

June 17, 1992

Docket No. 52-001

Mr. Patrick W. Marriott, Manager
Licensing & Consulting Services
GE Nuclear Energy
175 Curtner Avenue
San Jose, California 95125

Dear Mr. Marriott:

SUBJECT: CONFIRMATORY ITEMS IDENTIFIED IN THE FINAL SAFETY EVALUATION REPORT (FSER) FOR CHAPTER 18, HUMAN FACTORS ENGINEERING

The staff is developing the FSER for Chapter 18 of the GE Nuclear Energy (GE) Advanced Boiling Water Reactor Standard Safety Analysis Report (SSAR). We have identified 18 issues where the staff and GE have reached tentative agreement. For these items, an amendment to the SSAR or a revised ITAAC/DAC is required to complete closure.

Enclosed for your information is a summary of these 18 confirmatory items.

Please contact us as soon as possible should you have a different assessment of these issues.

Sincerely,

Original Signed By:

Son Q. Ninh, Project Engineer
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Enclosure:
As stated

cc w/enclosure:
See next page

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Docket No. 52-001

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18.02: HSI Design and Evaluation Process

18.06: Tests and Analysis to Support Design Implementation

Issue: The DSER states additional detailed information regarding the HSI design and evaluation process ... is necessary (Issue 18.02). In addition, the DSER states additional detailed information about the methods, criteria, and results of analyses performed which support the level and type of staffing, automation and function allocation to achieve the goals of safe and reliable performance of the operating crew and overall system is necessary (Issue 18.06).

Proposed Resolution: Close upon staff receipt of a description by GE of the studies performed in support of the design features contained in the SSAR.

Evaluation: This issue was addressed in the DSER Issues Responses letter dated February 18, 1992. The attachment to the response provides a "Summary Report on Design Development and Validation Testing of ABWR Main Control Room Equipment and Configuration," dated 2/21/92. Additional information was obtained in an audit of GE design files in San Jose in January 1992 and in visits and discussions held with Japanese ABWR CR designers. The information provided was evaluated to be satisfactory commensurate to the level of detail currently provided for the specification of the standard features. The features were the result of a five-year development program which included:

- the preparation of implementation plans for major design and evaluation activities
- the derivation of general HSI requirements from the design of individual systems
- task analyses for safety related functions based upon manual operations
- a systematic allocation of function strategy based upon workload analysis and an analysis of task characteristics, such as degree of repetitiveness and complexity
- an analysis of current trends and technology assessments of the major CR features including: approaches to automation, console design, video display units, display techniques, large display panels, use of fixed-position displays, alarms, and CR layout.

Following feature identification, the features were assessed in a validation program using two Japanese CR prototypes employing the standard features. The validation tests utilized three teams of operators performing a range of operational tasks including normal operation, equipment failures, alarms, and accidents. Information collected for the validation tests included videotape/observations and operator opinion.

test results generally supported the use of the standard features (as defined in the next section). Several limitations in the use of the test results are noted. The features as implemented in the validation tests were defined and at a level of design detail beyond the definition of the standard features defined in the SSAR. The data collected were limited and

the standard features were not specifically addressed in the tests; instead, the entire design as a package was evaluated. Thus it is possible that the same set of standard features (as defined in the SSAR) could be improperly designed and/or poorly integrated to result in an unacceptable design. The validation tests provide proof of concept; i.e., that the specified standard feature can be integrated into an acceptable design. However, since the SSAR level of detail is considerably less than that tested, the standard features are scoping in nature and their implementation in any ABWR implementation must be validated for the detailed design and implementation developed by the COL applicant as required under Element 8 of the HFE Program Review Model.

Since Element 8 is specified in general terms, the general issue of validation of the detailed design of the standard features is identified as a COL applicant action item to be addressed in the HFE Issue Tracking System. Therefore, the staff considers DSER items 18.02 and 18.06 resolved pending receipt of the amended SSAR which incorporates the February 1992 submittal. This is a confirmatory item.

18.08: Standardized Features and Prototype Evaluation

Issue: The DSER states additional detailed information is necessary which precisely indicates which aspects of the CR design are part of the standardized design and which are unique to a referencing applicant's implementation consistent with accepted human factors principles and practices and the requirements of 10 CFR Part 52. The staff believes development of a fully functional CR prototype of the standard design is appropriate in order to demonstrate acceptable human performance. Thus, there are several parts to this issue: (a) the aspects of the CR which are part of the standardized design, (b) the level of detail with which the standard features are described, and (c) the use of a prototype.

Proposed Resolution: Close upon staff receipt of a description by GE of the studies performed in support of the design features contained in the SSAR.

Evaluation: This issue was addressed in the DSER Issues Responses letter dated February 18, 1992, and in the revised standard feature description provided in the SSAR. SSAR Section 18.4 provides a description of the standard features which is revised from the list in the original SSAR reviewed for the DSER. Based upon the DSER issues, the feature-by-feature evaluation and subsequent discussions with GE, the description of the standard features was modified to a level of detail supported by the design and evaluation efforts discussed with respect to Issue 18.06 above. With regard to sub issue (c), the use of a prototype in design and evaluation is addressed as part of the Design Process discussed in Section 4.7. Therefore the staff considers DSER item 18.08 resolved pending receipt of the amended SSAR incorporating the agreed upon information. This is a confirmatory item.

18.09: Operator Workload

Issue: This issue addresses the workload-based rationale for allocation of function offered by GE. The DSER states that GE has not indicated "how workload was defined/measured [in the context of allocation of function] or what constitutes an appropriate operator workload level" (p. 16). The DSER further states that "It is unclear how validating allocation of function

decisions by a referencing applicant at this late point in the design process could result in a standardized design" (p. 16). Thus, there are three aspects to this issue: (a) workload definition for allocation of function studies, (b) the determination of satisfactory workload, and (c) implications for post certification evaluations which require modification to certified aspects to the design, in this case allocation of function.

Proposed Resolution: Close upon NRC receipt of a description by GE of the studies performed in support of the design features contained in the SSAR.

Evaluation: This issue was addressed in the DSER Issues Responses letter dated February 18, 1992. Sub issues (a) and (b) are addressed in the Evaluation section of Issue 18.06 above. With respect to sub issue (c), the specification of workload evaluations during post-certification will be addressed in the discussion of the Design Process in Section 4.7. Therefore the staff considers DSER item 18.09 resolved pending receipt of the amended SSAR incorporating the February 1992 letter. This is a confirmatory item.

18.11: Tests, Evaluations, Studies to Support Design Approaches

Issue: The DSER states that information on tests, evaluations, and trade studies performed to support the selection of design approaches, e.g., the use of touch screen interfaces is needed.

Proposed Resolution: Close upon staff receipt of a description by GE of the studies performed in support of the design features contained in the SSAR.

Evaluation: The discussion under the Evaluation of Issue 18.06 satisfactorily addresses this issue for the level of detail provided. It should be noted that, following discussions with GE, several design details were eliminated from specification as standard features, e.g., the use of touch screen interfaces. Those that remain are those supported by the test program. Therefore the staff considers DSER item 18.11 resolved pending receipt of the amended SSAR. This is a confirmatory item.

Issue 18.12: Adequacy of HSI Design Requirements

Issue: The DSER states that in the absence of a systems analysis and test/evaluation results, there is no basis to evaluate the reasonableness and adequacy of the HSI design requirements from a top-down [or bottom-up] perspective.

Proposed Resolution: Close upon staff receipt of a description by GE of the studies performed in support of the design features contained in the SSAR.

Evaluation: The discussion under the evaluation of Issue 18.06 which includes a description of HSI testing by GE satisfactorily addresses this issue for the level of detail provided. Therefore, the staff considers DSER item 18.12 resolved pending receipt of the amended SSAR. This is a confirmatory item.

18.26: Inventory

4.3.3 Findings

The staff concludes that GE has developed an acceptable minimum set of displays, controls, and alarms, required to mitigate transients and accidents associated with the GE ABWR EPGs and the ABWR PRA sensitivity study pending the incorporation of the descriptions for each of the comments in section 4.3.2.2.2, above, into the appropriate section of the SSAR. Therefore, DSER issue 18.26 is resolved and the minimum inventory of displays, controls, and alarms is considered adequate, pending receipt of the amended SSAR. The staff considers this a confirmatory item.

In addition, several specific issues were addressed as COL action items to be incorporated into the HFE Issue Tracking System:

- Review inventory against the results of the detailed task analyses
- Update of important human actions from PRA after PRA/HRA is completed
- Ensure alarming of EOP entry conditions

Issue 18.19: Remote Shutdown System Design Rationale

Issue: The DSER states that the staff concluded that before the review of Chapter 18 of the ABWR SSAR can be completed, additional information is needed (i.e., tests, evaluations and results) which will support GE's position and rationale on the RSS design for the ABWR. This information should address how human performance is effected when operators are required to use mixed control and display technologies (i.e., digital and analog) during emergency plant operations."

Proposed Resolution: This issue was considered a Design and Process Implementation Plan issue since the detailed design of the RSS is a COL applicant responsibility.

Evaluation: GE indicated that the RSS will not employ digital technology in order to maintain diversity from the CR. An assessment of the mix of analog and digital technologies in the plant as a whole will be included in the post-certification test activities conducted by the COL applicant as part of the verification and validation element. The staff notes that independence (i.e., isolation and separation) and diversity are needed for the RSS. The approach to RSS design shall be evaluated by the COL applicant as required by the HFE Program Review Model. This item will be incorporated into the HFE Issue Tracking System for consideration by the COL applicant in the design, and therefore, is resolved pending receipt of an amended SSAR. This is a confirmatory item.

DSER Issue 18.07: ABWR Human Factors Program Plan

Issue: The DSER states that Section 18.3 provides an outline for systems analysis and HSI design. However, since the GE ABWR human factors program plan (HFPP) is not provided or referenced, little detail is provided about actual analysis steps and procedures, and no results are provided. Additional detailed information about these analyses and design issues are necessary before the staff can complete its review of Chapter 18 of the ABWR SSAR.

Evaluation: The Design and Implementation Process described in the SSAR and in the ITAAC/DAC document adequately addresses the HFPP and the types of analyses to be performed. Therefore the staff considers DSER Issue 18.07 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.10: Detailed Task Analyses

Issue: The DSER states that detailed task analysis which should cover the full range of normal and off-normal plant operations, have not yet been performed. GE indicated that they will be performed as part of hardware/software procurement and design implementation activities.

Evaluation: The design commitment, ITAAC, and general criteria for task analysis described by GE in the ITAAC/DAC document for HFE Element D and in the Tier 2 SSAR description adequately address detailed task analyses. Therefore the staff considers DSER Issue 18.10 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Overly limited scope of HFE standardization

Issue 18.13: HSI Design Requirements for Cathode Ray Tube (CRT), Flat Panel and Large Screen Displays

Issue: The DSER states that additional detailed information on the ABWR HSI design requirements for control station C₁, flat panel and large screen displays is necessary.

Evaluation: The design commitment, ITAAC, and general criteria for HSI design described in the ITAAC/DAC document for HFE Element E and in the Tier 2 SSAR description adequately address the detailed design of the HSI. Therefore the staff considers DSER Issue 18.13 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.15: CRT display information

Issue: The DSER states that no details of the CRT displays are provided to permit visualization of the actual information available to the operator. This information about the ABWR CRT displays is necessary in order for the staff to complete its review.

Evaluation: The design commitment, ITAAC, and general criteria for HSI design described in the ITAAC/DAC document for HFE Element E and in the Tier 2 SSAR description adequately address the detailed design of the HSI. Therefore the staff considers DSER Issue 18.15 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.17: Alarm Suppression Criteria, Alarm Points

Issue: The DSER states that with regard to the criteria used as a basis for suppression of alarms, the SSAR states that the "limit number of alarm points which operators can simultaneously recognize is limited to (nominally) 10." No rationale is provided for this value, nor is its impact on the alarm system design clear. Additional detailed information about the ABWR alarm suppression criteria and rationale used to determine the limit number of alarm points which operators can simultaneously recognize is necessary before the staff can complete its review.

Evaluation: The design commitment, ITAAC, and general criteria for HSI design described in the ITAAC/DAC document for HFE Element E and in the Tier 2 SSAR description adequately address the detailed design of the HSI. Therefore the staff considers DSER Issue 18.17 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.21: Procedure Development

Issue: The DSER states that there are system level operating procedures that were developed concurrent with the development of the ABWR systems design. These procedures and the associated task analyses upon which the HSI interface requirements are based are not included in the References Section 18.6, thus, they could not be evaluated. For the ABWR design certification, the staff expects GE to provide detailed program descriptions for the development of standardized plant procedures and standardized plant personnel training materials. Further, the vendor is expected to develop integrated operating procedures (IOPs) which reflect the full level of detail consistent with and included as part of the final plant design. In addition, procedural development guidelines (e.g., procedure writer's guide, verification and validation guidelines, and generic technical guidelines) should be developed by GE with sufficient detail to ensure that implementation of the processes and criteria delineated in these guidelines by the purchaser of the ABWR, when making procedure revisions, will preserve the human factors insights that are part of the vendor developed procedures and the overall ABWR design.

Evaluation: The development of detailed procedures and training materials was determined by the staff to be beyond the scope of the ABWR certification and are the responsibility of the referencing COL applicant under 10 CFR Part 50. The design commitment, ITAAC, and general criteria for HSI design described in the ITAAC/DAC document for HFE Element F and in the Tier 2 SSAR description adequately address procedure development criteria. Therefore the staff considers DSER Issue 18.21 resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.05: Operator Workload Analysis

Issue: The DSER states that GE stated that tests and analyses will be conducted to ensure that the design implementation provides an appropriate workload. It is not clear to the staff what analyses have been performed in support of the design and development of the ABWR and what tests and analyses are yet to be done.

Evaluation: These V&V analyses conducted by the COL applicant as part of element G of the HFE ITAAC/DAC described in table 3.6 of the ITAAC/DAC document specifically address this issue and it is considered resolved pending receipt of the final ITAAC. This is a confirmatory item.

Issue 18.06: Tests and Analysis to Support Design Implementation

Issue: The DSER states that additional detailed information about the method criteria, and results of analyses performed which support the level and type of staffing, automation and function allocation to achieve the goals of safe and reliable performance of the operating crew and overall system is necessary. Also discussed is the fact that the design bases stated in Section 18.2 of Chapter 18 of the ABWR SSAR would be more appropriate as design requirements if they had been derived and justified on the basis of the systems analysis. The staff considers it more appropriate to develop design bases which are stated in terms that would help achieve the primary goal of developing interfaces (and a system) which makes possible safe, efficient, and reliable operator performance. The bases could be described in "operator-centered" terms which can objectively be linked with achieving the design goals and serve as criteria for test and evaluation activities. There are two aspects of this issue to consider: (a) the analyses conducted to date, and (b) the analyses that will be done in the future.

Evaluation: The V&V analyses conducted by the COL applicant as part of Element G of the HFE ITAAC/DAC described in table 3.6 of the ITAAC/DAC document specifically address this issue and it is considered resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

Issue 18.08: CR Prototype

Issue: The DSER states that the staff believes development of a fully functional control room prototype of the standard design is appropriate in order to demonstrate acceptable human performance.

Evaluation: These V&V analyses conducted by the COL applicant as part of element G of the HFE ITAAC/DAC described in table 3.6 of the ITAAC/DAC document specifically requires prototype evaluation and this issue is, therefore, considered resolved pending receipt of the final ITAAC/DAC. This is a confirmatory item.

18.18: Safety Parameter Display System Design Scope

Issue: The DSER states that at the present state of design, it could not be determined whether the ABWR SPDS meets all the NRC SPDS design criteria stated in NUREG-0737, Supplement 1. However, the SPDS function and the list of critical parameters as described in SSAR Section 18.4.6 did not include parameters that would provide operators with information about radioactivity control should there be a release of radioactive materials. The SSAR further states that the referencing applicant may provide a radioactivity release control information display. The staff finds that the GE approach to meeting NRC requirements for the SPDS function were not sufficient.

Proposed Resolution: This issue was to be closed as part of the process review, however since it is part of the standard feature list, it will be reviewed here.

Evaluation: See discussion of Standard Feature N below.

Paragraph 4.1d - GE's DSER response to item 4.1d in Table 3.b-1 states that the selection of information for inclusion in the SPDS is based on the current BWR Owner's Group EPGs rather than the ABWR EPGs. GE stated that this would be corrected to specifically address the ABWR EPGs. However, yet this correction has not yet been made to the SSAR. This is a confirmatory item.