TENNESSEE VALLEY AUTHORITY

5N 157B Lookout Place

January 19, 1988

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - TVA DIVISION OF NUCLEAR ENGINEERING (DNE) CALCULATION EFFORT

On October 30, 1987, an NRC inspection team from the Office of Nuclear Reactor Regulation (NRR) concluded a 1-week closeout inspection of open items associated with the TVA DNE calculation effort and the SQN Design Baseline and Verification Program. The team reviewed the corrective actions taken by TVA to address 48 open observations originating in eight previous NRC inspection reports (NRC Report Numbers 50-327, -328/86-27, 86-38, 86-45, 86-55, 87-06, 87-14, and 87-27).

The disposition of the DNE calculation effort open items is included in enclosure 1. Enclosure 2 contains a list of commitments.

If you have any questions, please telephone M. R. Harding at (615) 870-6422.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

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Enclosures
cc: see page 2

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ENCLOSURE 1

Sequoyah Nuclear Plant (SQN) TVA Division of Nuclear Engineering (DNE) Calculation Effort

Observation MEB-3 - Water Hammer

Resolution of this item will take place between TVA and the Office of Special Projects. TVA has not completed the evaluations and determination of corrective action to allow this item to be closed.

Revised Response

TVA will submit a revised response by a separate letter before restart of unit 2.

Observation MEB-6 - Component Cooling System (CCS) Design Pressure

In response to the team's initial concern that the design pressure of the CCS did not consider pump shutoff head and surge tank relief valve setpoint, Mechanical Engineering Branch (MEB) revised the subject calculation to substantiate the existing 150-psig design pressure. This was accomplished by subtracting frictional losses (because of the flow associated with the hot shutdown mode of operation) from the summation of static head, relief valve setpoint, and pump head at this flow rate for two operating CCS pumps. Based on the revised calculation, MEB has calculated the maximum operating pressure (including frictional pressure losses) to be exactly equal to the design pressure, 150 psig. The team disagrees with the approach used for the following reasons.

1. Using frictional losses to establish design pressure is not consistent with industry practice.

2. The governing design code (American National Standards Institute [ANSI] B31.1) as referenced in the latest TVA calculation defines internal design pressure as "including the effects of static head" but does not include the subtraction of dynamic effects, such as frictional losses, in the definition.

3. The Final Safety Analysis Report (FSAR) for SQN, section 9.2.1.2, states "The design pressure (150 lb/in^2g) for the remainder of the CCS was selected to exceed the component cooling pumps shutoff head plus the maximum static head applied to the system." --no mention of dynamic effects.

4. The subject calculation is viewed by the team to be nonconservative because of the following reasons.

   a. It does not address equipment outages because of maintenance, etc.

   b. The total developed head of the CCS pump was converted to psi at 120 degrees F water in lieu of 60 degrees F; the assumption that the CCS water temperature is 120 degrees F is not justified, because the essential raw cooling water (ERCW) may be at its minimum temperature.

   c. The pump head utilized to establish the system design pressure was not based on minimum CCS pump flow rate requirements of 3,500 gal/min per pump, but was inappropriately derived from a scenario associated with the surge tank relief valve discharging at its maximum flow rate that resulted in a CCS flowrate of 3,858 gal/min per pump.

d. The maximum pressure in train B was not calculated. Because train B may be operated at flow rates lower than train A, the frictional losses would be smaller and the resulting maximum pressure would be higher.

e. A correlation between the maximum system operating pressure and the design pressure of various CCS components was not addressed.

Revised Response

The CCS design pressure calculation has been revised to show that, under normal operating conditions, no portion of the system exceeds the design pressure of 150 psig. A separate calculation has been performed to show that pressure variations that result from deviations from normal operation will not exceed the allowances of ANSI B31.1.0 1967, the code of record for SQN.

FSAR section 9.2.1.2 is in error. Problem Identification Report (PIR) SQNMEB87113 has been written to document the discrepancy between the FSAR and the design criteria. The FSAR will be revised, in the April 1989 update, to indicate that the design pressure is the maximum normal operating pressure throughout the system.

Observation MEB-10 - Loss of Station AC Power Calculation

SQN is committed in accordance with the FSAR to achieve and maintain hot shutdown following a loss of station ac power for a period of two hours. The project does not appear to have a set of calculations and analysis that systematically shows that adequate ambient temperature is maintained for essential equipment during this postulated event.

Revised Response

Two things are required to meet the subject FSAR commitment. First, the vital batteries must have adequate capacity for a period of two hours, without chargers, to provide the necessary dc power to maintain both reactors at hot shutdown, assuming the loss of all ac power sources. TVA has demonstrated compliance to this part of the commitment. Second, the auxiliary feedwater turbine-driven pumps and associated system equipment must be capable of maintaining both reactors at hot shutdown until ac power is restored.

MEB calculation SQN-31C-D053 EPM-RG-060987 concludes that the auxiliary feedwater turbine-driven pump room maximum temperature can be adequately limited for more than two hours. While this calculation is based on a loss of coolant accident (LOCA) with loss of offsite power and does not directly address the loss of all ac scenario, it bounds this scenario and demonstrates that the auxiliary feedwater pump room will be maintained at an acceptable temperature. Therefore, the auxiliary feedwater turbine-driven pump is capable of meeting the commitment. All of the valves associated with the turbine-driven pump will support the intended function of the pump during this scenario. The motor-operated steam supply valves to the turbine (FCV-1-15, -17, and -18) are normally open and need not change position. Although the trip and throttle valve (FCV-1-51) must open, it will do so when the pumps receive a start signal before the pump room temperature rises. The air-operated level control valves (LCV-3-172, -173, -174, and -175) must open to provide an auxiliary feedwater flow path to the steam generators. Air accumulators for these valves are provided so that they will open during this event. Hand wheels are provided to ensure a flow path is maintained for the required 2-hour period. Consequently, both parts of the commitment are met.

Observation EEB-2 - Breaker Coordination

The NRC inspection team agrees with TVA's approach. However, TVA needs to provide a confirmatory letter providing a schedule for the completion of Engineering Change Notice (ECN)-6883.

TVA Response

ECN 6883 is field complete.

Observation No. EEB-7 - Heating, Ventilating and Air Conditioning (HVAC) Temperature and Flow Process Safety Limits

MEB calculation B44 860819 004, revision 0, 480-volt board room air handling unit temperature switch setpoint, did provide both setpoint and accuracy values but did not establish process safety limits for a large number of safety-related HVAC temperature and flow measurements. Some switch safety limits were established at 50 percent of the instrument's tabulated setpoint; however, the adequacy of this selection was not justified for any of the flow instrument loops.

Addendum to Observation EEB-7

The NRC team questions the 40 degrees F safety limit for the fifth vital battery room heater control in calculation SQN CPS 004 and believes that the calculation should be revised. The 40 degrees F temperature is actually the environmental qualification (EQ) limit.

Revised Response

The fifth vital battery room minimum temperature is being reevaluated by the Nuclear Engineering Branch (NEB) and Electrical Engineering Branch (EEB). The calculation in question and all other affected documents will be revised at the conclusion of the reevaluation. Resolution of this matter has been determined to be postrestart and will be completed by June 30, 1989.

Observation EEB-9 - Containment Electrical Penetration Protection

The NRC inspection team believes that TVA should revise the calculation to address the current ambient temperature and changes in resistence in the conductor because of temperature changes, including assessment of heat dissipation, which considers factors such as geometry of the penetration, wind effects, and HVAC.

TVA Response

The schedule for completion of this item is August 1, 1988.

Observation EEB-10 - Pump Start Time Delay Relay Setpoint Calculations

"Using the Calculation Cross Reference Information System (CCRIS) database output, the team determined that no calculations had been prepared to support the setpoint or accuracy of 15 to 25 second and 0.5 second time delay relays used in pump start circuits for the ERCW, CCS, and AFW systems. During the inspection, EEB stated that they are now preparing setpoint calculations for some of the safety-related time delay relays. There is no indication that all safety-related time delay relays will be addressed. This item is also viewed by the team as an indication of a coordination problem between EEB and MEB with regard to instrument setpoint calculations."

Revised Response

As discussed with NRC, the pump start time delay relay setpoint calculations required for restart have been issued. The postrestart calculations are scheduled for completion by June 30, 1989. TVA has issued Nuclear Engineering Procedure (NEP)-3.12 "Safety-Related Setpoints for Instrumentation and Controls - Establishment and Validation." NEP 3.12 provides the requirements and responsibilities for the establishment, coordination, and validation of all safety-related setpoints.

Observation EEB-11 - Component Cooling System Setpoint Coordination

"CCS flow switch setpoint calculation B44 MEB 870602 001 included records of telephone discussions between MEB and EEB regarding flow alarm accuracy values, but additional information to technically justify the selection of these values was not documented. This item is also viewed by the team as an indication of coordination problem between EEB and MEB with regard to instrument setpoint calculations."

Revised Response

As discussed with NRC, the CCS setpoint calculations required for restart have been issued. The postrestart calculations are scheduled for completion by June 30, 1989.

Observations CEB-2 through CEB-6 - Structural Steel/Steel Platforms

Background

An existing condition adverse to quality (CAQ) (Significant Condition Report [SCR] No. SQNCEB8711, revision 1) addresses observations CEB-2 through CEB-6 and describes corrective action for restart that is complete for restart of unit 2 as follows.

Platforms

Program: In order to determine the effect that the described deficiencies have on the qualification of platforms, a reanalysis was to be performed for six platforms. The six platforms were selected as representative of in-place conditions, and a walkdown procedure was developed and implemented to obtain the as-constructed condition of the selected platforms including all attachments.

Status: Analysis of the as-constructed condition has been completed for the representative platforms. The analysis considers all applicable design criteria requirements. With the following exceptions, the platforms met all design criteria requirements for normal operation.

Platform	Structural Feature - Primary Load	Result
Auxiliary Building El 724' -5" (48N1216)	Self-Drilling Anchors - Tension	F.S. 3.41
Auxiliary Building El 776' -7 1/2" (48N1216-3)	Self-Drilling Anchors - Tension	F.S. 4.69
	Self-Drilling Anchors - Tension	F.S. 3.49
Reactor Building	Beam - Weak Axis Bending	
	Operational Basis Earthquake (OBE)	I.R. 1.18
	Safe Shutdown Earthquake (SSE)	I.R. 0.80
El 705'-0" (48N937-1)	Self-Drilling Anchors - Tension	F.S. 2.80

Note: F.S. = Factor of Safety
I.R. = Interaction Ratio of Actual Divided by Allowable Stresses

The other three platforms that were evaluated (Reactor Building, El 693'-0", Loop 3, 48N905; Reactor Building, El 693'-0", Loop 4, 48N905; Auxiliary Building, El 720'-11 3/4", 48N910) met design criteria requirements in all regards.

With respect to the self-drilling anchor factors of safety shown above, it is noted that the approved allowables for interim operation are met (Design Standard DS-C1.7.1 - B41 870728 009) and that the least factor of safety identified, 2.8, is the minimum required factor of safety to which the platforms were originally designed.

In the one instance of weak axis beam bending stress in excess of design criteria and FSAR allowables, the controlling load case is the OBE. The actual maximum stress for that load case is 31.8 kip per square inch (k/in^2), and the maximum stress for the SSE load case is 33.1 k/in^2. For SSE load case, the beam stresses are below the allowables. Thus, beam yielding will not occur; and the beam will continue to perform its intended function for all design basis events.

Modifications have been scheduled for the unit 2 cycle 4 refueling outage for each of the cases noted above.

The status of three additional activities, discussed in the follow-up inspection of October 26, 1987, is as follows.

1. Design stresses that exceed design criteria and FSAR requirements are discussed above. As noted, the beam stresses do not exceed yield; thus, the beam is acceptable for restart. The anchor bolt factors of safety meet the original design requirements and approved interim operation criteria.

2. Certain beam connections were qualified by a testing program performed by TVA's Singleton Materials Engineering Laboratory. As agreed, an independent review of that testing was initiated, and the adequacy of the testing procedure and application of test results were confirmed by Dr. Edwin G. Burdette, of the University of Tennessee.

3. An administrative control program has been initiated to limit the amount of live load that can be imposed on safety-related platforms.

With the completion of the above-described activities, no further prerestart action is required.

Based on the results of the evaluation of the six representative platforms, additional postrestart evaluations will be performed utilizing the following procedure.

1. Develop attributes that will be considered in the selection of additional platforms.

2. Using the attributes, review the calculations and drawings and perform a field survey of the platforms from which to select additional platforms to be evaluated.

3. Walk down the platforms to be evaluated to establish as-constructed configuration.

4. Utilizing the as-constructed configuration, evaluate the platforms for conformance to design criteria requirements.

Walkdowns will be performed during unit 2 cycle 4 refueling outage to obtain as-constructed data. The structural evaluation of the as-constructed data will be completed before unit 2 cycle 5 refueling outage.

Postrestart evaluations will also include reconciliation of the original design requirements (Design Criteria SQN-DC-V-1.3.2) specifically contained in the FSAR and current design requirements (Design Criteria SQN-CEB-V-1.3.3.1). The current design criteria requirements are in full compliance with Standard Review Plan, section 3.8.4. This will be reflected in the April 1989 FSAR update.

TVA's existing procedures require the evaluation and documentation of future attachments to platforms.

Miscellaneous Steel (Excluding Platforms)

Program: The adequacy of the design of the remaining miscellaneous steel was verified through the technical review of 54 randomly selected features (reference Detailed Technical Review Plan SQN-CEB-87-02, B41 870[illegible] 002). As part of the resolution of SCR SQNCEB8711, revision 1, five randomly selected features were examined to determine if there are any significant attachments that were not considered in the design calculations or if there were any significant changes in configuration.

Status: The review of the five features is complete (B25 870529 801), and it has been determined that there are no significant attachments and no significant changes in configuration that have not been considered in the design. Based on this evaluation, the miscellaneous steel is determined to be acceptable for restart for significant attachments and configuration changes. Additional ongoing work in the area of miscellaneous steel is described in the response to observation CEB-15.

Structural Steel

Program: Because structural steel is generally of heavier type construction, it can be generalized that it is not as sensitive to additional attachments. Also, there are generally detailed fabrication and erection drawings that lessen the chance for field changes. However, in order to confirm the adequacy of structural steel, an examination of portions of five structural steel features has been performed before restart. The purpose of this examination was to determine if the configuration is significantly different from the drawing. If attachments existed that were not enveloped in the original design or if significant configuration differences existed, an evaluation of the structure considering the differences was performed.

Status: The review of the five features is complete (B25 870529 801), and it has been determined that there are no significant attachments and no significant changes in configuration that have not been considered in the design. Based on this evaluation, the structural steel is determined to be acceptable.

Actions Taken to Prevent Recurrence

Control of attachments to miscellaneous and structural steel is now addressed by the following:

1. Nuclear Engineering Procedure (NEP) 6.1 for change control.

2. SQN Modifications and Additions Instruction (M&AI) 11 for the control of attachments to miscellaneous and structural steel.

3. SQN Engineering Procedure (SQEP) Administrative Instruction (AI) 11A for field change requests (FCRs).

4. SQEP-13, Transitional Design Change Control.

5. SQEP-66 for interface control of attachments to civil features.

The adequacy of Civil discipline calculations is ensured by implementation of the following:

1. NEP-3.1.

2. Civil Engineering Branch (CEB) Policy Memorandum (PM) 86-02.

Observation CEB-13 - Regenerated CEB Pipe Support Calculations

The team reviewed the pipe support calculations that CEB regenerated for pipe supports 1-H10-555, H10-635, H10-680, and H10-1219. These pipe supports are located in the CCS.

The team notes the following:

1. CEB's calculation for pipe support H10-635, dated April 28, 1987 (B25 870429 306), demonstrated that the pipe support failed when CEB considered friction forces. CEB's restart pipe support design criteria requires consideration of friction forces. However, CEB did not note this deficiency on the calculation cover sheet or on the CAQR, and Bechtel did not address this deficiency in the supplemental calculation that Bechtel prepared to address the CAQR.

2. CEB's calculation for pipe support H10-1219, dated April 21, 1987 (B25 870422 302), did not include a thermal check of the pipe support. CEB's restart pipe support design criteria allows consideration of thermal loads postrestart. However, CEB did not note this unverified assumption on the pipe support calculation cover sheet or on CEB's pipe support calculation log for postrestart resolution. The NRC team agrees with TVA's approach, but TVA needs to submit a confirmatory letter stating the results of the analysis.

Revised Response

CEB calculation H10-635 required a prerestart modification that was completed under ECN 7299. This modification ensures that the support meets current design criteria requirements. This calculation was issued under B25 871002 806.

CEB calculation H10-1219 meets the current design criteria requirements and did not require modification. This calculation was issued under B32 880106 039.

Observation CEB-15 - Technical Adequacy of Miscellaneous Structural Steel

To determine the technical adequacy of miscellaneous structural steel, CEB reviewed 54 features from approximately 400 drawings. In most cases, there are more than one feature per drawing. Therefore, the number of features reviewed might be a small percentage of the total number of miscellaneous structural steel features at SQN. The NRC team questions the validity of CEB's conclusion that miscellaneous structural steel is technically adequate without increasing their sample size. The NRC team finds TVA's action plan acceptable; however, TVA needs to submit a confirmatory letter stating the results of the analysis.

Revised Response

The design of miscellaneous steel was originally performed to the requirements of design criteria SQN-DC-V-1.3.2, which was issued in 1970. This design criteria addressed OBE and SSE design conditions and specified a maximum allowable stress of 0.9Fy (where Fy equals allowable yield

stress). In 1980, design criteria SQN-DC-V-1.3.3.1 was issued that defined the requirements for new building additions. In 1983, this criteria was revised to allow its usage for evaluation and modification of existing structures. This design criteria is compatible with the NRC Standard Review Plan (SRP) loads, loading combinations, and allowable stresses. For comparison of the two criteria, refer to attachment 1.

Since SQN-DC-V-1.3.3.1 is compatible with the industry standard, it has been utilized in recent years for evaluations and modifications of steel structures. It was also utilized for the technical review of the calculations for the 54 miscellaneous steel features or portions of features discussed in the observation. The review was conducted utilizing Detailed Technical Review Plan SQN-CEB-87-02. The review determined that 49 of the features met the design requirements of SQN-DC-V-1.3.3.1. It also identified five CAQRs (SQP870188, 0209, 0210, 0550, and 0650), three of which dealt with inconsistencies in the design loads utilized versus vendor loads. These three CAQRs (SQP870188, 0209, and 0210) have been evaluated to verified loads, and two of them meet design criteria requirements. One of the CAQRs (SQP870188) required a modification of the structure, which is being completed by workplan (WP) WP-00120-01 prerestart. Based on work completed to date, the two remaining CAQRs (SQP870550 and SQP870650) are shown to meet design requirements. These calculations will be finalized before restart. After restart, miscellaneous steel calculations will be reviewed and revised as necessary to fully document that design requirements are met. An activity has been scheduled to complete this enhancement of the miscellaneous steel calculations.

In addition to the above, TVA has completed the following activities to verify the adequacy of the miscellaneous steel:

(1) For the generic evaluation of the CAQRs concerning inconsistencies in the usage of vendor loads, TVA has completed an evaluation of the structural adequacy of 60 equipment support designs. This evaluation also addressed the concerns identified by NRC Integrated Design Inspection (IDI) item D4.6-1 dealing with discrepancies between calculations and drawings.

The evaluation consisted of the following:

(a) The selection of an engineered sample of 60 equipment support designs for Category I electrical and mechanical equipment.

(b) Review of the vendor equipment load data to verify support loads. This included, where necessary, the reanalysis of the equipment and the development of support loads.

(c) Inspection of the supports to establish as-built configuration.

(d) Evaluation of the equipment supports for the verified loads and as-built configuration.

This evaluation determined that 59 of the 60 equipment support designs met design criteria requirements. One of the supports (reactor coolant pump anchorage) did not meet design criteria requirements. A restart determination for this support has been completed through the CAQR process. The referenced anchorage is determined to be acceptable for restart. The deficiency that was identified consists of weld stresses that exceed allowable stresses. The deficiency is because of an incomplete design calculation and a discrepancy between the design drawing and a fabrication drawing. However, this deficiency did not result from calculation/drawing discrepancies nor the usage of incorrect vendor loads. Further evaluation of the pump support indicated that the support is a unique design and that its design is governed by large primary coolant pipe break loads. It was also shown that the support will meet its functional requirements even under the calculated LOCA loads. Therefore, the corrective action for this support will be completed postrestart.

(2) TVA has regenerated 38 calculations for miscellaneous steel structures. Out of these, 36 features meet the design criteria requirements. The remaining two features did not meet criteria requirements, and CAQRs were issued. Work has been completed that demonstrates that the features represented by these CAQRs are acceptable for plant restart.

In conclusion, the miscellaneous structural steel and equipment supports have been evaluated through various sampling programs that have established a high confidence level that the structures will perform their design function. Postrestart programs to review and revise as required the remaining miscellaneous steel calculations will be completed to verify the adequacy of the remainder of the miscellaneous steel features.

TVA is providing the following information in response to a NRC concern that TVA has invoked interim criteria, specifically Design Criteria SQN-DC-V.1.3.5, "Evaluation of Structural and Miscellaneous Steel Features for Interim Operability," in evaluations performed relative to the subject NRC observation. TVA has not invoked that interim criteria in the evaluations. The criteria was given to NRC inspectors in November 1987 for information. TVA has not approved or issued the criteria for use.

Observation CEB-16 - Conduit and HVAC Duct Support Calculations

CEB's review of recently regenerated conduit (5) and HVAC duct (4) support calculations showed numerous discrepancies between the calculations and the associated design criteria. The team's review of the CEB's findings on these nine calculations showed that the analysis performed was incomplete and inadequate--specifically, clamps and welds were not evaluated. The findings also demonstrate to the team that the contract personnel used to regenerate these calculations lack knowledge about the applicable CEB design criteria and need specific training regarding TVA standard practices.

TVA'S REVISED RESPONSE

During the regeneration of calculations that had been identified as nonretrievable, TVA conducted independent technical reviews of other selected calculations. The conduit and HVAC support calculations were reviewed under Detailed Technical Review Plan SQN-CEB-87-03. During the initial review, five conduit and four HVAC support calculations were reviewed, and deficiencies in all nine calculations were identified. The review was expanded, and eight additional calculations were reviewed with deficiencies noted in one calculation.

In order to prevent recurrence of the deficiencies that were identified by the technical review of the calculations, the following documents have been issued:

1. A "Lessons Learned" memorandum has been issued to designers (TVA and contractor) defining the deficiencies and emphasizing need to improve quality (B41 870918 005).

2. Branch Instruction No. CI 21.53 has been issued that clarifies the duties and responsibilities of each individual (TVA and contractor) involved in the development of design calculations.

In addition, because of identified issues in the design of conduit, conduit supports, HVAC ducts, and HVAC duct supports, TVA is verifying the technical adequacy of these features through sampling programs. CAQRs SQT870626 and SQT870843 were generated to address these issues. A third CAQR has been issued since our initial response to CEB-16 (CAQR SQF870231). This CAQR addresses conduit attached to the inside of the steel containment vessel. These conduits were determined to be acceptable for restart based on the completed evaluations. The following corrective action has been implemented for the resolution of the CAQR's.

A. Conduit and Conduit Supports

1. <u>CAQR SQT870626 Conduit and Conduit Supports in All Category I Structures Excluding Attachments to the Inside of the Steel Containment Vessel</u>

   a. Design Criteria: The design criteria DC-V-13.10 has been revised to address the items described in the CAQR related to restart. The design basis is discussed in Attachment 2.

   b. Calculations for 60 representative "worst-case" supports and associated conduit runs have been developed. Results are shown in Attachment 3.

   c. In addition to the worst-case supports, several of the conduit typical supports, representing approximately 90 percent of the support population, were selected for evaluation. This effort was concluded when the 60 worst-case support sample met the acceptance criteria (See Attachment 3). A calculation (B25880114808) was issued with the unchecked bounding data as the appendix. This was issued in order to document the basis for the work and to insure retrievability.

   d. Some of the concerns in the CAQR were addressed through the usage of the earthquake experience data.

These activities are complete for restart. The conduit and conduit supports have been determined to meet design and/or operability requirements and thus are acceptable for restart. (See Attachment 3)

2. CAQR SQF870231 Conduit Attached to the Inside of the Steel Containment Vessel

The conduit attached to the inside of the steel containment vessel (SCV) were determined to meet design criteria based on analysis of the bounding case conduit systems. For the Permanent Hydrogen Mitigation System (PHMS) conduit attached to the SCV in the dome area, all supports except one conduit clamp meet the design criteria requirements. One conduit clamp is found to exceed the design interaction requirements by 17 percent, mainly in the slip-through direction. A review of the test results used in the development of the clamp allowables shows a minimum factor of safety of 2 is available against the slip-through condition. Therefore, it is concluded that the referenced PHMS conduit and its supports shall perform their intended function.

B. HVAC and HVAC Supports

CAQR SQT870843 HVAC Duct and Duct Supports

1. The design criteria has been revised to address the items described in the CAQR. The design basis is discussed in Attachment 2.

2. TVA has completed the review of all calculations for CAQR SQT870843. This CAQR dealt with various aspects of design for ducts and duct supports. The program for resolution of this CAQR was to analyze 5 systems selected as representative of the worst of the problems identified in the CAQR in addition to reviewing all rigid to flexible support transitions (50 transitions were identified).

   Four of the five systems were adequate for long term; that is, they meet design criteria allowables. The fifth sample (Sample #2) had 8 supports which did not meet the present long term anchorage criteria (Design Standard DS-C1.7.1). However, they do meet interim allowables of DS-C1.7.1. Seven supports have weld stresses beyond design allowables but would remain functional for all load conditions (See Attachment 4).

   All rigid to flexible interfaces were found to be acceptable.

   Based on these evaluations, we have determined that all safety related duct and duct supports are acceptable for restart. This was documented on November 18 in SQA135, Attachment B.

Attachment 1

SQN-DC-V-1.3.2		SQN-DC-V-1.3.3.1	
Loads	Allowable Stresses	Loads	Allowable Stresses
OBE	AISC	OBE	AISC
		OBE + Thermal	1.5 x AISC
SSE	0.9 Fy	SSE	1.6 x AISC Tension & Bending = 0.96 Fy (Non-Compact Sections) Tension & Bending = 1.06 Fy (Compact Sections) Shear = 1.6 x 0.4 = 0.64 Fy Weak Axis Bending = 1.2 Fy
		SSE + Pipe Break Pressure Loads	1.7 x AISC Tension & Bending = 1.7 x 0.6 Fy = 1.02 Fy (Non-Compact Sections) Tension & Bending = 1.7 x 0.66 = 1.12 Fy (Compact Sections) Shear = 1.7 x 0.4 = 0.68 Fy Weak Axis Bending = 1.28 Fy

NOTE: Not all loading combinations that are addressed in SQN-DC-V-1.3.3.1 are shown. For the specific loads, loading combinations and allowable stresses, see the design criteria.

ATTACHMENT 2

CONDUIT SUPPORTS

FSAR Section 3.10.2, PG 3.10-7

The following is the FSAR section on conduit and conduit supports:

"Conduit Banks and Supports"

1. Restraint Measures

   "The Category 1 electrical exposed conduit supports, and electrical conduit box supports have been designed to provide vertical and horizontal support for the spacing recommended in TVA Construction Specification."

2. Analysis (Conduit bank information is not included)

   The period, maximum seismic displacement, maximum stress, and reactions were determined for a range of lateral support spacings considered significant. The maximum support spacing is 10 feet. The loads used to design the supports were derived by using a maximum response spectrum. This spectrum was developed by taking the maximum seismic acceleration any period from the two horizontal response acceleration spectra. This was combined with the maximum vertical response acceleration spectra at 1.0 percent damping. The first four natural periods of the conduit were determined and the corresponding response for each of the four periods computed. The effects of higher numbered natural periods were conservatively considered by setting the fourth period response equal to the resonance response after the fourth period exceeded resonance. The modal participation factors for each mode were calculated and the important design data generated. A stress intensification factor of 2.3 was used for the threaded joints and they were assumed to be located at the point of maximum moment. Where conduit terminates in a conduit box, the conduit box and its attachment has been treated as a support point.

TVA designers presently use Design Criteria SQN DC-V-13.10 for design of conduit supports, except for those attached to the steel containment vessel. For conduit attached to the steel containment vessel, rigorous analyses are in accordance with the analytical intent of SQN-DC-V-13.31 with design allowables in accordance with SQN-DC-V-13.10.

HVAC DUCT AND SUPPORTS

Design of HVAC duct and supports is not addressed in the FSAR.

TVA designers presently use Design Criteria SQN-DC-V-13.8 for design of HVAC supports.

ATTACHMENT 3

Conduit Supports were reviewed under CAQR SQT870626 for 60 representative worst-case supports with the following results.

No. of Worst-Case Supports Evaluated	No. of Supports Meeting the Requirements of Design Criteria SQN DC-V-13.10***	No. of Spans of Conduit Evaluated	No. of Spans of Conduit Mtg. Requirements of Design Criteria SQN-DC-V-13.10***
60	60**	149	147*

Conduit Operability Determination

* The allowable conduit stress limit for these two cases is 5,217 lb/inch and the yield stress is 13,000 PSI.

1. Support Tag No. Ab25
   Max conduit stress 9,800 lb/in^2

2. Support Tag No. AB45
   Max conduit stress 8.800 lb/in^2

** All 60 of the structural steel supports met design criteria requirements. However, two supports had clamps that exceeded allowable values for the interaction equation. These interaction values were 1.3 and 1.06. Minimum factors of safety of 1.75 for SSE emergency and faulted condition were used to develop the allowable clamp loads. Therefore, there would be no loss of function of the support since only a maximum of 75 percent of the capacity of the clamp is used in any one direction.

*** In a meeting with NRC Technical Reviewers on 1/7/88, NRC indicated that in response to TVA's request for increased damping levels for conduit design 5% damping would be acceptable for all conduit. These samples were evaluated using 2% damping. All samples may be acceptable long term when this 5% damping is applied.

ATTACHMENT 4

HVAC supports were reviewed under CAQR SQT870843 for 5 worst-case samples with the following results:

System	Supports Evaluated No.	No. of Supports Meeting the Requirements of Design Criteria SQN-DC-V-13.8
1	21	21
2	37	27*
3	12	12
4	9	9
5	5	5

* All remaining 10 supports are acceptable for Interim Operation as described in the summary report for Sequoyah Nuclear Plant resolution of duct & duct support qualification issues (Task R0006).

Note 1: All spans meet Design Criteria SQN-DC-V-13.8

Note 2: Rigid to flexible transitions meet Design Criteria SQN-DC-V-13.8.

ENCLOSURE 2

List of Commitments

SQN TVA DNE
Calculation Effort

1. Observation Mechanical Engineering Branch (MEB)-6--TVA will revise the FSAR by April 15, 1989, to indicate that the design pressure for the CCS is the maximum normal operating pressure throughout the system.

2. Observations Electrical Engineering Branch (EEB)-7, EEB-10, and EEB-11--TVA will evaluate the calculations associated with these observations by June 30, 1989.

3. The calculation identified in observation EEB-9 will be revised by August 1, 1988.

4. a. Observations Civil Engineering Branch (CEB)-2 through CEB-6--TVA will modify during the unit 2 cycle 4 refueling outage the one beam identified as not meeting the design criteria and FSAR allowables.

   b. Walkdowns will be performed during unit 2 cycle 4 refueling outage to obtain as-constructed data.

   c. The structural evaluation of the as-constructed data will be completed before unit 2 cycle 5 refueling outage.

   d. Postrestart evaluations will be performed to include reconciliation of the original design requirements specifically contained in the FSAR and Design Criteria and revise the FSAR to reflect these evaluations by April 15, 1989.

5. Observation MEB-3--TVA will submit a revised response by a separate letter before restart of unit 2.