POLICY ISSUE
INFORMATION

April 1, 2002 SECY-02-0059

FOR: The Commissioners

FROM: William D. Travers
Executive Director for Operations

SUBJECT: USE OF DESIGN ACCEPTANCE CRITERIA FOR THE AP1000 STANDARD PLANT DESIGN

PURPOSE:

To inform the Commission of the staff's position on the use of design acceptance criteria (DAC) for the Westinghouse Electric Corporation's (Westinghouse's) AP1000 standard plant design.

SUMMARY:

In an August 28, 2000, letter, as supplemented by letter dated February 13, 2002, Westinghouse requested the staff to review the acceptability of Westinghouse's proposed use of DAC to support the development of the design certification application for the AP1000 design. As a result of this pre-application review, the staff concludes that it is acceptable to use the DAC approach in the instrumentation and control (I&C), control room (human factors engineering), and piping design areas, contingent upon the ability of Westinghouse and the staff to agree on adequate DAC during the design certification review.

BACKGROUND:

In its August 28, 2000, letter, as supplemented by letter dated February 13, 2002, Westinghouse requested that NRC proceed with Phase 2 of the AP1000 pre-application review to address the following issues:

1. applicability of the AP600 test program to the AP1000 design
2. applicability of the AP600 analysis codes to the AP1000 design

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3. acceptability of the proposed use of DAC for the AP1000 design
4. acceptability of certain exemptions for the AP1000 design that Westinghouse intends to request.

This correspondence provides the staff's position regarding the acceptability of the proposed use of DAC for the AP1000 design certification. The other issues will be addressed in a separate letter to Westinghouse.

DISCUSSION:

Historical Application of DAC

The certification process for a standard nuclear power plant design is described in Part 52 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 52), "Early Site Permits, Standard Design Certifications, and Combined Licenses for Nuclear Power Plants." Paragraph 52.47 (a)(2) requires that:

> [t]he 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 level of design information that is sufficient to allow accomplishment of these two tasks was addressed in SECY-90-377, "Requirements for Design Certification Under 10 CFR Part 52," dated November 8, 1990. Also, the Commission issued guidance in its Staff Requirements Memorandum (SRM) on SECY-90-377, dated February 15, 1991, which stated 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 [final safety analysis report] at the operating stage for a recently licensed plant, except for site-specific, as-procured, 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 [probabilistic risk assessment] are addressed in the design.

Responding to the Commission's SRM on SECY-90-377, the staff discussed the concept of DAC and its application in SECY-92-053, "Use of Design Acceptance Criteria During 10 CFR Part 52 Design Certification Process," dated February 19, 1992. In this paper, the staff explained that:

> [t]he concept of 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 use of inspections, tests, analyses, and acceptance criteria (ITAAC). The staff defined DAC as “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 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.

In SECY-92-053, the staff documented its observation regarding the level of detail submitted in support of design certification applications of General Electric’s Advanced Boiling Water Reactor (ABWR) and the ABB-Combustion Engineering’s System 80+. The staff observed that, in some technical areas, “the applicants [were] not providing design and engineering information at a level of detail customarily reviewed by the staff in reaching a design final safety decision.” Although recognizing the DAC approach as a possible substitute for required design details, the staff concluded 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.”

The DAC approach proposed for the ABWR and the System 80+ included the use of DAC in the following areas: I&C, control room (i.e., human factors engineering), radiation protection, and piping. The staff accepted the DAC approach during the certification of the ABWR and System 80+ designs because detailed information for certain portions of the designs was not available at the time of the safety review (radiation protection and piping design areas). Furthermore, the staff concluded that fixing certain design details was not appropriate due to the rapidly changing technologies of certain components and systems (I&C and control room design areas). The staff discussed how the DAC approach was being implemented on the ABWR in SECY-92-196, “Development of Design Acceptance Criteria for the Advanced Boiling Water Reactor (ABWR),” dated May 28, 1992, and in SECY-92-299, “Development of Design Acceptance Criteria for the Advanced Boiling Water Reactor (ABWR) in the Areas of Instrumentation and Control (I&C) and Control Room Design,” dated August 27, 1992. This approach was also used during the certification process for System 80+.

In its design certification application for the AP600, Westinghouse requested certification of a more complete design than the ABWR and System 80+ (evolutionary plants) designs. The staff applied the DAC process to only two areas: I&C and control room. Piping DAC was not used for the AP600 design. Although as-built and as-procured information was not available, Westinghouse performed a significant amount of the piping design calculations by assuming preliminary vendor information for such items as valves and components. The staff accepted use of DAC in the I&C and control room areas for the AP600 design certification based on the rapidly evolving technology aspects of these technical areas.

Using the DAC approach described in SECY-92-053, SECY-92-196, and SECY-92-299, the staff established a reasonable level of confidence in the final safety determination for these designs. However, as discussed in SECY-92-053, the staff still concludes that although perhaps justifiable, use of the DAC process is not the preferred way to certify nuclear plants. Two situations supporting the use of DAC were originally foreseen in SECY-92-053: (1) when the design area is in a field characterized by rapidly evolving technology (e.g., digital I&C), a design solution frozen at the time of certification could be obsolete by the time the plant was constructed, and (2) when closing the issue at the design certification stage would require a level of detail that could not be provided until a plant was actually built or its components were procured. Thus, the design certification application should provide essentially complete design information to comply with the requirements of 10 CFR 52.47(a)(2), and the use of DAC should be limited to a few technical areas where an applicant has provided a valid reason(s) for not providing the required level of design detail.

When justified for use, the DAC should be sufficiently detailed to provide an adequate basis for the staff to make a final safety determination prior to granting design certification. The use of DAC would result in less design detail at the design certification stage, and more detail regarding how the DAC 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 the 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.

As noted in SECY-92-053, 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.

As noted in SECY-92-053, 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.

Westinghouse Proposal for DAC on the AP1000

Westinghouse states that the AP1000 design is based closely on the AP600 design and that it maintains the AP600 design configuration, use of proven components, design basis and licensing basis by limiting the changes to the AP600 design to as few as possible. In seeking design certification for the AP1000 design, Westinghouse proposed to apply the DAC approach to the instrumentation and control (I&C) and control room design as it did in the AP600 application. However, it also proposed to apply the DAC approach to the piping and structural design, and (to some extent), the seismic analysis, citing the precedents set in the use of DAC during certification of the ABWR and the System 80+ standard plant designs. After discussions with the staff regarding the requirements of 10 CFR 52.47(a)(2), Westinghouse stated, as detailed in its letter dated February 13, 2002, that it would (1) limit the design certification to hard-rock sites and provide a seismic analysis, and (2) perform specified structural design calculations. This would provide sufficient seismic and structural design information for the staff to reach a safety determination prior to granting certification and preclude the need for DAC in these areas. In the same letter, Westinghouse provided information supporting its proposed use of DAC in the piping area. Therefore, the staff's assessment of the AP1000 DAC approach contained herein is limited to a discussion of the proposed use of DAC in the I&C, control room, and piping areas.

I&C and Control Room Design Areas

For the I&C and control room (human factors engineering) design areas, the staff agrees that DAC can be successfully developed during the AP1000 design certification review stage and implemented after a design is certified. The basis for allowing use of DAC in these areas is the same as that for the ABWR, System 80+, and AP600; the I&C and control room design areas are characterized by a rapidly evolving technology and requiring completion of the design in these areas may result in the design becoming obsolete by the time a plant is constructed. Therefore, the staff finds the use of the DAC approach in the I&C and control room areas acceptable for the AP1000 design certification review.

Piping Design Area

As evidenced by discussions on the level of detail required for a standard plant design contained in SECY-92-053 and SECY-92-196, the Commission previously allowed the use of piping DAC because General Electric and ABB-Combustion Engineering claimed that as-built and as-procured information was necessary but unavailable at the design certification stage to complete the piping analyses and design details. For the AP600 design, Westinghouse demonstrated that it did not need as-built or as-procured information to sufficiently complete the piping analyses and design. This is due, in part, to the fewer number of safety-related piping subsystems, and the fact that passive plants by nature have few, if any, active piping components (such as pumps and motor-operated valves with heavy, offset motors) where the as-procured information is necessary but not yet available to complete the piping analyses and design. Given the similarities between the AP600 and AP1000 designs, the basis established for using DAC for piping design (i.e., lack of as-built and as-procured information) may not apply to the AP1000 plant. A literal interpretation of the terms "as-built" and "as-procured" could lead one to argue that the as-built and as-procured information is not available until the components are purchased or constructed. One could also argue that the as-built and as-procured information is not necessary as demonstrated by Westinghouse's completion of the AP600 piping design. Regardless of these arguments, the staff's position remains consistent in that, although the DAC approach can be used to close some issues for which design details are lacking, it should not be used in technical areas where the design can be sufficiently completed. Otherwise, the benefits of certifying a standardized plant design are eroded when design certification applicants seek to achieve finality for significant portions of the design without providing the design details.

In the case of AP1000, the staff recognizes that the AP600 standard plant has completed the piping layout and analyses to a sufficient degree to ensure that there would be minimal, if any, design changes resulting from interferences or inadequate space for the piping when the plant is built. Thus, many of the benefits of standardization that are achieved by having completed the piping layout and analyses for the AP600 standard plant will carry over to the AP1000 plant design because the piping layout for the AP1000 plant is not expected to significantly change from that of the AP600 plant. Westinghouse noted in its February 13, 2002, letter that "the vendor information required to perform the piping analysis such as valve weights and centers of gravity is not available until vendors are selected." Furthermore, Westinghouse contended that it "gained very little regulatory benefit by performing detailed piping design and analysis during design certification of AP600." This conclusion was based on the little difference between the piping ITAAC for the AP600, ABWR, and System 80+ plants where nearly the same verification must be performed for any of the applications. The staff acknowledges that the final as-built piping design for the AP600 is still subject to ITAAC verification as were the as-built piping design for ABWR and System 80+. However, if there are no design changes (or only minor design changes) in the final, as-built AP600 piping, then the AP600 piping analysis completed during design certification would still be valid at the construction phase with no further analyses required to be completed by the COL holder. This benefit would not apply to the ABWR or System 80+ certified designs.

The staff finds that the completed AP600 piping layout and design provides a sufficient level of detail to assure that the benefits of standardization will be achieved for the AP1000 piping. The completeness of the AP1000 piping design using the AP600 piping design information would be equivalent to that typically found during the preliminary design stage of a nuclear power plant design. Based on information provided by Westinghouse, the staff expects that differences between the AP600 and AP1000 designs will necessitate minimal changes to the completed AP600 piping design. Any areas where there are changes will be evaluated to ensure the staff is able to reach a conclusion on all safety questions. Consequently, the staff finds that the use of DAC in the AP1000 piping design area would be an acceptable approach based on the completeness of the AP600 piping layout and design and the applicability of the AP600 piping design information to the AP1000 plant design. The use of DAC would assure that the final, as-built piping design and analyses, can be completed with adequate confidence that safety issues associated with the as-built piping design will not arise when the plant is constructed. This assessment is contingent upon the ability of Westinghouse and the staff to agree on adequate piping DAC.

Given the acceptability of using piping DAC for the AP1000 standard plant design, there exist some details regarding implementation of piping DAC that need to be resolved during the design certification review. For instance, Westinghouse states that it is proposing to use a DAC approach that is similar to the approach used for the ABWR and System 80+ standard plant designs. More specifically for AP1000 piping, Westinghouse proposes to provide the analyses for piping in which a leak-before-break (LBB) approach is applied as part of the COL application. The staff acknowledges that in SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Passive Advanced Light-Water Reactor Designs," dated April 2, 1993, it recommended approval of the application of the LBB approach for evolutionary and passive advanced light-water reactors (ALWRs) seeking design certification. In that same paper, however, the staff further recommended that this approval be limited to instances in which appropriate bounding limits are established using preliminary analysis results during the design certification phase and verified during the COL phase by performing the appropriate ITAAC. Westinghouse's proposed approach for the AP1000 is to establish bounding curves at the design certification phase and to provide analyses for LBB piping at the COL phase rather than during the design certification phase. This is not consistent with currently-approved ALWR policy. Postponing the completion of analyses for LBB piping until the COL phase would leave open the question of whether there is sufficient margin in the piping to demonstrate that the probability of pipe rupture is extremely low; thus, the finality of design might not be assured during design certification. The staff will continue to discuss this issue with Westinghouse during the design certification review (Phase 3) to assure that the safety question is adequately resolved prior to granting the certification.

Furthermore, for the AP1000 plant, the piping diameters have changed from those established in the AP600 standard plant design. The staff's experience gained during the AP600 review and the AP1000 pre-application review indicates that the changes in piping diameters affect the thermal-hydraulic characteristics of the passive safety systems, and therefore, might affect the validity of the staff's safety conclusions. The proposed DAC approach only increases the uncertainties already associated with the current safety analysis codes (although, at this time, the level of uncertainty appears acceptable given the completeness of the AP600 piping design, the applicability of the AP600 piping design to the AP1000 piping design area, and the staff's experience with implementation of piping DAC). The issue of applicability of the AP600 analysis codes to the AP1000 design will be discussed in separate correspondence. In addition, other safety issues related to the use of DAC that have been identified in the past design certification reviews and that will need to be addressed during the AP1000 design certification review include the assumptions used in consideration of flooding and sub-compartment pressurization analyses. The staff will also continue to pursue resolution of these safety issues during the design certification phase to assure that the safety questions are adequately addressed by Westinghouse prior to granting the design certification.

Summary of the Staff's Evaluation of Westinghouse's Proposed Use of DAC

The staff concludes on the basis of its review of Westinghouse's pre-application submittals, that it is acceptable for the AP1000 standard plant design to use the DAC approach in the I&C and control room design areas. The bases for allowing the use of DAC in these areas are consistent with those cited for the ABWR, System 80+, and AP600 design certifications. The use of DAC in the I&C and control room areas is acceptable because these areas are characterized by a rapidly changing technology. Requiring completion of the design at the design certification stage may result in the design becoming obsolete by the time a plant is constructed.

The use of DAC in the piping design area is also acceptable because it would supplement the AP600 piping design information that would remain applicable to the AP1000 plant. The use of DAC will not affect the staff's ability to make necessary safety determinations nor will it erode the economic and safety benefits of standardization to the extent that the completeness of the AP600 piping design can be carried over to the AP1000 plant. This assessment is contingent upon the ability of Westinghouse and the staff to agree on adequate piping DAC during the design certification review.

CONCLUSION:

The staff concludes that it is acceptable to use the DAC approach in the I&C, control room, and piping design areas, contingent upon the ability of Westinghouse and the staff to agree on adequate DAC during the design certification review.

<u>COORDINATION</u>:

The staff met with the ACRS to discuss the acceptability of using DAC for the areas mentioned as well as the status of the Phase 2 review. The Office of the General Counsel has no legal objections to this paper.

/RA/ William F. Kane

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