

January 10, 1994

Docket No. 52-002

APPLICANT: ABB-Combustion Engineering, Inc. (ABB-CE)

PROJECT: CE System 80+

SUBJECT: PUBLIC MEETING OF DECEMBER 14, 1993, REGARDING STRUCTURAL AND GEOSCIENCES ISSUES FOR THE ABB-CE SYSTEM 80+ STANDARD PLANT DESIGN

On December 14, 1993, a public meeting was held at the ABB-CE offices in Rockville, Maryland, between representatives of ABB-CE, ABB-Impell, Duke Engineering & Services Inc. (DESI), Stone and Webster Engineering Corporation (SWEC), and the U.S. Nuclear Regulatory Commission (NRC). Enclosure 1 is a list of attendees, and Enclosure 2 is the meeting agenda. Enclosure 3 provides a detailed meeting report. Enclosure 4 is the hand-out material presented by ABB-CE at the meeting. Enclosures 5A through 5L provide a status of the draft safety evaluation report (DSER) and the staff meeting open item issues.

The purpose of the meeting was to review the status of all outstanding issues in the civil/geosciences area and discuss the schedule for the closure of the remaining issues. All DSER and staff audit issues in this area are either closed or technically resolved, and there are no remaining open issues for which a technical resolution has not been achieved. ABB-CE is in the process of addressing items that are technically resolved but not closed.

(Original signed by)

Stewart L. Magruder, Project Manager  
Standardization Project Directorate  
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Enclosures:  
As stated

cc w/enclosures:  
See next page

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Docket No. 52-002

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ENCLOSURE 1  
LIST OF ATTENDEES  
DECEMBER 14 1993

<u>NAME</u>	<u>ORGANIZATION</u>
S. Magruder	NRC
G. Bagchi	NRC
T. Cheng	NRC
S. Ali	NRC
L. Gerdes	ABB-CE
S. Dermitzakis	ABB-Impell
T. Oswald	DE&S
S. Stamm	SWEC
G. Tilton	SWEC

ENCLOSURE 2  
CE SYSTEM 80+ STRUCTURAL/GEOTECHNICAL ISSUES UPDATE  
AGENDA FOR MEETING ON 11/10/93

1. Containment Performance Issues
2. Non-Nuclear Island Category I Structures Issues
3. Geosciences Issues
4. DSER Open Items
5. Open Items from Staff Audits



ENCLOSURE 3  
SYSTEM 80+ STRUCTURAL AND GEOSCIENCES  
ISSUES MEETING, DECEMBER 14, 1993

## 1. INTRODUCTION

Members of the Civil Engineering and Geosciences Branch (ECGB) met with representatives of Asea-Brown Bovari-Combustion Engineering (ABB-CE) and its contractors, ABB-Impell, Duke Engineering Services Inc. (DESI), and Stone and Webster Engineering Corporation (SWEC) on December 14, 1993 in Rockville, Maryland to discuss the details of outstanding issues related to structural design and geosciences for the System 80+ structures, systems and components (SSC).

The focus of the meeting was to review the status of all outstanding issues in the Civil/Geosciences area and discuss the schedule for the closure of the remaining issues. All DSER and staff audit issues in this area are either closed or technically resolved and there are no remaining open issues for which a technical resolution has not been achieved. ABB-CE is in the process of addressing items that are technically resolved but not closed. It is anticipated that most of the CESSAR-DC changes will be incorporated into Amendment U, although a few may trickle into later Amendments.

Enclosure 2 is a list of attendees and Enclosure 3 is the meeting agenda. Enclosure 4 is the hand-out material presented by ABB-CE at the meeting. Enclosures 5A through 5L provide a status of the DSER and the staff audit open item issues.

## 2.0 AUDIT SUMMARY

The meeting started at 1:00 pm, December 14, 1993 and ended at 5:00 pm, December 14, 1993.

The meeting consisted of two parts. In the first part, the status of DSER and previous audit open issues related to the Nuclear Island (NI) structures was discussed and it was concluded that all of the issues are either closed or technically resolved. In this part, ABB-Impell also presented the applicant's methodology for addressing the sliding stability of the NI structures. In the second part, the staff discussed its questions and concerns on the seismic analysis and design of Non-Nuclear Island (NNI) structures, and SWEC provided the status of its responses to the staff questions.

### 2.1 DSER and Previous Staff Audit Open Items

ABB-CE presented the approach for the evaluation of the sliding stability of the NI structures, as outlined in Enclosure 4. In this approach, a nonlinear dynamic analysis will be performed to determine the maximum displacement of the NI structure due to the seismic effects. It was noted by the applicant that this nonlinear approach is being applied in addition to complying with the conventional SRP 3.8.5 approach for the sliding and overturning stability. In

the nonlinear dynamic analysis, the slope of the  $F - \Delta$  curve is represented by Whitman type soil springs and the maximum amplitude is  $R + P + S$ .  $R$  is the friction force at base which is equal to the net weight (weight - buoyancy force -  $0.4 \times$  vertical seismic force) times the coefficient of friction of 0.5.  $P$  is the passive soil pressure on the embedded portion of the building.  $S$  is the at-rest soil pressure on the sides. The resulting maximum displacement is then used for designing interface structures and systems such as piping, etc.

ABB-CE indicated that this approach will be applied for the multitude of the seismic time histories being considered by the applicant. The staff expressed a concern that the effect of the frequency content variation may not be properly considered in this approach since the analysis results would be sensitive to the particular motions being applied. The applicant agreed to address this issue.

The status of all structural issues from the DSER and previous staff audits was discussed and updated. The updated status is shown in Enclosures 5A through 5L.

## 2.2 Non-Nuclear Island Seismic Category I Structures

ABB-CE has not completed the seismic analysis of the NNI Category I structures. The applicant noted that there is a change in the NNI seismic analysis approach. In the new approach, ABB-Impell will perform the seismic analysis of the NNI structures including the SSI effects. The north-south 2-D model will include the NI as well as the NNI Category I structures. The ABB-Impell analysis results will include response spectra as well as the seismic profiles. Output from this analysis will be utilized by SWEC for the static analysis and design of NNI Category I structures.

The staff expressed the concern that 3-D effects due to non-symmetry, e.g., effect of notch in the basemat need to be considered. ABB-CE agreed to consider these effects in the SSI analysis, if they can not demonstrate the symmetry of the NNI structures.

SWEC indicated the following schedule for their analysis:

CCW Building analysis and design:	12/24/93
DFSS Building analysis and design:	12/28/93
Calculation ready for audit:	12/29/93

ABB-CE indicated that the markups of CESSAR-DC Sections 3.7.2, 3.8.4 and 3.8.5, and Appendices 3.7C ( which will include the raw response spectra for the NNI Category I structures), 3.8A and 3.8B to the CESSAR-DC will be included in Amendment U. The peak-broadened response spectra will be included in Appendix 3.7D of the CESSAR-DC.

The detailed status of the SWEC response to the staff concerns is given in Enclosure 5L.

### 3.0 CONCLUSIONS

The main purpose of the meeting was to review the status of all outstanding issues in the Civil/Geosciences area and discuss the schedule for the closure of the remaining issues. All DSER and staff audit issues in this area are either closed or technically resolved and there are no remaining open issues for which a technical resolution has not been achieved.

ABB-CE is in the process of addressing items that are technically resolved but not closed. It is anticipated that most of the CESSAR-DC changes will be incorporated into Amendment U, although a few may trickle into later Amendments.

GEOSCIENCES ISSUES: ITEM 16**3.7 SEISMIC DESIGN****3.7.1 SEISMIC INPUT**

This section discusses the seismic design parameters and methodologies being used for the design of those systems and subsystems important to safety and classified as Seismic Category I in Section 3.2.

**3.7.1.1 Design Response Spectra**

The System 80+ Standard Design as defined by CESSAR-DC is not based on a specific site. The design response spectra which define the free field design ground motion or control motion specified either at the site soil surface or on a hypothetical rock outcrop are shown in Figure 2.5-5. Generic site conditions were selected to cover a range of possible conditions for the System 80+ sites. For the Nuclear Island, sets of representative cases from each of four generic site categories were evaluated. Ground surface and foundation level spectra which correspond to the design response spectra of control motions CMS1, CMS2 and CMS3 for rock and soil cases are shown in CESSAR Section 2.5. Out of 12 soil cases analyzed in Section 2.5.2, ten are used in the soil structure interaction (SSI) analyses. The two cases eliminated in the SSI analysis (B3 and D1) were non-governing cases whose soil response levels were enveloped by other cases. See Section 2.5.2 for details of this analysis phase. Two rock cases were analyzed, one with no backfill (fixed base at bottom of basemat) and one with concrete backfill (fixed base at all subsurface elevations).

The effect of differential seismic displacement on the equipment and supports is included in the analysis as described in Section 3.7.3.1.

For the seismic analysis of the Category 1 Diesel Fuel Storage Structure and the Component Cooling Water Heat Exchanger Buildings, one soil case (A-1) corresponding to the highest ground surface spectra and the fixed base rock case were evaluated using control motions CMS1, CMS2 and CMS3.

**3.7.1.2 Design Time History**

Since the System 80+ Standard Design is designed for generic site conditions, for the time history method of analysis, the generic free-field ground surface time histories are used as control motions in the analyses. In the soil-structure interaction

**DSER Open Item 2.5-1**

(CESSAR Insert in Section 3.7.1.1)

## Insert 1:

A sensitivity study was performed to demonstrate that the selected motions and the soil profiles provide a conservative design envelope for the System 80+ structures. In this study, a simplified analytical model of the 3D NI structure was developed and analyzed with five soil profiles and the CMS2 control motion. Three of the soil profiles were part of the 12 profiles selected for the System 80+ 3D SSI analyses (B-1, B-1.5, B-2). The remaining two soil profiles were developed to serve as "test" profiles. The two new profiles were chosen such that they have low strain soil properties that are in-between the soil properties of cases B-1, B-1.5 and B-2. Hence, they were named B-1.25 and B-1.75. Response parameters such as maximum in-structure acceleration, maximum base shear and maximum base overturning moment were used as the key parameters that determine the adequacy of the soil profile selection. The sensitivity analyses showed that structural response corresponding to the "test" soil cases B-1.25 and B-1.75 was under the envelope of structural response from the three generic cases B-1, B-1.5 and B-2. Therefore, it is concluded that the 12 generic soil profiles provide a conservative envelope of structural response and they cover a broad range of sites.

GEOSCIENCES ISSUE: ITEM 20**CESSAR** DESIGN  
CERTIFICATION

*all data pertaining to soil layers (including their thicknesses, densities, moduli and Poisson's ratios) between the casemat and the underlying rock stratum;*

instability or ground rupture due to steep topography, soft soils, liquefaction or fault rupture are treated as site-specific issues.

The enveloping analyses performed were based on the distribution of maximum shear wave velocities with depth and thus did not require specification of a depth to water table at the site. Therefore, the water table can be at any depth as long as the variations of maximum shear wave velocities with depth are within the range discussed above and provided that any local site instability issues are resolved.

**2.5.3 SURFACE FAULTING**

System 80+ plants will not be designed to withstand surface faulting related to earthquakes. Site-specific surface and subsurface geological and geophysical information to demonstrate that evidence of a potential for surface faulting has not been found will be provided by the COL applicant referencing the System 80+ Standard Design.

**2.5.4 STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS**

Subsurface material parameters are as specified in Table 2.0-1. Site-specific information relating to stability of subsurface materials and foundations resulting from site geotechnical and geophysical investigations will be provided by the COL applicant referencing the System 80+ Standard Design. Information for the specific site will include: geologic features underlying the site; properties of materials underlying the site and a description of the state of the art methods used to determine the static and dynamic engineering properties of foundation soils and rock in the site area; engineering classification and description of materials supporting the structural foundations; data concerning the extent of Seismic Category I excavations and backfills; groundwater conditions relative to foundation stability of safety-related structures; and liquefaction potential including testing methods used in the evaluation.

**2.5.4.1 Geologic Features**

Site-specific information will include geologic features underlying the site.

**2.5.4.2 Properties of Underlying Materials**

State-of-the-art methods used to determine the static and dynamic



ENCL 7A: Item 3.5.3-1  
ISSUES

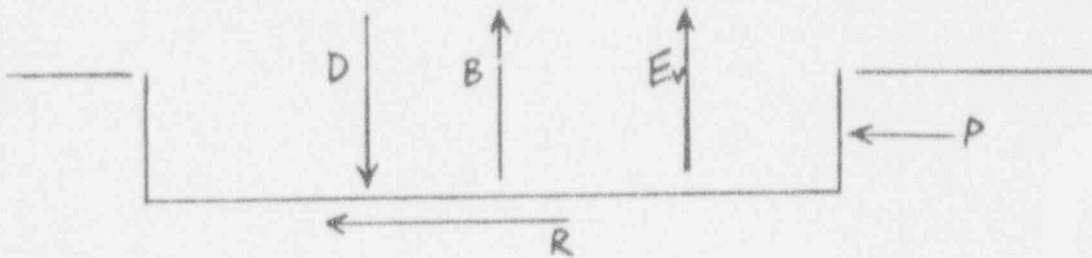
TABLE 3.5-3

MINIMUM ACCEPTABLE BARRIER THICKNESS REQUIREMENTS  
FOR LOCAL DAMAGE PREDICTION AGAINST TORNADO  
GENERATED MISSILES

<u>Regions*</u>	<u>Concrete Strength (psi)</u>	<u>Wall Thickness (inches)</u>	<u>Roof Thickness (inches)</u>
Region I	<del>3000</del>	<del>23</del>	<del>18</del>
	4000	20	16
	5000	18	14
Region II	3000	16	13
	4000	14	11
	5000	13	10
Region III	3000	<6	<6
	4000	<6	<6
	5000	<6	<6

\* For definition of Region I, II, and III, refer to Regulatory Guide 1.76

METHODOLOGY FOR COMPUTING SLIDING  
UNDER EARTHQUAKE LOADS

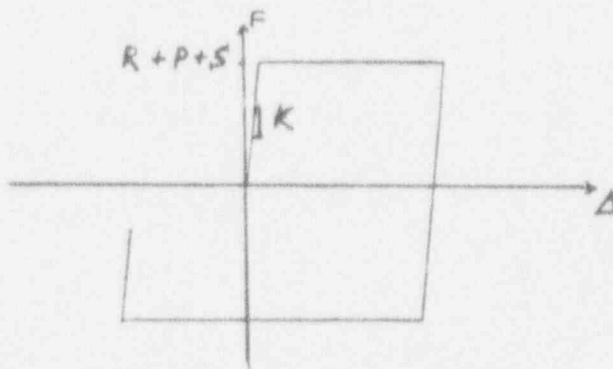


NORMAL LOAD :

$$D - B - (0.4) E_v$$

RESISTANCE TO SLIDING :  $R + P + S$

$$\mu [D - B - (0.4) E_v] + P + S$$



APPLIED HORIZONTAL LOAD :

$$E_H = \text{Earthquake Time History (EW, NS)}$$



ENCLOSURE 5A  
CE SYSTEM 80+ DSER STRUCTURAL ISSUES

DSER CONF ITEM	REVIEW STATUS	COMMENTS
2.4.3-1 CONTENTS OF ABB-CE LETTER LD-92-045 (DEVs/COMPLIANCE TO SRPs, TABLES 1.8-4 AND 1.8-5 OF CESSAR) SHOULD BE INCORPORATED INTO THE CESSAR.	CLOSED	APPLICABLE CONTENTS OF ABB-CE LETTER 92-045 HAVE BEEN INCORPORATED INTO THE CESSAR AMEND Q.
3.7-1 APPLICANT MUST MODIFY OR UPDATE CESSAR, AS DISCUSSED IN DSER SECTION 3.7.	CLOSED	CESSAR AMEND N INCLUDES CONSIDERATION OF TWO ADDITIONAL GROUND MOTIONS AND IS BASED ON THE NEW PLANT LAYOUT OF INTERCONNECTED SHIELD BUILDING AND NUCLEAR ANNEX STRUCTURES ON A COMMON BASEMAT.
3.7.2-1 APPLICANT MUST INCORPORATE RESPONSES TO RAIS Q220.5, Q220.11, Q220.20, AND Q220.21 INTO CESSAR.	CLOSED	CESSAR MARK-UP TO INCORPORATE RESPONSES TO RAIS 220.5, 220.11, 220.18, 220.20, AND 220.21 TO PROPERLY ACCOUNT FOR RELATIVE DISPLACEMENTS AMONG SUPPORTS AND ROCKING AND TORSIONAL EFFECTS HAVE BEEN INCORPORATED INTO THE CESSAR AMEND N.
3.7.2-2 APPLICANT HAS COMMITTED TO REVISE THE NOTE IN CESSAR TABLE 3.7-1 TO COMMIT TO ALL CONDITIONS OF RG 1.84 ON THE USE OF N-411-1.	CLOSED	NOTE IN TABLE 3.7-1 OF CESSAR AMEND N HAS BEEN REVISED TO STATE THAT CODE CASE N-411-1 DAMPING VALUES MAY BE USED AS LIMITED BY RG 1.84.
3.7.2-3 APPLICANT SHOULD CLARIFY CESSAR SECTION 3.7.2.11 TO STATE HOW THE ADDITIONAL ECCENTRICITY OF 5 % OF MAXIMUM BUILDING DIMENSION WILL BE APPLIED.	CLOSED	SECTION 3.7.2.11 HAS BEEN REVISED IN CESSAR AMEND N TO STATE THAT THE ADDITIONAL 5 % ECCENTRICITY WILL BE APPLIED TO THE STATIC FINITE ELEMENT STRUCTURAL MODEL TO CALCULATE ELEMENT FORCES AND MOMENTS.
3.7.2-4 APPLICANT HAS COMMITTED TO CLARIFY CESSAR SECTION 3.7.2.13 STATEMENTS ASSOCIATED WITH SEISMIC ANALYSIS OF SAFETY-RELATED DAMS.	CLOSED	SECTION 3.7.2.13 HAS BEEN REVISED IN CESSAR AMEND N TO STATE THAT SEISMIC ANALYSIS OF DAMS WILL BE DETAILED IN SITE SPECIFIC SAR.
3.7.3-1 STAFF WILL CONFIRM THAT APPLICANT USES THE MODELING ACCEPTANCE CRITERIA OF SRP SECTION 3.7.2.	CLOSED	CESSAR MARK-UP PROVIDED (JUNE 21-23 AUDIT) TO REVISE FIGURE 3.7-34 TO SHOW MASSES AND DEGREES OF FREEDOM FOR THE SURGE LINE INCORPORATED INTO CESSAR AMEND Q.
3.7.3-2 STAFF WILL CONFIRM THAT RESPONSES TO RAIS Q210.36 AND Q210.37 ARE INCORPORATED INTO CESSAR.	CLOSED	NOTE IN TABLE 3.7-1 OF CESSAR AMEND N HAS BEEN REVISED TO STATE THAT CODE CASE N-411-1 DAMPING VALUES MAY BE USED AS LIMITED BY RG 1.84.

DSEER OPEN ITEM	REVIEW STATUS	COMMENTS
2.4.14-1 APPLICANT SHOULD REVISE LETTER LD-92-045 TO REMOVE REFERENCES NOT ADDRESSED BY CESSAR.	CLOSED	INCORPORATED INTO CESSAR AMEN N.
2.5-1 APPLICANT SHOULD USE ENVELOPE RESPONSE SPECTRA FOR DESIGN ANALYSIS OF CAT I STRUCTURES.	CLOSED	ADEQUATE RESPONSE PROVIDED IN THE CESSAR.
2.5.2.5.1-1 TIME HISTORIES FOR CMS2 DO NO SATISFY SRP 3.7.1 FOR 7 % DAMPING.	CLOSED	RESPONSE (12/23/92) TECHNICALLY ACCEPTABLE. TRACK UNDER OPEN ITEM NO 3.7.1-1.
2.5.2.5.1-2 SIGNIFICANT "VALLEY" IN FOUNDATION SPECTRA PRESENTED IN A PREVIOUS MEETING MUST BE ADDRESSED.	CLOSED	RESPONSE (12/23/92) IS ACCEPTABLE.
2.5.2.5.1-3 CESSAR SHOULD BE REVISED TO INCLUDE CMS1 AND CMS3.	CLOSED	AMEND N TO CESSAR IS ACCEPTABLE. FURTHER REVIEW OF CMS1 AND CMS3 WILL BE TRACKED UNDER OPEN ITEM 2.5-1.
2.5.2.5.1-4 STAFF MUST REVIEW FORMAL DISCUSSION IN CESSAR ON HOW CMS1 WILL BE USED.	CLOSED	CESSAR NEEDS TO ELABORATE FURTHER ON THE USE OF CONTROL MOTION CMS1. FURTHER REVIEW WILL BE TRACKED UNDER OPEN ITEM 2.5-1.
2.5.2.8-1 APPLICANT SHOULD ADDRESS SOIL PROPERTIES ASSOCIATED WITH COMPRESSION WAVES.	CLOSED	RESPONSE (12/23/92) IS ACCEPTABLE AND HAS BEEN INCORPORATED INTO THE CESSAR AMEND N. STAFF TO INCORPORATE ADDITIONAL MATERIAL FROM MTG NOTES INTO FSER.
2.5.3-1 APPLICANT SHOULD CLEARLY STATE IN CESSAR THAT PLANT WILL NOT BE DESIGNED TO WITHSTAND SURFACE FAULTING.	CLOSED	AMEND N TO CESSAR IS ACCEPTABLE.
3.5.3-1 APPLICANT SHOULD INCORPORATE TABLE 1 OF SRP 3.5.3 INTO CESSAR.	CLOSED	ABB-CE PROVIDED CESSAR MARK-UP TO REVISE TABLE 3.5-3 TO SPECIFY APPLICABLE $f_v'$ AND TORNADO WIND VELOCITY

DSEI OPEN ITEM	REVIEW STATUS	COMMENTS
3.7-1 APPLICANT MUST COMPLETE SEISMIC ANALYSES OF ALL CAT I STRUCTURES AND UPDATE THE CESSAR TO INCLUDE TIER 1 AND 2 INFORMATION.	TECH RESOLVED	SEISMIC ANALYSES ARE NOT COMPLETE AND CESSAR NEEDS TO BE REVISED.
3.7.1-1 T/H'S OF CMS2 DO NOT SATISFY SRP 3.7.1 CRITERIA FOR 7 % DAMPING.	CLOSED	RESPONSE (12/23/92) IN CONJUNCTION WITH LETTER LD-92-030 (2/25/92) TECHNICALLY ACCEPTABLE. SEE ALSO ITEM 2.5.2.5.1-1.
3.7.1-2 SUBMIT T/H'S AND CORRESPONDING RESPONSE SPECTRA FOR CMS1 AND CMS3.	CLOSED	RESPONSE (12/23/92) AND CESSAR AMEND P ACCEPTABLE.
3.7.1-3 APPLICANT SHOULD CLARIFY IF N-411 DAMPING WILL BE USED AS PER RG 1.84.	CLOSED	NOTE IN TABLE 3.7-1 OF CESSAR AMEND N HAS BEEN REVISED TO STATE THAT CODE CASE N-411-1 DAMPING VALUES MAY BE USED AS LIMITED BY RG 1.84.
3.7.2-1 SEISMIC ANALYSES FOR ALL SEISMIC CAT I STRUCTURES ARE NOT COMPLETE.	CLOSED	TRACK UNDER OPEN ITEM 3.7-1.
3.7.2-2 STAFF REQUIRES THAT DETAILED PROCESS OF DEVELOPING DYNAMIC MODELS OF NUCLEAR ISLAND STRUCTURES, INCLUDING FINE-TUNING BE DOCUMENTED IN AN AUDITABLE FORM.	CLOSED	CALCULATIONS ARE AVAILABLE IN AUDITABLE FORM. STAFF TO INCORPORATE ADDITIONAL MATERIAL FROM MTG NOTES INTO FSER.
3.7.2-3 APPLICANT SHOULD DEMONSTRATE THAT THE 13 GENERIC SOIL CONDITIONS PROVIDE A CONSERVATIVE ENVELOPE.	CLOSED	TRACK UNDER ITEM NOS 12(c), 19, 20, AND 21 OF JUNE 8-10, 1993 SEISMIC ANALYSIS AUDIT.
3.7.2-4 APPLICANT SHOULD DEFINE CRITERIA TO ENSURE THAT THE STICK MODELS DEVELOPED ARE EQUIVALENT TO THE 3-D FINITE ELEMENTS AND CONNECTION TO OUTSIDE WALLS IS PROPERLY REPRESENTED.	CLOSED	RESPONSE PRESENTED IN LETTER OF 2/2/93 AND 6/8 TO 6/10/93 AUDIT IS ADEQUATE. STAFF TO INCORPORATE ADDITIONAL MATERIAL FROM MTG NOTES AND CESSAR SECTION 3.7.2.2 AMEND T INTO FSER.

DSEI OPEN ITEM	REVIEW STATUS	COMMENTS
3.7.2-5 APPLICANT SHOULD DEMONSTRATE THAT ISSUES ADDRESSED IN SRP 3.7.2 PARA II.1.A(III) ON REDUCING LARGE STATIC MODELS, HAVE BEEN SATISFACTORILY CONSIDERED.	CLOSED	RESPONSE (12/23/92) IS ADEQUATE.
3.7.2-6 APPLICANT SHOULD DESCRIBE ANALYSIS METHODS AND DESIGN CRITERIA THAT WILL BE USED TO ENSURE STRUCTURAL INTEGRITY OF NON-SAFETY RELATED STRUCTURES	CLOSED	CESSAR MARK-UP PROVIDED (JUNE 21-23 AUDIT) INCORPORATED INTO CESSAR AMEND Q. MARGIN OF SAFETY SAME AS CAT I STRUCTURES.
3.7.2-7 APPLICANT SHOULD CLARIFY CESSAR 3.7.2.9 TO CLEARLY DESCRIBE PROCEDURES USED TO ACCOUNT FOR VARIATION IN SOIL PROPERTIES.	CLOSED	TRACK UNDER OPEN ITEM 2.5-1.
3.7.2-8 APPLICANT SHOULD PROVIDE DEFINITIONS OF DAMPING TERMS USED AND GUIDANCE FOR ESTIMATING PROPORTIONAL DAMPING RATIO FOR TIME HISTORY METHOD.	CLOSED	CESSAR MARK-UP PROVIDED (JUNE 21-23 AUDIT) INCORPORATED INTO CESSAR AMEND Q.
3.7.3-7 APPLICANT SHOULD PROVIDE GENERIC APPROACHES/ACCEPTANCE CRITERIA USED IN EVALUATING INTAKE STRUCTURE.	TECH RESOLVED	ABB-CE TO MAKE THIS A COL ITEM BY INCLUDING IN CESSAR TABLE 1.9-1.
3.7.3-9 APPLICANT SHOULD PROVIDE GENERIC APPROACHES/ACCEPTANCE CRITERIA FOR BURIED OR ABOVE GROUND TANKS.	CONFIR	DRAFT CESSAR SECTION 3.7.3 "SEISMIC CATEGORY I TANKS" PROVIDED TO THE STAFF.
3.7.3-10 APPLICANT SHOULD PROVIDE GENERIC APPROACHES AND ACCEPTANCE CRITERIA FOR EVALUATION OF BURIED PIPING, CONDUITS, AND TUNNELS.	CONFIR	DRAFT CESSAR APPENDIX 3.8A PROVIDES CRITERIA FOR EVALUATION OF BURIED CONDUITS AND TUNNELS.
3.7.4-1 APPLICANT SHOULD CLARIFY CESSAR SECTION 3.7.4.4 BY REQUIRING THE PLANT OPERATING PROCEDURES TO DEFINE "SIGNIFICANT EXCEEDANCE" OF DESIGN EARTHQUAKE LEVEL OF INTEREST.	TECH RESOLVED	ABB-CE WILL INCORPORATE DRAFT REGULATORY GUIDE DG-1016 FOR SEISMIC INSTRUMENTATION AND ADDRESS EXCEEDANCE OF EARTHQUAKE LEVEL OF INTEREST. ABWR WRITE-UP PROVIDED TO ABB-CE.

DSEER OPEN ITEM	REVIEW STATUS	COMMENTS
3.8.2-1 APPLICANT SHOULD ADDRESS THE UNCERTAINTY OF MECHANICAL PROPERTIES, ENVIRONMENTAL QUALIFICATION, AND AGING EFFECTS ON THE SELF-EXPANDING CORK IN THE TRANSITION REGION.	CONFIR	ABB-CE TO REVISE CESSAR TO INDICATE THAT COMPRESSIBLE MATERIAL STIFFNESS WILL REMAIN IN THE RANGE 67.5 PSI/IN TO 360 PSI/IN DURING PLANT LIFE.
3.8.2-2 APPLICANT SHOULD ADDRESS MEASURES TO PREVENT COLLECTION OF MOISTURE IN THE TRANSITION REGION.	CLOSED	RESPONSE HAS BEEN INCORPORATED INTO CESSAR AMEND.
3.8.2-3 APPLICANT SHOULD ADDRESS CONTAINMENT SHELL SEISMIC FRAGILITY AND CONTAINMENT PERFORMANCE IN PRA EVALUATION FOR A BEYOND DESIGN BASIS EVENT.	CLOSED	TRACKED UNDER CHAP 19 OF CESSAR AMEND.
3.8.2-4 APPLICANT SHOULD PROVIDE STRESS ANALYSIS RESULTS FOR THE MOST HIGHLY-STRESSED MERIDIAN, AS PREVIOUSLY DISCUSSED WITH THE STAFF DURING A APRIL 29, 1992 MEETING.	CONFIR	CESSAR MARK-UP PROVIDED IN ENCLOSURE 6 NEEDS TO BE INCORPORATED INTO CESSAR AMEND.
3.8.2-5 APPLICANT SHOULD DESCRIBE THE METHOD USED TO VERIFY THAT DESIGN OF PENETRATIONS AND REINFORCEMENTS SATISFY STRESS LIMITS OF SRP SECTION 3.8.2.	CLOSED	CESSAR TO SPECIFY SOME DETAILS, SCOPING ANALYSIS, AND DESIGN CRITERIA.
3.8.2-6 APPLICANT SHOULD VERIFY THAT THE FINITE ELEMENT MESH SIZE IS SMALL ENOUGH TO HAVE ACHIEVED CONVERGENCE OF THE ANSYS BIFURCATION BUCKLING LOAD.	CLOSED	TRACK UNDER OPEN ITEM NO 3.8.2-4.
3.8.2-7 APPLICANT SHOULD SUBSTANTIATE THE BUCKLING SHAPE RESULTING FROM THE PREVIOUS ANALYSIS OR PERFORM AN ADDITIONAL ANALYSIS TO ELIMINATE ANOMALIES.	CLOSED	TRACK UNDER OPEN ITEM NO 3.8.2-4.
3.8.2-8 APPLICANT SHOULD JUSTIFY ACCEPTABILITY OF FACTOR OF SAFETY OF 2 FOR STABILITY WITH LEVEL C LOADING.	CLOSED	CESSAR AMEND N ACCEPTABLE.



DSER OPEN ITEM	REVIEW STATUS	COMMENTS
3.8.2-9 APPLICANT SHOULD SUBMIT PRE-BUCKLING STRESSES FOR THE MOST HIGHLY STRESSED MERIDIAN AND VERIFY THAT STRESSES AT BUCKLING ARE IN THE ELASTIC RANGE.	CLOSED	TRACK UNDER OPEN ITEM NO 3.8.2-4.
3.8.2-10 APPLICANT SHOULD VERIFY THAT SANDIA STRAIN CRITERIA HAVE BEEN SATISFIED FOR ALL STRAINS IN AXISYMMETRIC ANALYSIS MODEL.	CLOSED	TRACK UI = SEVERE ACCIDENT ANALYSIS REVIEW.
3.8.2-11 APPLICANT SHOULD DESCRIBE THE METHOD TO BE USED TO VERIFY THAT ALL STRAINS AT THE DISCONTINUITIES SATISFY SANDIA STRAIN CRITERIA.	CLOSED	CESSAR MARK-UP PROVIDED (JUNE 21-23 AUDIT) INCORPORATED INTO CESSAR AMEND Q.
3.8.2-12 APPLICANT SHOULD PROVIDE A CORROSION ANALYSIS OF THE CONTAINMENT FOR A 60-YEAR PLANT DESIGN LIFE.	CLOSED	CESSAR MARK-UP PROVIDED (JUNE 21-23 AUDIT) INCORPORATED INTO CESSAR AMEND Q.
3.8.3-1 APPLICANT SHOULD EXPLICITLY ADDRESS THE EFFECTS OF CONCRETE CRACKING IN SEISMIC ANALYSIS OF ALL CATEGORY I STRUCTURES.	CLOSED	CONSIDERATION AND JUSTIFICATION OF CONCRETE CRACKING IN SEISMIC ANALYSIS INTO CESSAR.
3.8.4-1 APPLICANT SHOULD PROVIDE DESIGN DESCRIPTIONS, ASSUMPTIONS AND CRITERIA FOR ALL SEISMIC CATEGORY I STRUCTURES.	CONFIR	DESIGN DESCRIPTIONS, CRITERIA AND SEISMIC ANALYSIS RESULTS FOR NNI CATEGORY I STRUCTURES HAS BEEN INCLUDED IN THE CESSAR.
3.8.4-2 APPLICANT SHOULD CLARIFY ITS COMMITMENT TO DESIGN ALL SUBCOMPARTMENTS FOR GLOBAL PRESSURE/TEMPERATURE EFFECTS.	TECH RESOLVED	RESPONSE (2/2/93) DOES NOT SPECIFICALLY ADDRESS SUBCOMPARTMENTS. ABB-CE NEEDS TO PROVIDE MORE DETAILS ON PRESSURE VALUES, PIPE WHIP RESTRAINT DESIGN AND WALL DESIGN FOR ANCHOR LOADS.

DSER OPEN ITEM	REVIEW STATUS	COMMENTS
3.8.5-1 APPLICANT SHOULD PROVIDE A DESCRIPTION OF THE DESIGN, ASSUMPTIONS AND CRITERIA FOR THE FOUNDATIONS MATS FOR ALL CATEGORY I STRUCTURES INCLUDING CONTAINMENT AND INTERNAL STRUCTURES.	CLOSED	DESCRIPTION OF DESIGN, ASSUMPTIONS AND CRITERIA FOR FOUNDATIONS OF SEISMIC CATEGORY I STRUCTURES HAS BEEN INCLUDED IN THE CESSAR.
3.8.5-2 APPLICANT SHOULD COMPLETE DESIGN ANALYSIS OF THE FOUNDATION MATS FOR NUCLEAR ANNEX AND CONTAINMENT AND INTERNAL STRUCTURES.	TECH RESOLVED (AUDIT)	DESIGN ANALYSIS OF FOUNDATION MAT FOR NUCLEAR ANNEX AND CONTAINMENT AND INTERNAL STRUCTURES HAS BEEN AUDITED BY THE STAFF.
3.8.5-3 APPLICANT SHOULD PROVIDE ACCEPTANCE CRITERIA REGARDING THE FACTORS OF SAFETY AGAINST OVERTURNING, SLIDING AND FLOATING OF THE SPHERICAL CONTAINMENT.	CONFIR	CESSAR HAS BEEN REVISED TO INDICATE POSITIVE CONNECTION OF SCV TO CONCRETE. SLIDING/OVERTURNING OF NI STRUCTURE IS STILL BEING EVALUATED BY ABB-CE.
3.9.3.1-9 APPLICANT SHOULD SUBMIT EXPLICIT INFORMATION REGARDING PROPOSED DESIGN CRITERIA TO BE USED FOR DUCT SUPPORT CONSTRUCTION.	CLOSED	CESSAR MARK-UP INCLUDING THE HVAC AND SUPPORT DESIGN CRITERIA HAS BEEN INCLUDED IN AMENDMENT T.
3.9.3.4-3 APPLICANT'S COMMITMENT TO ACI-349 IS UNACCEPTABLE BECAUSE ACI-349, APP B HAS NOT BEEN ENDORSED BY THE STAFF.	CLOSED	NRC STAFF EXCEPTIONS TO ACI-349, APPENDIX B HAVE BEEN INCORPORATED INTO CESSAR.

ENCLOSURE 5B  
STATUS OF OPEN ISSUES  
STRUCTURAL METHODOLOGY AUDIT - MARCH 17 - 18, 1993

3B.1 Seismic SSI Analysis and Building Models

- (1) In the development of independent stick models, connecting walls between various areas are arbitrarily divided in half, and therefore, the overall dynamic behavior of the building including the torsional mode might not be adequately represented. ABB-Impell should justify that the dynamic model is adequately developed and explain how the torsional effects are considered.

Status: Closed. Staff to reference material presented in audit meetings in FSER.

- (2) Justification should be provided to demonstrate that stick models properly represent 3-D structures including fine tuning of stick models and the effect of concrete cracking.

Status: Closed. Staff to reference material presented in audit meetings in FSER.

- (3) ABB-CE should provide the methodology for the seismic analyses of the Radwaste Building and the Turbine Building structures because the NI is affected by the lateral soil pressure surcharge caused by these structures.

Status: Technically Resolved. Item will be addressed in CESSAR-DC Appendix 3.8A, Section 6.1.2.

- (4) ABB-CE should provide details of the site interface requirements including conceptual details of the seismic Category I dike.

Status: Closed.

- (5) ABB-CE committed that the System CE 80+ plant shall have solid state relays to eliminate relay chatter. This would provide part of the justification for the comparison of site specific spectra to the CESSAR-DC spectra in the 1-20 Hz range.

Status: Closed.

- (6) The site acceptance criteria flow chart shown in Enclosure 2A should be revised to ensure that the exceedance rather than average exceedance of site-specific surface or foundation spectra over the spectra due to CMS1, or CMS2, or CMS3 would be less than 10 %. Furthermore, the NRC staff will verify whether the comparison in the 1-20 Hz frequency range rather than 1-33 Hz range is adequate.



Status: Closed.

- (7) In the CESSAR-DC, ABB-CE should provide a basis for the selection of key locations for providing in-structure response spectra. The staff suggested that the list of locations should include the operating floor.

Status: Closed.

- (8) ABB-CE should provide the detailed methodology for the determination of dynamic lateral soil pressures on embedded walls.

Status: Closed. Incorporated into CESSAR Amendment S.

- (9) ABB-CE should provide the methodology and its basis to account for concrete cracking. In addition, ABB-CE should assess the need to combine the cracked building model with the site condition that has a fundamental soil column frequency close to building frequency in the analysis.

Status: Closed.

- (10) ABB-Impell should check the significant modes of vibration of the stick model and identify and verify the torsional modes of vibration. Additionally, a verification of the modal frequencies of the stick model should be made by comparing them with the frequencies obtained from a detailed finite element model such as the static model.

Status: Closed.

- (11) ABB-Impell should provide plots of bending moments of the NI basemat using Winkler springs including the  $V_s = 500$  fps case and provide comparison with the finite element (FE) results. Furthermore the FE model of the soil should be deeper and the sensitivity of the response of outer walls should be investigated.

Status: Closed.

- (12) ABB-CE should provide the detailed calculation of the stiffness properties of various stick models and the methodology for matching the frequencies and mode shapes with the 3-D models.

Status: Closed. Staff to reference material presented in audit meetings in FSER.

- (13) Enclosure 2D of the presentation material states that the basis for not considering the flexibility of the floor slabs is that the slabs have a minimum of 3 ft thickness, and the maximum plan dimensions are approximately 25 ft x 25 ft, with natural frequency in the rigid range ( $> 33$  Hz). The NRC staff stated that the flexibility of floor slabs in the seismic analysis should be further evaluated because of the cracks that might develop in the slabs, consideration of appropriate boundary conditions and the unexpected heavy weights placed on the floors.

Status: Closed. Incorporated into CESSAR Amendment Q.

- (14) NRC observed that in addition to the enveloped seismic acceleration profiles provided in Enclosure 2D, actual profiles for each stick should be provided.

Status: Closed.

- (15) The characteristics of the backfill material (concrete or engineered soil) for the rock sites should be provided and appropriately considered in the analysis and design.

Status: Closed. Incorporated into CESSAR Amendment Q and S.

- (16) The stick model for the spent fuel pool area should include the water convective mass effect. Also address:
- effect of fuel rack drop
  - design of liner plate for free standing racks

Status: Closed. Staff to reference material presented in audit meetings in FSER.

- (17) The site parameter table should include a note stating that the lower bound (the lowest value including uncertainty effect) of the best estimate of soil shear wave velocity will be no less than 500 fps.

Status: Closed. Table in Section 2, CESSAR has been revised to indicate minimum  $V_s = 700$  fps and minimum bearing capacity = 12 ksf. Analysis is done for  $V_s = 500$  fps to account for soil variability.

- (18) ABB-CE should address how the coarse mesh size of the FE model in the static analysis accounts for local effects such as out of plane shear and bending.

Status: Closed. Incorporated into CESSAR Appendix 3.8A, Section 6.1.1.

- (19) ABB-CE should provide the details of the methodology for the 2-D structure-to-structure interaction analysis of the NI structure and other structures in the SASSI model.

Status: Closed. ABB-CE needs to incorporate material presented in audit meetings into CESSAR.

### 3B.2 Design of Non Nuclear Island Category I and II Structures

- (1) SWEC indicated that the seismic input for NNI structures will be provided by ABB-Impell based on the SSI analysis of NI structures. ABB-CE should include a discussion of this interface methodology in the CESSAR-DC.

Status: Closed.

- (2) ABB-CE should provide the details of the structural analysis and design methodology for the seismic Category II Turbine Building.

Status: Closed.

- (3) The structural analysis and design methodology for the Diesel Fuel Building should address the effect of fire and potential hydrogen explosion due to its proximity to hydrogen tanks.

Status: Closed. Incorporated into CESSAR Appendix 3.8A, Section 11.1.2, 11.2.2.

- (4) There is a discrepancy in the wind speed (110 mph versus 130 mph) in various documents such as CESSAR-DC and draft Structural Design Criteria. ABB-CE should clarify wind load criteria.

Status: Closed.

- (5) Buried piping design criteria have been developed by ABB-Impell but were not included in the ABB-CE response to DSER open items nor in the CESSAR-DC. ABB-CE should provide the buried piping design criteria for staff review.

Status: Closed.

### 3B.3 Design Issues

- (1) When reinforcing cages are used in modular construction and splices are at the same location, doubling of the amount of reinforcement, as required by code provisions, should be discussed in the CESSAR-DC and the SDCS.

Status: Closed.

- (2) External pressure condition due to malfunction of HVAC equipment should be investigated for the design of the shield building.

Status: Confirmatory. ABB-CE will send response formally in a letter.

- (3) The protection of the fire suppression system from natural hazards should be addressed.

Status: Closed. Not a design issue. Potential severe accident issue.

- (4) The SDCS should clearly state that in the case of conflicts between industry codes and standards and the CESSAR-DC commitments, the CESSAR-DC commitments would govern.

Status: Closed.

- (5) The SDCS should address corrosion protection of metal structures and reinforcing bars.

Status: Closed. Incorporated into CESSAR Section 3.8.5.6 and Appendix 3.8A, Section 9.2.1.5.

- (6) Various documents present discussions in metric units but U.S. customary units would govern the construction.  
Status: Closed.
- (7) ABB-CE should design all subcompartments for the appropriate design pressures.  
Status: Closed.
- (8) ABB-CE should provide in-structure response spectra, acceleration profiles, overturning moments, and base shear in the CESSAR-DC.  
Status: Closed.
- (9) ABB-CE should provide structural design details of removable block walls, if applicable, in the CESSAR-DC.  
Status: Confirmatory. Incorporated into CESSAR Amendment U, Section 3.8.4.4 and Appendix 3.8A, Section 6.2.1.1
- (10) The SDCS should provide structural analysis and design methodology for buried piping. This information should also be included in the CESSAR-DC.  
Status: Closed.
- (11) ABB-CE should consider both the global and local effects of live load in seismic analysis and structural design.  
Status: Closed. Incorporated into CESSAR Amendment S, Section 3.7.2.4.
- (12) ABB-CE should provide the location of the ASME jurisdictional boundary for RPV supports.  
Status: Confirmatory. ABB-CE will send response formally in a letter.
- (13) The structural details design should be included in an Appendix to CESSAR-DC.  
Status: Confirmatory. Structural details will be included in CESSAR Amendment U, Appendix 3.8B.
- (14) ABB-CE should include the following items in the CESSAR-DC for the 10 critical areas selected by DES:
- Add a section between Radwaste Building and the NI wall.
  - Provide a connection detail for steel columns inside the containment.
- Status: Closed.

#### 3B.4 Status of Seismic Margin Analysis

- (1) ABB-CE should address whether programmable digital logic control circuits are subject to fragility from seismic motions.

Status: Confirmatory. ABB-CE will send response formally in a letter.

- (2) Valve fragility should be based on worst case amplification, and the fragility calculations of the CRD and core should be provided for staff review.

Status: Closed.

ENCLOSURE 5C  
STATUS OF OPEN ISSUES  
HVAC/CABLE TRAY DESIGN AUDIT - MAY 18 - 19, 1993

CRITERIA FOR DUCTWORK AND SUPPORTS  
CESSAR APPENDIX 3.9A

2.1 GENERAL

- (1) Describe the applicable codes for bolts and welds, particularly for connections between interfacing elements such as ductwork and steel angle members or between ductwork and supports.

Status: Closed.

- (2) Note that ANSI/AISC N690 is not fully endorsed by NRC.

Status: Closed.

- (3) DSDG specifies that ASME code will be used for ductwork constructed of piping. Provide justification for not using appropriate sections of AISC or AISI for round sections.

Status: Closed.

2.2.1 Pressure

- (4) Pressure effects should include operating and accident pressures.

Status: Closed.

- (5) Provide equations or methodology for calculating duct stresses due to internal pressure.

Status: Closed. Incorporated into CESSAR Amendment R.

2.2.2 Gravity

- (6) Gravity loads should include allowance for fire proofing material, if applicable.

Status: Closed.

2.2.3 Thermal

- (7) Thermal loads should include operating and accident temperatures.

Status: Closed.

- (8) DSDG states that for ductwork exposed to high temperatures, thermal loads will be considered. State the basis for defining "high" temperature.

Status: Closed.



#### 2.2.4 Seismic

- (9) Seismic load effects should include global and local effects. Global effects are determined by beam type analysis and local effects are determined by analysis of panels bounded by stiffeners and subjected to pressures due to inertial loads.

Status: Closed. Incorporated into CESSAR Amendment R.

- (10) DSDG should clarify what are the "other less conservative methods" for combining 3-D earthquake effects.

Status: Closed.

#### 2.2.5 Wind/Tornado

- (11) Safety related ductwork exposed to wind/tornado should be designed for missiles due to tornados in addition to pressures due to these effects.

Status: Closed. Incorporated into CESSAR Amendment R.

#### 2.2.6 Live

- (12) Provide the basis for the 250 # live load at mid span.

Status: Closed.

#### 2.3 DESIGN LOAD COMBINATIONS

- (13) Load combinations are not complete since effects such as  $P_o$ ,  $T_o$ ,  $P_s$ ,  $T_s$ , etc are not included. Also, the combinations are given as service levels A, B, C, and D whereas the applicable cited codes (such as AISC/ANSI N690) define load combinations as severe, extreme etc. Load combinations should be revised for consistency with the applicable codes.

Status: Closed.

#### 2.4.3 Seismic Analysis

- (14) First sentence in Section 2.4.3.2 is incomplete.

Status: Closed. Incorporated into CESSAR Amend Q.

- (15) Specify the method for calculating the beam section properties and masses to be used in the seismic analysis.

Status: Confirmatory. CESSAR Amendment U will incorporate response.

- (16) Specify the method of calculating the support frequencies and the method of modeling the supports in the duct seismic analysis.

Status: Closed. Incorporated into CESSAR Amendment R.

- (17) Specify the response spectra to be used for duct seismic analysis when the duct is supported at multiple locations.

Status: Closed. Incorporated into CESSAR Amendment R.

- (18) Specify the methodology for establishing the cut-off zero period acceleration frequency to be used for the simplified static analysis method. This frequency should take into account the frequencies of both the duct span and the support.

Status: Closed.

- (19) Describe the methodology to be used for taking into account the contribution of those modes whose modal contributions were not included since their modal frequencies exceeded the cut-off frequency (missing mass contribution).

Status: Closed.

- (20) The effect of eccentricity of forces relative to the duct centerline should be considered.

Status: Closed.

## 2.5 ALLOWABLE STRESS CRITERIA

- (21) Provide the method of calculating actual tensile, compressive, and bending stresses for comparison with the allowable stresses. In particular, describe the method for calculating the sectional properties of the duct cross-section to be used in calculating the actual stresses.

Status: Closed. See item 15.

- (22) Provide the basis for the allowable stresses specified for ductwork as well as supports. The current description is neither complete nor consistent.

Status: Closed. Incorporated into CESSAR Amendment R.

## CRITERIA FOR CABLE TRAY/CONDUIT AND SUPPORTS

### 3.1 GENERAL

- (1) Describe the applicable codes for bolts and welds, particularly for connections between interfacing elements such as connections between cable trays and supports.

Status: Closed.

- (2) Note that ANSI/AISC N690 is not fully endorsed by NRC.

Status: Closed.

### 3.2.5 Overlapping Regions

- (3) Specify the criteria that will be used to design non-safety related cable tray and conduit that pass over or near safety related structures, systems or components.



Status: Closed. Incorporated into CESSAR Amendment R.

### 2.3 DESIGN LOAD COMBINATIONS AND STRESS LIMITATIONS

- (4) The terminology for service load combination limits should be consistent with the applicable codes or the SRP.

Status: Closed.

- (5) Provide the basis for using the stress limit coefficient of 1.6 for the service load combination including SSE. In particular, justify the use of this factor for compressive stresses.

Status: Closed.

- (6) Provide the allowable stresses for welds and bolts.

Status: Closed.

### 3.4 DAMPING VALUES

- (7) Conduits are pipe-like members and hence damping values for the piping corresponding to the appropriate conduit size should be used unless justified otherwise.

Status: Closed. Incorporated into CESSAR Amend Q.

- (8) Provide the justification of using 5% damping for combination welded/bolted structures in lieu of the appropriate modal damping values.

Status: Closed.

### 3.5 CABLE TRAY SEISMIC QUALIFICATION PROCEDURE

#### 3.5.1 Cable Tray Properties

- (9) The discussion in this section is based on a specific configuration of the cable tray section as shown. The DSDG should be revised to either provide methodology for generic sections or state specifically that the cable tray sections will be limited to the typical section shown.

Status: Closed.

- (10) Provide the justification for using an effective moment of inertia of two-thirds of that corresponding to the ultimate buckling load obtained in the load test.

Status: Closed. Incorporated into CESSAR Amendment R.

#### 3.5.2 Allowable Moments

- (11) Provide the methodology for calculating the values of "I" and "C" in the equation. How is the effect of lateral members, either ladder type or solid, considered in these computations. Also provide a more complete definition of the allowable stress " $F_b$ ".

Status: Closed.

### 3.5.3 Seismic Analysis

#### 3.5.3.2 Dynamic Analysis Method

- (12) Define the methodology for determining the cutoff frequency for the zero period acceleration.

Status: Closed.

- (13) Specify the method of calculating the support frequencies and the method of modeling the supports in the cable tray/conduit seismic analysis.

Status: Closed. Incorporated into CESSAR Amendment R.

- (14) Specify the response spectra to be used for cable tray/conduit seismic analysis when the cable tray/conduit are supported at multiple locations.

Status: Closed.

- (15) Specify the methodology for establishing the cut-off zero period acceleration frequency to be used for the simplified static analysis method. This frequency should take into account the frequencies of both the cable tray/conduit span and the support.

Status: Closed.

- (16) Describe the methodology to be used for taking into account the contribution of those modes whose modal contributions were not included since their modal frequencies exceeded the cut-off frequency (missing mass contribution).

Status: Closed.

ENCLOSURE 5D  
STATUS OF OPEN ISSUES  
SEISMIC MODELING/ANALYSIS AUDIT - JUNE 8 - 10, 1993

- (1) CE presented several general concepts for the calculation of basemat uplift. CE needs to select and finalize a calculation method and submit it to the staff for review.

Uplift analyses will be performed for individual soil cases rather than an envelope of all soil cases.

Status: Technically Resolved. Results will be incorporated into CESSAR Amendment U.

- (2) The site acceptance criteria is based on a set of 12 generic soil profiles. Adequacy of Option 3 of the acceptance criteria for subsystem design needs to be addressed for multi-modal subsystems. In addition, floor response spectra at key locations associated with Options 2 and 3 should be included in the CESSAR.

Status: Closed. Incorporated into CESSAR Amendment R, Appendix 3.7D.

- (3) The envelope spectra being considered is a jagged spectra which has valleys at frequencies between the peaks of the individual soil column response. These valleys should be suitably smoothed to ensure that slight variations within the soil columns are incorporated.

Status: Closed.

- (4) CE will use ACI Code Section 21 and revise the CESSAR to reflect this position.

Status: Closed. Incorporated into CESSAR Appendix 3.8A, Section 6.2.1.1.

- (5) The NI/NA FEM will be used for global in-plane distribution of forces. CE presented a general concept for the design of walls for out-of-plane bending. CE will finalize the concept and submit it to the staff for review.

Status: Closed.

- (6) CE will modify site acceptance criteria flow chart by eliminating the comparison of spectra at foundation level and the first two diamonds in the "No" route. CE will also perform a sensitivity study for multi-modal systems to see if a comparison of site specific surface spectra to the envelope of CMS1, CMS2, and CMS3 can be used instead of comparing the site-specific spectra to individual CMS's in the flow chart.

Status: Closed.

- (7) Site acceptance criteria include minimum soil bearing capacity of 15 ksf and lower bound shear wave velocity of 500 fps. It is not clear how the 15 ksf bearing capacity can be achieved in a soil profile with 500 fps shear wave velocity.

Status: Closed.

- (8) CE will use symmetrical reinforcement pattern for the basemat to address the issue associated with the basemat differential settlement.
- Status: Closed. Incorporated into CESSAR Amend Q.
- (9) CE has added one additional point (i.e., the top of shield building) at which floor response spectra will be developed and included in the CESSAR.
- Status: Closed.
- (10) In the SSI methodology for calculating lateral soil pressures, CE will use horizontal rigid links between the side walls instead of the rigid beams proposed to simulate the side walls.
- Status: Closed. Incorporated into CESSAR Amend S.
- (11) CE needs to perform sensitivity analysis regarding (a) relative dimensional mismatch between the crane wall and the lower support structure, and (b) relative displacement in the foundation.
- Status: Closed. Incorporated into CESSAR Section 3.8.3.6.
- (12) In the SSI analysis, sensitivity of the surface motions to the three effects needs to be addressed:
- (a) effect of depth on degradation in soil stiffness and damping for deep soil sites,
  - (b) degradation sensitivity to soil type (i.e., sand or silt),
  - (c) effect of Poisson's ratio (0.4 was assumed) on vertical SSI analysis.
- Status: (a): COL item, (b): COL item, (c): COL item. ABB-CE to incorporate COL items.
- (13) CE needs to submit a marked-up CESSAR documenting all updates before the meeting scheduled for June 21, 1993.
- Status: Closed.
- (14) CE needs to address issue associated with the effects of incoherent ground motion on the basemat, which has large horizontal dimensions. Sensitivity study with inclined seismic wave may be needed.
- Status: Technically Resolved.
- (15) CE needs to show that Winkler soil spring and the uniform soil spring derived from a finite element analysis are compatible for a governing SSI case.
- A comparison of global base shear and the lateral earth pressure needs to be performed.
- Status: Closed. See July 28, 1993 meeting notes.

- (16) CE will clarify the statements regarding rigid body rocking modes on page 159, Volume 1 of "Seismic Structural Model Development."
- Status: Closed. Results will be incorporated into CESSAR Amendment U.
- (17) Detailed analysis of steel containment vessel and design calculation of concrete structures needs to be performed.
- Status: Closed.
- (18) CE will assess the hydrogen-combiner to see if it should be included in the dynamic analysis.
- Status: Closed.
- (19) Explain the criteria for selecting the cut-off frequency for SSI analysis.
- Status: Closed.
- (20) All soil columns typically have spectral peaks which fall in the range of about 1 Hz to 20 Hz. At the low frequency end, are there systems (such as sloshing fluids) which are of concern which require inputs of frequencies less than 1 Hz, e.g., crane frequency.
- The spectra for soil column D1 exceeds spectra for other soil cases at frequency below 0.7 Hz.
- Status: Closed. Crane freq > 1 Hz, CEDM freq > 1 Hz, Sloshing freq < 1 Hz, but does not control loads.
- (21) Are deep soil sites of relatively stiff soils covered in the range of columns investigated?
- Status: Closed. See July 28, 1993 meeting notes.
- (22) Vent stack is seismic Category I but is not designed for tornados. CE needs to provide justification.
- Status: Closed.
- (23) Structural design criteria Chapter 10 should address uplift in addition to sliding and overturning.
- Status: Closed.

ENCLOSURE 5E  
STATUS OF OPEN ISSUES  
STRUCTURAL DESIGN AUDIT - JUNE 21 - 23, 1993

- (1) For the design of Category I buildings with flat roofs, consideration for probable maximum precipitation and how it is handled needs to be considered.

Status: Closed. Incorporated into CESSAR Appendix 3.8A, Section 5.1.1.2.1.

- (2) SWEC/CE needs to provide justification that the equipment room attached to the Diesel Fuel Storage Structure (DFSS) is non-Category I and the MCC's in the equipment room are not safety related.

Status: Closed. ABB-CE will send response formally in a letter.

- (3) SWEC/CE needs to define the distance and orientation of the DFSS with respect to the NI/NA structure.

Status: Closed. CESSAR Fig 1.2-1 has been revised to provide orientation and distance.

ENCLOSURE 5F  
STATUS OF OPEN ISSUES  
STRUCTURAL DESIGN AUDIT - JULY 28, 1993

- (1) ABB-Impell will repeat the sliding/overturning analysis by evaluating the stability in the plane of the maximum seismic moment about the center of the SCV instead of the plane of the resultant horizontal seismic force.

Status: Closed. ABB-Impell will incorporate into calculations.

2. Instead of the time phasing of the vertical earthquake, ABB-Impell will use 40 % of the maximum vertical earthquake and apply it in the upward direction in all cases.

Status: Closed. ABB-Impell will incorporate into calculations.

3. Positive shear transfer mechanism such as shear keys will be provided to resist the review level earthquake sliding force taking into account the friction force based on a coefficient of friction of 0.3.

Status: Closed. Positive shear transfer mechanism using shear keys will be provided to attach SCV to the concrete.



ENCLOSURE 5G  
STATUS OF OPEN ISSUES  
STEEL CONTAINMENT VESSEL DESIGN AUDIT - AUGUST 10 - 11, 1993

- (1) DESI needs to resolve the issue of properly applying the horizontal and vertical earthquake effects.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes which will be further clarified in CESSAR.
- (2) The thickened embedded portion of SCV at the bottom (2") is intended for corrosion allowance and, therefore, DESI should analyze the SCV for both 1 3/4" and 2" thickness in the bottom embedded region.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes.
- (3) DESI needs to analyze the thermal buckling for the service level A loading of 290 F temperature and 53 psig pressure on the axisymmetric model.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes.
- (4) There is a difference in the modeling of the worst imperfection wavelength between the DESI and Ames models. DESI needs to reconcile this difference in the modeling of the imperfection wavelength.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes.
- (5) All hot pipe penetrations are connected to the SCV with bellows. ABB-CE needs to provide displacements limits and/or performance requirements for bellow connections.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes.
- (6) The 100, 40, 40 rule for the combination of 3-D earthquake is referenced in Table 3.8-5 of the CESSAR. DESI needs to provide the description, justification, and references for this rule.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes which will be further clarified in CESSAR.
- (7) The mesh size near the base in the DESI FEM is somewhat coarse and may not be able to represent the thermal stress gradient adequately. DESI needs to review their work and perform further work if necessary.

Status: Closed. ABB-CE provided the response shown in Enclosure 3A of October 6-7, 1993 meeting notes which will be further clarified in CESSAR.



ENCLOSURE 5H  
STATUS OF OPEN ISSUES  
STEEL CONTAINMENT VESSEL DESIGN AUDIT - OCTOBER F - 7, 1993

- (1) ABB-CE has completed most of their analyses and addressed the staff concerns but the results need to be incorporated into the CESSAR so that the staff may complete their safety evaluation.

Status: Confirmatory. See Enclosure 6 of this meeting summary.

- (2) ABB-CE/DESI provided the CESSAR markup for the 100 %, 40 %, 40 % rule for the combination of 3-D earthquake. However, ABB-CE needs to clarify that this rule is utilized only for static analysis and/or design and that the summation of the 3-D earthquake effects under this rule is an absolute sum.

Status: Closed. Incorporated into CESSAR Appendix 3.8A, Section 6.1.2, and Table 3.8-5.

- (3) ABB-CE needs to identify a COL item to address soil properties variation effect on the vertical soil-structure interaction analysis.

Status: Technically Resolved.

- (4) ABB-CE needs to add an Appendix or Subsection in the CESSAR to provide results of Non-Nuclear Island structures seismic analyses.

Status: Closed. ABB-CE has added Appendix 3.7C.

ENCLOSURE 51  
STATUS OF OPEN ISSUES  
NNI STRUCTURAL DESIGN AUDIT - OCTOBER 12 - 13, 1993

- (1) ABB-CE needs to resolve the issue that SSI analysis performed by ABB-Impell indicates significant amplification of input motions to DFSS and CCW structures due to the influence of NI structures on NNI structures.

Status: Technically Resolved. ABB-Impell model will include NNI structures and determine base response to be used by SWEC.
- (2) SWEC should use its own geotechnical standard as an independent check of the design soil pressure values calculated using ASCE 4-86 by comparing dynamic soil pressure results for the buried tunnel and the CCW structure.

Status: Technically Resolved. SWEC will perform the comparison indicated.
- (3) SWEC needs to perform the seismic analysis and design calculations of the CCW structures with the changed plant configuration of two separate structures. These calculation are essential for the staff to arrive at its safety conclusions.

Status: Technically Resolved. SWEC will perform the seismic analysis and design calculations indicated.
- (4) SWEC needs to re-evaluate the seismic analysis of the DFSS to rectify the input error and also to account for the effects of interference from the NI structure.

Status: Technically Resolved. SWEC will perform the seismic analysis calculations indicated.
- (5) The CCW structure has heat exchangers (HX) on the upper floor; however, the floor supporting the HXs is not being designed to withstand the hydrostatic head of water in the cubicle enclosing the HXs in the event that leakage occurs in the HXs. NRC staff needs to determine if internal flooding is a viable design condition; however, ABB-CE needs to provide its rationale for not considering the hydrostatic head for structural design of the floor slab.

Status: Closed. SWEC responded that internal flooding is not a design basis loading.
- (6) ABB-CE/SWEC needs to define compact structural backfill and provide appropriate acceptance criteria in the design guideline to be incorporated into the CESSAR.

Status: Confirmatory. Incorporated into CESSAR Appendix 3.8A.
- (7) Current SWEC design is based only on the A1 soil case. ABB-CE/SWEC needs to address the impact of the remaining foundation conditions for the design of NNI structures.

Status: Technically Resolved. See discussion in Section 2.2 of this report.
- (8) ABB-CE/SWEC needs to present typical details of the buried tunnel cross

sections showing reinforcement patterns and the tunnel connections at the building interfaces.

Status: Technically Resolved. SWEC/ABB-CE will provide the details requested.

- (9) SWEC calculation 03308-SC(B)-002, Rev 0 is not complete and does not provide details of the mode shapes, frequencies, and seismic responses such as shears and moments. In addition, the staff questioned the reasonableness of the results which resulted in SWEC identifying an error in the calculation. ABB-CE/SWEC need to revise the calculation and make it available for the staff audit.

Status: Technically Resolved. SWEC will revise the calculations indicated.

- (10) SWEC calculation 03308-SC(B)-003, Rev 0 was well prepared. However the calculation needs to be revised to reflect the revised results of the calculation in item (9) above. In addition, the calculation should be revised since it does not consider the effect of negative vertical acceleration in checking the overturning factor of safety.

Status: Technically Resolved. SWEC will revise the calculations indicated.

ENCLOSURE 5J  
STATUS OF OPEN ISSUES  
SEISMIC MARGIN ANALYSIS AUDIT - OCTOBER 19 - 20, 1993

- (1) For components to be qualified using seismic testing, ABB-Impell's approach relies on the assumption that the test response spectra (TRS) will envelope the design basis spectra by 10 % in amplitude. The design response spectra in turn is obtained by an envelope of the 13 soil cases for the three input control motions, i.e., envelope of 39 spectra. ABB-CE/ABB-Impell needs to justify this approach in light of the four options discussed in the CESSAR for the design and qualification of the SSC.

Status: Technically Resolved. ABB-CE will provide justification in SMA Section, Chapter 19.

- (2) Due to the soil-structure interaction effects of the Nuclear Island (NI) structures on the Non-Nuclear Island (NNI) structures, there is a potential that the HCLPF value for the NNI structures might be less than 0.6 g. This may have a potential impact on the PRA-based SMA presented in the CESSAR. ABB-CE will evaluate this impact and incorporate into the CESSAR.

Status: Technically Resolved. ABB-CE will evaluate the sliding of NI and NNI structures under design basis as well as seismic margin earthquake.

- (3) The staff expressed a concern on the use of high concrete shear strength  $v_c$  which was used in the determination of shear capacity of shear walls in comparison to the ACI code value. ABB-CE's consultant Dr. R. Kennedy provided a detailed basis for the  $v_c$  value used in the SMA calculations. He stated that the value of  $v_c$  utilized by the applicant is based on a significant number of test results well-documented in the literature and that the ACI code value is over-conservative for walls with low height to length ratios used in the nuclear power plants. He also stated that this value has been utilized for most of the PRA studies performed for the operating plants. The staff concluded that the response provided is adequate.

Status: Closed.

- (4) Although ABB-CE provided  $HCLPF_{50}$  (median fragility value) as well as  $HCLPF_{84}$  (84 % probability of non-exceedance) in the CESSAR, only the  $HCLPF_{84}$  is utilized in the PRA-based SMA. The staff will only use  $HCLPF_{84}$  for its safety conclusions regarding the seismic margin for the plant and the components. However, in cases where the HCLPF values are close to 0.6 g, e.g., steam generator snubber support pin, ABB-CE will refine their analysis to remove any over-conservative assumptions. The staff questioned about the failure mode assumed for the steam generator support pin and ABB-CE indicated that they had scaled the results from a stress report and that it will be further reviewed.

Status: Technically Resolved. ABB-CE will refine their analysis to remove any over-conservative assumptions. ABB-CE will send response formally in a letter.

- (5) ABB-Impell presented an update of the evaluation of the potential of overturning and sliding between the steel containment vessel (SCV) and the concrete interfaces. Shear bars are designed to take the design basis shear and the additional shear due to seismic margin earthquake is resisted by the plastic capacity of shear bars and friction. The staff concludes that this is a rational and conservative design concept and is acceptable.

Status: Closed.

- (6) The staff audited the System 80+ SMA calculations for structures and equipment for rock and soil cases and the containment overturning and sliding calculation. The staff concluded that the calculations properly implement the criteria provided in the CESSAR, are prepared in an acceptable manner and are well-documented. Based on the audit, the staff concludes that the HCLPF values computed in the calculations and utilized in the PRA-based SMA presented in the CESSAR are reasonable and acceptable.

Status: Closed.

ENCLOSURE 5K  
STATUS OF OPEN ISSUES  
STRUCTURAL DESIGN AUDIT - OCTOBER 28 - 29, 1993

- (1) Several typical connection details including spacing, edge distance, lap lengths, and clearances for main steel and shear reinforcement should be included in the CESSAR.
- Status: Confirmatory. ABB-CE will include the details in the CESSAR Appendix 3.8B, Section 6.0.
- (2) Reinforcement in walls should be consistent with wall thicknesses, unless loading patterns are too different to justify uniform reinforcement patterns.
- Status: Technically Resolved. ABB-CE/DESI will ensure consistency of reinforcement with wall thicknesses.
- (3) Shear reinforcement should be considered in the basemat, especially in the vicinity of the major shear walls and load bearing walls.
- Status: Confirmatory. ABB-CE/DESI will investigate shear reinforcement requirements for the base mat. See CESSAR Amendment U, Appendix 3.8B, Section 5.11.
- (4) Punching shear, especially at major pipe support locations (e.g., Mainstream House) should be considered while evaluating wall thickness and reinforcement. If necessary, additional steel supports should be provided to reduce loads on wall penetrations. When multiple penetrations exist, minimum distance between penetrations or openings should be specified. Similarly, minimum edge distances from penetrations should be specified.
- Status: Confirmatory. ABB-CE/DESI will incorporate into the calculations. See CESSAR Amendment U, Appendix 3.8B, Section 5.5.6 and 5.8.6.
- (5) In designing the steel columns at E1. 91+9, the effects of thermal loads should be considered.
- Status: Confirmatory. DESI will revise the calculations to address thermal loads. See CESSAR Amendment U, Appendix 3.8B, Section 5.10.2 and 5.10.4.
- (6) The use of a friction coefficient of 0.7 (based on  $\phi = 35^\circ$ ) is not acceptable. As such, the sliding evaluation must be revised.
- Status: Technically Resolved. DESI will revise the calculations to address issue of coefficient of friction.
- (7) All calculations supporting the CESSAR must satisfy applicable Quality Assurance Requirements and conform to good engineering practices. References to input documents should be clearly noted and superseded/invalid segments of the calculations should be clearly marked so that a reviewer or user of the calculation can understand the calculation process in absence of the originator of the calculations.



Status: Technically Resolved. DESI will revise the calculations to address the staff concerns.

- (8) Not all the critical areas in the present list have been evaluated by DESI. The remaining areas e.g., Areas 5c, 8, etc. must be evaluated.

Status: Confirmatory. See CESSAR Amendment U, Appendix 3.8B, Section 5.5 and 5.6.

- (9) ABB-Impell will include simplified models of adjacent structures in its NI SASSI analysis. Translational and rotational motions computed at the base of these structures will then be used by SWEC in performing detailed analyses of adjacent structures.

Status: Technically Resolved. ABB-Impell and SWEC will perform the analysis as indicated.

- (10) While evaluating sliding potential of NI using nonlinear analysis, ABB-Impell will perform sensitivity analysis to determine the effects of using lower friction coefficient and simultaneous vertical motion.

Status: Technically Resolved. DESI will address the staff concerns.

ENCLOSURE 51  
STATUS OF OPEN ISSUES  
STRUCTURAL STATUS MEETING - NOVEMBER 10 - 11, 1993

Containment Performance under Severe Accident Conditions

1. The margin against buckling due to the severe accident temperature loading should be addressed in the CESSAR-DC.  
ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.  
Status: Confirmatory.
2. ABB-CE should provide information regarding the median pressure capacity and its uncertainty due to variation in material properties and modeling of the containment fragility curves.  
Status: Technically Resolved. ABB-CE has not provided CESSAR-DC mark-up.
3. ABB-CE should provide material selection for penetration seals and the extent of anticipated degradation under severe accident condition temperature.  
Status: Confirmatory. ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.
4. ABB-CE should revise the CESSAR text to indicate that the incompatibility of displacements between the SCV and the penetrations, and the buckling of hatch cover will be addressed and stiffeners will be provided, if needed, under the severe accident conditions.  
Status: Confirmatory. ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.
5. ABB-CE's should clarify the statement that the cold legs alone could adequately support the reactor vessel.  
Status: Technically Resolved. ABB-CE has not provided CESSAR-DC mark-up.
6. ABB-CE's should provide the basis for the design of the reactor cavity under design and severe accident conditions.  
Status: Closed. ABB-CE's response regarding the design of the reactor cavity under design and severe accident conditions is acceptable.
7. ABB-CE's response that the exceptions to ACI 349 are identified in CESSAR-DC Appendix 3.8A is acceptable.  
Status: Closed. ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.
8. ABB-CE should provide the procedure for the determination of the reactor cavity and corbel capacity.  
Status: Confirmatory. ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.

9. ABB-CE should address the treatment of reactor vessel upward movement due to an ex-vessel steam explosion.

Status: Confirmatory. ABB-CE has provided CESSAR-DC Amendment U mark-up. This mark-up is acceptable.

## 2.2 Non-Nuclear Island Seismic Category I Structures

1. In response to the staff's question regarding the validation of the SWEC computer codes, SWEC responded that all SWEC computer programs have been validated according to the SWEC Quality Assurance Program, and computer codes REFUND and FRIDAY will not be used for generating the seismic responses.

Status: Closed.

2. The applicant should address the methodology and procedure for the modeling of NNI structures in the CESSAR.

Status: Technically Resolved.

3. ABB-CE should address the consideration of embedment on the seismic response of NNI structures.

Status: Technically Resolved.

4. ABB-CE should provide the description, analysis method and design procedure for field erected tanks.

Status: Technically Resolved.

5. The applicant should address the draft stiff positions for ACI 349 Code and ANSI/AISC N690 Standard.

Status: Closed.

6. ABB-CE should provide the analysis method and design procedure for the embedded exterior walls of the NNI structures.

Status: Technically Resolved.

7. ABB-CE should provide the analysis and design procedure for seismic Category I embedded structural components such as buried tanks and tunnels.

Status: Technically Resolved.

8. ABB-CE should address the structure-to-structure interaction between the NI and NNI structures.

Status: Technically Resolved.

9. The applicant should address the soil-structure interaction (SSI) of NNI structures in the CESSAR-DC.

Status: Technically Resolved.

10. Questions on the SSI of NNI structures:

- a. Provide the basis for considering only one soil case A1 in the SSI analysis.

Status: Technically Resolved.

- b. Provide the basis for considering CMS1 and CMS2 as free-field surface motions.

Status: Closed.

- c. Provide the justification for not considering embedment effects for the DFSS and CCW building.

Status: Closed.

- d. SWEC should not use the computer program REFUND since it can only be used for surface founded structures.

Status: Closed.

- e. ABB-CE should provide the justification for not including the live load in the lumped masses.

Status: Closed.

2.3 Geosciences Issues

1. Confirmatory Item 2.4.3-1 closed.

2. COL Action Item 2.4.3-1 closed.

3. COL Action Item 2.4.4-1 closed.

4. COL Action Item 2.4.5-1 closed.

5. COL Action Item 2.4.6-1 closed.

6. COL Action Item 2.4.7-1 closed.

7. COL Action Item 2.4.8-1 closed.

8. COL Action Item 2.4.9-1 closed.

9. COL Action Item 2.4.10-1 closed.

10. COL Action Item 2.4.11-1 closed.

11. COL Action Item 2.4.12-1 closed.

12. COL Action Item 2.4.13-1 closed.

13. COL Action Item 2.4.9-1 closed.
14. COL Action Item 2.4.14-1 closed.
15. Open Item 2.4.14-1 closed.
16. Open Item 2.5-1 technically resolved. ABB-CE will add a paragraph in the CESSAR to summarize presentation made in the June 21-25, 1993 meeting.  
Status: Mark-up provided as shown in Enclosure 4. This will be incorporated into Amendment U.
17. Col Action Item 2.5.2.5.2-2 closed. See page 2.5.2 of CESSAR.
18. Open Item 2.5.2.8-1 Amendment Q has properties of soils for vertical component convolution. Prof. Carl Costantino is reviewing it so it is confirmatory item.  
Status: ABB-CE has to add a COL applicant requirement that site specific surface motion is enveloped by the Standard Design response spectra at the ground surface.
19. COL Action Item 2.5.4.2-2 closed. ABB-CE has met all three criteria of min S velocity 700 ft/sec, min bearing capacity of 12 ksf and no liquefaction potential at site specific SSE.
20. COL Action Item 2.5.4.3-1 ABB-CE will incorporate.  
Status: Mark-up provided as shown in Enclosure 4. This will be incorporated into Amendment U.
21. Section 2.6 being handled by PM Stewart Magruder.