ASEA BROWN BOVERI

March 15, 1991
LD-91-012

Project No. 675

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

Subject: Response to NRC Requests for Additional Information

Reference: NRC Letter, Plant Systems Branch RAIs, G. S. Vissing (NRC) to A. E. Scherer (C-E), dated January 19, 1989

Dear Sirs:

The reference requested additional information for the NRC staff review of the Combustion Engineering Standard Safety Analysis Report - Design Certification (CESSAR-DC). Enclosure I to this letter provides our responses and Enclosure II provides the corresponding revisions to CESSAR-DC.

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

Very truly yours,

COMBUSTION ENGINEERING, INC.

S. E. Ritterbusch for EHK

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Enclosure I to
LD-91-012

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION,
PLANT SYSTEMS BRANCH

Question 240.1:

Except for table 2.0-1, no information is provided for Section 2.4, "Hydrologic Engineering". To complete the review of this section, all pertinent information and interface requirements should be provided.

Response 240.1:

Section 2.4 was revised in Amendment H. The site-specific SAR will include information to demonstrate compliance with the site envelope described in Table 2.0-1.

Question 270.1:

Review of Section 3.11, "Environmental Design of Mechanical and Electrical Equipment", indicates that additional information should be submitted for the following:

(a) As stated in Section 3.11.2.2, page 3.11-3, "other applicable Regulatory Guides and Standards have been utilized." However, these guides were not included in the reference listing. It is, therefore, requested that these references be provided for further evaluation,

(b) Identify rooms and locations that require temperature control during accidents. Also provide the bases for the analysis that supports the need for redundant ventilation and cooling systems,

(c) Although the design bases for normal conditions was given on page 3.11-1, those associated with abnormal, accident and post-accident environment were not provided. Please forward this information for further review,

(d) Although there are no detailed requirements for mechanical equipment, GDC 1 and 4; Sections III and XVII of Appendix B to 10 CFR 50; and SRP 3.11, Revision 2, contain the following requirements and guidance related to equipment qualification:

- Components shall be designed to be compatible with the postulated environmental conditions, including those associated with LOCAs,

- Measures shall be established for the selection and review for suitability of application of materials, parts, and equipment that are essential to safety-related functions,

- Design control measures shall be established for verifying the adequacy of design, and

- Equipment qualification records shall be maintained and shall include the results of tests and materials analyses.

In order to demonstrate compliance with General Design Criterion 4 of Appendix A to 10 CFR part 50 for mechanical equipment, the staff requires that the applicant perform a review and evaluation that includes the following:

1) Identification of safety-related mechanical equipment located in harsh environmental areas, including required operating time,

2) Identification of the nonmetallic subcomponents of this equipment,

3) Identification of the environmental conditions for which this equipment must be qualified. The environments defined in the

electrical equipment program are also applicable to mechanical equipment,

4) Identification of nonmetallic material capabilities and

5) Evaluation of environmental effects.

CE must make provisions for the above as part of the detailed plant-specific interface requirements, otherwise provide above information,

(e) As described in Section 3.11 of the SRP, the applicant should develop a well-supported maintenance/surveillance program to maintain equipment in accordance with 10 CFR 50.49. In Section 3.11.2.1, page 3.11-2, the applicant only stated that, assuming proper routine preventive maintenance is performed,..." without providing a well-developed maintenance/surveillance program as required by the SRP. Thus, additional information should be submitted to clarify the applicant's position regarding this issue and CE must make provision for the above as part of the detailed plant-specific interface requirements, otherwise provide above information,

(f) Equipment Qualification fo electrical equipment, important to safety, must be conducted in accordance with the requirements of 10 CFR 50.49. CE must make a commitment to comply with 10 CFR 50.49.

(g) Provide a copy of the reference listed on page 3.11-9, Qualification of Combustion Engineering Class 1E Instrumentation, CENPD-255-A Revision 3, Combustion Engineering, Inc., October 1985, for further evaluation and

(h) The review of Section 3.11 cannot be completed without the submission of Appendices 3.11.A and 3.11.B.

<u>Response 270.1</u>:

(a) The phrase "and other applicable regulatory guides and standards..." has been removed, and additional references listed in Amendment I.

(b) Amendment I, Section 3.11.4 and Table 3.11-1 address the question.

(c) Amendment I, Section 3.11.2.2 addresses harsh and mild environments.

(d) 1) Identification of safety-related mechanical equipment located in harsh environment is listed in Table 3.11B-1 of Amendment I. Duration of operation is addressed in the table.

2) For standard plant designs, lists will be available when <u>specific</u> equipment and components are procured. This is expected to occur after design certification. Section 3.11.3.2, Amendment I, describes the measures taken in the selection of materials. This section addresses mechanical equipment, but it is equally true for all equipment. Documentation as described in CENPD-255-A, Rev. 3 will be

available for staff audits of qualification files after specific equipment and components are purchased.

3) Environmental conditions are listed in Tables 3.11B-1, -2, and -3 of Amendment I.

4) This comment is covered by the response of (d) 2).

5) The evaluation of environmental adequacy of equipment is initiated by the full definition of environmental requirements in equipment specifications, as stated in 3.11.3.2. Test reports and analyses which substantiate operability after exposure to the environment, and the quality assurance documentation, are filed and available for staff audit, as discussed in Section 6.0, Documentation, CENPD-255-A, Rev. 3.

(e) The word "assuming" has been replaced by equipment is subjected to a surveillance program and a preventative maintenance program..." CENPD-255-A, Rev. 3 commits to a surveillance/preventative maintenance program in several places in Section 3.3, Qualification Program. The detailed maintenance/surveillance program for specific plants will be developed based on the specific equipment for that plant, and the results of qualification testing and analysis for that equipment and is the responsibility of the applicant for an operating license who references the certified design.

(f) Combustion Engineering, Inc., is committed to comply with 10 CFR 50.49 consistent with CENPD-255-A, Rev. 3, as discussed in Section 3.11.2 of Amendment I. NRC letter dated 9/8/83, C. O. Thomas to A. E. Scherer, Acceptance for Referencing of Licensing Topical Report CENPD-255, Rev. 3, Class 1E Qualification - Qualification of Class 1E Electrical Equipment states on page 5 of the enclosure that "...CENPD-255 is acceptable and meets the requirements of 10 CFR 50.49 as well as NUREG-0800 and its associated standards." the NRC review of CENPD-255-A (Rev. 3) is summarized in Appendix J of NUREG-0852, Supplement 3 (the System 80 Safety Evaluation Report).

(g) CENPD-255-A was previously docketed. An additional copy of CENPD-255-A, Rev. 3, has been recently provided separately to the NRC Project Manager.

(h) Appendices 3.11.A and 3.11.B were submitted with Amendment I.

Question 410.32:

Review of Section 3.4.4, as related to flood protection, was based on the guidelines of Section 3.4.1 of the SRP. The review indicates the need for additional information on the following:

(a) Provide generic drawings showing the waterproofing and water stop details for Seismic Category I structures and typical flood doors,

(b) Provide an evaluation of the operations of safety-related systems or components while they are completely or partially flooded,

(c) Provide an assessment of the leakage from liquid carrying systems, and an evaluation of measures taken to protect safety-related equipment,

(d) Discuss whether or not the "cooling water system structures" will be protected against flooding,

(e) Discuss the reasons for not having a permanent dewatering system to control the groundwater level (3.4.4.2),

(f) Waterproofing of walls subjected to floods should also be considered as a safeguard presented in Section 3.4.4.1.

(g) Provide a list of all Seismic Category I structures and equipment that will be protected against flooding, and the associated interface requirements.

In addition, the review of this section cannot be completed until the completion of Section 2.4.

Response 410.32:

(a) Generic drawings for the waterproofing and water stop details for Seismic Category I structures and typical flood door details are not available at this time because, with changing technology, the most reliable and effective means of providing acceptable waterproofing may change. For this reason, only the walls and doors which need waterproofing are identified.

(b) The physical separation of divisions of safety-related systems and components prevents the disabling of both divisions from a single internal flood. Therefore, no safety-related system or component is required to operate under flooded conditions.

(c) The floor drain system and/or local sump pumps are provided to locate, identify, and handle this leakage (see CESSAR-DC, Section 9.3.3, Amendment I).

(d) The "cooling water system structures" will be flood-protected.

(e) The need for a permanent dewatering system depends on actual site conditions such as soil properties, water table level, etc. A permanent dewatering system will not be necessary at all potential

sites; therefore, the requirement for a permanent dewatering system will not be placed in CESSAR-DC. Section 3.4.4.2 of CESSAR-DC, Amendment I, provides the interface requirement to determine the need for a dewatering system.

(f) Waterproofing of walls, as necessary, has been added to the list of safeguards in Section 3.4.4.1 (Amendment I).

(g) The equipment and structures are identified in Tables 3.2-1 and 3.2-4 (Amendment I).

Section 2.4 has been revised (see the response to 240.1).

Question 410.33:

Review of Section 3.5.1.1, which addresses internally generated missiles (outside the containment), indicates that additional clarification should be provided on the following:

A. Review of Section 3.5.1.1.3 indicates that not only pressure but also temperature conditions should be available to determine the energy level classification of a pressure vessel. Provide the maximum allowable temperature for moderate energy pressure vessels outside the containment and also identify the section of the CESSAR 80+ SAR where the energy level classifications are given for the pressure vessels,

B. Provide an assessment of the potential missiles that could be generated outside the containment from piping systems and associated monitoring equipment (temperature probe, flow measurement devices, pressure gauges, etc.) and from vessel monitoring devices,

C. No high energy systems which may generate missiles outside containment were identified. Provide drawings of sufficient details which will identify all major energy line classifications for all locations outside containment,

D. Missiles generated by the overspeed of rotating systems (fans, diesel generators, turbines, etc.) and the protection against these missiles should be discussed,

E. Discuss the possibility of safety relief valves becoming internally generated missile outside containment and

F. Provide a list of the safety-related systems, components and structures located outside the containment that require missile protection.

Response 410.33:

(A) The maximum temperature for moderate energy systems is 200°F. This is defined in Section 3.6.1.1.2.

(B) The potential missiles referenced are typically of low energy and not capable of significant damage to safety-related systems. Furthermore, the redundant safety systems outside containment are physically separated so that no single missile is capable of disabling both systems.

(C) Piping layout "envelopes" will be provided in a future amendment. Detailed drawings are not available until after procurement engineering is complete (which is after design certification).

(D) The redundant safety systems outside containment are physically separated so that no single missile is capable of disabling both systems.

(E) The potential missiles referenced are typically of low energy and not capable of significant damage to safety-related systems. Furthermore, the redundant safety systems outside containment are physically separated so that no single missile is capable of disabling both systems.

(F) The following safety-related systems and components located outside the containment require missile protection.

A. Emergency feedwater system (including safety-related condensate transfer and storage system and emergency feedwater storage tank).

B. Safety injection system (including refueling water tank).

C. Main steam and feedwater system (from unaffected steam generator out to the containment isolation valves, including the atmospheric steam dump, steam supply to the turbine-driven auxiliary feedwater pump, and the steam generator blowdown line).

D. Shutdown cooling system.

E. Class 1E electrical systems, AC and DC (including switchgear, batteries, and distribution systems).

F. Diesel generator system, including diesel generator starting, lubrication, and combustion air intake and exhaust systems.

G. Diesel fuel oil storage and transfer system.

H. Component cooling water system (portions required for operation of other listed systems).

I. Station Service Water system.

J. Control building HVAC system.

K. Main control board.

L. Essential chilled water system.

M. Containment isolation systems:

(1) Penetration assemblies

(2) Isolation valves

(3) Equipment hatch

(4) Emergency personnel hatch

(5) Personnel lock

(6) Test connections

(7) Piping between penetration assemblies and isolation valves

N. Fuel building HVAC system.

O. Diesel generator building HVAC system.

The safety related structures design for missile impact are listed in Table 3.2-4.

Question 410.34 (3.5.1.1):

Provide an assessment of the potential gravitational missiles generated outside the containment and a review of nonsafety-related SSC protected from internally generated missiles if their failure by a missile impact could prevent a required safety function of the SSC.

Response 410.34:

The redundant safety-related system outside containment are physically separated so that no single missile can impact both systems. All nonsafety-related SSCs are evaluated for their potential interaction with safety-related SSCs. There are no requirements to provide missile protection to nonsafety-related SSCs. Section 3.5.1.1 of CESSAR-DC has been modified, in Amendment I, to reflect this response.

Question 410.35:

Review of the information presented in Table 3.5-1 of Section 3.5.1.2, which deals with internally generated missiles (inside the containment), indicates the following concerns:

a) Provide the reason for deletion of the statement, "Control Rod Drive Assembly" from Item 1 in the latest amendment, and

b) Provide justifications for not including instrumentation assembly and components, and not only the safety valve flange...(bolts)...but also the safety valve itself, in the list of internally generated missiles.

Response 410.35:

a) CESSAR-DC, Amendment E, includes the Control Rod Drive Assembly in Table 3.5-1.

b) Temperature nozzle and RTD assemblies for RC Pump, piping, and surge and spray piping are included in Table 3.5-1 (Amendment E).

There are no missiles postulated for safety valves for the following reasons:

1. The safety valve is retained to the flange with redundant bolting.

2. The safety valve stems are provided with a backseat or shoulder larger than the valve bonnet opening.

3. The safety valve stems are restrained by spring force.

4. The safety valve bonnets are retained with redundant bolting.

This is consistent with the approach for the System 80 design previously approved (see the Safety Evaluation Report, NUREG-0852).

Question 410.36:

The third sentence on page 3.5-3, starting with "Other items which..." is not clear. Provide additional information that will clarify this statement.

Response 410.36:

There are no missiles postulated for valve stems, valve bonnets, and pressurized cover plates because sufficient retention redundance is provided by the following features:

1. All valve stems are provided with a backseat or shoulder larger than the valve bonnet opening.

2. Motor operated and manual valve stems are restrained by stem threads.

3. Operators on motor, hydraulic and pneumatic operated valves prevent stem ejection.

4. Pneumatic operated diaphragms and safety valve stems are restrained by spring force.

5. All valve bonnets are either pressure sealed, threaded or bolted such that there is redundant retention for prevention of missile generation.

Question 410.37:

Provide an assessment of the potential gravitational miss``s generated inside containment and credible secondary missiles generated as a result of impact with primary missiles.

Response 410.37:

All non-safety related equipment inside containment is evaluated for its potential interaction with safety systems. Potential gravitational missiles are evaluated for impact and are anchored as necessary to prevent loss of function of safety systems caused by interaction with non-safety equipment.

Potential secondary missiles, such as concrete spalling, are evaluated for impact on safety systems and equipment. When necessary, protective structures are added to prevent interaction of secondary missiles with safety systems.

The response above is being added to CESSAR-DC, Section 3.5.1.2.

Question 410.38:

The details and references for the tornado-missile analysis were not identified in Section 3.5.1.4. Please discuss the compliance of the analysis with the Regulatory Guides (RG) 1.76, 1.117; and postulate missiles as required by the SRP.

In addition, this section cannot be reviewed completely until the completion of Table 3.2-4.

Response 410.38:

The guidance from Regulatory Guide 1.76 for Region 1 is used. Tornado missiles are in accordance with SRP 3.5.1.4 Spectrum II. Missile impacts are in accordance with SRP 3.5.3 and ACI 349, Appendix C. The minimum shield wall thickness is in accordance with Table 1 of SRP 3.5.3. Missiles will not penetrate the shield building. Missile loads are combined with tornado wind and pressure differentials. Non-Category I structures are not assumed to shield the reactor building or other Category I structures from tornado wind or missiles.

Section 3.5.1.4 and Table 3.2-4 were revised via Amendment I.

Question 410.39 (3.5.2):

Please discuss the compliance of Section 3.5.2, "Structures, Systems, and Components to be Protected from Externally Generated Missiles", with the requirements of RG 1.13; RG 1.27 positions C.2 and C.3; RG 1.115 position C.1; RG 1.117 positions C.1, C.2, and C.3.

Response 410.39:

Table 3.2-4 identifies the Category I structures and their loading criteria. The Spent Fuel Pool structure is designed for external missile impact and therefore precludes external missile interaction with the fuel storage. the structures associated with the Ultimate Heat Sink are designed for external missile impact. The Turbine Generator is positioned such that all Category I structures are outside of the potential turbine missile zone. The postulated tornado missiles are listed in Table 3.5.1-4.

Question 410.40 (3.5.2):

Identify structures, systems, and components that will be protected from externally generated missiles.

Response 410.40:

Table 3.2-4, Amendment I, identifies the structures that are designed to withstand external missiles.

Question 410.41:

In general, the information provided in Section 3.6.1, which relates to postulated piping failure outside the containment, is inadequate for a full review. Specifically, the evaluation cannot be completed until the completion of Sections 3.6.1.1 and 3.6.1.2, and the inclusion of a safety evaluation that demonstrates compliance with the guidelines of the SRP Section 3.6.1 and the Branch Technical Position (BTP) ASB 3-1. Provide above information in order to permit the staff to perform an integrated review of the involved fluid systems.

In addition, the applicant should also provide additional information on the following:

(a) Discuss in detail the elements that are considered as environmental effects in Section 3.6. Clarify whether flooding, high temperature, pressurization, radiation, and humidity conditions are considered to be environmental effects,

(b) Provide the criteria used for the protection against dynamic effects associated with the postulated pipe rupture and

(c) Provide references relating to the requirements listed as items "a" and "b" at the beginning of page 3.6-2.

CE must make provisions for the above as part of the detailed plant-specific interface requirements, otherwise provide above information.

Response 410.41:

CESSAR-DC, Section 3.6, was replaced with Amendment E and additional tables were provided in Amendment I.

Question 410.42:

Regarding the Reactor Coolant Pressure Boundary (RCPB) leakage detection systems (Section 5.2.5), provide information on the following:

(a) Confirm that the applicable portions of RCPB leak detection systems are in accordance with the RG 1.29, Positions C.1 and C.2,

(b) As described in RG 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems", identified sources of leakage within the primary containment include pump and valve seals, and the reactor vessel closure seals. However, these sources were not mentioned in the Section 5.2.5. Thus, indicate whether or not these sources will be considered as identified leakage. your response should also include descriptions of other identified leakage sources that may be unique to the CE System 80+ (except those that were already described in Section 5.2.5, Amendment D), and how the total leakage rate will be obtained as related to Position C.1 of RG 1.45,

(c) Although it was mentioned that the sensitivity and operability tests of the leakage detection systems could be found in Sections 7, 9, and 11, the information was either inadequate or not submitted for a complete review. As a result, it is requested that this information be provided for further evaluation,

(d) Describe how all RCPB leakage detection systems will be in conformance with Positions C.7 and C.8 of RG 1.45 and

(e) Identify all interface requirements relating to the RCPB leakage detection systems (except those presented in Section 5.1.4).

Response 410.42:

(a) RG 1.45, Position C.6, states that: "The airborne particulate radioactive monitoring system should remain functional when subjected to the SSE." Section 5.2.5.1.1.3 of CESSAR-DC states that the system is "...capable of functioning when subjected to the SSE." It follows that RG 1.29, Position C.1.k(1), is complied with. It is confirmed that applicable portions of RCPB leakage detection systems are in accordance with RB 1.29, Positions C.1 and C.2.

(b) New sections 5.2.5.1.2.3 and 5.2.5.1.2.4 have been added to CESSAR-DC (Amendment I) to address additional identified leakage sources. RG 1.45, Position C.1, is addressed in 5.2.5.1.2.

(c) Sensitivity is addressed in new section 5.2.5.6 and operability testing is addressed in new section 5.2.5.7 of Amendment I.

(d) Position C.7 for control room instrumentation is addressed in 5.2.5.2, to which new sections have been added to more fully address the question. Conversion of nonvolumetric indications of leakage is addressed in Section 5.2.5.2.4.

Position C.8, concerning operability testing and calibration during plant operation is addressed in 5.2.5.7.

(e) The interface requirements which have appeared in numerous chapters of CESSAR-DC have been incorporated into the section describing the interfacing system. Historically, the lists are a holdover from CESSAR-F where the applicant's SAR was a completed document made up of CESSAR-F plus the BOP. CESSAR-DC will be a complete document, making the interface requirements list unnecessary

Question 410.43:

According to Position C.3 of RG 1.45, at least three separate methods for detecting RCPB leakage should be employed: sump level and flow monitoring, airborne particulate radioactivity monitoring and a third method to be achieved either by monitoring condensate flow rate from air coolers, or be monitoring of airborne gaseous radioactivity. A review of the Section 5.2.5 reveals little information on these detection methods. Thus, provide the information on the following:

(a) Clarify how the proposed RCPB leakage detection systems will conform to Position C.3 of RG 1.45 and

(b) In particular, describe how the airborne particulate radioactivity monitoring system will be in conformance with Position C.6 of RG 1.45, as related to the functionality of the system when subjected to the Safe Shutdown Earthquake (SSE).

Response 410.43:

Sections have been added to 5.2.5 which clarify the request.

(a) Sump level and flow method is discussed in new sections 5.2.5.1.1.2 and 5.2.5.2.4.2.

Airborne particulate radioactivity is discussed in new sections 5.2.5.1.1.3 and 5.3.5.2.4.1.

Airborne gaseous radioactivity is discussed in new sections 5.2.5.1.1.3 and 5.3.5.2.4.1.

(b) A statement has been added to 5.2.5.1.1.3 stating that the airborne particulate monitoring system is designed to meet a SSE.

Question 410.44:

Is there any distinction between RCPB leakage "inside" and "outside" the primary containment? If there is such a separation, provide information on the sources (where it is applicable) and the methods used to detect identified and unidentified RCPB leakage outside the primary containment. Otherwise, justifications for no separation should be provided.

Response 410.44:

Section 5.2.5 addresses all Regulatory Positions of Section C of RG 1.45. These positions concentrate on inside containment leaks. Position 4, intersystem leaks, does concern leaks outside the containment and is addressed in Section 5.2.5.4. Additionally, Section 5.2.5.1.1.1, Inventory Method, deals with activities and measurements in the CVCS outside the containment, such as VCT level and RCS makeup.

Question 410.45:

Describe how potential intersystem leakages will be identified, monitored, and quantified for all applicable systems and components connected to the Reactor Coolant System that are listed in Table 1 of SRP Section 5.2.5, and other systems that are unique to the CE System 80+.

Response 410.45:

Section 5.2.5.4 has been rewritten and retitled "Intersystem Leakage." Table 1 items are addressed.

Question 410.46:

As stated in Section 5.4.11, "Pressurizer Relief Tank", the refueling water storage tank is used as the pressurizer relief tank. However, the design and description of this tank were not provided in the submittal. and were shown as "later". Therefore, the following information on this tank should be provided for evaluation:

(a) Provide legible copies of the piping and instrumentation diagrams (P&IDs), and layout drawings of the system,

(b) provide justifications and effects of using the refueling storage tank as the pressurizer relief tank,

(c) indicate whether the design will be in conformance with RG 1.26, as related to the quality group classification of the tank, and RG 1.29, position C.2, as related to seismic design classification,

(d) verify that the system will remain functional after anticipated abnormal events,

(e) verify that other systems are protected from high- and moderate-energy line breaks and leakage cracks in the pressurizer relief system and

(f) identify all interface requirements relating to the pressurizer relief system.

Additionally, all other pertinent information on this tank should also be included in the responses in order to complete the review of this section.

Response 410.46:

(a) Amendment I to CESSAR-DC provides Section 6.8 which describes the In-containment Refueling Water Storage Tank (IRWST). Piping and instrumentation diagrams (P&IDs) and layout drawings are provided.

(b) The Reactor Drain Tank which served as the pressurizer relief tank on System 80 had a minimum volume of 2850 gallons. Excess pressure resulting from a pressurizer discharge was relieved by the release of steam to the containment through a rupture disk. By contrast, the IRWST which serves as the pressurizer relief tank on System 80+ has a minimum water volume of 495,000 gallons. The important reason for having the IRWST is the PRA benefit obtained from eliminating the Recirculation Actuation Signal (RAS) and the switch-over from the external refueling water tank to the containment sump as the source of water for safety injection and containment spray.

Two of the functions of the IRWST are the collection of Pressurizer Safety Valve (PSV) and Rapid Depressurization Valve (RDV) leakage and the primary heat sink for PSV and RDV discharges. The purpose of the Steam Relief System (SRS) is to transport steam from the PSVs and RDVs to the IRWST.

The IRWST can be cooled either by the Containment Spray System heat exchangers or the Shutdown Cooling System heat exchangers. Overpressure protection for the IRWST is provided by four IRWST safety valves. These valves are sized to accommodate the consequences of a design basis accident steam release and RDV actuation assuming no cooling of the IRWST is available.

(c) The IRWST design conforms to RG 1.26, as related to the quality group classification of the tank, and RG 1.29, position C.2, as related to seismic design classification.

(d) The IRWST will remain functional after anticipated operational occurrences and design basis accidents. If the pressure in the IRWST exceeds the safety valve set pressure, the valves will open and relieve to the containment.

(e) The design requirements of the Steam Relief System and the IRWST include protection of other systems from high- and moderate-energy line breaks and discharges from the IRWST.

(f) The System 80+ Standard Design encompasses an essentially complete plant. All systems connected to the IRWST and all associated structures are now within the scope of System 80+. The interfacing information has therefore been incorporated into the sections of CESSAR-DC which describe those supporting systems.

Question 480.1:

The following general questions resulted from a review of Section 6.0, "Engineered Safety Features."

With regard to the design features and basis for the containment, discuss containment performance in response to severe accidents (e.g., core melt and ejection into containment) which are analyzed in Probabilistic Risk Assessments (PRA). These events result in a greater thermal-hydraulic and radiological challenge to the containment Specific details which should be addressed include:

(a) expected containment integrity above design pressure (actual failure pressure and mode of failure),

(b) features/actions available to mitigated containment failure,

(c) survivability of equipment exposed to the severe accident environment which is needed for containment heat removal and fission product retention, and

(d) design details of the reactor vessel cavity which reduce the magnitude and extent of direct containment heating by high pressure molten core ejection.

Response 480.1:

(a) The System 80+ design utilizes a large dry steel containment with a design pressure of 49 psig (based on a conservative guillotine pipe break design basis accident). The estimated actual failure pressure is 190 psia for the pressure boundary shell (earlier leakage may occur in the vicinity of penetrations).

The robust containment design selected for the System 80+ design permits C-E to state its expectations for containment performance based on the following definitions:

(1) "Credible core damage sequences" is defined as all core damage event sequences with a frequency greater than 1.0E-6 per reactor-year. External events which would cause both core damage and concurrently fail the containment and which have a frequency of less than 1.0E-5 per reactor-year will not be considered in this evaluation.

(2) "Containment failure" is defined as a post-core-damage release resulting in a dose greater than 25 rem beyond one-half mile from the reactor.

Based on the above, the System 80+ containment design is expected to be such that the containment conditional failure probability, when weighted over credible core damage sequences, will be less than one in ten (1.0E-1).

It must be noted, however, that containment integrity is assured by a conservative design (see Chapter 6 and Section 3.8). Severe

accident analysis is an evaluation tool to provide insight into the design, but severe accident calculations are not part of the design analysis process.

(b) The System 80+ design includes features to mitigate the effects of a transient that can liberate sufficient energy to the containment atmosphere and, ultimately, challenge containment integrity. First, a containment spray system is available for fission product scrubbing and for heat transfer with the containment atmosphere. Second, a hydrogen ignitor system is available to allow adiabatic, controlled burning of hydrogen at low concentrations to preclude hydrogen concentration buildups to detonable levels. Please see CESSAR-DC Section 6.2.5 for a complete description of this system. Third, a Safety Depressurization System (Section 6.7) is available to preclude a high pressure core melt ejection that could result in direct containment heating, and possible challenge of containment integrity.

(c) Information regarding equipment survivability in a severe accident environment is addressed in the response to NRC Question 440.20.

(d) The System 80+ reactor vessel cavity design includes features to mitigate the effects of a degraded core which penetrates the vessel under high pressure. First, a large floor area (0.02 m^2/mwt) enhances debris dispersal and coolability. The second feature is an indirect cavity vent path, including a debris collection chamber which is configured to trap solid core debris and minimize direct containment heating. The third feature is an In-Containment Refueling Water Storage Tank which provides a source of water for flooding the reactor cavity and cooling core debris. Note that the Safety Depressurization System mentioned in part (b) is intended to help prevent a high-pressure core melt ejection.

Question 480.2:

Describe the containment vent lines and their isolation provisions. Discuss design conformance with Branch Technical Position CSB 6-4, "Containment Purge During Normal Operations."

Response 480.2:

A description of containment isolation was provided in Amendment E of CESSAR-DC, Section 6.2.4. A description of the Containment Purge System is in Section 9.4.5. As suggested by Branch Technical Position CSB 6-4, separate purge systems are provided for shutdown modes and operation modes. Section 9.4.5 of CESSAR-DC contains detailed information on the shutdown purge system.

Question 480.3:

Define the design bases for the containment spray system and the safety classification of the spray system components.

Response 480.3:

The design bases for the containment spray system (CSS) are presented in Section 6.5.1 of CESSAR-DC (Amendment I). The safety classification of CSS components is summarized in Section 6.5.2.4 of CESSAR-DC.

Question 480.4:

It appears that the CESSAR System 80+ containment design relies on the traditional mechanisms of containment volume, active and passive heat sinks, and containment spray to control LOCA/MSLB containment temperature and pressure response. Discuss the rationale for not upgrading the containment fan cooler system design to safety-grade and higher heat removal capacity to augment the containment spray system. Include an evaluation of the effect on core melt risk of the modification of the fan cooler system.

Response 480.4:

On System 80+, the safety-grade containment spray is sized to remove energy from the containment to prevent exceeding containment design pressure and temperature for all design basis accidents. While the containment fan cooler system is designed to be a highly reliable system, it is not required (or credited) for any safe shutdown or accident mitigation function.

The System 80+ Probabilistic Risk Assessment is provided in CESSAR-DC Appendix B. Making the fan cooler system a safety-grade system would not significantly benefit the PRA because core melt accidents usually involve a complete loss of power or loss of the Station Service Water System (i.e., the fan cooler system would be lost regardless of its safety classification).

Question 480.5:

To complete the review of Section 6, the following chapters which were blank in Amendment D must be submitted:

6.2.2 Containment Heat Removal Systems,
6.2.3 Secondary Containment Functional Design,
6.2.5 Combustible Gas Control in Containment,
6.2.6 Containment Leakage Testing,
6.4 Habitability Systems, and
6.5 Fission Product Removal and Control Systems

Response 480.5:

The requested sections were provided in Amendments E and I. The title of Section 6.2.3 has been changed to Annulus Ventilation System. With respect to Section 6.2.3 of the Standard Review Plan, any high-energy line through the annulus is provided with a guard pipe, so the annulus pressure and temperature response to the rupture of such a pipe is not analyzed. Section 3.6.1 is being modified to reflect this commitment. The annulus pressure/temperature analysis as a result of accidents inside containment is presented in Section 6.2.1.8.

Question 480.6:

For the minimum containment pressure analysis discussed in Section 6.2.1, "Containment Functional Design," justify the use of concrete and steel thermophysical properties in Table 6.2.1-38 which are different from those in Branch Technical Position CSB 6-1.

Response 480.6:

Material property values for the minimum containment pressure analysis are listed in CESSAR-DC, Table 6.2.1-21, Amendment G. Except for the thermal conductivity of concrete, the material properties for the minimum containment pressure analysis (Section 6.2.1.5) are 10% larger than those for the maximum pressure analysis (the 10% margin is added for conservatism).

Branch Technical Position (BTP) CSB 6-1 identifies thermophysical property data for two materials, concrete and carbon steel, that "would be acceptable" for use in minimum containment pressure analyses. the following table compares the data for concrete and carbon steel that were used in the analysis versus that given in the BTP.

	Volumetric Heat Capacity BTU/ft³-°F		Thermal Conductivity BTU/ft³-°F	
Material	Analysis	BTP CSB 6-1	Analysis	BTP CSB 6-1
Concrete	31.68	22.62	1.5	0.92
Carbon Steel	59.95	58.8	26.4	27.0

The analysis for the volumetric heat capacity and thermal conductivity of concrete are significantly more conservative (large) then the BTP values (40% and 63% larger, respectively). The values for carbon steel are similar (2% larger and 2% smaller, respectively). Because the analysis values used for concrete are significantly larger than the BTP values while the carbon steel values are effectively the same, taken together, the analysis values are more conservative than the BTP values. Therefore, they are justified for use in the minimum containment pressure analysis.

Larger values for thermophysical property data are conservative for calculating minimum containment pressure because they increase the ability of the passive heat sinks to absorb energy. This increases the amount of steam condensation inside containment during the LOCA and, consequently, decreases the containment pressure.

Enclosure II to
LD-91-012

REVISIONS TO THE COMBUSTION ENGINEERING STANDARD SAFETY ANALYSIS REPORT - DESIGN CERTIFICATION

Main steam and main feedwater (downcomer and economizer) lines outside containment are separated from essential systems and components by virtue of the plant arrangement that places these lines in a special enclosure constructed along the roof of the primary auxiliary building. The two sides of this chase adjacent to the primary auxiliary building (floor and one wall) are Seismic Category I concrete walls. The other two sides of this chase are metallic siding adjacent to the environment. In the event of a high-energy line break in this enclosure, the metallic siding will blow out and no significant pressurization will result. The essential portions of these systems (containment isolation valves) are located in the MSIV rooms. These rooms are separated from all other essential systems and components by Seismic Category I concrete slabs and walls.

Insert A →

The NSSS design consists of two steam generators per unit, which facilitates separation of redundant systems and components inside containment. Other than for the safety injection system components, which must circulate cooling water to the vessel, the engineered safety features are generally located outside the secondary shield wall. The safety injection system pipes and cables, which terminate inside the secondary shield wall, are routed outside the secondary shield wall to the extent practical to avoid postulated hazards. Most of the main steam and feedwater piping inside containment is located at higher elevations, and the postulated dynamic effects are separated from safe shutdown systems and components by distance and configuration. Table 3.6-1 provides a list of plant fluid systems that contain high- and moderate-energy piping in the auxiliary and containment buildings.

Table 3.6-2 provides a list of the systems that are required for safe shutdown or to support safe shutdown. E

High- and moderate-energy pipe failure locations are postulated as described in Section 3.6.2. Each postulated rupture location is evaluated for its effect on safe shutdown systems and components required following the specific pipe failure event.

3.6.1.1.1 High-Energy Piping Systems

A high-energy pipe failure is postulated in branches or piping runs larger than one inch nominal diameter and which operate during normal plant conditions with high energy fluid.

Included in this category are fluid systems or portions of fluid systems which are pressurized above atmospheric pressure during

Insert A

Any high-energy line routed through the annulus between the primary containment and its shield building is provided with a guard pipe so that rupture of high-energy lines in the annulus need not be analyzed.

Q410.37

D. Industry pump designs are such that (and service history shows) no occurrences of impeller pieces penetrating pump casings.

3.5.1.1.2 Valves

There are no missiles postulated from valves for the following reasons:

A. All valve stems are provided with a backseat or shoulder larger than the valve bonnet opening.

B. Motor operated and manual valve stems are restrained by stem threads.

C. Operators on motor, hydraulic and pneumatic operated valves prevent stem ejection.

D. Pneumatic operated diaphragms and safety valve stems are restrained by spring force.

E. All valve bonnets are either pressure sealed, threaded or bolted such that there is redundant retention for prevention of missile generation. D

3.5.1.1.3 Pressure Vessels

All pressurized vessels are considered moderate energy (275 psig) or less and are designed and constructed to the standards of the ASME Code. In addition to the ASME Code examination and testing requirements, all vessels will receive periodic in-service inspections. Where appropriate, these components are provided with pressure relief devices to ensure that no pressure buildup will exceed material design limits.

On this basis, moderate energy pressure vessels are not considered credible missile sources.

3.5.1.2 <u>Internally Generated Missiles (Inside Containment)</u>

Table 3.5-1 lists postulated missiles from equipment inside containment, and summarizes their characteristics. Included are major pretensioned studs and nuts, instruments, and the CEDM missile. Other items which were considered and specifically excluded because of redundant retention features are valve stems, valve bonnets and pressurized cover plates.

{Insert}

Insert 3.5.1.2

All non-safety related equipment inside containment is evaluated for its potential interaction with safety systems. Potential gravitational missiles are evaluated for impact and are anchored as necessary to prevent loss of function of safety systems caused by interaction with non-safety equipment.

Potential secondary missiles, such as concrete spalling, are evaluated for impact on safety systems and equipment. When necessary, protective structures are added to prevent interaction of secondary missiles with safety systems.