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Mar. 7, 1983

Mr. Herman Alderman
U. S. Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards
Washington, D.C. 20555

SUBJECT: Review of Dr. Lipinski's concerns relative to reliability computation.

References:
1. Letter, H. Alderman to P. R. Davis, Feb. 22, 1983
2. Letter, W. Lipinski to Richard Major, Jan. 11, 1983
3. Letter, W. Lipinski to C. P. Seiss, Dec. 2, 1982
4. Paper, "Reliability of Engineered Safety Features as a Function of Testing Frequency", Nuclear Safety Magazine, Vol. 9, No. 4, July-Aug. 1982.

Dear Mr. Alderman,

Pursuant to your recent request (Reference 1), I have reviewed Dr. Lipinski's concerns as expressed in Reference letters 2 and 3. I have the following comments:

1. Use of average reliability over an interval- Dr. Lipinski contends in reference letter 2 that use of the standard formula for computing average reliability over an interval is non-conservative, and that conservative analysis should be used in reliability analyses. I agree with Dr. Lipinski that using an average reliability over an interval is non-conservative (it is instead best estimate), but I do not agree that conservative analysis should be used in risk and reliability assessment. These issues are discussed separately as follows:

A. Use of an average reliability over a test interval produces a best estimate result for the case when system demand occurs at a random time during an interval. Since there is generally no coupling between the occurrance of the demand and the time since the system was last tested, the approach is valid. A conservative approach that could be used would be to use the computed reliability of the system at a time just before the next test. However, for essentially all system reliability assessments important to nuclear plant safety, these two approaches would not produce substantially different results (i.e.- the reliability of the system is not a strong function of the elapsed time since test). For example, if the failure rate is between 10^{-4} and 10^{-6}/hr., and the test interval is 200 hr. (about one month), the difference is about a factor of two between the average and maximum (end of test interval) reliability. These numbers are fairly typical of many nuclear plant systems.

B. I have always been an advocate of best estimate risk and reliability assessment coupled with a sound uncertainty assessment except for those instances where substantial lack of knowledge or data dictate prudent use of conservative assumptions. (Of course, there are occasions when a conservative approach is useful for bounding of upper limit analysis to determine if a more realistic treatment is necessary). In general, best estimate risk and reliability assessment is more appropriate for the following reasons:

a. Conservative risk assessments can produce an unrealistic and alarming conception of risks.

b. Conservative assessments can obscure the relative risk (reliability) contributors and lead to unwise and possibly counter-productive decisions made in an effort to improve risk (reliability).

c. The NRC's proposed safety goals already appear to include a substantial conservative bias. Attempting to meet these goals with a conservative risk assessment could lead to unrealistic and perhaps impossible system reliability requirements.

For these reasons, I do not agree with Dr. Lipinski that conservative risk and reliability assessments are appropriate except for the circumstances noted.

2. Equipment Testing- On page 4 of Reference 3, Dr. Lipinski states, "If electrical or mechanical equipment is in standby, energizing the equipment (for a test), in general subjects the equipment to stresses greater than those encountered during normal operation (a demand) and can contribute to a reduction in useful life..." While I agree that testing can contribute to a reduction in useful life, I do not agree that testing, in general, subjects equipment to greater stress than a demand. In fact, my impression is that the opposite is true; testing produces less stress than "normal' (demand) operation. I base this impression on the following;

A. In some (perhaps many) cases, a certain amount of equipment "prepping" is done to assure a successful, non-damaging test. This "prepping" may include assurrance that all support systems (lubrication, cooling, power, etc.) are operating in an optimum configuration and prepared for the test, checking all important components of the system for proper alignment before the test, etc. This "prepping" procedure generally produces a more favorable (less stressful) environment for the equipment when it is subsequently tested.

B. In many instances, usually for practical reasons, equipment is not tested "end-to-end" (i.e. from actuating sensor through the actual sustained production of the required sustem response). This produces less stress on the equipment as a whole because some components are not activated.

C. The equipment is not tested under environmental conditions which can be produced by the initiating event (or accident) which initiates the demand. For some equipment, the accident environment can be severe, for some it may be mild, but in many cases the accident environment is not duplicated during a test.

D. The testing period is generally of much less duration than would be required in a demand situation. Extended operation (which can be several months for RHR equipment) obviously produces equipment stresses which cannot be duplicated during limited duration testing.

I hope these comments are of use to you and the ACRS. Please call if you have any questions.

Sincerely,

P. R. Davis

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