; the first argument is an overriding theme repeated in both the letter and the supporting documentation.

The purpose of this review is to assess the supporting information for the arguments outlined above to assist the ACRS in evaluating the twofold thrust of the Utility Group position. Actually, our comments will be focussed on our review of the information supporting the first two arguments.

At the outset of this review, it is worthwhile to state that we concur with the Utility Group's feeling that any rule dealing with ATWS should reduce total risk (vs just ATWS risk) to an acceptable level and that the rule must be cost effective. Whether the Utility Group's Rule satisfies these criteria to the exclusion of the NRC rules is, of course, a major point of the ACRS review. One question that seems appropriate with respect to actions taken as a result of the different proposals on ATWS is whether any action should be taken prior to the establishment of firm requirements (safety goals?) that must be met. Presumably, the action taken would be dependent on the results required which are not quantitatively defined.

Another question involving actions concerns the overall use of risk requirements in reliability assurance programs. The purpose of the Hendrie rule was to reduce ATWS risk via formal reliability assurance programs. Clearly it is a small extrapolation to extend the objectives of the Hendrie rule to all risk-significant accidents. There seems to be universal acceptance that a well-defined reliability assurance program has the potential of significant benefits and should be considered for plant wide application. As we pointed out to the ACRS before undertaking the review, ANL is currently involved in a research program for the NRC to investigate the requirements of such a program. If such programs were to be initiated within the industry, ATWS-specific fixes such as described in all the proposed Rules might become unnecessary.

To summarize the thrust of our specific comments which follow herewith, we feel that a number of the statements made in support of the acceptability of the Utility Rule vis-a-vis the two NRC Rules are based on unfair qualitative comparisons and value-impact comparison numbers whose overall uncertainties probably swamp the indicated differences among them. Another concern is the plant-to-plant variation in overall plant risk as well as ATWS risk. While recent PRA's seem to demonstrate this variation to be substantial among different plants, comparisons made in the Utility Group documentation are along generic plant type lines. Thus, a specific plant may have a risk posture requiring improvements that are not compatible with the recommended fixes in all the proposed Rules.

The above discussion, as well as the specific comments that follow, are presented as information that could be considered in resolving any risk-significant accident and its solution as well as evaluating the Utility Group's response to the ATWS issue.

Specific Comments

1. Comments with respect to ATWS Risk Acceptability

1.1 Current Acceptability of ATWS Risk

An unstated underlying principle of this review is that if ATWS risk were acceptable with sufficient certainty, no proposal Rules would exist. Until quantitative acceptability criteria (safety goals?) are set, however, it is hard to see how an industry-wide fix, even on a generic plant basis, can be made or justified. With safety goals to be set after the fact, there would be the economic risk that the fixes were insufficient or represented expensive safety overkill. In the actual wording of the Utility Group Rule, p. 5 of Appendix C, there is an exemption clause, "If a licensee can demonstrate, based on a plant-specific analysis, that any or all of the measures required by ¶ 50.60 would not produce a significant increase in safety at his plant, then he need not adopt those measures". However, how such a demonstration would be made is not clearly defined, seeming to create a Catch-22 situation with respect to implementation of ATWS fixes.

1.2 ATWS Risk with Utility Group Rule Improvements

The bottom line ATWS Risk after Utility Group improvements is calculated to be 0.15×10^{-4} ATWS-caused core melts/reactor year. Many qualitative arguments, some of which are discussed later in this review, are presented as to why this calculation overestimates the true but unknown frequency.

Herewith we very briefly discuss some of the key assumptions that seem to separate the current studies from past studies and our major concerns regarding them. Because of time limitations we limited our review to BWRs and the following comments are based on this class of plant.

- Scram unavailability -- this rate is assumed to be the NUREG 0460 value of 3×10^{-5} in the absence of modifications. However, this is reduced to $\sim 1 \times 10^{-5}$ via the following arguments:

  --One third (1×10^{-5}) of the above unavailability is assumed to be due to failures in the mechanical subsystem, based on the historical record that only one (Browns Ferry) of the three events (Browns Ferry, Kahl, Monticello) that had the potential to cause failure to scram was a mechanical subsystem failure.

  --The proposed alternate rod injection system (ARI) will have an unavailability of 10^{-2}. Thus, the contribution of the electrical subsystem to the RPS unavailability becomes $2/3 \times 3 \times 10^{-5} \times 10^{-2} = 2 \times 10^{-7}$ or insignificant.

  The assumption that one third of the RPS failures is due to mechanical subsystem failures is not supported by sufficient operating experience. If the utility analysis had been performed two years ago (before the Browns Ferry event), a much lower estimate for the mechanical subsystem unavailability would have been presented. Further, redesign of the scram discharge volume does not guarantee that there are no other common cause failures of the same frequency as the SDV failure. Whether the ARI unavailability can be assured to diminish to 2×10^{-7} was not investigated. Nevertheless, an overall frequency of 1×10^{-5} may be optimistic.

- Transient Frequencies -- The following transient frequencies were based on operating experience data presented in EPRI NP-801:

  (a) Initial power 0-25%
  1st Year of Operation: 7.1 events/reactor year
  Subsequent Years: 1.61 events/reactor year

  (b) Initial power 25-110%
  1st Year of Operation: 15.8 events/reactor year
  Subsequent Years: 3.51 events/reactor year

  In NUREG 0460, the NRC staff used a frequency of 6 events per reactor year.

  Although a distinction between the first year and subsequent years in estimating transient frequencies can be supported by the existing data, the data cannot support the assumption that after the first year all the subsequent years (2 to 40) can be characterized by the same transient frequency. As a plant becomes older, higher transient frequencies cannot be precluded.

- ATWS Core-melt Frequency -- Based on the above assumptions an ATWS frequency of 4.1×10^{-5} per reactor year is estimated. This estimate is about five times lower than the NRC estimate presented in NUREG 0460 with no plant modifications (4.1×10^{-5} vs 2×10^{-4}). This is further reduced to 0.15×10^{-4} by the addition of improved training and operating procedures, an assumption that we did not review. Any increases in the above contributors to this ultimate frequency would of course translate directly into an increased estimate of ATWS core melt frequency.

2. Comments with Respect to Value-Impact Comparisons

2.1 Conservatism of ATWS Costs

The Utility Group claims its value-impact numbers are conservative, in part because it uses NRC cost estimates which include downtime penalties. On p. 2 of the April 23 cover letter to the Secretary of NRC, it states that downtime should not be considered in value-impact numbers. Why not?

It also claims conservatism on the basis that exceedance of certain design parameters was treated as the equivalent of core melt and offsite damage. An estimate of this conservatism should be quantified, probably in terms of the combined conditional probabilities of ATWS causing core melt and subsequent offsite damage.

In short, two claims for conservatism are made: the first is not defended qualitatively or quantitatively; the second is not quantified.

2.2 Value-impact Quantitative Comparisons

Comparisons are only made between the value-impact of the Utility Rule and the incremental value-impact of implementing the NRC Rules above and beyond implementation of the Utility Rule. No direct comparisons are made. Although an incremental comparison may provide a means of measuring the worth of the additional costs imposed by Rules other than the Utility Groups, avoiding the direct comparison is a clear biasing of the presentation of material and does little to provide reviewer confidence in any comparisons.

To understand what was done in the Utility Group V/I comparison, and indeed to arrive at a direct comparison, we redid the arithmetic comparisons for the GE BWR case assuming all Utility Group assumptions to be correct. The Table shows our manipulations. Rather than the incremental ratios of 30 calculated for BWRs in the Utility Group study, ratios of 2 1/2 to 3 are found.

The significance of this comes to bear when the uncertainties in all the estimates associated with both value and impact are considered. Those uncertainties tend to make both the incremental and direct ratios calculated for BWRs highly suspect. Since the Utility Study indicates a much closer comparison for values and impacts of the various Rules for PWR application, analogous conclusions on the superiority of the different Rules are even more tenuous for PWRs. An incomplete list of the uncertainties that bear on both incremental and direct V/I ratios follows:

- ATWS Core-melt Frequency -- Each plant as well as plant type has a specified but unknown ATWS core-melt probability for current practice as well as for the improvements associated with each Rule. Incremental changes are known with less certainty than absolute values, which themselves probably vary over at least a couple orders of magnitude for individual plants.

- Value -- the actual worth of ATWS risk reduction is not only arguable but very uncertain as noted in the Utility Group study. The real value would be measured in terms of total risk reduction, which is not addressed. Although it is expected that total risk reduction by ATWS improvements would be largely ATWS risk reduction, the Hendrie Rule reliability assurance program has far greater implications for reduction in overall risk. Other things being equal, the value of the Hendrie rule relative to the other alternatives, especially if the reliability assurance aspects are extended to all risk-significant accidents, is probably greatly underestimated.

- Impacts -- the costs assumed by the Utility Group are likely to be arguable by a factor of several for each alternative. For example, the factoring in of analytic costs for DBA analyses in the NRC Rules would appear to be a questionable practice. We suspect that cost treatments would differ greatly depending upon who was doing the analysis.

- V/I Impacts -- given the above, it would appear that the uncertainties so swamp the absolute numbers, for direct and even moreso for incremental numbers, that such comparisons are meaningless, at least given the information provided in the Utility Response. Since the Utility Group concluded that the greatest superiority for their Rule manifested itself for BWRs, we assume that the comparisons of the Rules for PWRs are at least as suspect.

The upshot of all this is obviously to give little confidence in the Utility-published comparisons and the attendant conclusion that the Utility Rule is the only alternative.

3. Comments with Respect to Consistency with Current Policies

Briefly, the claim is made that the Utility Rule is the only Rule that complies with three principles of sound rulemaking: use of cost-benefit analysis, consideration of competing risks, and use of safety goals and PRA. While we do not know the complete history of the various NRC Rules, we doubt very much whether the NRC generated these Rules immune to these principles. Since we are currently involved in developing a pilot program on reliability assurance that was guided in part by the Hendrie rule, we can say with certainty that a good reliability assurance program is very much tied in to all these principles. In fact, life cycle costs and analysis of competing risk contributions are used in the establishment of systems reliability requirements. Safety goals obviously would establish the level of absolute risk that the plant would have to meet.

In summary, the claim that the Utility Rule is the only Rule satisfying sound rule making simply appears to be rhetorical.

General Conclusions

To reach general conclusions regarding the Utility Group Rule we questioned the purpose of the review. If the purpose of the review is to broadly assess the Utility Group's investigation, the overriding conclusion is that there are so many uncertainties in the values and impacts of the assorted Rules, that we have little confidence in the numbers actually used for comparison. The general tone of the report, which appears to reflect the Utility Group's frustration over the fact that ATWS is and has been a long standing issue, does not improve our confidence in the comparisons of the Rules.

On the other hand, if the real purpose of this review is to access the acceptability of the Utility Group's Rule, our general conclusions are more favorable. First, we did not attempt to review the PRA-type analysis to verify the claims for safety and overall risk improvements. We assume here, for the sake of argument, that such reviews will be made by others consulting for the ACRS and the NRC and that these reviews will generally support the analyses for the safety improvements cited. If this assumption is borne out, then the safety issue is whether the Utility Rule changes provide an adequate level of safety. As we have pointed out throughout this review, the level of safety achieved will vary from plant-to-plant and some sort of acceptability criterion or safety goal will have to be used to answer this question.

V/I Comparisons of GE BWRs[1]

	ATWS Core-melt Frequency x 10^{-4}/rx-yr	Value[2]	Impact (cost) of Alternative	V/I
Current Practice			-0-	
NRC Estimate	2.0			
SAI Estimate	1.3			
Utility Group Rule	0.15	34.5 M	11.9 M	2.9
Alternative 3A	0.065	37.1 M	27.5 M	1.3
Alternative 4A	0.0065	38.8 M	42.6 M	0.9
Hendrie Rule	0.065	37.1 M	30.5 M	1.2

1. All values for frequencies and impacts taken from the SAI study.

2. Value defined by assigning \$21 M to a decrease in core melt frequency of 0.7 x 10^{-4}/rx-yr as was done on p. 62 of Utility Group Document and by appropriately multiplying by the decrease in frequency relative to the SAI base case for each Rule. For example, the Hendrie Rule Value is (1.3 - 0.065)/0.7 x \$21 M = \$37.1 M.