UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

January 14, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: FINAL REPORT ON THE USE OF THE DESIGN ACCEPTANCE CRITERIA PROCESS IN THE CERTIFICATION OF THE GENERAL ELECTRIC NUCLEAR ENERGY ADVANCED BOILING WATER REACTOR DESIGN

During the 405th meeting of the Advisory Committee on Reactor Safeguards, January 6-7, 1994, we completed our review of the Design Acceptance Criteria (DAC) to be included in the Certified Design Material (CDM) for the General Electric Nuclear Energy (GENE) Advanced Boiling Water Reactor (ABWR). The four subject areas addressed by DAC are Human Factors Engineering, Radiation Protection, Piping Design, and Instrumentation and Control.

Our Ad Hoc Subcommittee on DAC, in a joint meeting on November 2, 1993, with the Computers in Nuclear Power Plant Operations Subcommittee, reviewed Chapter 7, "Instrumentation and Control Systems," of the GENE Standard Safety Analysis Report (SSAR), the NRC staff Final Safety Evaluation Report (FSER) for this Chapter, and the related DAC. This DAC was further discussed during our November 4-6, 1993 meeting. Our ABWR Subcommittee, during its meeting of November 17, 1993, reviewed the human factors aspects of Chapter 13, "Conduct of Operations," and Chapter 18, "Human Factors Engineering," of the GENE SSAR, the NRC staff FSER for these Chapters and the related DAC for Human Factors Engineering. The DACs on Radiation Protection and Piping Design were discussed during our December 9-11, 1993 meeting. In each of these meetings, we had the benefit of discussions with representatives of the NRC staff and GENE. We also had the benefit of the documents referenced.

In addition to the meetings described above, both ACRS and its Ad Hoc Subcommittee on DAC (which was established to review the DAC process as requested by the Commission in its April 1, 1992 Staff Requirements Memorandum) met on a number of occasions to consider the overall DAC process as it was evolving. We provided two interim reports during this period. With this report, we believe that the Ad Hoc Subcommittee on DAC has now completed its assignment.

BACKGROUND

Since our last report, considerable effort has been expended by the NRC staff, GENE, NUMARC, and interested industry participants in the development of the Tier 1 CDM for the ABWR. As described in the GENE CDM submittal of December 7, 1993, the Tier 1 CDM relevant to the four subject areas that use the DAC process is contained in Section 3.0 "Additional CDM." This section consists of those aspects of the certified design that do not lend themselves to the system-by-system coverage provided in Section 2.0 of the CDM for individual plant systems. Each of the four DAC CDM sections consists of a Design Description and associated Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). Certain elements of these ITAAC are designated as DAC because they describe the design process to be used in implementing the design commitments stated in the Design Description. This is in contrast to the general case in which ITAAC will be used to confirm that the as-built plant systems have the design characteristics stated in the Design Description. Both the CDM and the associated Tier 2 material constitute the complete set of requirements for the certified design.

RECOMMENDATIONS AND COMMENTS

With respect to the material in Section 3.0 "Additional CDM" covering the four subject areas historically referred to as DAC, we are generally satisfied that it provides a reasonable basis for the staff final safety determination needed to support Final Design Approval. Our comments on each of these CDM are as follows:

Section 3.1 - Human Factors Engineering (HFE)

This section imposes Tier 1 requirements on the Combined Operating License (COL) holder with respect to the implementation of the human-system interface (HSI) for certified design. All six elements of ITAAC associated with this CDM have been designated as DAC by the staff and GENE.

Our review of HSI covered Chapter 18 of the FSER and the "HFE Program Review Model and Acceptance Criteria for Evolutionary Reactors," both dated December 1993. The latter document provides the technical basis for the staff review of the HFE design process proposed for certification. It also specifies the acceptance criteria by which the staff will evaluate the HFE program elements proposed by an applicant. We commend the staff for the development of this document. It provides much needed guidance to applicants on the staff expectations with regard to HFE for evolutionary reactors.

The HSI scope is limited to the main control room and the remote shutdown system. We commented, in our report of June 16, 1992, that the scope of the DAC then under development should be expanded

to include "... transmission switchyard work stations, because of the importance of offsite power to the safety of nuclear power plant operations" and "... incorporation of human factors principles in the design of local panels where instrumentation and controls important to safety are located." Although not included in this section of the CDM, we believe that these issues have been appropriately addressed elsewhere in the CDM.

Section 3.2 - Radiation Protection

This section imposes Tier 1 requirements on the COL holder with respect to the design of radiological shielding and ventilation systems. The scope of this section includes the design of these features for the Reactor Building, Turbine Building, Control Building, Service Building, and Radwaste Building. All six elements of ITAAC associated with this section have been designated as DAC by the staff and GENE.

The Design Description requires that the plant shielding design permit operators to perform required safety functions in "vital areas" of the plant under "accident conditions." The definition of "vital areas" in the Design Description differs from that in 10 CFR 73.2. We believe that other terminology should be used in this Design Description to avoid confusion with the definition used by the nuclear power plant security community.

ITAAC 3 of Table 3.2a contains the design commitment that "the plant shielding design shall permit plant personnel to perform required safety functions ... under accident conditions," and defines the accident radiation source term to be used for the shielding design. We agree that this source term is appropriate for this purpose.

Acceptance Criteria 1.a, b, and c of Table 3.2b distinguish, for purposes of ventilation system design, among "normally occupied rooms," "rooms that require infrequent access," and "rooms that seldom require access." The distinction between 1.b and 1.c is not obvious and should be more sharply drawn.

Section 3.3 - Piping Design

This section imposes Tier 1 requirements on the COL holder with respect to: (1) the design of nuclear safety-related piping systems and certain non-nuclear safety-related piping systems; (2) the analysis of the dynamic effects associated with postulated high energy pipe breaks on structures, systems, and components that are required to be functional during and following a safe shutdown earthquake; and (3) the reconciliation analysis of the as-built piping against the piping design. All three elements of this ITAAC have been designated as DAC by the staff and GENE.

The scope of this section is spelled out in the Design Description. There are, however, a number of additional aspects of piping design and analysis important to nuclear power plant safety which are not covered by this section. These have been discussed in detail with the staff and GENE on a number of occasions. We have been told that these piping design and analysis issues will be included elsewhere in the CDM. We will continue to follow this matter until we are satisfied that these issues have been properly addressed.

Section 3.4 - Instrumentation and Control

This section imposes Tier 1 requirements on the COL holder with respect to: (1) the configuration of safety-related digital instrumentation and control (I&C) equipment encompassed by the Safety System Logic and Control (SSLC); (2) the hardware and software development process used in the design, testing, and installation of I&C equipment; and (3) the diverse features included in I&C system design to provide backup support for postulated worst-case common-mode failures of SSLC. ITAAC 7 through 11 have been designated as DAC by the staff and GENE.

We would have preferred that the staff had based its review and acceptance of this section, the related Section 2.0, and SSAR Chapter 7 on a documented review model and specific acceptance criteria, as was done in the case for the Human Factors Engineering section discussed above. The staff has not yet formulated an identifiable set of criteria which must be met by digital I&C systems. In the FSER, reference is made to a menagerie of NRC regulations and regulatory guides, to a set of industry standards, and to several NRC publications which provide the basis for the staff conclusions concerning the process being followed by GENE. However, an examination of these indicates that most were developed before any significant application of digital technology to reactor safety systems, that only a few are relevant to many of the staff concerns, and that several are obsolescent if not obsolete.

We continue to recommend that the staff produce, on an expedited basis, a soundly conceived Standard Review Plan for digital I&C systems for both ALWRs and operating plant backfits.

Sincerely,

J. Ernest Wilkins, Jr.

J. Ernest Wilkins, Jr.
Chairman

References:

1. GE Nuclear Energy, "ABWR Certified Design Material," Volumes 1 and 2, December 7, 1993

2. GE Nuclear Energy, "ABWR Standard Safety Analysis Report," September 1993
3. Staff Requirements Memorandum from Samuel J. Chilk, Secretary of the Commission, to David A. Ward, ACRS Chairman, dated April 1, 1992, Subject: Periodic Meeting with the Advisory Committee on Reactor Safeguards on March 5, 1992
4. NRC staff Final Safety Evaluation Report for the General Electric Nuclear Energy Advanced Boiling Water Reactor, December 1993
5. NRC staff Final Safety Evaluation Report for the General Electric Nuclear Energy Advanced Boiling Water Reactor, "HFE Program Review Model and Acceptance Criteria for Evolutionary Reactors" (Appendix 18A), December 1993
6. ACRS report dated June 16, 1992, from Paul Shewmon, ACRS Chairman, to Ivan Selin, NRC Chairman, Subject: Interim Report on the Use of Design Acceptance Criteria in the Certification of the GE Nuclear Energy Advanced Boiling Water Reactor Design
7. ACRS report dated October 16, 1992, from Paul Shewmon, ACRS Chairman, to Ivan Selin, NRC Chairman, Subject: Second Interim Report on the Use of the Design Acceptance Criteria Process in the Certification of the General Electric Nuclear Energy Advanced Boiling Water Reactor Design