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PLANT NAME: Bellefonte

ENCLOSURES:
Enclosures 1 & 2 - consist of the requested add'l info pertaining to Chapter 7 to the PSAR.

ACKNOWLEDGED

(1 cy ea encl rec'd)

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TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE
37401

TVA 40TH ANNIVERSARY OF PEOPLE IN PARTNERSHIP

March 29, 1974

RECEIVED APR 3 1974 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

Mr. A. Giambusso
Deputy Director for Reactor Projects
Directorate of Licensing
U.S. Atomic Energy Commission
7920 Norfolk Avenue
Bethesda, Maryland 20014

Dear Mr. Giambusso:

In the Matter of the Applications of) Docket Nos. 50-438
Tennessee Valley Authority) 50-439

It was not possible to schedule an amendment to the Bellefonte PSAR by April 1, 1974, in order to respond in a timely manner to A. Schwencer's request dated March 7, 1974, for additional information pertaining to Chapter 7 of the PSAR. Therefore, in order to document our responses to these items in the appropriate time frame and thus to expedite the review, our response to the referenced request for additional information is included in Enclosure 1.

In order to expedite the review further, Enclosure 2 includes responses to various incomplete, outstanding, and deferred questions. All of the above enclosed information will be included in Amendment 11 to the Bellefonte PSAR, which is scheduled to be submitted to the AEC on May 15, 1974.

Very truly yours,

J. E. Gilleland

J. E. Gilleland
Assistant to the Manager of Power

Enclosures
CC (Enclosures):
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Scottsboro, Alabama 35768

Mr. William D. Paton, Esquire
Office of the General Counsel
Office of Regulation
U.S. Atomic Energy Commission
Washington, DC 20545

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2848

ENCLOSURE I

Questions 7.25
7.26

REQUEST FOR ADDITIONAL INFORMATION
TENNESSEE VALLEY AUTHORITY
BELLEFONTE NUCLEAR PLANT, UNITS 1 & 2
DOCKET NOS. 50-438 AND 50-439

7.25 Based on the information presented in Section 6.3.2.17, we believe that:

a. The proposed design of the circuits used to change over to the cross-over mode (using the LPI pumps as boosters for the HPI Pumps) and the recirculation mode of operation following a LOCA does not conform to the requirements of IEEE Std 279-1971, and

b. The complexity of the proposed change-over may not provide adequate assurance that the operator will correctly perform the required actions.

The staff's position is that the instrumentation and controls provided to accomplish the change-over to the recirculation mode and the cross-over mode should be designed to meet the requirements of IEEE 279-1971 including the requirements for manual initiation of protective actions at the systems level. In addition, the procedures should be of such simplicity as to provide a high degree of assurance that the operator will perform correctly all actions that are necessary to protect the health and safety of the public.

Therefore, either modify your design to show conformance with the staff's position, or justify your design, as opposed to a design which provides automatic and system level manual initiation of switch over as required by the literal interpretation of IEEE Std 279-1971.

Justification of the present design should include the following:

1. Define the time available for the operator to complete the necessary monitoring and switching functions for the cross-over mode (i.e., using LPI pumps as boosters for HPI pumps) and the recirculation mode prior to onset of conditions (assume and define worst case) that are unacceptable from the standpoint of plant safety.

2. Provide a description of the control panel arrangement of the indicators and switches which the operator must monitor and operate to affect switchover.

3. Describe the permissive interlocks that are provided (for equipment protection or other reasons) between the various ECCS components that are operated during switchover.

4. Identify the system conditions that require the use of the cross-over mode prior to or coincident with the initiation of the recirculation mode of operation.

Response

The basic procedure that the operator must follow in each of the two redundant loops, when changing the Low Pressure Injection (LPI) pump suction from BWST to RB emergency sump is to open the RB sump valve and close the BWST suction valve. These valves can be operated from the control room. Just prior to making the change in LPI pump suction from the BWST to the RB emergency sump, the operator must determine if the RC System pressure has remained high enough (> 200 PSIG) such that cascaded operation of the LPI and High Pressure Injection (HPI) pumps is required as discussed in Section 6.3.2.17. This determination is made by observing the LPI flow; if LPI flow has not been established, then one valve (in each loop) must be opened to connect the LPI pump discharge to the HPI pump suction. B&W's position is that this basic procedure is of such simplicity as to provide a high degree of assurance that the operator will perform correctly the actions required with no additional electrical controls.

The monitoring instrumentation for affecting the cross-over mode of operation and the monitoring instrumentation and remote manual controls for affecting the recirculation mode of operation does conform to the single failure criterion of IEEE Std. 279-1971. Refer to Sections 7.4 and 7.5 for a detailed discussion of this instrumentation and its conformance to IEEE Std. 279-1971.

As indicated in paragraph 6.3.2.17, the following controls, indications, and alarms to assist the operator in making the transfer of the ECCS suction from the BWST to the RB emergency sump are provided in the main control room:

1. Remote control and position indication for BWST discharge valves.

2. Remote control and position indication for RB emergency sump suction valves.

3. BWST level indication and low-low level alarms.

4. LPI flow indication, high/low flow alarms, and throttle capability.

5. HPI flow indication, high/low flow alarms, and throttle capability.

6. RBS flow indication, high/low flow alarms, and throttle capability.

The controls and indications are located on the main control panels and, as practicable, are grouped on these panels for ease of monitoring and action by the operator.

Question
7.26

In Request 7.16, we stated our belief that the Auxiliary Feedwater System as described in Section 7.4.2.3.1 did not comply with Section 4.12 of IEEE Std. 279-1971. Subsequently, you revised your PSAR to comply with this standard. We now find that another control system, the Steam Line Break Instrumentation and Control, that is essential to plant safety does not comply with Section 4.12. Discuss your intent to comply with Section 4.12 of IEEE Std. 279-1971 for all Essential Control Instrumentation and describe the necessary design changes, or justify your design by discussing your reasons for concluding that such an exception is in accordance with requirements of IEEE Std. 279-1971.

Response

The design of the SLBIC will be changed to include inhibit bistables that will automatically remove the operating bypass when the steam generator pressure exceeds permissible conditions. Paragraphs 7.6.1.4 and 7.6.2.4.2 (12) have been revised. The SLBIC and AFWC are the only Essential Controls Instrumentation that require bypassing.

7.6.1.3.2. System Description

The flow of reactor coolant at the outlet of the decay heat removal system cooler is monitored by instrumentation provided in the ECI cabinets. Using this instrumentation, the operator will have the information necessary to control the flow of reactor coolant through the system. A hand controller is provided in the main control room so that the flow control valve on the cooler outlet can be adjusted as necessary to maintain maximum decay heat pump efficiency and to prevent pump runout during decay heat removal operations.

7.6.1.3.3. Supporting Systems

The supporting systems are: emergency power distribution system (refer to Chapter 8) and safety-related display instrumentation (refer to section 7.5).

7.6.1.3.4. Portions Not Required for Safety

All portions are required for safety.

7.6.1.4. Steam Line Break Instrumentation and Control (Refer to Figures 7.4-14 and 7.6-2) 8

The steam line break instrumentation and controls are packaged in the ECI X and Y cabinets and consist of redundant, seismically qualified channels. Each channel is capable of independently implementing the necessary control actions. The two channels are powered from separate 120 V a-c vital busses. The loss of vital bus does not compromise steam generator isolation capability.

Steam pressure is monitored for each channel by pressure transmitters located on each of the two outlet lines of both steam generators. The transmitters are placed upstream of the main steam isolation valves. Using channel X as an example, pressure transmitters signals from PT-1 and PT-4 are input to control circuitry which drives relays K_1 and K_4, respectively. In the event of a steam line break, these relay circuits energize K_1 and K_4 to close contacts 8
in the circuits of the steam and feedwater isolation valves and in the actuator circuit of the feedwater control valves. The valves close to isolate the steam generators (refer to Figure 7.4-14).

A steam line break will cause a reactor trip (refer to Chapter 15), which causes a turbine trip, thus closing the turbine stop valves.

Actuation of both the feedwater isolation and control valves provides redundancy in the feedwater system. Steam line break actuation to the main and startup feedwater control valves has priority over normal control signals.

The steam line break circuitry includes provisions for manually bypassing steam generator isolation whenever the steam generator is to be depressurized below the trip point of the bistables. Bypassing is initiated manually for each channel when the steam generator pressure 11
is less than the manual bypass permit pressure. The bypass is automatically removed when the steam generator pressure exceeds the manual bypass permit values. Once a bypass has been initiated, the condition is indicated by the plant annunciator.

Manual initiation of steam generator isolation can be accomplished by closing each isolation valve with manual switches located in the main control room and in the auxiliary control area outside the main control room.

BNP-11

5. Channel Integrity — The channels are designed to maintain necessary functional capability under extremes of conditions relating to environmental, energy supply, malfunctions, and accidents.

6. Channel Independence — The controls consist of two independent and physically separated channels to reduce the likelihood of interactions between channels during maintenance operations or in the event of channel malfunction.

7. Control and Protection System Interaction — The controls do not interface with any protection system.

8. Derivation of System Inputs — Inputs are derived from signals that are direct measures of the desired variables.

9. Capability for Sensor Checks — Means are provided for checking, with a high degree of confidence, the operational availability of the input sensors during reactor operation.

10. Capability for Test and Calibration — Capability is provided for testing and calibrating channels and the devices used to derive the final system output signal from the various channel signals. For those parts where the required interval between testing will be less than the normal time interval between generating station shutdowns, there is a capability for testing during power operation.

11. Channel Bypass or Removal From Operation — The SLBIC does not perform its function if one channel is removed from service and the remaining channel is degraded by a single failure.

12. Operating Bypass - The SLBIC bypass is described in Section 7.6.1.4. It will allow for a normal lowering of steam generator pressure without the tripping of the SLBIC. Once the bypass is initiated, if the steam generator pressure increases above a predetermined level, the bypass will automatically be removed, thereby precluding normal operation with the SLBIC bypassed. 11

13. Indication of Bypasses — If the SLBIC has been bypassed for any purpose, this fact shall be continuously indicated in the control room.

14. Access to Means for Bypassing — The design permits the administrative control of the means for manually bypassing channels or functions.

15. Multiple Setpoints — Not applicable.

16. Completion of Protective Action Once Initiated — Not applicable.

17. Manual Initiation — Means are provided for manual initiation. No single failure within the automatic, manual, or common portion of the SLBIC prevents initiation and control of auxiliary feedwater.

18. Access to Setpoint Adjustments, Calibration, and Test Points — Access to all setpoint adjustments, module calibration adjustments, and test points is limited by administrative controls.

19. Identification of Actions — Indication of operation at the system level is provided.

ENCLOSURE II

Questions	2.67	3.22
	2.68	3.23
	2.69	3.37
	2.70	3.74
	2.71	3.75
	2.72	3.88
	2.73	5.3
	2.74	7.22
	2.75	9.53
	2.80	9.55
	3.11	9.58

2.67 Identify the sections shown on Figures 2.5-162 and -163 as to location and extent on Figures 2.5-160 and -161. The sections should be drawn to a larger scale, sufficient to show soil conditions and top of rock. Show excavation limits and proposed channel areas on the sections. The scale should be sufficient to permit showing details of the logs of borings, such as are shown on Figures 2.5A-4 through -9. Discuss the reasons for relatively low blow counts in borings 17, 38, and 22.

Response

TVA will show on Figure 2.5-160 the location and extent of the channel cross-sections shown on Figures 2.5-162 and -163. It is not considered beneficial to show the sections on the crowded Figure 2.5-161, which is only a reproduction of exploration layout Figure 2.5A-1 in Appendix 2.5-A.

It is believed that the scale of Figures 2.5-162 and -163 is adequate for their intended purpose as generalized channel cross-sections. The sections show the top of rock, overburden depth, and the proposed channel excavation. To show details of the graphic logs of borings from Appendix 2.5-A, Figures 2.5A-4 through -9 would require a very large scale. The logs are the "originals," presenting as nearly as practical raw data, and it is believed proper to utilize them in their present form.

The lower blow counts in boring 17 were recognized on Appendix A, page 2.5A-3, second paragraph, where it is stated that soils in the vicinity will be removed to rock. Figure 2.5A-1 indicates the removal will be over a wide area, approaching other borings that show firm soil. The boring is in the back of the draw at waters edge elevation 595. The graphic log on Appendix 2.5-A, Figure 2.5A-7 shows the soil moisture contents to be at the liquid limits. The blow counts in boring 22 and the upper part of boring 38, while lower than some, are generally 10 or more, indicative of firmness in the clay soils. There is no evident explanation for the one blow count of 6 just below mid-depth of boring 22. The boring is beyond the limit of the channel excavation. In boring 38 the one blow count of 6 is in the surficial 3 feet. The upper half of boring 38 will be removed in the channel excavation.

2.68 The slope stability analyses illustrated on Figure 2.5-164 assume a horizontal groundwater level equal to the elevation of water in the intake channel. In other sections of the PSAR the groundwater level is described as generally paralleling the top of rock and ground surface, which is reasonable and appropriate in the stability analyses. It appears that the actual depth to groundwater has not been determined. Groundwater level observations made when borings are made can be grossly misleading, but other groundwater level information in the vicinity of the slopes is not presented. Install piezometers to record groundwater levels or alternatively, use conservative assumptions in the stability analyses.

Response

Groundwater over the general plant area was indicated in area explorations to be generally paralleling the topography. This does not apply specifically to the draw in which the intake channel is located. On Appendix A, page 2.5A-3, groundwater conditions in the draw are discussed and summarized as groundwater being present in the overburden at normal reservoir elevation 594 wherever top of rock is below that elevation. In all borings that went to rock lower than elevation 594, groundwater was observed and recorded. Where rock is above elevation 594, groundwater was observed only in three scattered borings, about one foot above rock. All borings, split-spoon and undisturbed, were made by dry procedures and remained open without casing. Groundwater level was obtained with an electric probe 36 to 48 hours after completion of the boring. After more than a month, all borings except 9 and 38 were still open. Groundwater levels were observed and were unchanged except in a few instances where a small rise was ascribable to probable entrance of surface water. (Guntersville Dam was closed and its reservoir filled in January 1939.)

The field exploration extended from September 8 to November 6, 1972. The year had more than normal rainfall to influence groundwater conditions. Specifically, at a rain gage at the site, rains were as follows:

Month	June	July	August	September	October	November	December
Rain	4.6	9.0	1.5	5.5	5.9	4.1	6.5
Normal*	3.8	5.5	3.6	3.2	3.1	4.1	5.4

*Normal at Scottsboro, Alabama, 8 miles away. 91-year record.

The draw in which the intake channel is located is wooded, but the ground slope back from the flood plain is about 1 vertical or 3 horizontal, permitting surface runoff to the wet draw bottom. Groundwater drainage is available into the bedrock, the upper portion of which is cavernous and jointed. It is believed that the groundwater condition has been adequately determined.

At a conference held on February 6, 1974, between WES, AEC, and TVA, it was agreed that the groundwater level in the intake channel area was near the top of rock. TVA and WES agreed that a water table level 2 feet above the rock surface would be used in the stability analysis of the slopes. WES considered 2 feet above rock to be conservative and acceptable for the water table level, if the top of rock is above the reservoir level.

2.69 Details of the pseudostatic slip circle analyses are not presented. Present the details of these analyses including (1) the type of circular arc analyses performed, (2) details of the dynamic shear beam analyses, (3) input ground motions, (4) calculated maximum acceleration at top or ground surface, and (5) computation of average acceleration that was used as the seismic coefficient.

Response

The information will be provided with additional analyses on July 1, 1974.

2.70 Table 2.5A-1 contains a footnote, No. d, stating "Triaxial R test results not required for channel slope stability analysis." This table presents the results of triaxial Q, triaxial R, and unconfined compression tests. From this it appears that the only strength data used for analyzing the stability of the slopes are the Q data shown in the table. While such data are applicable for determining slope stability immediately after excavation, they are not applicable for long-term slope stability nor for slope stability during drawdown. Perform consolidated-drained shear tests or use conservative values in stability analyses for long-term stability. In addition, discuss the possible need for long-term stability to be based upon residual shear strength. Discuss the presence or absence of natural slides along slopes in the general area of the plant. Provide stability analyses appropriate for drawdown and for long-term stability, with and without earthquake loadings.

Response

As the question states, stability analysis was done only with Q strengths. The selected Q strength design values are considered reasonably conservative. As recorded on Figure 2.5-164, the assigned 1 on 3 channel slopes have a calculated critical circle safety factor of 4.4 versus required 1.3 for the static case with drawdown and 2.6 versus required 1.15 for drawdown plus 1/2 SSE. The dynamic case is the more critical. To show the sensitivity of the analysis to change in soil strength, the dynamic case tabulation on Section B-B records calculated safety factors for reduced values of cohesion (for their individual critical circles). This was considered as showing the sufficiency of the analysis for slopes beyond the 75-foot bench on rock.

All the R tests recorded on table 2.5A-1 were inadvertently run saturated. With the groundwater condition as previously determined for the intake channel area, saturation would be correct only for the lower half of the flood plain soil profile and the bottom of slopes over most of the remaining channel length. The recorded R test results are not seriously different from the selected Q strength design values except for the soils in underwater borings 13 and 17 that will be removed in the channel excavation.

At the February 6, 1974, conference with WES and AEC, TVA agreed to provide more complete stability analyses of the slopes using the total and effective stress results of the saturated $\bar{R}$ tests. These analyses will be submitted to the AEC on July 1, 1974.

In addition, presence or absence of natural slides in the general plant area was discussed at the February conference. Using topographic maps and aerial photographs for reference it was agreed that there had been no slides in the plant area. However, WES requested that we make some additional investigations to determine the origin of an anomalous protrusion from the south bank of the intake channel. TVA agreed to make additional soil and rock borings to determine the origin and nature of the protrusion. The information will be provided to AEC by July 1, 1974.

2.71 Cyclic loading triaxial compression tests of soils overlying bedrock were not made. Perform such tests or provide adequate justificiation for the assumption that the static strength can be used as the dynamic strength for the various wide ranges of materials present in the slopes overlying rock.

Response

At the February 6, 1974, conference between WES, AEC, and TVA, it was agreed that TVA did not need to conduct cyclic tests based on TVA's evaluation of the materials and the groundwater presentation.

2.72 Provide additional information concerning the details of the R triaxial compression tests. This should include (1) magnitude of back pressure, if used to obtain saturation and corresponding B values, (2) pore water pressures if measured during undrained shear, (3) stress-strain and pore pressure data, and (4) constraints placed as regards use of shear strength resulting from negative pore water pressures during undrained shear.

Response

The R tests were made using normal laboratory procedures. Saturation was by back pressure to 100 psi in 20 psi increments. Pore pressure was measured to permit determination of effective strength.

2.73 Discuss the need for riprap or slope protection to assure stability in the vicinity of seepage exit from the slopes.

Response

See the response to Question 2.78. Riprap on graded filter will be provided on the channel banks from elevation 590 to 600. Elevation 600.0 is 5 feet above the normal maximum pool level of 595.0. Therefore, the seepage exists in the intake channel slopes are covered by riprap.

2.74 Sections selected for analyzing stability of slopes should pass through the highest and steepest portions of both flanks of the intake channel; i.e., at about sta 1+50 in the southwest and sta 0+00 in the northeast. The latter section should extend from about the center of the intake structure to about 18+00 and 0a. Present the details of the analyses for the sections.

Response

Stability analyses for the slopes agreed upon at the February 6, 1974, conference between WES, AEC, and TVA will be provided on July 1, 1974.

2.75 Consideration should be given to removing soil above rock on the flank slopes of the intake channel, using these areas as borrow areas, since this would remove many concerns regarding the stability of the slopes.

Response

As stated on page 2.5-29, Section 2.5.5, and Appendix 2.5-A, page 2.5A-1, and indicated on Figures 2.5-162 and -163, and Figures 2.5A-2 and -3, a 50-foot wide trench will be excavated into rock to furnish essential cooling water. The channel slopes above rock will be set back a minimum of 100 feet from the channel centerline on both sides as indicated in Figures 2.5-161, -162, and -163 to obtain fill material for use in the plant area. To remove additional material would require spoilage.

At the February 6, 1974, conference between WES, TVA, and AEC, it was agreed that the data presented in Appendix 2.5-A, pages 2.5A-4 and -5, show the soils in the intake area are not susceptible to liquefaction. Therefore, it is TVA's position that the 75-foot wide bench on each side of the channel is adequate to protect the rock trench from any conceivable slope failure as stated in Sections 2.5.5 and 2.5.5.2.2.

~~3.0 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS~~

3.88 The response to Request 3.67 is inadequate. In order to enable us to complete our review, provide the following additional information:

(a) It appears that a number of expressions shown in the PSAR are incompatible with regard to dimensional analyses. Therefore, describe the basis and assumptions used to establish the equations (1) through (17).

(b) The velocities and accelerations of the missiles have been expressed in a form of relative quantities with respect to the wind field. In terms of the applicable relative velocity and acceleration components, provide the expression of the maximum height attained by the missile, the maximum horizontal velocity attained by the missile and the peak velocity of the missile attained during flight.

Response

(a) The question of dimensional compatibility of equations (1) through (17) in the TVA response to Question 3.67 was raised. These equations, like many found in engineering practice, appear to be dimensionally incompatible because of their empirical nature. In fact, the equations become dimensionally correct only if the constants in the equations take on particular units, which, in turn, makes the equations applicable only for particular units for the variables in the equations. For equations (1) through (17) the particular units are feet, for all distances, and feet per second, for all velocities.

As noted earlier, equations (1) through (17) are empirical in nature, based on observed phenomena. The equations result from an effort to represent these phenomena mathematically. The equations are applicable only for the units noted earlier, and they are dimensionally correct when appropriate units are assigned to the constants.

(b) A question has been raised with regard to the maximum height, maximum horizontal velocity, and peak velocity of the six missiles described in Question 3.67. The answers to these questions are provided in figures and tables submitted in TVA s original response to the question. As noted in the original response, reference was made to Duke Power Company s response to AEC Question 3.39 in Amendment 14 to the PSAR for the Catawba Nuclear Station, Units 1 and 2, Docket Numbers 50-413 and -414.

3.74 The response to Request 3.40 is not adequate since sufficient justification has not been provided for the proposed deviation from Regulatory Guide 1.35. As indicated in the Guide, containments that differ from the defined "typical" prestressed concrete containments should have a tendon surveillance program which follows the Guide as the basis for a comparable program. While the opportunity exists to provide justification for other programs, it is the opinion of the Regulatory staff that insufficient historical evidence or experience is available to warrant any significant change in the surveillance program outlined in Regulatory Guide 1.35. Provide additional information to support the contention that a reduced program of tendon surveillance is adequate or adopt a program similar to that in Regulatory Guide 1.35.

Response:

TVA will comply with the revision of Regulatory Guide 1.35 which is in effect at the time of submittal of the FSAR.

See revised Sections 3.8.1.7.4.1 and 16.4.4 which have been revised to comply with the latest issue of Regulatory Guide 1.35 dated February 5, 1973.

3.8.1.7.4. Inservice Surveillance Program

3.8.1.7.4.1. Tendon System Surveillance

The inservice surveillance program for the containment tendon system consists of evaluating the tendon system performance and the corrosion protection system performance. It is the intent of the surveillance program to provide sufficient inservice historical evidence necessary to maintain confidence that the integrity of the containment is being preserved.

Tendon Surveillance

To accomplish the surveillance program the following quantity of tendons will be made available for inspection and lift-off readings in the first containment structure constructed:

1. Horizontal - Ten 180° tendons each from ten complete hoop systems.
2. Vertical - Five tendons spaced at approximately 72° apart.
3. Dome - Six tendons spaced at approximately 60° apart.

~~Justification for the selection of ten tendons as being representative of the tendon system will be provided by a topical report in preparation.~~

The surveillance program for structural integrity and corrosion protection will consist of the following operations being performed during each inspection:

1. Lift-off readings will be taken for all ten tendons.
2. One tendon in each directional group will be relaxed and one wire or strand from each relaxed tendon will be removed as samples for inspection. The selection of tendons will be such that with the fourth inspection wires or strands from all ten surveillance tendons will have been tested.
3. After inspection, the tendons will be retensioned to the stress level measured at the lift-off reading, and then checked by a final lift-off reading.
4. Tensile tests will be conducted on three samples cut for each wire or strand with one sample taken from each end and one from the middle of each.
5. Tendon anchorage assembly hardware for all ten tendons will be visually inspected.

Should the inspection of the wire or strand reveal any significant corrosion (pitting or loss of area), further inspection of the other two (or three) sets will be made to determine the extent of the corrosion and its significance to the load-carrying capacity of the structure. Samples of corroded wire or strand will be tested to failure to evaluate the effects of any corrosion.

For the second containment structure constructed, the surveillance program will consist of the following:

1. Ten tendons will be designated as surveillance tendons with selection being in the same manner as for the first containment structure constructed.

2. Tendon anchorage assembly hardware for all ten tendons will be visually inspected.

3. Concrete end anchor blocks for all ten tendons will be inspected for abnormal cracking using as a basis for comparison the records of cracking made during the structural acceptance test. This inspection will be scheduled to be performed, if possible, at the same time as a containment leakage rate test.

The method for checking the presence of sheathing filler grease and the inspection intervals for the surveillance program will be provided in the Final Safety Analysis Report.

A quantitative analytical report covering the results of each inspection will be prepared and will specifically address the following conditions, should they develop:

1. Broken wires or strands.

2. The force-time trend line for any tendon, when extrapolated, that extends beyond either the upper or lower bounds of the predicted design band.

3. Unexpected changes in corrosion conditions or properties of corrosion protection materials.

The tendon system surveillance program described above complies with the requirements of AEC Regulatory Guide 1.35 ~~with the following exception:~~

~~1. The number of tendons selected for surveillance shall be limited to ten, as previously stated.~~ 5

3.8.1.7.4.2. Liner Surveillance

The liner is considered to be nonstructural in that it is not depended upon to furnish strength to the containment for the load conditions in the design criteria. It is, however, required to maintain leaktightness of the structure and that characteristic is determined as a part of the containment system leakage rate testing as given in subsection 6.2.1.4.

(ii) Seals on equipment and personnel hatches shall be tested pneumatically for leakage once per operating cycle or after each replacement.

(iii) Seals on the fuel transfer tube covers shall be tested pneumatically for leakage once per operating cycle. The fuel transfer tube flange covers shall be tested each time they are replaced.

(iv) Penetration isolation valves shall be tested for leakage and operability once per operating cycle using the normal means of closure.

B. Structural Integrity

(1) Tendon Surveillance

For the initial surveillance program, [illegible] *twenty-one* tendons in the first containment structure completed shall be selected for periodic inspection for ~~symptoms of material deterioration or force reduction.~~ The surveillance tendons shall consist of [illegible] *ten* horizontal tendons, [illegible] complete hoop systems, [illegible] *five* vertical tendons located at approximately [illegible] *72* degrees apart; and ~~three~~ *six* dome tendons located approximately [illegible] *60* degrees apart. *(each from ten)*

a. Lift-Off

Lift-off readings shall be taken for all 10 surveillance tendons.

b. Wire Inspection and Testing

One surveillance tendon of each directional group shall be relaxed and one wire from each relaxed tendon shall be removed as a sample and visually inspected for corrosion or pitting. The selection of tendons shall be such that with the fourth inspection wires from all [illegible] *twenty-one* surveillance tendons will have been tested.

After the wire removal, the tendons shall be retensioned to the stress level measured at the lift-off reading and then checked by a final lift-off reading.

Tensile tests shall be conducted on three samples cut for each wire with one sample taken from each end and one from the middle of each wire.

Tendon anchorage assembly hardware for all ten tendons shall be visually inspected.

Should the inspection of one of the wires reveal any significant corrosion (pitting or loss of area), further inspection of the other two (or three) sets in that directional group will be made to determine the extent of the corrosion and its significance to the load-carrying capability of the structure. The sheathing filler will be sampled and inspected for changes in physical appearance. Samples of corroded wire will be tested to failure to evaluate the effects of any corrosion.

c. For the second containment structure constructed, the surveillance program shall consist of the following:

(i) Twenty-one tendons shall be designated as surveillance tendons with selection being in the same manner as for the first containment structure constructed.

(ii) Tendon anchorage assembly hardware for all twenty-one tendons shall be visually inspected.

(iii) Concrete end anchor blocks for all twenty-one tendons shall be inspected for abnormal cracking using as a basis for comparison the records of cracking made during the structural acceptance test. This inspection will be scheduled to be performed, if possible, at the same time as a containment leakage rate test.

d. Inspection Intervals and Report

The inspection intervals, measured from the date of the initial structural test, shall be every (FSAR) years. Tendon surveillance may be conducted during reactor operation provided design conditions regarding loss of adjacent tendons are satisfied at all times.

A quantitative analytical report covering results of each inspection shall be submitted and shall especially address the following conditions, should they develop:

(i) Broken wires.

(ii) The force-time trend line for any tendon, when extrapolated, that extends beyond either the upper or lower bounds of the predicted design band.

(iii) Unexpected changes in corrosion conditions or sheathing filler properties.

(2) Liner Plate Surveillance

The liner plate will be examined prior to the initial pressure test in areas which are accessible during reactor operation to determine the following:

a. Location of area which has the greatest inward deformations. The magnitude of the inward deformation shall be measured and recorded. This area shall be permanently marked for future reference and the inward deformation shall be measured between the angle stiffeners which are on 15-inch centers. The measurements shall be accurate to ±0.01 inch. Temperature readings shall be obtained on both the liner plate and outside containment wall at the location where inward deformation occurs.

9.55 Auxiliary Systems

In your response to Request 9.23, regarding the effects on the separating wall and the fuel pool in the event that a cask is dropped in the tipped position, it is stated that the crane will be moving at a very slow rate and if a cable should break over the cask loading area, the cask will be tipped in the north-south direction. However, an examination of Figures 9.1-4 and 9.1-5 indicates that the top of the 150 ton overhead crane rail overlaps the spent fuel pool area. Thus taking this into consideration in conjunction with the velocity vector of the cask, it appears that the possibility of a cask falling into the fuel pool may not be as remote as it has been suggested.

It is requested that you provide either a modification of the rail arrangement or an analysis indicating the velocity, momentum and the resultant external forces of the cask to support the conclusions you have reached.

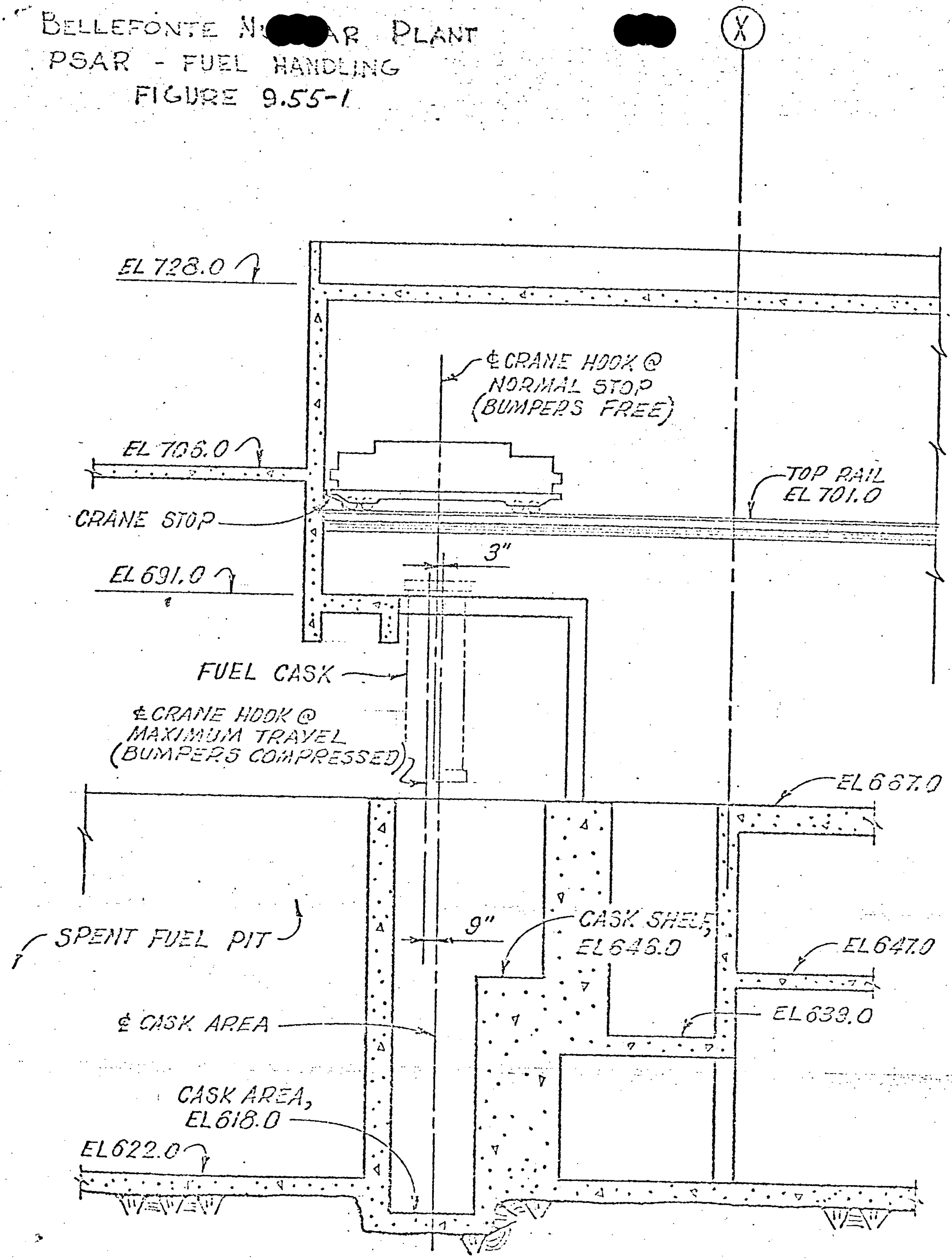
Response

Although the rail for the 150 ton crane overlaps the spent fuel area, no part of the fuel cask and the crane hook can pass over any part of the spent fuel area. The relationship of the spent fuel area, the cask area, the crane, the hook, and the fuel cask to each other is shown in Figure 9.55-1 which shows an up-to-date detail of part of section A-A on Figure 9.1-5 in the PSAR. The slab and beam at elevation 700.0 has been lowered to elevation 691.0 to prevent the cask from swinging over the spent fuel pit. The crane hook is located at the centerline of the crane so that the hook and the cask must stop at about 15 feet from the end of the crane rail. The crane stop will be designed to take the full load, plus impact, of the crane. The crane will have a six-inch bumper on it which will cushion the impact and stop the crane centerline somewhere between three inches and nine inches west of the centerline of the cask area. In view of the layout of the spent fuel pit, the cask area, the rail stop, and the crane hook, we consider it [redacted] impossible for the cask to fall into the spent fuel pit.

BELLEFONTE N[redacted]AR PLANT [redacted]

PSAR - FUEL HANDLING

FIGURE 9.55-1



SECTION A22-A22

@ CASK LOADING AREA

2.80 In regard to Figure 2.5-3 (Amendment 5), Geologic map of plant site, provide the following information:

(a) Explain what is meant by "assumed contact" in the legend. Indicate whether the stratigraphic contact is assumed but its location is known, or whether the contact is known but its location is uncertain.

(b) It seems strange that although more than two dozen outcrops are shown in the hills southeast of the plant site, only three strike and dip symbols are shown. This is important because the Och-Srm contact indicates reversal of dip. Resolve this inconsistancy.

(c) Between points approximately 1,000 feet, S. 50° E., and approximately 2,000 feet, S. 30° E., from the plant site the Och-Srm contact shows a dip of 8°-9° to the west-northwest, which does not accord with any dip and strike symbol. Further, approximately 2,000 feet nearly due east of the plant site a symbol shows the dip to be 18° to the southeast; the nearest stratigraphic contact just to the west in this vicinity, however, does not indicate more than about 8° dip to the southeast. Resolve these inconsistancies.

(d) It seems that the area northeast of the arm of Guntersville Lake about 4,000 feet east-northeast of the plant site has not been examined, because only one outcrop is evident compared with the area southeast of the arm. Provide the result of your examination of this area.

Response

(a) "Assumed contact" in the context used on this map means that the stratigraphic contact is assumed on the basis of scattered outcrops, but that its exact location is unknown. Perhaps better terminology would have been "indefinite contact" or "inferred contact."

(b) We presume the reviewer is a geologist and therefore must know that all outcrops are not adequate to produce strike and dip readings, nor is it usual practice to place such readings on all outcrops when they are similar in direction of strike and angle of dip. When the reviewer receives Figure 2.5-3, Revision 3, (submitted prior to these questions) he will note some additional dip-strike and joint symbols. He will also note that some strike symbols have been modified by more accurate readings.

We complement the reviewer for a thorough analysis and concede an error which does indeed indicate an implied reversal of dip in the two ravines east and southeast of the plant along the Och-Srm contact. It is, however, unusual for a geologist to make a literal interpretation of a dashed contact which always specifie uncertainty.

(c) Refer to paragraph (a) above. Literal interpretation of dashed contacts for stratigraphy is never accurate. It should be pointed out that the width of the dashed Och-Srm contact line, used for increased legibility in the final half-size reduction, may cover two to six feet of elevation depending on topography. This fact alone precludes an accurate calculation of dip in reference to the contact line.

(d) The answer to this question is held pending additional field observations.

3.11. Recent studies indicate that the design spectrum has an equal probability of occurrence in any horizontal direction, and the records show that earthquake motions occur in all three directions simultaneously, without consistent relations among the motions in the various directions. In section 3.7.3.7, indicate the effects of earthquakes on structures, components, or elements computed by taking the square root of the sum of the squares of the particular effects or responses at a particular point caused by each of the three components of motion (two horizontal motions at right angles to one another, and one vertical motion).

Response

Section 3.7.3.7 was revised by Amendment 5.

3.22. Section 3.9.1.2, if analysis without testing is used to guarantee the operability of mechanical equipment under faulted condition loads, justification of criteria is necessary.

3.23. In section 3.9.2.4, while active pumps and valves are identified, the stress levels allowed under the various loading combinations listed in section 3.9.2.2 are apparently the same for active and nonactive pumps and valves. Justify this inconsistency with current practice.

Response

See the responses to Questions 3.62, 3.63, and 3.66 added in Amendment 5.

3.37. With respect to the seismic instrumentation program state your procedures for detailed comparisons between measured seismic responses of seismic Category I structures and equipment and the corresponding responses determined from original seismic analyses. Details to be followed in calibrating the originally established seismic design model should be provided.

Also state possible dispositions which will be taken if the comparison between results of the seismic response analysis, based on the "calibrated dynamic model" and that of the original seismic analysis, show a significant discrepancy.

Response

See the response to Question 3.71.

4

3.75 The response to Request 3.46 is not adequate. The statement in Section 3.7.2.1.1.3 that the turbine and service buildings will be designed in a manner similar to the requirements of the Uniform Building Code does not present sufficient justification to guarantee that these structures will not collapse and possibly damage adjacent Category I structures. Provide sufficient information to demonstrate that:

1. the collapse of any non-Category I structure will not strike a seismic Category I structure or component,

2. the collapse of the non-Category I structure(s) will not impair the integrity of Seismic Category I structures or components, or

3. the non-Category I structures will be designed to prevent their failure under seismic conditions in a manner such that the margin of safety of these structures is equivalent to that of Category I structures.

Response

A dynamic analysis will be performed on the non-Category I turbine building to assure that this structure will have an adequate margin of safety against failure from the safe shutdown earthquake loading.

The applicable loading case is:

$$1.6S = D + L + E^1$$

where S = The required section strength based on elastic design methods and the allowable stresses defined in Part I of the AISC "Specification for the Design, Fabrication, and Erection of Structural Steel Buildings," February 12, 1969.

D = Dead load of structure and equipment plus any other permanent loads excluding soil and hydrostatic pressure. An allowance is also made for future permanent loads.

E^1 = Safe shutdown earthquake resulting from horizontal acceleration of 0.18 g (0.18 g vertical);

INSERT

The roof of the service building is located approximately 29 feet above grade elevation 628.0, and the diesel generator roof is approximately 41 feet above grade elevation 628.0. The service building and diesel generator building are located approximately 50 feet apart. Therefore, due to location, the collapse of the service building during a seismic event would not endanger the safety function of the diesel generator building.

L = live loads (loads which may vary in intensity and occurance including movable equipment, soil and hydrostatic pressure loads).

BNPQ 9.58

9.58 The PSAR states that the auxiliary building air-conditioning, heating, cooling, ventilating and air cleanup systems are designed to maintain an acceptable building environment for plant equipment and control, and limit the release of radioactivity to the atmosphere. Certain areas in the auxiliary building are considered to be essential for plant safety during either normal or accident mode operation, and hence must be designed to satisfy safety and seismic criteria. The areas such as the safety equipment rooms which are essential for safe plant shutdown operation and the spent fuel handling areas are under the domination of this system. Therefore, it is requested that you provide the following information:

(a) Tabulate the seismic and safety design criteria for the ESF ventilation subsystems including equipment, components and ductwork, etc.

(b) Discuss the conformance of the system with the intent of Regulatory Guides 1.13 and 1.29, particularly for the portion of the system exhausting to the atmosphere.

Response

A statement specifying that all of the safety related Auxiliary Building air-conditioning, heating, cooling, ventilating and air cleanup systems are seismic Category I installations have been added to Section 9.4.2.1.

Safety design criteria for the Auxiliary Building air-conditioning, heating, cooling, ventilating and air cleanup systems are provided in Section 9.4. Temperature limitation criteria utilized to size the air-conditioning units and coolers serving areas containing ESF equipment are given in section 9.4.2.2.4. Safety design criteria governing the design of the Auxiliary Building mechanical equipment zone exhaust air cleanup systems are described in Table 9.4-3. Safety design criteria utilized to design the Auxiliary Building fuel handling area ventilation and air cleanup system are described in Table 9.4-4.

Equipment and components in the ESF ventilation and air cleanup subsystems will be seismically qualified by analysis and/or testing in accordance with procedures given in Sections 3.7.2.1.2 and 3.9. A listing of the qualification techniques to be employed for these safety related components is given in the following table:

Safety Related Components	Qualification Needs
Motors	Analysis and/or Test
Fans	Analysis
Condensers	Analysis
Compressors	Analysis and/or Test
Coils	Analysis and/or Test
Electrical Heaters	Analysis
Filters	Analysis
Controls	Analysis and/or Test
Fire Doors	Analysis

Air flow control duct networks in the essential areas of the auxiliary building will be seismically qualified by analysis. The installation techniques to be employed will force the ducting to behave as rigid structures. As such the ducting network accelerations during a seismic event will be equivalent to floor response spectrum at zero acceleration. Further details on these essential duct network installation techniques are provided in a TVA document entitled "Design Criteria for Category I Round and Rectangular Ducts" which is now being prepared.

Glenn German
March 5, 1974

9.4.1.4.3. The two main control room emergency air cleanup fans (one redundant) will be of ESF quality and shall be connected to separate trains of the emergency power system.

The main control room emergency air cleanup system was designed to be in general accordance with the guidelines set forth in Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Atmospheric Cleanup System Air 9
Filtration and Adsoprtion Units of Light-Water-Cooled Nuclear Power Plants." A tabulation showing the degree of compliance with this regulatory guide is shown in Table 9.4-2.

Each of the main control room emergency air cleanup filter trains will consist 4
of a bank of prefilters to remove larger-sized particulates, followed by a bank of HEPA filter cells rated at 99.9% efficiency based on 0.30-micron DOP test, mounted in series with a bank of carbon adsorber modules rated at 99.99% efficiency for removal of elemental iodine and 95.0% efficiency for removal of methyl iodide. Each HEPA filter cell will be rated for an initial resistance of 1.0-inch water gauge when clean and will be replaced with a new filter cell upon an increase in resistance to 2.0 inches. Each HEPA filter bank will be provided with a static pressure differential indicating gauge. An electric heater will maintain the charcoal temperature during system shutdown at a temperature above the possible entering air wet bulb temperature upon system startup.

9.4.1.4.4. The two main control room emergency pressurizing air supply fans are of ESF quality and shall be connected to separate trains of the emergency power system.

9.4.1.4.5. Two isolation dampers will be mounted in series in each of the control room floor toilet rooms exhaust duct to the outdoors, and in the control room floor pressure relief duct to the outdoors. These dampers will be designed to low-leakage, seismic Category I requirements. Each pair of dampers will be served from separate trains of the emergency power system and each damper will fall in the closed position.

9.4.1.4.6. The spreading room supply and exhaust fans have no safety related task to perform. Therefore these fans will not be connected to emergency power.

9.4.1.4.7. The battery board rooms supply and exhaust fans are not ESF equipment. The battery board room air supply filters will be rated at approximately 85% efficiency based on the NBS dust spot method.

9.4.1.4.8. The locker and toilet rooms exhaust fan will not be connected to emergency power.

9.4.1.4.9. An electric steam generator will be provided for air-conditioning system humidity control. Humidifiers, mounted in each air-conditioning system air handling unt, will automatically supply steam to the conditioned air stream in response to a humidistat for each system. The control room system humidistat will be a wall mounted in the main control room, and the electric board rooms system humidistat will be mounted in the system return air duct. The steam generators will not be ESF equipment and will not be connected to emergency diesel power.

In order to reduce the quantity of building air exhaust and its attendant filtering equipment, potentially contaminated areas will be ventilated for contamination control. Air coolers will be provided for removal of heat from mechanical and electrical equipment in excess of that provided by ventilation.

Building environmental control system fans, air coolers, and air-conditioning units, essential to the operation of safety-related equipment, will be assigned to redundant equipment trains having separate emergency power and raw cooling water sources. 9

For environmental control and isolation purposes, the auxiliary building will be considered to be divided into separately controlled and isolated zones as follows:

1. Mechanical equipment zone 1A (Unit 1 - Power train A).
2. Mechanical equipment zone 1B.
3. Mechanical equipment zone 2A.
4. Mechanical equipment zone 2B.
5. Essential electrical equipment zone 1A
6. Essential electrical equipment zone 1B.
7. Essential electrical equipment zone 2A.
8. Essential electrical equipment zone 2B.
9. Units 1 and 2 fuel-handling zones.
10. Common equipment zone.

All of the above temperature control and/or air cleanup systems except the common equipment zone ventilation and air cleanup system have safety-related functions to perform during accidents. Therefore, these are considered to be engineered safety feature systems. Each of these systems is designed to the requirements of seismic Category I. 9

9.4.2.2. System description

9.4.2.2.1. The auxiliary building ventilating, cooling, heating, air-conditioning, and air cleanup systems are shown on Figure 9.4-2. They will consist of the following subsystems:

1. Building air supply systems.
2. Building air exhaust and air cleanup systems.
3. Engineered safety feature (ESF) equipment and essential electrical equipment coolers.
4. Auxiliary control room air-conditioning system.
5. Miscellaneous ventilating and air-conditioning systems.

The building supply and exhaust fans, air supply heating and filtering assemblies, and exhaust air cleanup filter trains will be located in the fan rooms at El 686. Air cooling units will be provided for rooms or cubicles containing engineered safety feature equipment. Air-conditioning units will be provided for essential electrical equipment rooms.

doing so is to avoid the possibility of saturating the carbon adsorbers in the air cleanup unit serving the main control room if a dense cloud of chlorine gas momentarily engulfed the general plant area.

Such findings indicate that safety would best be preserved by having two different kinds of main control room ventilation system responses to accident signals. This could be done by having an automatic transfer to the emergency ventilation mode occur upon receipt of a Engineered Safety Features Actuation Signal (ESFAS) ~~safety injection signal (SIS)~~ or indications of steam, smoke, or high radiation in the makeup air intake. An indication of chlorine in the makeup air intake, however, would stop the entry of makeup air into the building but would initiate the processing of a portion of the recirculated control room air through the air cleanup unit. This practice would continue until a manual switch was operated to start the emergency ventilation mode used for the other accidents. Such a capability would permit an assessment to be made of outdoor conditions before the use of the air cleanup units.

Sections 6.4 and 9.4.1 have been revised to describe changes made to provide the dual operating mode capability described above.

5.3. In section 5.2.1.6, the information presented on active pumps and valves is not sufficient to demonstrate that they will function under faulted condition loadings. Apparently no differentiation is made in design stress limits between active and inactive pumps and valves. Justify this inconsistency with current practice.

Response

See the response to Question 3.83.

Question 7.22

The response to Request 7.10 indicates a deficiency in the number of essential parameters being monitored. In recently licensed plants acceptable designs included containment pressure; borated water storage tank level and containment radiation monitoring as part of safety-related instrumentation available for following accident and post-accident conditions. The Staff considers these parameters essential for long term accident monitoring, therefore, modify your design to include the above.

Your response also states that signals from essential parameters pass from ECI cabinets to the NNI cabinets where they can be selected for recording. It is noted that the NNI cabinets are not seismically qualified. We require that the recording system (recorders and associated circuitry and components) be seismically qualified to verify their operability following (not during) a seismic event. Therefore, modify your design to include this requirement.

Response

Section 7.5.1.2.2 lists many parameters that are redundant, safety-related instrumentation with qualified indicators. Among those parameters are containment pressure, borated water storage tank level and containment radiation monitoring. The indicators provide the operator with the capability of following the course of an accident and monitoring post-accident conditions. The first paragraph of the response to Request 7.10 provides information on the method of maintaining separate and redundancy for all safety.

Redundant, seismically qualified instrument strings from sensor to indicator are provided on those parameters that are essential for monitoring and performing safety functions to maintain the plant in a safe condition during and after a postulated accident. The safety-related parameters, listed in Table Q7.10-1, in the response to Request 7.10, are supplied with recorders to provide an indication of process trend to enable the operator to run the plant smoothly during normal plant startups, power operators, and shutdowns. The recorders do not perform any safety function as do the redundant, seismically qualified indicators. Although the recorders would provide information to be used in conducting a post-mortem of an accident, this is not considered vital to the safety of the plant.

General Design Criteria 2 of 10 CFR 50, Appendix A states the basis for requiring seismic (and other) qualification. It specifically calls on the designer to consider "the importance of the safety functions to be performed" in the design against natural phenomena. Since it has been shown that the recorders are not important to the safety of the plant, it is clear that seismic qualification of the recorders is unnecessary.