POLICY ISSUE
(Information)

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For: The Commissioners

From: James M. Taylor
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Subject: USE OF DESIGN ACCEPTANCE CRITERIA DURING 10 CFR PART 52 DESIGN CERTIFICATION REVIEWS

Purpose: To provide the Commission with a method for using design acceptance criteria (DAC), together with detailed design information, during the 10 CFR Part 52 process for reviewing and approving designs. The staff is proposing this approach to the design review and resulting design certification to resolve the difficulties being experienced in obtaining detailed design information for selected areas of the plant, during the design reviews of the General Electric Company (GE) advanced boiling water reactor (ABWR), and the Combustion Engineering, Incorporated, (CE) System 80+.

Summary: This paper describes the staff's current approach for using DAC during the 10 CFR Part 52 design certification reviews. It is expected that the staff's positions will become more fully developed as experience is gained during the ABWR and System 80+ design reviews.

Background: On October 17, 1991, the NRC staff briefed the Commission on alternative approaches to 10 CFR Part 52 design certifications. The staff discussed the use of DAC during the staff's design review and subsequent safety determination. This paper responds to the Commission's request for additional information and to the staff requirements memorandum (SRM) of November 7, 1991.

NOTE: TO BE MADE PUBLICLY AVAILABLE IN 10 WORKING DAYS FROM THE DATE OF THIS PAPER

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Since issuing 10 CFR Part 52 on April 18, 1989, the NRC staff has worked closely with the industry and applicants to review the facility designs and develop the procedures and policies to effectively implement 10 CFR Part 52. The staff has submitted Commission papers on the level of design detail (SECY-90-377); inspections, tests, analyses, and acceptance criteria (ITAAC) (SECY-91-178); the ITAAC requirements for issuing a final design approval (SECY-91-210); severe accident mitigation design alternatives for certified designs (SECY-91-229); and the resolution of selected technical and severe accident issues for evolutionary light water reactor designs (SECY-91-262).

In reviewing the designs for the GE ABWR and the CE System 80+, the staff has identified a number of technical review areas for which the applicants are not providing design and engineering information at a level of detail customarily reviewed by the staff in reaching a design final safety decision. These areas include pipe stress analyses, radiation shielding and airborne concentrations, instrumentation and control systems, and control room design details. The staff discussed two of these areas in SECY-91-272, "Role of Personnel and Advanced Control Rooms in Future Nuclear Power Plants," of August 27, 1991, and SECY-91-292, "Digital Computer Systems for Advanced Light Water Reactors," of September 16, 1991.

The primary reasons for the vendors not providing this detailed design information include a consideration of: (1) technologies that are changing so rapidly that it would be unwise for the NRC to freeze the details of the design many years before an actual plant is ready to be constructed, and (2) design areas such as pipe stress and support analyses, where vendors do not have sufficient as-built, or as-procured information to complete the final design.

Discussion: Part 52 of the regulations requires the applicant for a design certification to provide the technical information required of applicants for construction permits and operating licenses by 10 CFR Parts 50, 20, 73, and 100. The applicant must also provide information regarding the Three Mile Island requirements, the postulated site parameters, the resolution of unresolved safety issues and medium- and high-priority generic safety issues, a design-specific probabilistic risk assessment (PRA), ITAAC, interface requirements for the non-certified site-specific design features, and ITAAC for the interface requirements. Section 52.47(a)(2) states the following:

> The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted.

The Commission previously issued guidance on the level of design detail required for design certification. The SRM of February 15, 1991, SECY-90-377, "Requirements for Design Certification Under 10 CFR Part 52," states that applications for design certification should:

> (1) reflect a design which, for all structures, systems, or components that can affect safe operation of the plant, is complete, except to the extent that some further adjustment to the design within established design envelopes may be necessary -- during what the staff has referred to as the design reconciliation process -- to accommodate actual, as-procured hardware characteristics; (2) encompass a depth of detail no less than that in an FSAR at the operating stage for a recently licensed plant, except for site-specific, as-procured, and as-built information; (3) be sufficient to allow staff to evaluate the resolution of severe accident issues in the design, as well as to incorporate the experience from operating events in current designs which we want to prevent in the future; and (4) provide a sufficient level of detail to ascertain how the risk insights from the design-specific PRA are addressed in the design.

The concept of design acceptance criteria (DAC) would enable the staff to make a final safety determination, subject only to satisfactory design implementation and verification by the combined license (COL) licensee, through appropriate ITAAC. It would be limited in use, and would resolve some of the level of detail problems being experienced during the ABWR review.

The DAC are a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in a limited number of technical areas, in making a final safety determination to support a design certification. The DAC are to be objective (measurable, testable, or subject to analysis using pre-approved methods), and must be verified as a part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design. That is,

the acceptance criteria for DAC become the acceptance criteria for ITAAC, which are part of the design certification. The extent to which the NRC accepts the use of DAC will vary between technical areas and between the various vendors' applications.

Design acceptance criteria would have to be sufficiently detailed to provide an adequate basis for the staff to make a final safety determination regarding the design. The use of DAC would result in less design detail, and more detail regarding how the DAC acceptance criteria will be demonstrated by the COL licensee during construction. Analysis methods, performance tests, and inspections, would be specified in lieu of design detail. All of these acceptance criteria must be met by the COL holder before loading fuel. The DAC, and any related interface requirements, need to be sufficient for the staff to conclude that any additional design detail developed after the design certification, which satisfies those criteria, would not alter the staff's safety conclusion.

The applicant and staff would need to clearly define which portions of the plant design could use DAC, rather than detailed design information. Although there is nothing in Part 52 which would necessarily limit the use of DAC, the staff believes that the use of DAC, instead of detailed design information, should be limited. The restrictions should be based upon a consideration of those design areas affected by rapidly changing technologies, or design areas for which as-built, or as-procured, information is not available. However, the staff must have sufficient information to reach a final conclusion on all safety questions associated with the design, before it can issue a design certification.

The applicants and staff must exercise care so that the use of DAC does not unnecessarily complicate the design completion process or the construction of the facility. The DAC should be capable of being objectively verified. The applicant should minimize the use of DAC to reduce the potential for systems interactions. The staff will require applicants to identify possible systems interactions which result from the use of DAC.

The staff believes that, for certain evolving technologies, it would be premature to complete the final design details before the COL is issued. By waiting until the COL is issued to complete the final design for those areas, the COL applicant or holder could use the most recent technology for each plant.

The use of design acceptance criteria would enable the staff to arrive at a safety determination regarding a specific aspect of the overall plant design. By designating the DAC in the design certification rule, the Commission will establish the criteria which the staff will utilize to confirm that the as-built plant conforms to the design certification. The determination that the DAC have been satisfied will be made throughout the design implementation and construction process, as part of the ITAAC program. The NRC staff intends to perform inspections that will audit the satisfactory completion of ITAAC requirements, including the DAC. In accordance with section 52.99, "At appropriate intervals during construction, the NRC staff shall publish in the Federal Register notices of the successful completion of inspections, tests, and analyses."

The staff has identified four review areas in which it anticipates the need to use DAC as part of the design review and certification process for the ABWR: (1) piping design, (2) radiation shielding and airborne concentrations, (3) control room design, and (4) advanced instrumentation and controls. The staff may find that it needs to use the DAC in other review areas in the future for other designs. During the Part 50 licensing process, as-built, as-procured information was available before the staff made its final safety determination regarding the design. In contrast, much of that detailed design information will not be available at the time of certification, for the four areas identified.

In the area of piping design, the vendor will not have completed piping layout and final stress analyses, before design certification, and will not have as-built, site-specific, or vendors' component data. However, the staff will specify DAC in the design certification rule (DCR) that will enable the staff to make a final safety determination on all piping issues. The DCR will contain a description of the methodologies, design processes, and acceptance criteria that will be used to complete the design details and verify that the requirements for piping design have been properly implemented. The staff expects to perform detailed reviews of representative sample analyses that will form the basis for approving the applicant's design methodology. An approved piping analysis methodology would ensure that the final piping stress analyses, performed by the utility with as-built and as-procured information, would result in a design that adequately addresses all applicable safety concerns. The staff will review the final piping design analyses, using as-built, as-procured information as part of the

implementation of the ITAAC program during plant construction. Using the approved methodology, and verifying that the acceptance criteria were satisfied, will provide confidence that the plant was properly designed and constructed.

The staff is developing a two-part approach to the review of the man/machine aspects of the control room design. The first part involves a detailed review to establish the minimum inventory of fixed alarms, displays, and controls, necessary for the operators to implement the emergency operating procedures, and to carry out those human actions shown to be important from the applicant's PRA. This minimum inventory will be included in the design certification. The second part of the staff's review will utilize DAC to ensure the implementation of a systematic approach to the incorporation of human factors principles in completing the design of operator workstations in the control room, such as CRT driven alarms, displays, and controls. This is similar to the Three Mile Island action plan requirements, for the conduct of a detailed control room design review (DCRDR), with the exception that human factors will be considered in the design development process. The DAC for this process could be a series of ITAAC which are all specified in the certified design, but drafted so that they are phased to the development of a detailed design and subsequent construction. NRC inspections at key points during detailed design development and construction would confirm adequate implementation of the ITAAC (DAC).

For example, the first ITAAC review point would require establishment of an appropriate human factors design review team, for which specific criteria for team composition and qualifications would be specified. The first ITAAC would also require development of licensee procedures for implementation of the design review, such as procedures for task analysis, and prototyping of new technology. Criteria regarding the necessary content of such procedures would also be specified. Later in the design development and construction process, ITAAC would address such issues as man-in-the-loop testing.

The staff will use a similar two-part approach for the review of advanced instrumentation and controls (I&Cs). The first part will involve a detailed, functional review at the block diagram level, to ensure appropriate implementation of NRC requirements related to postulated single failures, common-mode failures, appropriate signal isolation, and other aspects of NRC review, typical of an analog control system review. This review will establish the detailed

functional requirements for the I&C systems. The second part of the review will address the implementation of digital control systems to meet the functional system requirements. This will rely upon a formal process with phased ITAAC for design development. As in the case of control room design, the ITAAC will all be specified in the design certification rule but could be satisfied at various points in time. An early ITAAC would address the procedures to be used by the COL holder to implement an acceptable design process for digital control systems. Acceptance criteria for the various phases of the design program would be specified, such that the NRC could objectively inspect and determine whether the licensee's procedure met the ITAAC criteria. As the design is subsequently developed and implemented, subsequent ITAAC would be used to verify key steps in the development process that have been satisfactorily accomplished. Because design detail is not available in this review area, and several design implementation methods would be acceptable to the staff, the ITAAC requirements and acceptance criteria in the design certification will be general in nature. The applicants and the NRC will establish agreed upon review points in the design development process to verify that the implementation is proceeding in accordance with the design certification.

The limited use of DAC will not affect the staff's ability to make necessary safety determinations or the safety benefits of standardization. Although numerous detailed design configurations may satisfy a given set of DAC, the staff expects that economic considerations will likely prompt all subsequent COL holders to make their final designs identical to the first unless major technical advances prompt consideration of a design change.

The use of DAC has the potential to increase the likelihood of post-construction hearing petitions and to expand the scope of a hearing, if it occurs. While the staff and a licensee may agree at various points during construction that DAC are met, compliance with DAC, including those intended to be verified early in the construction process, can be the subject of a hearing just prior to operation.

Coordination: The Office of the General Counsel has reviewed this paper and has no legal objection to its contents. The NRR staff met with the ACRS to discuss drafts of this paper during full committee meetings on December 12, 1991, January 9, 1992 and February 7, 1992. We understand that the ACRS plans to provide formal views and recommendations to the Commission on the use of Design Acceptance Criteria shortly.

Recommendation: That the Commission defer any decisions on the use of Design Acceptance Criteria until after ACRS views are received.

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