September 30, 2005

Patricia Schroeder
Standards Administrator
American Nuclear Society
555 North Kensington Avenue
LaGrange Park, IL 60526

SUBJECT: NRC STAFF REVIEW COMMENTS ON THE AMERICAN NUCLEAR SOCIETY "LOW-POWER AND SHUTDOWN PRA METHODOLOGY STANDARD," DRAFT #6C, JUNE 1, 2005

Dear Ms. Schroeder:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the American Nuclear Society "Low-Power and Shutdown PRA Methodology Standard," Draft #6c, dated June 1, 2005. We find that the draft low power and shutdown (LPSD) standard has considerable merit and potential as a future consensus standard. The staff's general issues with the standard are summarized below.

1. In Section 1.1, the standard indicates that a qualitative risk assessment is within the scope of a probabilistic risk assessment (PRA). A qualitative assessment is not quantitative, and therefore, it is *not* a probabilistic risk assessment.

2. A major contributor to the risk from LPSD operations is human failures due to errors of commission, such as inadvertent drain down, over draining, maintenance on the wrong train, etc. The LPSD standard appropriately relies on the ASME full-power standard to a great extent; however, in this area (addressing errors of commission), reliance on the full-power standard is insufficient, since human errors and failures are a significant element for LPSD operations. Without appropriate consideration of errors of commission, the contributors to risk from LPSD operations will be incomplete. The LPSD standard needs to address errors of commission, specifically, the standard needs to include requirements to identify initiating events and potential recovery strategies and needs to address the dependency between the cause of the initiating events and their mitigation.

3. There is technical difficulty in defining an "average outage." Even when plant operational states (POSs) can be defined in a relatively unambiguous manner, the equipment configurations within those defined POSs can vary from outage to outage. Unlike full power operation, when the equipment taken out of service is constrained by technical specifications, during LPSD operations there are far fewer constraints. Because multiple systems, structures, and components may be taken out of service simultaneously, the basic events in the fault tree models need to represent the unique combinations of equipment out of service (OOS) in order to model LPSD operations properly.

In addition, the OOS times need to be estimated for each combination. Because the number of such combinations is potentially very large, it is not clear if this is feasible. In this case, some sort of bounding sets of configurations would have to be proposed.

The standard needs to address:

(1) Requirements that define the “average” configurations and parameters. In addition, the treatment of configurations in the “average” PRA is highly uncertain, and this has to be recognized as a key uncertainty and handled with appropriate compensatory measures in applications. OR

(2) Requirements that ensure that the LPSD model has the structure that would support a configuration specific assessment, and leave it to the application specific guidance on how to define and evaluate “average” conditions.

4. Screening methodology (Section 4.7 and Appendix C): The use of a reference plant to screen a POS from requiring a quantitative risk assessment as described in Section 4.7 is not appropriate. It is not clear that without doing a detailed review of a reference plant's shutdown PRA, and the reference plant's administrative controls and TS, a comparison of risk between a reference plant and the analyzed plant can be performed. The screening methodology approach is more of a “how to do” than a “what to do,” which is not appropriate for this standard. The method needs to be better defined and tested in a pilot to ensure its appropriateness.

5. The use of the qualitative risk assessment methodology as described in Section 4.8 does not evaluate the quantitative risk of a given POS. The risk levels as described in Section 4.8.2 consider only the number of systems capable of meeting a safety function (i.e., the depth of a licensee’s mitigation capability). The supporting requirements for the qualitative risk assessment in Table 4.8-2 have no correlation with risk. The qualitative methodology does not provide a structured approach to analyze the impact of human error on the likelihood of causing an initiating event in a given POS (i.e., ongoing work activities, availability and quality of instrumentation for determining reactor coolant system conditions and residual heat removal system status, administrative controls, etc.). The method needs to be better defined and tested in a pilot to ensure its appropriateness. Further, since the standard’s objective is to “set forth requirements for a LPSD PRA,” this section is not appropriate for this standard. It needs to be removed and incorporated in a separate standard.

6. The units used for core damage frequency (CDF) are inconsistent between the requirements and Appendix B. The second sentence in the second paragraph of Appendix B states that the CDF for a particular POS, calculated according to the requirements of the standard, is the conditional probability of core damage if the POS “existed for a specified time interval, usually one year.” Supporting Requirement IE-C3, on the other hand, requires the initiating event frequencies to be calculated on a per calender year basis, taking into account the duration of the POS. In piloting the ASME standard there was, in addition, some confusion about the terms reactor year and calender year. A note has been added to IE-C3 in Addendum B to the ASME standard to resolve this issue. The LPSD standard needs to be reviewed carefully to ensure that units are used consistently both internal to the standard and with the ASME Standard Addendum B.

This consistent use of units will ensure, among other things, that the contributions to CDF from the various POS, can be simply added to provide the total CDF.

7. As with the ASME standard, there is concern about the accuracy and robustness of thermal hydraulic codes used for thermal hydraulic analysis at shutdown conditions, particularly given the variety of POS's, reactor coolant system openings, and containment openings. As with the ASME standard, the code requirements for acceptability need to be stated. Specifically, the thermal hydraulic computer codes used need to be (1) developed, validated, and verified in sufficient detail to analyze the phenomena of interest, (2) applicable in the pressure, temperature, and flow range of interest, and (3) utilized by qualified trained users who have an understanding of the code and its limitations.

8. Appendix A, Plant Operational State Analysis Methodology, requires clarification in numerous places and requires additional technical guidance. Until this guidance is developed, it may be more appropriate to remove this appendix. The examples which help in defining the POSs would be useful to ensure definitions have adequate resolution before considering grouping. The examples on page 106 need to be provided as examples within POS-A3.

9. The commentary is useful, but in many cases, it should be more specific. For example, in Supporting Requirement IE-C3, the second paragraph of the note states that the requirement may not be necessary. This comment is not informative, and would be strengthened by an example of when and under what conditions it would not be necessary. In Supporting Requirement IE-C4, the commentary suggests that it might be necessary to develop different criteria. An example of when this might be the case would be useful. In general, additional commentary should be considered where it can help highlight the special considerations, but it should be explicit, even if only through the use of examples.

We believe that this standard, in its current form, has a number of issues that require resolution before the standard is adequate for use in regulatory applications. We recognize that to resolve some of the issues, it is necessary to "pilot" or "test" the standard. Therefore, we understand that the standard will need to be issued and then revised before all the issues are completely resolved. Further, it is anticipated that this standard, similarly to the ASME standard, the NEI peer review and self-assessment process, and the ANS external events standard, other issues will be identified once the standard is issued and used. Consequently, we strongly encourage ANS to issue this standard for trial use as expeditiously as possible.

The NRC staff supports the development of the standard and will continue to work with the writing and steering committees to address these comments. The NRC staff person (Daniel O'Neal) on the ANS LPSD writing group will provide more detailed comments and explanations for the above comments along with proposed resolutions for ANS consideration. If you have any questions, please call Daniel O'Neal of my staff at 301-415-4146.

Sincerely,

/RA/ N.Chokshi for

Charles E. Ader, Director
Division of Risk Analysis and Applications
Office of Nuclear Regulatory Research

cc: K. L. Kiper, FPL
S. P. Burns, SNL
J. R. Lehner, BNL
M. B. Gardner, ANS

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