Advanced Reactor Human Factors (FIN E-2090)
Task Order No. 2: ABB-CE System 80+ Review
BNL Technical Report E2090-T2-5-3/93

Draft Technical Evaluation Report

Review of the ABB-CE System 80+ Operating Experience Review

Prepared for:

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

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March 22, 1993

Enclosure 2

PREFACE

This draft technical report (DTR) has been prepared by Brookhaven National Laboratory for the Human Factors Assessment Branch of the U.S. Nuclear Regulatory Commission's (NRC's) Office of Nuclear Reactor Regulation. This report is submitted under the *Advanced Reactor Human Factors Review Project* (FIN E-2090) as part of Task 2 - "Review of the ABB-CE System 80+ Advanced Reactor Human Factors Program." The DTR addresses Subtask 2 - "Review and Evaluate Responses from ABB-CE" by providing a draft TER evaluating ABB-CE's operating experience review. The NRC Project Manager is Harold Polk, the Project Engineer is Clare Goodman, and the Technical Monitor for Task 2 is Garmon West. The BNL Principal Investigator is John O'Hara.

1. INTRODUCTION

The NRC Human Factors Engineering Program Review Model (PRM) for advanced evolutionary reactors specified that an Operating Experience Review (Element 2) should be performed. The staff's Draft Safety Analysis Report (DSER) review of the CESSAR has identified Operating Experience Review as a open issue (DSER Issue 18.4). .

2. OBJECTIVES

The objective of this preliminary review is to provide an evaluation of the CE-ABB efforts related to PRM Element 2 - Operating Experience Review.

3. METHODOLOGY

3.1 Material Reviewed

The following ABB-CE documents were used in this review:

1. Operating Experience Review for System 80+ Design (NPX80-IC-RR790-01, Rev. 00), 12/8/92. (OER)

2. CESSAR DC Chapter 17, Appendix A, Closure of Unresolved and Generic Safety Issues, through Amendment K, October, 1992. (DC)

3. Letter ABB-CE to NRC, LD-92-120, Closure of System 80+ DSER Issues, dated December 18,1992.

4. Human Factors Program Plan for the System 80+ (TM) Standard Plant Design, NPX80-IC-DP790-01, Rev. 1, December 15, 1992

5. System 80+ Shutdown Risk Report, FSP-92-131, July 31, 1992

3.2 Review Scope

This review focused on (1) the overall scope, structure, and completeness of the CE documents, and (2) the evaluation of the documents with respect to the PRM. In conducting this review, absolute adherence to the PRM was not considered to be mandatory. Differences in approach would be considered acceptable provided (1) the program can still meet the HFE commitment and goals, (2) the difference between the proposed criteria and those contained in the PRM are adequately justified, and (3) there is no adverse impact on other program elements.

Due to the fact that the CE System 80+ plant and control room design is quite far along, there is a considerable amount of actual design material available. CE has chosen to submit much of this design information along with the control room HFE Program description. Hence, the scope of the documents reviewed go beyond the "submittal requirements" of the PRM. We have organized our review to be model driven, i.e., we have in general reviewed just those portions of the documents that were within scope of the PRM and have not addressed the details of the control room design. These details will be reviewed at the appropriate time as part of later program elements (e.g. Elements 4 - 8). In a few cases, where particular aspects of the design presented obvious questions, these questions are delineated herein, in order to give as much time as possible to evaluate the issues in question before design decisions become "locked in."

3.3 Review Procedure

The OER was reviewed utilizing the PRM. The BNL draft TER was also used since it identified open issues with an earlier version of CE's OER. Further, since the OER addresses various NRC unresolved and generic safety issues, a number of CE and NRC documents, covering these items were also reviewed. The unresolved and generic issues were reviewed for the satisfactory resolution of their human factors engineering (HFE) aspects.

The BNL draft TER identified a concern regarding the adequacy of CE's review of operating experience relevant to System 80, the immediate predecessor of the System 80+ plant. As a result, BNL collected and reviewed LERs from System 80 and visited a System 80 plant to interview their operators regarding their opinion of the HFE and operating experience of their plant. The results of this effort is contained in a separate report (document 5 below).

The following materials were consulted as part of the evaluation:

1. NUREG-1492 Draft Safety Evaluation Report, September, 1992. (DSER)

2. Public Meeting minutes from September 10-11, 1992, hereafter referred to as the "September meeting."

3. NRC Program Review Model for Evolutionary Reactors (PRM).

4. Preliminary Technical Evaluation Report for ABB Combustion Engineering's Human Factors Program Plan and Operating Experience Review for System 80+, BNL Draft Technical Report, O'Hara and Higgins, November 25, 1992. (BNL draft TER)

5. System 80 Operating Experience Issues Based upon Interviews with System 80 Operators, BNL Draft Technical Report, O'Hara and Luckas, March 17,1993

4. RESULTS

4.1 DSER Issues Review

4.1.1 DSER Issue

In the staff's initial review of this element reported in the DSER, Open Issue 18-8 was defined, indicating that ABB-CE had not submitted an OER. In the September meeting, CE agreed to address the open issue by:

(a) Identifying past problems and lessons learned (in an organized coordinated usable, and auditable form) for the control room, remote shutdown panel, and local control stations.

(b) Give examples and the rationale for problems and issues encountered in similar systems of previous designs that were identified and analyzed so that they are avoided or in the case of positive features, to ensure their retention.

(c) Address the criteria of PRM element 2

(d) Submit the following documents: Nuplex 80+ Design Basis Document and NUPLEX 80+ Information System Design Basis Document.

4.1.2 Issue Resolution

Items (a), (b), & (c):

(a) Identifying past problems and lessons learned (in an organized coordinated usable , and auditable form) for the control room, remote shutdown panel, and local control stations.

(b) Give examples and the rationale for problems and issues encountered in similar systems of previous designs that were identified and analyzed so that they are avoided or in the case of positive features, to ensure their retention.

(c) Address the criteria of PRM element 2

Evaluation: The CE OER, document 1 in paragraph 3.1 above, contains the information identified in these three items. The review as to the adequacy of the OER submittal is discussed below.

Status: These three items are closed.

Item (d): Submit the following documents: Nuplex 80+ Design Basis Document and NUPLEX 80+ Information System Design Basis Document.

Evaluation: These two documents were submitted to the NRC and are currently being used by BNL for the review of other PRM elements.

Status: This item is closed.

4.2 PRM Criteria-Based Evaluation

The ABB/CE Operating Experience Review for System 80+ MMI Design, Nov 4, 1992 (CE OER) was evaluated according to the criteria of the NRC HFE Program Review Model (PRM). Table 2 lists the 10 components of the pertinent sections of the OER.

4.2.1 Implementation Plan

Criterion: An OER implementation plan shall be developed.

Evaluation: As per the review of the ABB-CE Human Factors Program Plan, implementation plans for HFE program elements currently underway or completed are not required. Instead, a description of the methodology used is to be incorporated in the report. In sections 1, 2, and 5.2 of the OER document, CE describes their OER process. This satisfies the need to document the scope and process of the OER for System 80+, and hence a separate implementation plan is not needed.

As to the scope and details of the OER, it is generally comprehensive. The OER states that guidance and associated design resolutions apply to the entire Nuplex 80+ design, which is considered appropriate. It also states that all areas of the plant are being subjected to a detailed operability and maintainability review. This is considered good design practice. Further the commitment, to continue to review new industry and government reports and other applicable documents from this time forward, is considered an excellent practice.

A few areas were identified however, where the scope of the OER was too limited. These areas are:

- remote shutdown panels (RSPs),
- local control stations (LCSs), and
- review of System 80 experience.

The review of System 80 experience will be discussed under other topics below. Regarding the RSPs and LCSs, the review was somewhat weak. The limitation (identified on p. 8) to only those LCSs identified in the EPGs is too narrow and the statement on p. 9 that only "a limited set of problems and issues related to LCSs" is indicative of too narrow a scope. The coverage of both environment and communications issues relative to RSPs and LCSs appears particularly slim. The OER should review some of the more recent documents on LCSs developed in the review of the HF generic issue on LCSs, and noted in paragraph 4.2.5 below. Further, the CE OER design resolutions appeared to somewhat narrowly exclude LCSs and RSPs from their scope (see paragraph 4.2.2 for specifics.) Related to this issue is CE's response to Human Factors Generic Issue HFI 5.1, Local Control Stations in their submittal to the NRC dated 12/18/92. This states that the issue is addressed because LCSs are within the scope of the CE "HFE Standards Guidelines and Bases for System 80+." However this document was briefly reviewed and it appears to be quite weak in the area of guidelines for LCSs. As an example there does not appear to be anything regarding labeling of valves or valve position indication.

Status: This item is open (pending the resolution of scope issues).

4.2.2 Analysis Results Report

Criterion: The analysis of operating experience shall be conducted in accordance with the plan and the findings shall be documented in an evaluation report.

Evaluation: The OER is the evaluation report for this element of the PRM. This report contains the objectives, methods, results, conclusions, and recommendations/implications for HSI design of the OER as required by the PRM.

Section 3 of the CE OER contains the detailed results of the OER analysis. There are a considerable number of human factors/HSI issues addressed. As noted above, a decision has been made not to review at this time the technical design resolutions of the various OER issues. However, it should be noted that CE appears to have given careful consideration to many of the identified issues and thus many should have reasonable design resolutions identified. Despite the fact that the design resolutions have not been reviewed in detail, the following observations were made and are provided here as preliminary information.

1. The use of touch screens in the design seems quite prevalent for process control. Given the fact that touch screens have some well-noted drawbacks, have flexible alternatives been provided in the design for other input methods?

2. Section 3.1.16, on RCP seal failures looked at references 11 & 17, which are the documents that describe the RCP seal generic issue. However, the OER did not reference any of the more recent documents associated with the generic issue, which provide a much more detailed description of the problem and which provide many recommended solutions. Some example documents are NUREG/CR-4544 and NUREG/CR-4948. An example of an item in these documents is the recommendation for seal flow line valve position indication and RCP shaft vibration displacement or velocity. The lack of more recent documents was also noted in the discussion of other generic issues in Appendix A.

3. Section 3.5.1, General Access. This is certainly a problem area with current plants. There is not enough detail in the resolution here, particularly with regard to other types of personnel and work which can distract the control room operators, such as: maintenance work and personnel, testing, development and issuance of tagouts, various other administrative tasks, and communications both within and external to the plant.

4. Section 3.5.3, Noise. This item identifies the purchase of quiet fans for the MCR. CE should ensure that the control room noise concerns identified in document no. 9 above are addressed by this resolution.

5. Section 3.5.5, Storage. Another item identified in document no. 9 above is the lack sufficient permanent laydown area in the MCR for procedures. This item should address that concern, but currently does not.

6. Section 3.6.1, Inconsistent Coding Conventions. This item should also be applicable to LCSs.

7. Section 3.6.2, Insufficient Tag Legibility, should be clarified to say that it applies the MCR, the RSP, and other local control stations.

8. Section 3.8.2, Standardization of MMI, should also apply to RSPs and LCSs.

9. Section 3.9.2, Low Power Automated Feedwater Control. This item states that Main Feedwater is designed for fully automatic control at low power (down to 1% power), however, other CE documents indicate that there is a separate startup feedwater system for low power operations. This should be clarified.

Status: This item is open.

4.2.3 HSI Design Team Report Review

Criterion: The analysis shall be reviewed by the HSI Design Team and shall be documented in an Evaluation Report.

Evaluation: CE did not initially provide in their Program Plan a description of a formalized Design Team Review of the final analysis reports of each Process Element. CE stated at the NRC meeting of Nov. 19, 1992 that they do perform an interdisciplinary design team review of each of the major design element results, and that this review is formally documented. They further stated that their review process would be described in their HF Program Plan.

In the CE HF Program Plan Section 1.3.1.3, Design Review Meetings, CE describes a process which is basically a working meeting with three to 20 reviewers present. Minutes and action items are documented. This type of review does not appear to suffice for the more formalized and documented HSI Design Team Evaluation envisioned in the NRC HFE PRM. This item is currently open in Element 1, Human Factors Program Plan as it applies to the Design Team Report Review of all PRM elements.

Status: This item is open.

4.2.4 List of Issues (Appendix A)

Criterion: The operating experience review issues listed in Appendix A of the PRM should be included in the OER as part of the design and implementation process.

Evaluation: The CE OER, Appendix A discusses the list of issues from the PRM, including each of the types of issues documents: USI issues, TMI issues, NRC Generic Letters, AEOD Studies, and Low Power and Shutdown Issues. All of the USIs, TMI issues, and NRC Generic Letters listed in the PRM were addressed in Appendix A of the OER. Appendix A also addressed AEOD studies and Low Power and Shutdown studies.

Status: This item is acceptable and it is recommended that NRC close it.

4.2.5 Review of Issues

Criterion: The operating experience issues that are identified shall be reviewed for:

- Human performance issues, problems and sources of human error shall be identified.
- Design elements which support and enhance human performance shall be identified.

Evaluation: This evaluation will address in turn each category of issue: USIs, TMI issues, NRC Generic Letters, AEOD studies, and Low Power and Shutdown issues

USIs and TMI issues

The CE OER treats USIs and TMI issues similarly. They are divided into the following groups of items by CE: HFE tracking system issues, issues addressed by and incorporated into the NUPLEX 80+ design, COL applicant issues, and issues that are not applicable (NA.) Those classified as going into the HFE tracking system are discussed in the paragraph on the tracking system, below. Those incorporated into the design were reviewed in some detail immediately below. Those designated as COL applicant issues are summarized in Appendix A to this report. CE should provide a summary list of all COL issues to ensure that they are properly tracked. Those issues designated as NA were reviewed on a sampling basis and no problems were identified .

The next paragraphs discuss those items identified as incorporated into the design. The discussions in the DSER, the OER, and the CESSAR DC were reviewed. Often the issues appear to be resolved by hardware/systems types of fixes. Also, the discussions of just how an item has been resolved in the design are somewhat sketchy, especially concerning the human factors aspects of the resolution. Further, at times the references seem to list only the material which generated the unresolved issue and not the technical findings documents, which resolve or partially resolve the issue.

- Item B-17 was not addressed in the DSER or the DC, and is not covered in sufficient detail in the OER.

- Item GI-23 was open in the DSER and is not covered sufficiently here (see also discussion in section 4.2.2 above.)

- GI-57 and GI-130 are listed in the OER as incorporated in the design, however the DSER lists them as COL issues. This is a discrepancy; also there is no information as to how GI-57 is incorporated.

- GI-75 and 76 are not in the DSER nor the DC and are inadequately addressed in the OER.

- TMI issue 2iv is not in the DSER and is currently being reviewed elsewhere by the NRC.

- Item 2xix was a DSER open item and is not adequately addressed in the OER. However, it is also being reviewed elsewhere by the NRC.

- Items 2v, 2xi and 2xviii were acceptable in the DSER.

- Item 2xxv states that the MMI design of the TSC and OSC is complete. However, while the TSC may be covered by the CE HF Program Plan (see HFPP review), the OSC does not appear to be.

NRC Generic Letters

Three Generic Letters are addressed in the OER. For Letters 91-06 & 91-11the OER states that monitoring, surveillance, equipment status, and testing are COL issues. This is an extremely broad transfer of responsibility to the COL. Certainly there are HF aspects of these four areas which need to be addressed in the design. To defer all consideration of these issues to procedural type resolutions that a COL would create does not seem appropriate. Letter 91-07 on RCP seals is discussed is paragraph 4.2.2 above.

AEOD Studies

The PRM specifies a review of recent AEOD studies in the human performance area. A brief discussion of this report series is contained in the OER. A bit more detail as to how the items identified were incorporated into the design would be desirable. Further, AEOD has recently issued the final summary report (NUREG-5953) in this series, which generalizes the findings to a level applicable to most all plants. Based on ABB-CE's commitment to continue to review new documents and the importance of this summary report, the reviewers expect that CE will review this new report.

Low Power and Shutdown Issues

CE's review of this area is described in a separate report, System 80+ Shutdown Risk Report, FSP-92-131, July 31, 1992. Based upon a brief review, the document was deemed to be reasonably thorough and comprehensive. The list of reference documents was also appropriate and extensive. One item noted was, that considering the OER commitment to continue to be updated as new information and documents come out, there are two documents that would be particularly valuable to include. They are: the final version of NUREG-1449 and the 12/91 NUMARC "Guidelines for Industry Actions to Assess Shutdown Management."

Status: This item is open.

4.2.6 Interview Topics

Criterion: This item lists the topics which should be included in the operator interviews.

Evaluation: The original version of the CE OER stated that operator interviews were not conducted per se. Operator input was, however, noted to be utilized to some extent. The BNL draft TER raised the question as to why operator interviews with System 80 operators were not

conducted, since System 80 is the direct predecessor of the System 80+. At the Nov. 19, 1992 meeting between NRC, BNL and CE the issue of System 80 operator interviews was discussed and CE reiterated their position that the use of other plant operators and their own staff with operating experience was sufficient. As a result, the reviewers conducted interviews with licensed System 80 operators regarding their experience with the System 80 plant and its operations. A report has been issues which details the results of these interviews and raises a number of questions and issues relative to the incorporation of System 80 experience into the System 80+. This item will remain open pending CE's response to this report.

In the current version of the OER, CE makes further statements regarding operator interviews, which are not justifiable and which indicate an approach to operating experience which is not appropriate. As an example, section 5 states that, "By definition, further problems that might be identified during operator interviews are not safety related; the plants operating today are determined safe .." One should recognize that safety problems cannot be defined away. If this logic were correct, neither the TMI accident nor any subsequent incident or LER could be considered to contain a safety problem. Thus the overall approach to operating experience should be clarified to correct the impression given by this and a few other isolated sections of the OER.

Status: This item is open.

4.2.7 Literature Review

Criterion: The review shall include a literature review.

Evaluation: From the documents listed, it appears that a substantial literature review was conducted. However, the list of references appears to be lacking in documents from CE System 80 plants. Since System 80 is the direct predecessor to System 80+ it is especially important to consider System 80 experience. As an example, there appears to be valuable information in the System 80 LERs, as noted in document no. 9.

Status: This item is open.

4.2.8 Sources

Criterion: This item identifies those industry wide and plant or subsystem relevant sources that should be included in the OER.

Evaluation: This item was closed in the DSER.

Status: Closed by the NRC.

4.2.9 Tracking System

Criterion: Each operating experience issue shall be documented in the HFE tracking system.

Evaluation: Section 2.0 of the OER states that any unresolved design issues identified during the reviews, which may impact the design, will be entered into the HFE tracking system for subsequent resolution and documentation. Section 5.0 of the OER states that the tracking system was implemented in early 1992. Many items in Sections and Appendix A of the OER are listed as being included in the tracking system. This all appears appropriate and programmatically the tracking system is acceptable and is closed.

During a trip to CE on March 11, 1993 BNL attempted to verify the use of the tracking system for OER items as described in the OER report. However, CE stated that the system was undergoing improvements, was not fully operational, and was not immediately available for review. Thus, this item is kept open in order to verify proper implementation of the system for tracking OER items as noted in the OER report.

Status: Closed programmatically in the HFPP review, however, the item is Open for implementation verification.

4.2.10 Reference Documents

Criterion: This item lists four documents that the OER program should use in developing the implementation plan.

Evaluation: The OER has satisfactorily utilized the four identified documents.

Status: This item is acceptable and it is recommended that NRC close it.

5. CONCLUSION

A evaluation of the "CE Operating Experience Review for System 80+ MMI Design" was completed using the NRC HFE PRM as guidance. Overall, the CE OER was quite impressive and showed a detailed review of many aspects of pertinent commercial nuclear power plant experience, and the subsequent incorporation of appropriate design features into the System 80+ design. Not all aspects of the PRM were completely addressed however, and so several components of the PRM remain open. Table 1, below, summarizes the status of each component of the NRC HFE PRM for the CE Operating Experience Review. Also listed is the Section of this TER where that component is discussed.

Table 1
Summary of Element 2 Evaluation Status

PRM COMPONENT	TER SECTION	STATUS
1 Implementation Plan	4.2.1	Open
2 Analysis Results Report	4.2.2	Open
3 HSI Team Report Review	4.2.3	Open
4 List of Issues (Appendix A)	4.2.4	Acceptable
5 Review of Issues	4.2.5	Open
6 Interview Topics	4.2.6	Open
7 Literature Review	4.2.7	Open
8 Sources	4.2.8	Closed by NRC
9 Use of Tracking System	4.2.9	See Note below
10 Reference Documents	4.2.10	Acceptable

Note: Programmatically closed but the implementation remains open

APPENDIX A

LIST OF COL ISSUES FROM CE OER

Generic Issues: GI-75, GI-116, GI-117, B-32

TMI items: 2xxv, 2xvv

Generic Letters: 91-06, 91-11