ABB
ASEA BROWN BOVERI

February 18, 1992
LD-92-022

Docket No. 52-002

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Response to NRC Requests for Additional Information

Reference: Letter, Human Factors Assessment Branch RAIs, T. V. Wambach (NRC) to E. H. Kennedy (C-E), dated September 19, 1991.

Dear Sirs:

The Reference requested additional information for the NRC staff review of the Combustion Engineering Standard Safety Analysis Report - Design Certification (CESSAR-DC). Enclosure I to this letter provides responses to those questions and associated changes to CESSAR-DC.

As part of the request for standardized procedures and training materials in the Reference, the NRC made the following statement:

> "In your submittal dated April 12, 1991, you stated in part that you intend 'to comply with the staff's 'training and procedures' position by providing standardized training and operation procedures guidance. This guidance would then be input to the site-specific training program and operating procedures." The C-E submittal failed to provide any additional detailed information on these procedural and training materials. C-E must provide this information for review as part of the design certification process."

It is C-E's intention to provide input to owner/operators for their detailed plant procedures and operational programs in the form of an Operational Support Information Program (OSIP). However, C-E has been cautioned by both the C-E System 80+ Executive Advisory Committee and the NUMARC Standardization Oversight Working Group that the issues addressed in RAI's 620.6 - 620.10 are within the purview of the NPOC Strategic Plan Building Block #7 entitled, "Enhanced Standardization Beyond Design." In the period since our April 12, 1991 response, NPOC has assigned the industry lead for Block #7 to INPO. A description of the Block #7 Action Plan (November 1991 Revision) is provided in Enclosure II.

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In order to preclude undermining the extensive industry effort associated with standardization of plants during the operational phase, C-E submits that it would be inappropriate to include the OSIP within the design certification rule. This topic would be more appropriately reviewed on the COL application after Building Block #7 is complete.

Should you have any questions on the enclosed material, please contact me or Mr. Stan Ritterbusch of my staff at (203) 285-5206.

Very truly yours,

COMBUSTION ENGINEERING, INC.

C. B. Brinkman
Acting Director
Nuclear Systems Licensing

SER:MLS

Enclosure: As Stated

cc: J. Trotter (EPRI)
T. Wambach (NRC)

Enclosure 1 to
LD-92-022

RESPONSE TO NRC REQUESTS FOR ADDITIONAL INFORMATION
HUMAN FACTORS ASSESSMENT BRANCH

1.

Question: TASK ACTION PLAN ITEM B-17

CRITERIA FOR SAFETY-RELATED OPERATOR ACTIONS

C-E did not address this item. An assessment of how the System 80+ design meets Item B-17 is required to close out this issue.

Response:

Task Action Plan Item B-17 is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item B-17 was identified as a category 1e item which is defined on Page A-1 of Appendix A as follows: "The issue has been superseded by one or more USI's and GSI's."

TMI Action Plan Item I.D.1, Control Room Design Review, will address this concern. Automated, redundant, safety grade controls will be employed to reduce the potential for operator error during accident conditions.

The Operational Support Information (OSI) Program will provide or reference the material necessary to determine what safety related operator actions may be necessary in the emergency procedure guides. A description of this plan will be submitted in the near future.

2.

Question: HUMAN FACTORS ISSUE ITEM HF4.4

GUIDELINES FOR UPGRADING OTHER PROCEDURES

C-E did not address this item. An assessment of how the System 80+ design meets Item HF4.4 is required to close out this issue.

Response:

Human Factors Issue Item HF4.4 is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item HF4.4 was identified as a category 1d item which is defined on Page A-1 of Appendix A as follows: "The NRC identified the issue as either an operational, environmental, licensing or NRC internal issue. NUREG-0933 identifies this issue as being resolved with no new requirements established."

The documents used by the owner/operator to develop the types of procedures addressed by this issue will be developed throughout the design, construction and start-up phases as discussed in the Operational Support Information (OSI) Plan.

3.

Question GSI HF 5.1:

HUMAN FACTORS ISSUE ITEM HF5.1: LOCAL CONTROL STATIONS
The C-E response to this item states, "The resolution of GSI HF5.1 is identified in GSI HF 1.3.4 and is addressed and resolved in this Appendix. Since GSI HF5.1 is subsumed by the above GSI, this issue is resolved for the System 80+ Standard Design".

Paragraph (a) of HF 1.3.4 MAN-MACHINE INTERFACE addresses local control stations. The C-E response states, "each local control station shall be designed to meet the intent of the guidance given in Reference 2, 3, 4, and 5."

References referred to in the HF 1.3.4 MAN-MACHINE INTERFACE are:

Reference 2	-	Human Engineering Guide to Equipment Design
Reference 3	-	MIL-STD 1472C Human Engineering Design Criteria for Military Systems, Equipment and Facilities
Reference 4	-	NUREG-CR-3696 Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces in Nuclear Power Plants
Reference 5	-	NUREG-0700 Guidelines for Control Room Design Reviews

Under the subsection of HF 1.3.4 entitled RESOLUTION, the reader is referred to Section 18.7.1.6.2 Component Control Strategies, for the Nuplex 80+ local control station design philosophy and Section 18.7.1.6.2.10 Component Control Flashing Status Indication, for a discussion of alarms. Section 18.7.1.6.2 deals exclusively with hardware and describes hardware design features such as the ESFAS Control Signals, Bypassed or Inoperable Status Monitoring, ESF Actuation Status Monitoring, Interlocks and Actuation Signals, Operator Selected Automatic Control Signals, Standby Control Functions, Process Signal or Component Selection, and Subgroup Controls.

The regulatory guidance, NUREG-0933 ITEM HF5.1: LOCAL CONTROL STATIONS, states: "Information will be developed to determine if guidance on local control station design and auxiliary operator interfaces with these stations is required. To accomplish this task, job/task analyses of control room crew activities will be conducted to identify and describe communication and control links between the control room and auxiliary control stations. In addition, the functions of auxiliary personnel will be analyzed from the task analyses to estimate the potential impact of auxiliary personnel job errors on plant safety."

The regulatory guidance provided for Item HF5.1: LOCAL CONTROL STATIONS addresses the man-machine aspects of the use of local control stations. The CESSAR-DC documentation which addresses Item 5.1: LOCAL CONTROL STATIONS describes the hardware attributes of some of the components and systems that will be located at local control stations.

In order to meet the intent of NUREG-0933 ITEM HF5.1: LOCAL CONTROL STATIONS, the man-machine interface issues must be addressed. C-E must provide additional documentation showing the process that was used and the results of the analyses described in NUREG-0933 ITEM HF5.1. An assessment of the results of the studies and their impact on control room and auxiliary operator tasks must be provided in order to close out this item.

Response GSI HF 5.1:

C-E has not designed the majority of local workstations for certification submittal. This work will be performed primarily during first-of-a-kind engineering activities. C-E will perform human factors analysis for all local control stations and man machine interfaces which require operation or monitoring in relation to executing the Emergency Procedure Guidelines. This includes the equivalent to "job/task analyses of control room crew activities that will be conducted to identify and describe communication and control links described in NUREG-0933, in that such situations are those which involve emergency procedure operation. At this time there are no local control stations envisioned for this purpose.

The man-machine interfaces at EPG-required local control stations will be identical to that in the main control room. The type of hardware, panel layout conventions, display format, navigation through software, color coding, and all other salient aspects of the MMI shall be the same. This is assured through C-E's design review process, described in the HF program plan, and through the application of standard design basis documents such as the Nuplex 80+ Information Systems Description Document (NPX80+-IC-SD 791-01) and the Human Factors Standards and Guidelines. Additionally, C-E's team of human factors experts performs reviews of local control stations.

The remote shutdown panels will receive a functional task analysis and verification, the same as all control room panel designs. Additionally, the complete task analysis for the control room will include the MMI for local control stations having interface with the control room, precisely as described in the segment of NUREG 0933 indicated in the RAI question.

Other local control stations also receive man-machine interface design attention, although not to the level of the main control room or EPG-required local control stations. No formal human factors analyses have been conducted or are planned for non-EPG required local control stations. C-E uses review and design input by human-factors trained engineers as the primary method of assuring good man-machine interface at these local control stations. This is supplemented in several ways. First, large sections of the Human Factors Standards and Guidelines pertain to the balance-of-plant (and MMI conventions do not differ from the control room to the balance of plant control stations). The Standards and Guidelines have been given to local control station designers for use in their design process, as have other project documents which pertain to the MMI (such as the Control Panel Layout Document). Second, the C-E control room design team including human factors specialists, reviews all

engineering documents, drawings and other System 80+ products to assure a consistent MMI with the control room. This, of course, ensures that an auxiliary operator moving between local control stations or a control room operator going to a local control station will have a consistent interface as well as one that meets regulatory requirements on a stand-alone basis. Thus, negative transfer of training is avoided.

C-E does not intend to produce or document major analyses of non-EPG required local control stations, since they follow the same guidance and design practice as the control room. In order to review the local MMI conventions, a review of the control room design documents will provide the necessary details.

C-E is aware that job/task analyses for non-EPG required local control stations might result in improved inventory or arrangement of controls and indicators. However, due to the relatively uncomplicated nature of these interfaces, the designers and reviewers will be able to accomplish the task of developing an adequate local control station MMI without formal analysis. Further, given the lack of safety and time constraints in operation of these control stations, their detailed design will be conducted later in the design process and should not be required for certification submittal. C-E does intend to control the interface format and review design of all aspects of the balance-of-plant man-machine interface, as described above.

4.

Question GSI HF 5.2

HUMAN FACTORS ISSUE ITEM HF5.2: REVIEW CRITERIA FOR HUMAN FACTORS ASPECTS OF ADVANCED INSTRUMENTATION AND CONTROLS (ANNUNCIATORS)

The C-E response to this item states, "The acceptance criteria for the resolution of GSI HF5.2 are encompassed in GSI HF1.3.4." Under RESOLUTION, the response states, "Since GSI HF5.2 is subsumed by the above GSI, this issue is resolved for the System 80+ Standard Design."

Under HF1.3.4: MAN-MACHINE INTERFACE paragraph (b) the C-E response states, "annunciator systems shall be designed to incorporate the criteria in References 2 and 3, and meet the intent of References 5, 6, and 7."

The reference referred to in the response are:

Reference 2	-	Human Engineering Guide for Equipment Design
Reference 3	-	MIL-STD 1472C Human Engineering Design Criteria for Military Systems, Equipment and Facilities
Reference 5	-	NUREG 0700 Guidelines for Control Room Design Reviews
Reference 6	-	NUREG/CR-3217 Near-Term Improvements for Nuclear Power Plant Control Room Annunciator Systems
Reference 7	-	NUREG/CR-3937 Computerized Alarm Systems

Under RESOLUTION for this item, the C-E response states, "The Nuplex 80+ annunciator system meets the intent of the guidance and each of the basic functional criteria given in References 5 and 6...Of major importance is the reduction of stimulus overload which can occur during major transients. This reduction has been achieved by decreasing the number of alarm displays by using group alarm tiles with dynamic message windows and by including processing algorithms to generate the alarms." The reader is referred to Section 18.7.1.1.4 Alarm Philosophy, Section 18.7.1.5 Alarm Characteristics, Section 18.7.3.2.3 RCS Panel Alarms, and 18.7.3.2.4 Alarms on the CRT.

The C-E response does not provide a systematic presentation of the human factors studies, evaluations and analyses that lead to the development of the System 80+ control room alarm scheme. No discussion is included in the description of the alarm system on how the specific criteria in the references were met by the System 80+ alarm design. No mention is made of human factors guidelines, derived from the reference documentation, to be provided to engineers to ensure consistency in the man-machine interface across the various components of the alarm system (IPSO, CRTs and panel alarms).

The paragraphs referenced describe the hardware aspects of the annunciator, alarm and operator aid systems. No discussion is presented on the human factors aspects of how the alarm system meets the informational requirements of the operators. Discussions are not

presented to support such statements as: "reduction of overload stimulus" (page A-116); "minimization of memory requirements on the operator" (page 18.7-27); "alarms are categorized by control room panels and operator functions" (page 18.7-25); and "Fewer annunciator tiles also makes it easier for the operator to distinguish important alarms during transients" (page 18.7-26).

To close out this issue, C-E must provide a compilation of the human factors studies and evaluations that influenced the current configuration of the alarm system. The documentation should include how the cognitive and physical task analyses were performed. The documentation must also provide a human factors discussion detailing how the current configuration meets the informational needs of the operators for the command, control, and monitoring tasks they are expected to perform. A relationship should also be established between the findings of the original human engineering analyses, especially the critical task analysis, and the current configuration of the alarm system.

Response GSI HF 5.2:

C-E is in the process of providing a systematic presentation of the human factors studies, analyses, and evaluations that led to the Nuplex 80+ control room alarm scheme. This will include a description of applicable guidelines and design criteria, such as those described by C-E in meetings with the NRC Human Factors Branch (11/17/91, 12/4/91).

A description of the human factors aspects of the alarm system (current configuration), including information needs, operating details, and other relevant factors will be provided to supplement the materials provided in CESSAR-DC, at the aforementioned meetings, and in previous RAI responses.

C-E will provide the consolidated alarm scheme details in a supplemental response to RAI 620.13, Question subsection A, as previously committed.

QUESTION 5

TMI ACTION ITEM PLAN ITEM II.K.1(5) SAFETY RELATED VALVE POSITION DESCRIPTION

C-E did not address this item. An assessment of how the System 80+ design meets ITEM II.K.1(5) is required to close out this issue.

RESPONSE 5

NUREG-0933, "A Status Report on Unresolved Safety Issues", U.S. Nuclear Regulatory Commission, January 1989, Item II.K.1(5) of Task II.K states: "This NUREG-660 item was divided into two parts to: (a) review all valve positions and positioning requirements and positive controls along with all related test and maintenance procedures to assure proper ESF functioning, if required; and (b) verify that AFW valves are in the open position. Part (a) affected all operating plants. For all OL applicants, it was determined that this part was covered by Items I.C.2 and I.C.6. Part (b) affected all B&W operating plants. For OL applicants with B&W reactors, this part was also determined to be covered by Items I.C.2 and I.C.6."

Part (a), which is covered by Items I.C.2 and I.C.6, is not required to be addressed as a plant design issue according to NUREG-1197, "Advanced Light Water Reactor Program," December 1986, and is therefore not included in CESSAR-DC. Appendix A of NUREG-1197 identifies six categories of "not applicable issues" for use in the categorization of issues in the ALWR Program. Appendix A identifies items I.C.2 and I.C.6 as not applicable to plant design issues (Table A-1e).

Part (b) does not affect C-E plants, and is therefore not included.

6.

Question: TMI ACTION PLAN ITEM II.K.1(10)

REVIEW AND MODIFY PROCEDURES FOR REMOVING SAFETY RELATED SYSTEMS FROM SERVICE

C-E did not address this item. An assessment of how the System 80+ design meets ITEM II.K.1(10) is required to close out this issue.

Response:

TMI Action Plan Item II.K.1(10) is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item II.K.1(10) was identified as a Category 1 item which is defined on Page A1-1 of Appendix A as follows: "Issue not relevant to the System 80+ standard design".

NUREG-0933 identifies Item II.K.1(10) as being resolved with new requirements issued. The issue is covered by Items I.C.2 and I.C.6. Items I.C.2 and I.C.6 are addressed in Appendix A of CESSAR-DC and are classified as follows:

I.C.2: "Not applicable in the EPRI Regulatory Stabilization Program (see NUREG-1197)."

I.C.6: "The NRC identified the issue as either an operational, environmental, licensing or NRC internal issue."

NUREG-0933 also identifies this item in Appendix B as an issue that is resolved. Removing safety related systems from service will be addressed in site specific procedures and will be developed by the owner/operator from information provided in the Operational Support Information (OSI) Program. Site specific technical specification procedures will also address this concern.

7.

Question - TMI Action Plan Item I.A.1.4

LONG TERM UPGRADE OF OPERATING PERSONNEL AND STAFF

C-E did not address this item. An assessment of how the System 80+ design meets Item I.A.1.4 is required to close out this issue.

Response

TMI Action Plan Item I.A.1.4 is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item I.A.1.4 was identified as a Category 1g item which is defined on Page A-1 of Appendix A as follows: "The issue was classified as not applicable in the EPRI Regulatory Stabilization Program (See NUREG 1197)."

Item I.A.1.4 is also identified in NUREG-0933, Appendix B, as an issue that is resolved and since this item addresses only plant operations, it is not addressed in detail in CESSAR-DC.

The operator staffing levels identified in 10 CFR 50.54(m) are the responsibility of the owner/operator and are considered during the design process of the System 80+.

8.

Question - TMI ACTION PLAN ITEM I.C.9

LONG TERM PROGRAM PLAN FOR UPGRADING PROCEDURES

C-E did not address this item. An assessment of how the System 80+ design meets Item I.C.9 is required to close out this issue.

Response

TMI Action Plan Item I.C.9 is addressed in Table A1-1, CESSAR-DC, Appendix A, dated 12/15/89. Item I.C.9 was identified as a Category 1e item which is defined on Page A-1 of Appendix A as follows: "The issue has been superseded by one or more USI's or GSI's."

This action plan is also identified in NUREG-0933, Appendix B, as an issue that is resolved and since this item addresses procedures that will be developed by the operating staff, it is not addressed in detail in CESSAR-DC.

Per NUREG-0933, USI 1.C.1 supersedes the majority of the concerns of 1.C.9., Item 1.C.1 is addressed in Appendix A of CESSAR-DC. The remainder of 1.C.9 concerns were resolved with no new requirements by the NRC in 1985.

Normal and abnormal operating procedures, maintenance, test, surveillance and other procedures are beyond design certification scope and will be addressed by the owner/operator. As the plant designer, ABB-CE will provide necessary Operation Support Information (OSI) to the owner/operator.

9.

Question HF1.1

C-E did not address this item. An assessment of how the System 80+ design meets ITEM HF1.1 is required to close out this issue.

Response HF1.1

The Nuplex 80+ staffing design bases are provided in CESSAR-DC Section 18.3.3. These bases concur with the minimum and maximum staffing levels for an ALWR provided in the EPRI ALWR Utility Requirements Document. The Nuplex 80+ control room is designed to accommodate a variety of shift complements, as determined by the owner/operator. Evaluations have been performed for the minimum and maximum operating staffs. These evaluations and the staffing approach are further discussed in the responses to RAI's 620.24 and 620.25.

Question 10

NUREG-0985 HUMAN FACTORS ISSUE ITEM HF1.3.4 MAN-MACHINE INTERFACE

Several tasks in Section 4, HUMAN FACTORS ISSUES, of NUREG-0933 appear to have the same titles and technical content as the C-E designation HF1.3.4 MAN-MACHINE INTERFACE (see below). Identify the source of item number HF1.3.4, its purpose and its relationship to the Human Factors USIs and GSIs that appear in NUREG-0933. Provide clarification concerning which items are intended for review under the HF1.3.4 rather than the corresponding NUREG-0933 task. Identify the location of the source and review criteria for any items retaining the item number of HF1.3.4.

CESSAR-DC	TITLE	NUREG-0933	TITLE
1.3.4a	Local Control Stations	HF5.1	Local Control Stations
1.3.4b	Annunciator Systems	HF5.2	Review Criteria for Human Factors Aspects of Advanced Controls and Instrumentation
1.3.4c	Operational Aids	HF5.3	Evaluation of Operational Aid Systems
1.3.4d	Automation and/or Artificial Intelligence Systems	HF4.5	Application of Automation and Artificial Intelligence
1.3.4e	Computers and Computer Display Technology	HF5.4	Computers and Computer Displays

Response 10

The HF 1.3.4 number system was based on early documentation (1986) which was used at the time EPRI was evaluating the applicability of USIs/GSIs to the design of ALWRs. The HF 1.3.4 numbers correspond to HF 5.1 - HF 5.4 and HF 4.5 as shown in this RAI. HF 5.1 and HF 5.2 are applicable to the design process and are discussed questions 3 and 4 of this letter as well as in Appendix A of CESSAR-DC. Items HF 4.5, HF 5.3, and HF 5.4 are considered not applicable to ALWR designs, based on Appendix B of NUREG-0933, Supplement 13. Accordingly, the attached revisions will be made to CESSAR-DC in a future amendment.

TABLE A1-1 (Cont'd)

(Sheet 32 of 55)

LISTING OF
UNRESOLVED SAFETY ISSUES AND
GENERIC SAFETY ISSUES

ISSUE NUMBER	ISSUE TITLE	ISSUE TYPE	CATEGORY
HF 1.3.2	HUMAN FACTORS PROGRAM PLAN--LICENSING EXAMINATIONS	GSI	1d
HF 1.3.3	HUMAN FACTORS PROGRAM PLAN--PROCEDURES-OPERATING AND MAINTENANCE	CSI	1d
HF 1.3.4a	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - LOCAL CONTROL STATIONS	GSI	2
HF 1.3.4b	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - ANNUNCIATORS	GSI	2
HF 1.3.4c	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - OPERATIONAL AIDS	GSI	2
HF 1.3.4d	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - AUTOMATION AND ARTIFICIAL INTELLIGENCE	GSI	2
HF 1.3.4e	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - COMPUTERS AND COMPUTER DISPLAYS	GSI	2
HF 1.3.5	HUMAN FACTORS PROGRAM PLAN--STAFFING AND QUALIFICATIONS	GSI	1d

TABLE A2-1 (Cont'd)

(Sheet 6 of 9)

LIST OF UNRESOLVED SAFETY ISSUES AND HIGH/MEDIUM PRIORITY GENERIC ISSUES APPLICABLE TO THE SYSTEM 80+ STANDARD DESIGN

ISSUE NUMBER	ISSUE TITLE	ISSUE TYPE
C-2	STUDY OF CONTAINMENT DEPRESSURIZATION BY INADVERTENT SPRAY OPERATION	GSI
C-4	STATISTICAL METHOD FOR ECCS ANALYSIS	GSI/RI
C-5	DECAY HEAT UPDATE	GSI/RI
C-10	EFFECTIVE OPERATION OF CONTAINMENT SPRAYS IN A LOCA	GSI
C-12	PRIMARY SYSTEM VIBRATION ASSESSMENT	GSI
HF 1.3.4a	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - LOCAL CONTROL STATIONS	GSI
HF 1.3.4b	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - ANNUNCIATORS	GSI
HF 1.3.4c	HUMAN FACTOR PROGRAM PLAN - MAN MACHINE INTERFACE - OPERATIONAL AIDS	GSI
HF 1.3.4d	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - AUTOMATION AND ARTIFICIAL INTELLIGENCE	GSI

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TABLE A2-1 (Cont'd)

(Sheet 7 of 9)

LIST OF UNRESOLVED SAFETY ISSUES AND HIGH/MEDIUM PRIORITY GENERIC ISSUES APPLICABLE TO THE SYSTEM 80+ STANDARD DESIGN

ISSUE NUMBER	ISSUE TITLE	ISSUE TYPE
HF 1.3.4e	HUMAN FACTORS PROGRAM PLAN - MAN MACHINE INTERFACE - COMPUTERS AND COMPUTER DISPLAYS	GSI
HF 5.1	LOCAL CONTROL STATIONS	GSI
HF 5.2	REVIEW CRITERIA FOR HUMAN FACTORS ASPECTS OF ADVANCED CONTROLS AND INSTRUMENTATION	GSI
I.C.1	(1-4) SHORT TERM ACCIDENT ANALYSIS AND PROCEDURES REVISION	GSI
I.D.2	CONTROL ROOM DESIGN REVIEWS -- PLANT SAFETY PARAMETER DISPLAY CONSOLE	GSI/TMI
I.D.4	CONTROL ROOM DESIGN STANDARD	GSI
I.D.5	(1) CONTROL ROOM DESIGN -- IMPROVED INSTRUMENTATION RESEARCH ALARMS AND DISPLAY	GSI
I.D.5	(2) CONTROL ROOM DESIGN -- IMPROVED INSTRUMENTATION RESEARCH	GSI
I.D.5	(3) CONTROL ROOM DESIGN -- ON-LINE REACTOR SURVEILLANCE SYSTEMS	GSI/LI

TABLE A4-1 (Cont'd)

(Sheet 5 of 8)

LIST OF TECHNICAL RESOLUTIONS FOR USIs AND GSIs APPLICABLE TO THE SYSTEM 80+ STANDARD DESIGN INCLUDED IN SECTION 4.0

NRC ISSUE NUMBER	ISSUE TITLE	PAGE NO.	
B-56	DIESEL RELIABILITY	A-105d	G
B-60	LOOSE PARTS MONITORING SYSTEM	A-106	
B-61	ALLOWABLE ECCS EQUIPMENT OUTAGE PERIODS	A-107b	I
B-63	ISOLATION OF LOW PRESSURE SYSTEMS CONNECTED TO THE REACTOR COOLANT PRESSURE BOUNDARY	A-108a	G
B-66	CONTROL ROOM INFILTRATION MEASUREMENTS	A-108c	I
C-2	STUDY OF CONTAINMENT DEPRESSURIZATION BY INADVERTENT SPRAY OPERATION	A-108f	
C-4	STATISTICAL METHODS FOR ECCS ANALYSIS	A-109	
C-5	DECAY HEAT UPDATE	A-111	
C-10	EFFECTIVE OPERATION OF CONTAINMENT SPRAYS IN A LOCA	A-112a	I
C-12	PRIMARY SYSTEM VIBRATION ASSESSMENT	A-113	
HF 1.3.4a	HUMAN FACTORS PROGRAM PLAN - LOCAL CONTROL STATIONS	A-115	
HF 1.3.4b	HUMAN FACTORS PROGRAM PLAN - ANNUNCIATOR SYSTEMS	A-116	
HF 1.3.4c	HUMAN FACTORS PROGRAM PLAN - OPERATIONAL AIDS	A-117	

TABLE A4-1 (Cont'd)

(Sheet 6 of 8)

LIST OF TECHNICAL RESOLUTIONS FOR
USIs AND GSIs APPLICABLE TO THE SYSTEM 80+
STANDARD DESIGN INCLUDED IN SECTION 4.0

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HF 1.3.4: MAN-MACHINE INTERFACES

ISSUE

Human Factors Issue HF 1.3.4 in NUREG-0985 (Reference 1), addresses the need to appropriately configure several aspects of the man-machine interface design to reduce the potential for human errors during normal and off-normal operations. These aspects are:

(a) local control stations,
(b) annunciator systems,
(c) operational aids,
(d) automation and/or artificial intelligence systems, and
(e) computers and computer display technology.

ACCEPTANCE CRITERIA

The acceptance criteria for the resolution of Human Factors Issue HF 1.3.4 are that:

(a) each local control station shall be designed to meet the intent of the guidance given in References 2, 3, 4, and 5;

(b) annunciator systems shall be designed to incorporate the criteria in references 2 and 3 , and meet the intent of References 5, 6 and 7;

(c) operational aids shall be designed to meet the intent of the guidance given in References 8 through 13;

(d) automatic systems are required to initiate and control all protective actions such that the control room operator is not required to take any action before plant conditions are such that manual action is permitted (IEEE Standard 603, Reference 14);

(e) computers and computer displays in the control room shall be designed to meet the intent of References 5, 15, and 16.

RESOLUTION

The System 80+ Standard Design incorporates a NUPLEX 80+ Advanced Control Complex (see CESSAR-DC, Chapter 18). Details of the NUPLEX 80+ design relevant to the resolution of HF 1.3.4 are as follows:

(a) All aspects of the local control stations in NUPLEX 80+ are designed to meet the intent of the guidance given in

References 2, 3, 4, and 5. The man-machine interfaces at the local control stations are consistent with the information presentation and control methodologies used in the NUPLEX 80+ main control room.

The design philosophy of the NUPLEX 80+ local control stations is described in CESSAR-DC, Section 18.7.1.6.2. Adequate communications are provided between the local stations and the main control room as discussed in CESSAR-DC, Section 9.5.2. Because the actuation of local controls is on a single component basis, indication of locally repositioned components is provided in the main control room. A detailed discussion of abnormal component conditions which are indicated by various alarms is given in CESSAR-DC, Section 18.7.1.6.2.10. It should be noted that in the NUPLEX 80+ design, the ability to achieve cold shutdown during conditions of control room evacuation is provided at the remote shutdown panel. Local control stations are used only for maintenance and testing activities. Consistent information presentation and control techniques reinforce desired operator performance behavior and reduce the chance of error during normal and off-normal operation situations.

(b) The NUPLEX 80+ annunciator system meets the intent of the guidance and each of the basic functional criteria given in References 5 and 6. The annunciator system is described in CESSAR-DC, Sections 18.7.1.1.4 and 18.7.1.5. Of major importance is the reduction of the stimulus overload which can occur during major transients. This reduction has been achieved by decreasing the number of alarm displays by using group alarm tiles with dynamic message windows and by including processing algorithms to generate the alarms. Stimulus overload is further reduced by basing alarms on validated parameters instead of on individual sensor channels. Mode and equipment status dependency are included in the alarm logic to eliminate nuisance alarms. The alarms are functionally grouped (see CESSAR-DC, Sections 18.7.3.2.3 and 18.7.3.2.4). Also incorporated into the annunciator system are prioritization; availability of first-out alarm information via the CRT's; implementation of the dark-board concept; and adherence to the accepted criteria for labeling, location, auditory signal intensity, flash rates and readability. The appropriate recommendations in Reference 7 have also been incorporated into the NUPLEX 80+ annunciator system.

(c) The NUPLEX 80+ man-machine interface employs operator aids primarily to process data prior to presentation to the control room operators. The aids are integrated into the presentation hierarchy through application programs of the Data Processing System (DPS) and the Discrete Indication and Alarm System (DIAS). Each of these systems conforms to the human factors criteria given in CESSAR-DC, Section 18.7.1.1. Conformance of NUPLEX 80+ to References 12 and 13 is described in CESSAR-DC, Sections 7.5.1.1.5, 7.5.2.5, and 7.1.2.21.

The following operator aids are provided as part of the NUPLEX 80+ man-machine interface (with the corresponding CESSAR-DC Sections indicated):

(1) Signal reduction and validation - 18.7.1.4 and 18.7.3.2.1.6,
(2) Integrated Process Status Overview (IPSO) - 18.7.1.2,
(3) Alarm handling - 18.7.1.5 and 18.7.2.3,
(4) Critical function monitoring - 18.7.1.8.2 and 7.7.1.10,
(5) Success path monitoring - 18.7.1.8.2,
(6) Core limit monitoring - 7.7.1.8.1, and
(7) Computer aided surveillance testing - 7.7.1.8.2.M.

(d) The control automation of safety systems in NUPLEX 80+ conforms to the requirements of Reference 14, that is, the automatic systems are designed to initiate and control all protective actions such that the control room operator is not required to take any action before plant conditions are such that manual action is permitted (see CESSAR-DC, Section 7.1.2.13). The level of control automation for other systems is determined by the functional allocation of the task analysis which is described in CESSAR-DC, Section 18.5. NUPLEX 80+ controls for safe shutdown systems are discussed in CESSAR-DC, Sections 7.4.1 and 7.4.2. The human factors related to the Engineered Safety Features Actuation Systems and to automatic controls are discussed in CESSAR-DC, Sections 18.7.1.6 and 18.7.1.6.2.6, wherein the acceptability of the automatic controls for safety and non-safety systems is demonstrated. Automation in process control systems and non-safety component controls are discussed in CESSAR-DC, Sections 7.7.1.1 and 7.7.1.2. The Megawatt Demand Setter is discussed in CESSAR-DC, Sections 7.7.1.1.3 and 7.7.1.2.3. NUPLEX 80+ employs no artificial intelligence systems.

(e) The philosophy of information presentation and the employment of computer technology in plant operations are discussed in CESSAR-DC, Section 18.7. NUPLEX 80+ utilizes

the computer's ability to process raw data and to manipulate and arrange information to support efficient data access by the operator. Process information is made available in a logically structured hierarchical format which is based on the results of functional task analysis. This format is designed to support monitoring, diagnostics and control tasks.

The Integrated Process Status Overview (IPSO) is a dynamically updated computer display which presents information to the operator to enable assessment of the overall plant process performance. IPSO has been found to improve operator performance during transients based upon validation experiments conducted at the Halden Reactor Project. NUPLEX 80+ meets the intent of the human factors criteria identified in References 15 and 16.

Since all the acceptance criteria have been met, the man-machine interface issue is resolved for the System 80+ Standard Design.

REFERENCES

1. NUREG-0985, Rev. 02, "U.S. Nuclear Regulatory Commission Human Factors Program Plan", April 1986.

2. VanCott & Kincade, "Human Engineering Design for Equipment Design", 19[illegible].

3. MIL-STD-1472C, "Human Engineering Design Criteria for Military Systems, Equipment & Facilities", December 1974.

4. NUREG/CR-3696, "Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces in Nuclear Power Plants", April 1984.

5. NUREG-0700, "Guidelines for Control Room Design Reviews", U.S. Nuclear Regulatory Commission, September 1981.

6. NUREG/CR-3217, "Near-Term Improvements for Nuclear Power Plant Control Room Annunciator Systems", U.S. Nuclear Regulatory Commission, April 1983.

7. NUREG/CR-3984, "Computerized Alarm Systems", U.S. Nuclear Regulatory Commission, June 1985.

8. NUREG-0696, "Functional Criteria for Emergency Response Facilities", U.S. Nuclear Regulatory Commission, February 1981.

9. NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability", Generic Letter 82-83, U.S. Nuclear Regulatory Commission, December 1982.

10. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants -- LWR Edition", U.S. Nuclear Regulatory Commission.

11. Regulatory Guide 1.29, Rev. 03, "Seismic Design Classification", U.S. Nuclear Regulatory Commission, September 1978.

12. Regulatory Guide 1.97, Rev. 03, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident", U.S. Nuclear Regulatory Commission, May 1983.

13. Regulatory Guide 1.47, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems", U.S. Nuclear Regulatory Commission, May 1973.

14. IEEE Standard-603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations", 1980.

15. EPRI NP-3701, "Computer-Generated Display System Guidelines", Volumes 1 & 2, September 1984.

16. NUREG/CR-4227, "Human Engineering Guidelines for the Evaluation and Assessment of Video Display Units", U.S. Nuclear Regulatory Commission, July 1985.

HF 5.1: LOCAL CONTROL STATIONS

ISSUE

Generic Safety Issue (GSI) HF 5.1 in NUREG-0933 (Reference 1), addresses additional NRC guidance for the design of local control stations.

ACCEPTANCE CRITERIA

The acceptance criteria for the resolution of GSI HF 5.1 ~~are encompassed in GSI HF 1.3.4.~~ is that (insert A)

RESOLUTION

INSERT B

~~The resolution for GSI HF 5.1 is identified in GSI HF 1.3.4 and is addressed and resolved in this Appendix.~~

~~Since GSI HF 5.1 is subsumed by the above GSI, this issue is resolved for the System 80+ Standard Design.~~

REFERENCES

1. NUREG-0933, "A Status Report On Unresolved Safety Issues", U.S. Nuclear Regulatory Commission, April 1989.

2. VanCott & Kincade, "Human Engineering Design for Equipment Design", 1972.

3. MIL-STD-1472C, "Human Engineering Design Criteria for Military Systems, Equipment & Facilities", December 1974.

4. NUREG/CR-3696, "Potential Human Factors Deficiencies in the Design of Local Control Stations and Operator Interfaces in Nuclear Power Plants", April 1984.

5. NUREG-0700, "Guidelines for Control Room Design Reviews", U.S. Nuclear Regulatory Commission, September 1981.

Insert A

, each local control station shall be designed to meet the intent of the guidance given in References 2, 3, 4, and 5.

Insert B

The System 80+ Standard Design incorporates a NUPLEX 80+ Advanced Control Complex (see CESSAR-DC, Chapter 18). Details of the NUPLEX 80+ design relevant to the resolution of HF [redacted] are as follows:

All aspects of the local control stations in NUPLEX 80+ are designed to meet the intent of the guidance given in References 2, 3, 4, and 5. The man-machine interfaces at the local control stations are consistent with the information presentation and control methodologies used in the NUPLEX 80+ main control room.

The design philosophy of the NUPLEX 80+ local control stations is described in CESSAR-DC, Section 18.7.1.6.2. Adequate communications are provided between the local stations and the main control room as discussed in CESSAR-DC, Section 9.5.2. Because the actuation of local controls is on a single component basis, indication of locally repositioned components is provided in the main control room. A detailed discussion of abnormal component conditions which are indicated by various alarms is given in CESSAR-DC, Section 18.7.1.6.2.10. It should be noted that in the NUPLEX 80+ design, the ability to achieve cold shutdown during conditions of control room evacuation is provided at the remote shutdown panel. Local control stations are used only for maintenance and testing activities. Consistent information presentation and control techniques reinforce desired operator performance behavior and reduce the chance of error during normal and off-normal operation situations.

HF 5.2: REVIEW OF CRITERIA FOR HUMAN FACTORS ASPECTS OF ADVANCED INSTRUMENTATION AND CONTROLS (ANNUNCIATORS)

ISSUE

Generic Safety Issue (GSI) HF 5.2 in NUREG-0933 (Reference 1), addresses additional NRC guidance for the design of advanced instrumentation and controls, in particular with respect to plant annunciators.

ACCEPTANCE CRITERIA

The acceptance criteria for the resolution of GSI HF 5.2 ~~are encompassed in GSI HF 1.3.4.~~ is that (Insert C)

RESOLUTION

~~The resolution for GSI HF 5.2 is included in the resolution for GSI HF 1.3.4 contained in this Appendix.~~ Insert D

~~Since GSI HF 5.2 is subsumed by the above GSI, this issue is resolved for the System 80+ Standard Design.~~

REFERENCES

1. NUREG-0933, "A Status Report On Unresolved Safety Issues", U.S. Nuclear Regulatory Commission, April 1989.

2. VanCott & Kincade, "Human Engineering Design for Equipment Design", 1972.

3. MIL-STD-1472C, "Human Engineering Design Criteria for Military Systems, Equipment & Facilities", December 1974.

4. NUREG-0700, "Guidelines for Control Room Design Reviews", U.S. Nuclear Regulatory Commission, September 1981.

5. NURFG/CR-3217, "Near-Term Improvements for Nuclear Power Plant Control Room Annunciator Systems", U.S. Nuclear Regulatory Commission, April 1983.

6. NUREG/CR-3967, "Computerized Alarm Systems", U.S. Nuclear Regulatory Commission, June 1985.

Insert C

annunciator systems shall be designed to incorporate the criteria in References 2 and 3, and meet the intent of References 4, 5 and 6.

Insert D

The NUPLEX 80+ annunciator system meets the intent of the guidance and each of the basic functional criteria given in References 4 and 5. The annunciator system is described in CESSAR-DC, Sections 18.7.1.1.4 and 18.7.1.5. Of major importance is the reduction of the stimulus overload which can occur during major transients. This reduction has been achieved by decreasing the number of alarm displays by using group alarm tiles with dynamic message windows and by including processing algorithms to generate the alarms. Stimulus overload is further reduced by basing alarms on validated parameters instead of on individual sensor channels. Mode and equipment status dependency are included in the alarm logic to eliminate nuisance alarms. The alarms are functionally grouped (see CESSAR-DC, Sections 18.7.3.2.3 and 18.7.3.2.4). Also incorporated into the annunciator system are prioritization; availability of first-out alarm information via the CRT's; implementation of the dark-board concept; and adherence to the accepted criteria for labeling, location, auditory signal intensity, flash rates and readability. The appropriate recommendations in Reference 6 have also been incorporated into the NUPLEX 80+ annunciator system.

//.

Question CSI I.D.2

Human Factors Issue Item I.D.2: Plant Safety Parameter Display Console - The C-E response provided for I.D.2 states that, "The SPDS functions shall be integrated into the overall control room design." In order to meet the intent of Item I.D.2, a focused discussion must be provided which specifically states how System 80+ meets the requirements for an SPDS, as identified in NUREG-0737 Supplement 1 Section 4, Safety parameter Display System and NUREG-0696 Functional Criteria for Emergency Response Facilities, Section 5, Safety Parameter Display System.

Response GSI I.D.2

The Nuplex 80+ advanced control complex design integrates the SPDS function into the man-machine interface design. This response will address each of the major SPDS requirements in NUREG-0696 and NUREG-0737, Supplement 1.

NUREG-0696

Section 5.1 - Function

The SPDS function in Nuplex 80+ is met by the critical functions CRT display hierarchy in the Data Processing System (DPS). This hierarchy displays the results of algorithms which monitor the status of nine critical safety functions (including those specified in NUREG-0696) and indicates alarms which allow rapid detection of challenges to the critical safety functions. Additional information is provided on a display page specifically designed for each critical safety function and on detailed success path pages.

Human factors considerations are incorporated in all aspects of the design as documented in CESSAR-DC and the Human Factors Program Plan. As described in Section 18.7.1.4 of CESSAR-DC, the Nuplex 80+ design uses validated process representation values for display and alarm processing for all man-machine interfaces, including the SPDS function. As part of the normal CRT display system, the SPDS function is in operation during both normal and abnormal conditions and is used to monitor critical power production fractions normally in a similar manner to safety fractions. Parameter trending is available for any monitored parameter in the DPS.

Section 5.2 - Location

The SPDS function (i.e., critical function display) is available at all MCR CRTs (one at each panel), in the control room offices, in the TSC and at the EOF.

Section 5.3 - Size

CRTs for the DPS are sized to be integrated in the control room panels as shown in CESSAR-DC, Figure 18.7.3-39. A control room supervisor (SRO) has access to CRT displays and, hence, the SPDS function at the control room supervisor's console.

Section 5.4 - Staffing

No additional operating personnel are required for DPS CRT operation.

Section 5.5 - Display Considerations

The single primary display presenting critical function status and plant success path status is the IPSO. This is presented continuously (as discussed in GSI 125.1.3) on a big board overview and is available on any CRT. The important plant functions indicated in Section 5.5 are included in the Nuplex 80+ critical functions design.

Section 5.6 - Design Criteria

The Nuplex 80+ DPS is a highly reliable non-safety system which meets the operational unavailability goal of NUREG-0696. It has redundant computers and multiple man-machine interfaces. The availability of control room information from the DPS using the current reference design has been calculated as 99.98% with an MTTR of 4 hours. These numbers can vary depending on final hardware selection but the SPDS reliability goal will be met.

NUREG-0737, Supplement 1

Section 4.1.a

As discussed in the section for NUREG-0696, Section 5.5, the IPSO display provides a concise, highly processed status of critical safety functions. In conjunction with the DPS critical functions hierarchy, it allows rapid determination of critical function and success path status, which are both indicative of plant safety status.

Section 4.1.b

As discussed further in the response to question GSI 125.1.3, each control room panel has a CRT with access to all critical function information. The big board IPSO display also provides continuous display of critical function and success path status.

Section 4.1.c

The DPS design criteria is discussed under NUREG-0696. The DPS is independent of, and isolated from the Discrete Indication and Alarm System (DIAS) which provides spatially dedicated information to operators in Nuplex 80+.

Section 4.1.d

Information presented on critical function display pages (and throughout Nuplex 80+ MMIs) is selected based on the requirements of operator's functions and tasks, making consideration of regulatory requirements such as those in Reg. Guide 1.97 for post-accident monitoring.

Section 4.1.e

The DPS displays and all Nuplex 80+ MMIs do incorporate human factors principles, as previously discussed.

Section 4.1.f

As described under NUREG-0696, Section 5.5, information for all of these safety functions is provided in the DPS critical functions hierarchy.

Further detailed information on the integration of NUREG-0737 and NUREG-0696 SPDS functional requirements are provided in the following documents:

A. CESSAR-DC

(1) Chapter 7.5 Safety Related Display Instrumentation

Section 7.5.1	Description
Section 7.5.1.1.5	Post-Accident Monitoring
Section 7.5.2.5	Analysis of PAMI

(2) Chapter 7.7 Control Systems Not Required for Safety

Section 7.7.1.4	Discrete Indication and Alarm System
Section 7.7.1.5	Integrated process Status Overview
Section 7.7.1	Data Processing System
Section 7.7.1.0	DPS Critical Functions Monitoring Program

(3) Chapter 18 Human Factors Engineering

Section 18.7.1.2.2	Plant Functional Information on IPSO
Section 18.7.1.4	Discrete Indication Displays
Section 18.7.1.8	Safety Related Information in Nuplex 80+

B. Nuplex 80+ Reference Design Documentation

(1) NPX80-IC-SD710-00 System Description for the Rev. 00 Data Processing System

Section 4.1.3	Overview of Functions
Section 6.11.5	Display Information Organization

(2) NPX80-IC-SD790-02 Rev. 00 System Description for Critical Function and Success Path Monitoring in Nuplex 80+

Section 4	Nuplex 80+ Critical Function and Success Path Information

12.

Question GSI I.D.4:

HUMAN FACTORS ISSUE ITEM I.D.4: CONTROL ROOM DESIGN STANDARD
For this item, NUREG-0933 states, "In accordance with 10 CFR 50.34(g) all future applications for LWRs shall include an evaluation of the proposed facility against SRP Section 18.1 which addresses control room design and references, NUREG-0700 as appropriate guidance for control room design." The Standard Review Plan 18.1 part IV EVALUATION FINDINGS states that the staff's conclusion should be based on the following:

"The applicant conducted and documented a systems analysis, using existing guidelines and good HFE practice, to identify man/machine interface requirements, using allocation of functions to man and machine (manual and automatic) and identification of information and controls provided to the operators. The applicant demonstrated that all the necessary information and controls needed for normal, abnormal, and emergency operations of the plant are identified and provided. The allocation of functions to man and machine were addressed and established that the systems have been optimized to take advantage of the strengths of human operators and automatic systems."

The C-E response to ITEM I.D.4 states, "The analysis detailed the operator's tasks involved in decision processing to ensure that: (a) only information needed is presented to the operator, (b) the amount of information does not exceed human cognitive limitations, and (c) information is presented in usable form. The functional task analysis and its results are described in CESSAR-DC Section 18.5."

CESSAR-DC Section 18.5 does not address the breadth and level of detail required by the Standard Review Plan for a human factors effort. From the description provided in Section 18.5, Functional Task Analysis, it does not appear that the human engineering effort was conducted within the framework of a systems analysis, or according to an established human factors program plan. Section 18.5.1.5 Analysis of Operator Tasks refers to event sequences being reviewed by experts in operations. However, no mention is made of the contribution provided by human factors expertise. Section 18.5.1.8.3 Estimated Cognitive Processing Time for Task Element List states, "Operations and cognitive experts reduced all complex decisions into simple decisions. Cognitive processing time estimates were assigned to all simple decisions." Reducing the decision making process of the control room operator to simple decisions does not account for the complex nature of the tasks actually encountered in an operating control room. Control room operators must routinely take into account the power mode, plant status, maintenance and surveillance activities, any special information conveyed during shift turnover, conformance with plant technical specifications, and utility operating conventions. Comparisons between pieces of data that are not co-located must also be frequently made. Variables such as these contribute to making simple decisions complex ones.

In order to meet the requirements of ITEM I.D.4: CONTROL ROOM DESIGN STANDARD C-E must provide documentation showing that the human factors program was conducted within the context of a systems analysis, in accordance with a prescribed human factors program plan, and that human factors guidance such as NUREG-0700 was implemented knowledgeably and consistently. Documentation must also be provided that demonstrates that the task analysis and function allocation performed took into consideration the complex nature of the tasks performed by control room operators.

Response GSI I.D.4:

C-E has addressed the issue of a Human Factors Program Plan in meetings with the NRC Human Factors Branch (11/17/91 and 12/4/91) as well as in the response to RAI 620.1. C-E is currently in the process of preparing a detailed Human Factors Program Plan, based on content requirements of MIL-H-46855B, tailored to the System 80+ design program. This document includes a description of design basis, organization and level of human factors engineering effort for the System 80+ ALWR Standard Design as well as a description of all past, present, and planned human factors engineering analyses, reviews and design efforts. C-E believes that this document will meet the NRC's requirements for documentation of the Human Factors program at C-E.

C-E believes that reference documentation provided previously, namely the Nuplex 80+ Function and Task Analysis Report and the Nuplex 80+ Verification Report provide suitable documentation "that demonstrates that the task analysis and function allocation performed took into consideration the complex nature of the tasks performed by control room operators." Additional details on function and task analyses are provided in the response to RAI 620.2. C-E further points out that the operating sequences for System 80+ are largely based on existing, licensed System 80 plants as noted in the afore-referenced meetings with the NRC Human Factors Branch. Thus, C-E's human factors team and other designers are aware of, and have given due consideration to, the complex nature of the tasks performed by control room operators. The full-time presence of two licensed PWR operators on the design team further assures that the complex nature of real operational practice is given constant consideration during the design of the man-machine interface.

13.

Question GSI I.D.5 (1):

HUMAN FACTORS ISSUE ITEM I.D.5(1) OPERATOR PROCESS COMMUNICATION
The C-E response to this item states, "The acceptance criteria for the resolution of GSI I.D.5(1) are included in GSI HF1.3.4b." Under RESOLUTION, the response states, "The resolution for GSI I.D.5(1) is subsumed by the above GSI, this issue is resolved for the System 80+ Standard Design."

Under HF1.3.4: MAN-MACHINE INTERFACE paragraph (b) the C-E response states, "Annunciator systems shall be designed to incorporate the criteria in References 2 and 3, and meet the intent of References 5, 6, and 7."

The reference referred to in the response are:

Reference 2	-	Human Engineering Guide for Equipment Design
Reference 3	-	MIL-STD 1472C Human Engineering Design Criteria for Military Systems, Equipment and Facilities
Reference 5	-	NUREG 0700 Guidelines for Control Room Design Reviews
Reference 6	-	NUREG/CR-3217 Near-Term Improvements for Nuclear Power Plant Control Room Annunciator Systems
Reference 7	-	NUREG/CR-3987 Computerized Alarm Systems

Under RESOLUTION for this item, the C-E response states, "The Nuplex 80+ annunciator system meets the intent of the guidance and each of the basic functional criteria given in References 5 and 6...Of major importance is the reduction of stimulus overload which can occur during major transients. This reduction has been achieved by decreasing the number of alarm displays by using group alarm tiles with dynamic message windows and by including processing algorithms to generate the alarms." The reader is referred to Section 18.7.1.1.4 Alarm Philosophy, Section 18.7.1.5 Alarm Characteristics, Section 18.7.3.2.3 RCS Panel Alarms, and 18.7.3.2.4 Alarms on the CRT.

The C-E response does not provide a systematic presentation of the human factors studies, evaluations and analyses that lead to the development of the System 80+ control room alarm scheme. No mention is made in the description of the alarm system on how the specific criteria in the references were met by the System 80+ alarm design. No mention is made of a set of human factors guidelines, derived from the reference documentation, that was used to ensure consistency in the man-machine interface across the various components of the alarm system (IPSO, CRTs and panel alarms).

The paragraphs referenced in Chapter 18 describe the hardware aspects of the annunciator, alarm and operator aid systems. No discussion is presented on the human factors aspects of how the alarm system meets the informational requirements of the operators. Discussions are not presented to support such statements as: "reduction of overload stimulus" (page A-116); "minimization of memory requirements on the operator" (page 18.7-27); "Alarms are

categorized by control room panels and operator functions..." (page 18.7-25); and "Fewer annunciator tiles also makes it easier for the operator to distinguish important alarms during transients" (page 18.7-26).

C-E must provide background human factors studies and evaluations that influenced the current configuration of the alarm system. A discussion must also be provided concerning how the current configuration meets the informational needs of the operators for the command, control, and monitoring tasks they are expected to perform. An auditable human factors path should also be established between the findings from the original human factors analyses and the final configuration of the System 80+ alarm system.

Response GSI I.D.5 (1):

C-E agrees to provide additional information on the basis of the alarm scheme for Nuplex 80+ in RAI 620.13, with content as alluded to in the response to HF 5.2.

14.

Question GSI 125.1.3

In NUREG-0933, Item 125.1.3: SPDS AVAILABILITY, the paragraph OTHER CONSIDERATIONS cites two important factors to be considered in the design of an SPDS system. They are that (1) "The SPDS is used in addition to the control room instrumentation system to aid and augment the control room system," and (2) "The SPDS addition provides a diverse and improved diagnostic system but in itself is redundant to the plant instrumentation..." TMI Action Plan Item I.D.2 Safety Parameter Display System (SPDS) required that licensees install a system to continuously display information from which the plant safety status can be readily assessed. The SPDS should be a continuously available, consolidated display of, at a minimum, reactivity control, reactor core cooling and primary system heat removal, reactor coolant system integrity, radioactivity control, and containment conditions.

The C-E response to this item states, "In the ACC, SPDS functions are implemented by three distinct information display systems regularly used by the operator: the Integrated Plant Status Overview (IPSO) panel, the Data Processing System (DPS), and the Discrete Indication and Alarm System (DIAS)."

In order to close out GSI 125.1.03 a detailed description needs to be provided of how the System 80+ control room design meets the intent of a continuously available consolidated display of the plant parameters, as required, for an SPDS.

Response GSI 125.1.1.3

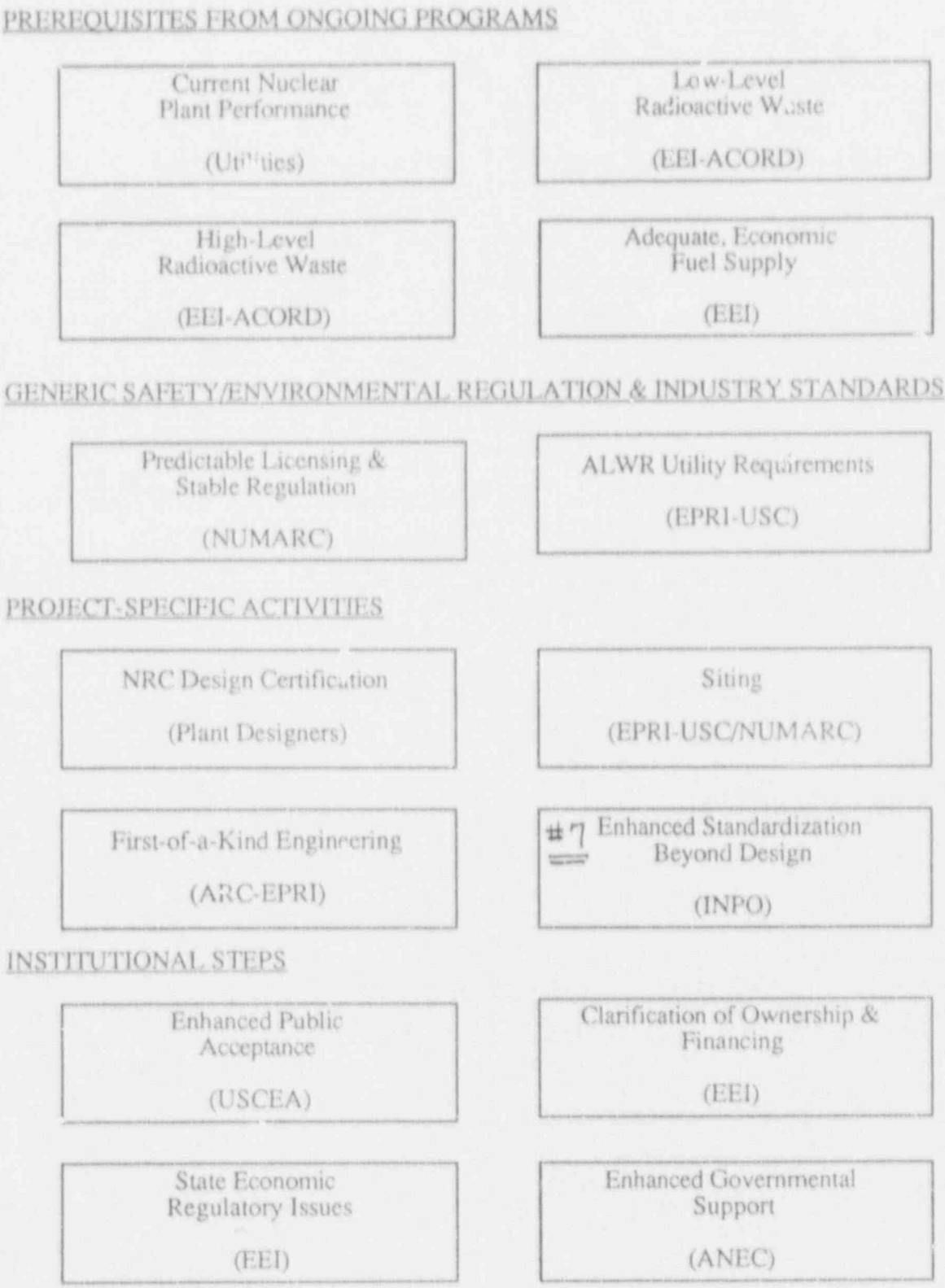
The TMI Action Plan Item I.D.2 SPDS provides requirements for adding a system to an existing control room. Since it is a new design, Nuplex 80+ does not employ an SPDS that is added to an existing control room, but meets SPDS requirements by integrating SPDS functions into the Nuplex 80+ Advanced Control Complex design. Critical functions monitoring and post-accident monitoring requirements are integrated into the DPS and DIAS designs.

The continuously displayed SPDS information is provided on the big board overview display or IPSO. This non-selectable display continuously provides status of the critical safety functions including key plant parameter values or trends and status of all success paths for safety functions. The IPSO display and additional SPDS critical function information is continuously available (if selected) at any DPS CRT (one located on each MCR panel). This combination of a continuously displayed overview, with highly processed SPDS information, and continuously available CRT critical function display pages, of increasing detail, meets the intent of the GSI.

See the response to GSI I.D.2.

NPOC BLOCK #7 ACTION PLAN

Figure I-1: BUILDING BLOCK SUMMARY



ACTION PLAN FOR BUILDING BLOCK #7: ENHANCED STANDARDIZATION BEYOND DESIGN

I. Goals and Responsibilities

Goal:

1. Establish an institutional framework and approach to implement and oversee a model for operational standardization of a family of plants.
2. Develop standardized operational elements to provide a basis for uniformity in appropriate aspects of the organizational structure, administrative controls, and startup, operating and maintenance practices.
3. Develop an approach to maintain the standard design and design intent in all units of a family of plants over their lifetimes.

Responsibilities:

Industry Lead	INPO
Primary	Utilities
Industry Supporting	NUMARC/EPRI-USC/EEI

II. Summary Action Plan

Background:

Building Block 7, entitled "Enhanced Standardization Beyond Design" in the initial November 1990 issue of the NPOC Strategic Plan, encompassed the following goal:

> "Develop and enhance standardization concepts and cooperative arrangements as a means to increase the predictability of construction costs and schedules, and to improve operational reliability and cost."

The NPOC Position Paper on Standardization published in April 1991 addresses the concept of standardization as follows:

> "Nuclear power plant standardization is a life-cycle commitment to uniformity in the design, construction, and operation of a family of nuclear power plants. Rigorous implementation of standardization is expected to achieve the efficiency and economy typically associated with increases in scale or breakthroughs in technology."

Finalization of NPOC's Position Paper on Standardization completed a significant milestone toward the original goal of this building block and necessitated a restatement of the goal in more specific terms as provided in Section I above.

This building block is based on Section 5 of the position paper and addresses standardized elements for operation of a family of plants, regulatory acceptance of appropriate aspects of these elements, and resolution of related issues that impact the standardized operational elements.

Standardized Operational Elements

Standardization beyond design is intended to foster uniformity in startup, operation, maintenance, training, and quality assurance practices that provide a clear benefit in terms of effective operational performance, reliability, efficiency, or economy. To realize the full benefits of standardization beyond design, a set of essential elements consistent with this goal needs to be defined for a family of standardized plants. These elements will include areas such as:

a. Organization Structure
b. Administrative Procedures
c. Technical Procedures
d. Operating Procedures
e. Maintenance Procedures
f. Personnel Qualification
g. Training
h. Performance Standards
i. Logistics Support
j. Operating Experience
k. Configuration Management
l. Quality Programs
m. Emergency Planning
n. Information Data Processing and Records Management
o. Regulatory/Licensing/Engineering Interface

Approach:

It is expected that the approach to development of the standardized operational elements will involve the formation of a steering group and appropriate expert working groups selected from nuclear utilities. It is also anticipated that the actual owner/operators will be heavily involved as this effort proceeds to the level of detailed procedure development.

Interface with the NRC on appropriate aspects of the standardized operational elements will be necessary to achieve regulatory acceptance and to ensure that the regulatory process and associated regulatory decision making does not impact standardization beyond design. In addition, it is recognized that through this effort, elements may be identified that may be directly linked to the regulatory process and/or that may extend beyond the mission of INPO. Such elements may include:

a. Technical Specifications
b. Security
c. Operator Licensing
d. Severe Accident Management
e. Cost-Benefit Analyses/Applications
f. Probabilistic Risk Assessment Application
g. Equipment Procurement/Qualification
h. Access Authorization

The regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements, as well as the development of elements that extend beyond the mission of INPO, will be addressed by NUMARC, EPRI, or other appropriate industry organizations on a cooperative basis.

III. Milestones

7M1	Develop a mechanism to address the fundamental issues associated with the approach to startup and operation of a family of standardized plants.	6/92
7M2	Utilizing the NPOC Position Paper on Standardization as a basis, review the policies and underlying principles as well as the ALWR Utility Requirements Document Volume I Policies and recommend any adjustments.	8/92
7M3	Assess the experience with standardization beyond design in selected current plants both domestically and internationally.	9/92
7M4	Review the summary listing of Standardized Operational Elements included in this action plan and recommend adjustments.	12/92
7M5	Using the adjusted listing of Standardized Operational Elements as a basis, define the interfacing requirements for standardization beyond design with all phases of plant design, construction and startup leading to operations. This activity should consider all of the operational user's needs including design bases, as-built data, equipment specifications and test results.	3/93
7M6	Assess the extent of standardization beyond design to be pursued on the basis of expected benefits in terms of operational performance reliability, efficiency, and economy.	3/93

7M7	List appropriate guidelines and practices to be developed for a model family of plants consistent with the above.	3/93
7M8	Formulate an action plan for prioritization, development, review, validation and finalization of the guidelines and practices.	6/93
7M9	Develop a model mechanism for maintaining standardization within a family of plants throughout the operational life of the plants.	12/93

IV. Tie-Ins

7T1 From Block 2--Stable regulatory environment that encourages industry self-improvement initiatives.

7T2 From Block 2--Mechanisms for regulatory interface and regulatory acceptance of appropriate aspects of the standardized operational elements.

7T3 From/to Block 3--Evolutionary and passive ALWR Utility Requirements Document submitted to NRC and plant designers as a foundation for the design basis for standardization beyond design.

7T4 From Block 4--Design input to approaches taken in standardization beyond design.

7T5 From/to Block 6--Exchange information on the design basis to support enhanced standardization beyond design.

7T6 To Blocks 2, 3 and 4--Provide input to the ITAAC process.

7T7 From/to Blocks 9 and 10--Enhance the basis for assessment of financial issues.

Schedule Display for Block 7