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LIST OF ABBREVIATIONS

AFW	Auxiliary Feedwater
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAQ	Condition Adverse to Quality
CAQR	Condition Adverse to Quality Report
CCP	Centrifugal Charging Pump
CCRIS	Calculation Cross Reference Information System
CCS	Component Cooling Water System
CEB	Civil Engineering Branch
DBVP	Design Baseline and Verification Program
DIM	Design Input Memorandum
DNE	Division of Nuclear Engineering
EA	Engineering Assurance
ECB	Engineering and Computer Methods Branch
ECCS	Emergency Core Cooling System
ECN	Engineering Change Notice
EEB	Electrical Engineering Branch
ERCW	Essential Raw Cooling Water System
ESF	Engineered Safety Features
EQ	Environmental Qualification
FCN	Field Change Notice (Westinghouse)
FCR	Field Change Request
FSAR	Final Safety Analysis Report
HVAC	Heating, Ventilation and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
LOCA	Loss of Coolant Accident
MEB	Mechanical Engineering Branch
MOV	Motor Operated Valve
NEB	Nuclear Engineering Branch
NEP	Nuclear Engineering Procedure
NRC	Nuclear Regulatory Commission
NPSH	Net Positive Suction Head
NRR	Office of Nuclear Reactor Regulation, NRC
NSA	Nuclear Safety Analysis Section in NEB
NSSS	Nuclear Steam Supply System
OIE	Office of Inspection and Enforcement, NRC
OSP	Office of Special Projects, NRC
PIR	Problem Identification Report
RIMS	Records Information Management System
RP	Radiation Protection Section in NEB
RWST	Refueling Water Storage Tank
SCR	Significant Condition Report
SI	Safety Injection
SQEP	Sequoyah Engineering Procedure
SQN	Sequoyah Nuclear Plant
T-H	Thermal-Hydraulics Section in NEB
TVA	Tennessee Valley Authority
WBN	Watts Bar Nuclear Plant

SEQUOYAH NUCLEAR POWER PLANT
DESIGN CALCULATION REVIEW PROGRAM
INSPECTION REPORT 50-327/87-27 AND 50-328/87-27
JUNE 1-5, 1987

1. INTRODUCTION AND BACKGROUND

The design calculation review program was developed by the Division of Nuclear Engineering (DNE) because past audit findings and other reviews have shown that the design basis for TVA's nuclear power plants have not been adequately documented by supporting calculations or such calculations, if performed, are no longer retrievable. This calculation review program was identified by TVA as augmenting the Design Baseline and Verification Program (DBVP) by providing detailed technical reviews of calculations that supported engineered changes to the plant design since the initial license to operate was granted. The TVA calculation review program is, however, broader in scope than the DBVP and also includes a review of initial design calculations. The NRC decided to conduct an inspection of the calculation review program because it was determined in a previous inspection of the DBVP (50-327/86-55, 50-328/86-55) that the DBVP did not perform a detailed technical review of the calculations that supported the engineered changes made to the plant since receipt of the operating license. The DBVP review of calculations only included a check to verify that appropriate calculations existed, and that the proper technical attributes had been considered. The design calculation review program is described in an enclosure to TVA letter from Mr. R. L. Gridley dated January 20, 1987 and revision 1 to section III.4 of Sequoyah's Nuclear Performance Plan dated March 27, 1987.

The NRC has previously inspected the design calculation review program and documented the results of that inspection in report 50-327/87-06, 50-328/87-06 which was forwarded to TVA via letter dated April 8, 1987. The purpose of that inspection was to assess the adequacy of the design calculation review program including its augmentation of the DBVP and to assess Engineering Assurance's audit of the subject program.

2. PURPOSE

This inspection report summarizes the results of the NRC inspection conducted to review the corrective actions resulting from the design calculation review program.

The purpose of this inspection was to:

(1) Review TVA corrective actions associated with NRC observations documented in Inspection Report 50-327 87-06, 50-328/87-06 and the associated generic implications.

(2) Review TVA's corrective actions associated with their in-house Engineering Assurance (EA) Audit 87-09 of the DNE Calculation Review Effort and the associated generic implications.

(3) Review Conditions Adverse to Quality (including CAQR's, SCR's and PIR's) generated by DNE as a result of their calculational review program to ensure that (a) the stated corrective action is responsive to the problem identified; (b) the corrective action is implemented; and (c) the associated generic implication is adequately addressed.

(4) Review additional calculations as time permitted.

(5) Assess TVA's planned corrective actions and ensure that they have been appropriately classified as pre- or post-restart.

(6) Review the Calculational Cross Reference Information System (CCRIS) to determine how the discipline interfaces were being addressed and whether the accuracy of the design information transmitted across discipline interfaces was being verified.

3. RESULTS OF NRC INSPECTION

The following paragraphs characterize the team's observations and conclusions as they relate to the inspection purpose identified in Section 2 with the detailed description of the observations in each discipline provided in Attachment A.

3.1 Review of corrective actions from NRC Inspection Report 50-327/87-06, 50-328/87-06

Refer to Attachment A for the status of all previous inspection report observations.

3.2 Review of corrective actions from EA Audit of the DNE Calculation Review Effort 87-09

The EA audit report which was enclosed to TVA memorandum BO5870210001 from A. P. Capozzi, Manager of EA, dated February 10, 1987, identified 6 "deficiencies" and 20 "concerns." The team's review of this EA Audit focused on the more significant deficiencies/concerns and their associated corrective action, on a sampling basis. Summarized below for each discipline is the team's review of the EA Audit of the design calculation review effort.

MEB

The team reviewed the three deficiencies identified for MEB and finds the corrective actions in response to these EA findings to be adequate. The team concurs with the EA decision requiring additional auditing for deficiencies 87-09-01 and 87-09-02, which will remain open until completion of reviews by MEB and verification by EA. The EA items reviewed by the team are summarized below.

EA deficiency 87-09-01 part 1 identified that the faulted (injection phase) temperature for the containment spray ring header could be between 60°F and 110°F in lieu of a single ambient temperature of 70°F as described in the associated operational mode calculation. Part 2 of this EA deficiency identified that the maximum faulted (recirculation) temperature to the

containment spray header was not adequately justified. The corrective actions being taken are to revise the operational mode calculation and to expand the review to other operational mode calculations.

EA deficiency 87-09-02 described incorrect application of preoperational test data in lieu of performing calculations for the containment spray and RHR pumps. The test data did not reflect the limiting condition for NPSH nor did it address piping inside containment including risers, spray rings and flow nozzles. The corrective action being taken is to revise the calculation and to expand the review to other calculations that utilize test data.

EA deficiency 87-09-03 describes lack of documentation that certain reviews required by MEB were, in fact, conducted. Specifically, no documentation was available to substantiate that the mechanical calculations reflected a review of the FSAR, current design and technical specifications. The corrective action taken was to require all MEB managers to document that calculations in the lead engineer's calculation log were properly reviewed and approved.

NEB

The team reviewed the single EA concern directed towards the NEB. The concern was associated with the NEB calculation review process. Specifically, the NEB program did not appear to address the representativeness of the purpose and scope of the calculation being reviewed. The corrective action was to revise the interim review procedure to incorporate a step which would require the reviewer to determine how well the scope and title related to the goal of the calculation. Also, the interim procedure (B45-861010-259) will be issued as a permanent branch instruction. The team reviewed a revised draft of the procedure and found that reference was made to assessing the clarity of the "Statement of Problem" (purpose) but there was no mention of the appropriateness of the title. NEB, realizing the oversight, revised the draft accordingly. The procedure was then issued formally as a permanent instruction for the branch (NEB-I-25.5.8 Rev. 0). The team considers the corrective action and the implementation thereof as adequately satisfying the original TVA/EA-NEB concern.

EEB

In EEB, the EA audit resulted in the identification of three multi-part deficiencies and various concerns. EEB had not completed implementation of all the corrective actions, however, the team reviewed the appropriateness of the stated corrective actions and found them acceptable. Summarized below are the EA items reviewed by the team.

EA deficiency 87-09-04, part 1, identified that calculations for the voltage drop used values of the cable length equal to the design length plus an arbitrary margin of 15 percent, instead of the actual pulled length. EEB's corrective action involved issuance of an internal memorandum (PM-87-26) to direct all EEB personnel to use the pulled length of the cable for future calculations, and to reevaulate all existing calculations. Sequoyah has redone all the existing calculations using the actual cable length.

EA deficiency 87-09-04, part 2, identified that EEB submergence calculations assumed an elevation of 693 feet for the maximum post LOCA flood level in lieu of the correct elevation of 698.8 feet. EEB's corrective action involves revising the list of submerged equipment to consider flood levels of 699 feet (outside of the crane wall) and 704 feet (inside the crane wall).

EA deficiency 87-09-04 part 3 identified that some of the computer programs used by EEB were unverified. The corrective action by EEB involved redoing all the affected calculations. However, the voltage profile analysis was not redone; instead, the validity of the computer program results was established through PSB-1 testing.

EA deficiency 87-09-05 part 1 identified that no calculations were retrievable for the diesel generator 125 VDC distribution board short circuit analysis. EEB's corrective action involved doing the required calculations.

EA deficiency 87-09-06 noted that TVA was using certain portions of Westinghouse's setpoint accuracy calculation methodology for balance-of-plant instrument setpoint accuracy calculation without a formal procedure. Since no technical problems were found in the calculations using TVA's approach, EA closed this item.

EA concern D-2a noted that the ambient temperature effects on fluid density for the RWST level measurement had not been considered. Since the effects on loop accuracy are expected to be small, EA closed this item with the understanding that TVA would revise the calculation to address this concern.

EA concern D-2b noted that an explicit conclusion had not been reached for the loop accuracy calculation of reactor building sump level. TVA agreed to revise the calculation to address this concern, and the item was closed on this basis.

CEB

For CEB the team reviewed EA concerns A-3 and C-4, and EA observations C-1 through C-9. The team also reviewed CEB's responses to these concerns and observations, and EA's review of CEB's responses. The team concurs with EA's acceptance of CEB's responses to EA Concerns A-3 and C-4, and EA observations C-2 through C-9. The team does not concur with EA's acceptance of CEB's response to EA Observation C-1 (Observation CEB-14).

EA concern A-3 noted a lack of coordination between the four lists of essential calculations which NEB, EEB, MEB and CEB were compiling. To address this concern, DNE created a computer data base entitled "Calculation Cross Reference Information System" (CCRIS), which will become the official DNE calculation log after DNE verifies the computer software, the indexed calculations and cross-references. CEB has identified the "other discipline" calculations that are source documents for the essential CEB calculations indexed in CCRIS for entry into the CCRIS data base. EA accepted DNE's response to EA Concern A-3, pending EA's final review of the CCRIS data base.

EA concern C-4 noted that CEB did not yet have a list of missing essential calculations for the audit team to review. EA also commented on CEB's proposed plan to compile a list of missing CEB essential calculations, plan SQN-C-Q102, entitled "Essential Calculation Verification Program." EA accepted CEB's responses to this concern, subject to additional EA review.

EA observation C-1 noted that CEB could not retrieve many of the pipe support calculations required to demonstrate pipe support adequacy in accordance with design criteria SQN-DC-V-24.1. EA additionally noted that CEB was also generating calculations for modifications to pipe supports which lacked calculations. EA accepted CEB's response to EA observation C-1, subject to additional EA review. However, the team considers EA's acceptance of CEB's program to identify and regenerate missing pipe supports to be premature, based on the team's review of CEB's pipe support program during the period June 1-5, 1987 (NRC Observation CEB-14).

EA observations C-2 and C-3 noted specific concerns with pipe support calculations 2-H36-72 and 2-H36-105. Specifically, no adequate justification was provided for spring load rating, various weld sizes, pipe clamp qualification, lug sizing, etc. CEB's response recognized the need to document engineering judgments. EA accepted CEB's responses to these observations, subject to additional EA review of the revised calculations and drawings for pipe support 2-H36-105.

EA observation C-4 identified a missing document in rigorous piping analysis 0600104-13-07 which was needed to verify coordination between the TVA piping designer, EDS, and the NSSS manufacturer for nozzle allowables. EA observation C-5 identified document discrepancies in rigorous piping analysis N2-68-A-314R in that longitudinal bending stresses due to occasional loading were omitted and lapping considerations were included. CEB's response stated that the nozzle allowable verification would be obtained and changes to the calculations would be made. EA accepted CEB's responses to these observations subject to additional EA review.

EA observation C-6 generally questioned the use of 3-way restraints at all support points in a thermally hot alternate analysis problem. EA observation C-7 identified the lack of supporting calculations for CEB report 80-5, the alternate analysis "cookbook," which provides the basis for design criteria SQN-DC-V-13.7. CEB responded to C-6 by stating that all alternate analysis piping required for restart with operating temperatures greater than 200°F will be reviewed. CEB responded to C-7 stated that backup calculations for the alternated analysis cookbook will be made part of the design records post-restart. EA accepted CEB's responses to these observations, subject to additional EA review.

EA observation C-8 identified that a containment penetration seismic qualification document was missing. CEB responded that all penetration seismic qualifications would be obtained or regenerated. EA accepted CEB's response to this observation.

EA observation C-9 related to the stress allowable used by Chicago Bridge and Iron in the containment vessel calculations. The discrepancy in the allowables stated by EA in their observation apparently was a misunderstanding of the ASME code. CEB has explained the source and the formula

used to obtain the allowable stress. This response has been accepted by EA and the observation was closed.

3.3 Review CAQRs generated by DNE as a result of their calculational review program.

The findings of the DNE disciplines which resulted from the calculational review program are documented and tracked through their CAQR process defined in procedure NEP-9.1. The team reviewed a sample of CAQRs for each design discipline to ensure (1) the stated corrective action is responsive to the problem identified, (2) adequate corrective action is implemented and, (3) the associated generic implication is adequately addressed.

MEB

During the inspection period the team reviewed CAQRs generated as a result of calculation reviews by MEB. From a sample of 22 calculation reviews inspected by the team, MEB had issued 16 CAQRs. Nine were considered to be minor discrepancies for which the corrective action taken was to require revision, but after restart. Seven CAQRs, all associated with HVAC calculations, resulted from unverified ventilation heat loads. The corrective action being taken is to revise the calculation with verified input before restart. MEB is addressing the generic implications of the unverified ventilation heat loads by conducting a review of all HVAC calculations for Sequoyah and the other TVA plants and by the actions discussed under resolution of Observation MEB-4.

The team finds the corrective actions being taken by MEB to be adequate and responsive to the generic implication of their findings.

NEB

The team reviewed four CAQRs, three SCRs and two PIRs, all of which resulted from the DNE/NEB calculation review program. The reports involved were:

CAQR/SQF870041 (B05-870114-853)
CAQR/SQT870907 (S13-870520-850)
CAQR/SQF870022 (B05-870407-004)
CAQR/SQF870076 (B05-870518-300)
SCRSQNNEB8636 (B45-861223-851)
SCRSQNNEB8711 (B45-870204-859)
SCRSQNNEB8713 (B45-870204-360)
PIRSQNNEB8703 (B45-870114-853)
PIRSQNNEB8704 (B45-870114-854)

Four of the above reports concerned calculations performed by the Nuclear Safety Analysis (NSA) section. Three of the four were directed towards the group located at the plant site. The remaining report concerned calculations performed by the Knoxville NSA section. Two of the above reports were directed at calculations performed by the Radiation Protection (RP) section. Two of the above reports concerned calculations performed by the Thermal-Hydraulics (T-H) section. One of the nine reports was found to be baseless in that the original assertion of

technical errors in the calculation was found to be without foundation. In all other cases the corrective action was deemed to be the reissuance of the affected calculations. The team found the corrective action to be appropriate and did adequately resolve the problems identified.

The team reviewed 12 calculations that had been reissued in order to implement the corrective action prescribed by the NEB/CAQR's. The team found that in each instance the reissued calculation was appropriate and adequately implemented corrective action.

The team further inspected the generic implication review activity for the CAQR's generated as part of the DNE calculation review program and found the generic consideration of these CAQRs for plant or branch wide implications to be adequate.

EEB

In the electrical power systems area the team reviewed the related documentation for evaluation of corrective actions for various SCRs, PIRs and CAQR's generated by DNE as a result of their calculations review program. The team found the corrective actions reviewed acceptable except for SCR-SQN-EEB-8676, which is documented as Observation EEB-9.

In the instrumentation and controls area the team reviewed the corrective actions of five CAQRs associated with the setpoint accuracy calculation program. In four instances, the corrective actions taken by EEB were deemed to be correct and appropriate. EEB's corrective action for the fifth sample appeared to be too narrow and was deemed to be incomplete. In this instance, instrumentation equipment in the emergency ventilation system for the diesel generator building was stated as being seismic Category I in the FSAR, but the equipment was subsequently found to be unqualified (Refer to Observation EEB-12).

For the CAQRs in the instrumentation and controls area, the team noted that EEB did adequately assess the potential for generic implications at other TVA facilities.

CEB

Civil/Structural

The team reviewed various programs undertaken by CEB to determine the technical adequacy of Sequoyah calculations. The CAQRs generated by DNE as a result of these reviews were also evaluated by the NRC team. CEB technical reviews covered the following areas:

1. Miscellaneous Structural Steel (SQN CEB 87-02)
2. Conduit and HVAC Supports (SQN CEB 87-03)
3. Embedded Plates (SQN CEB 87-04)
4. Civil/Structural Regenerated Calculations (SQN CEB 87-06)

Miscellaneous Structural Steel Review

CEB, after reviewing approximately 400 drawings, selected 54 features to be reviewed in detail. Each feature was located on a different drawing. The existing calculations were then obtained for each feature. The details of this review are included in TVA Review Plan SQN-CEB-87-02 (B41 870204 002). The CEB review showed that most of the calculations for these features were incomplete and that the technical adequacy could not be determined. Therefore, CEB performed additional calculations to determine whether the features met the design criteria. Of the 54 features selected, five failed to meet the applicable design criteria. The corrective actions for CAQRs SQP870188, SQP870209, SQP870210, SQT870550 and SQT870650, which all relate to the miscellaneous structural steel review, are responsive to the problems identified. The CAQRs written showed that 3 features did not properly consider the vendor supplied data in the calculations. CEB feels that there might be a generic concern for failing to use vendor loads properly. CEB will be expanding the sample basis to determine whether a generic problem exists with the use of vendor supplied design input data.

CEB has concluded that with the exception of the concerns raised in the CAQRs, the technical adequacy of the miscellaneous structural steel features has been determined to be acceptable for restart. The NRC team questioned the validity of CEB's conclusion without any further sampling for all features beyond those only dealing with vendor data (Observation CEB-15).

Conduit and HVAC Duct Support Review

In order to determine the technical adequacy of the conduit and HVAC duct supports, CEB reviewed 9 regenerated calculations that were identified as missing by the Sequoyah Design Baseline and Verification Program. The details of this technical review is included in technical review plan SQN-CEB-87-03 (B41 870316 001).

The CEB reviewed recently regenerated calculations (5 conduit and 4 HVAC duct support) and found all of them unacceptable. The two CAQRs written, SQT870843 and SQT870626, documented that the TVA design criteria for both HVAC duct support design and conduit support design are not adequate. In addition, the NRC team believes that the analysis performed was inadequate and the contract personnel used to regenerate these calculations may not have had enough knowledge about the available TVA design criteria (Observation CEB-16).

In response to CAQR SQT870626, TVA has prepared a program, "Sequoyah Nuclear Plant Unit 2 Conduit Restart Evaluation Program Plan," dated May 8, 1987. TVA stated that a similar program was being developed for the HVAC duct supports. The team, however, did not review the conduit program during this inspection due to time constraints.

Embedded Plate Review

CEB performed a technical review of the calculations dispositioning significant condition report SQNCEB8607, which dealt with the failure to consider the effects of free concrete edges on embedded plates. A review plan, SQN-CEB-87-04, was prepared for this evaluation. The CEB review of the calculations, drawings and design criteria showed 11 findings. The more significant findings are summarized below:

1. The location of all embedded plates in question was not determined.

2. The embedded plates qualified to the restart criteria were not tracked for post-restart evaluation.

3. The applicable design criteria were not used appropriately.

CEB has written CAQR No. SQP870963 to resolve all the 11 findings. The NRC team is concerned that there may be other technical problems with these recently generated calculations.

Review of Regenerated Civil/Structural Calculations

In accordance with review plan SQN CEB-87-06 (B41 870323 002), CEB reviewed 11 regenerated calculations determined to be missing by the design baseline and verification program. The sample calculations included subjects such as evaluations for reinforcing bar cuts and design for reinforced concrete, structural steel and equipment supports. CEB reviewers found 3 calculations not to be acceptable. Therefore, an additional sample of 4 calculations have been added to the sample basis. CEB has not reached a conclusion on the technical adequacy of these recently generated calculations, since their evaluations are still ongoing.

CEB Piping/Supports

The team reviewed the nonconformance reports for deficiencies which CEB identified in calculations for each of the four pipe supports in the component cooling water system (CCS) which the DBVP program identified as missing and which CEB regenerated. The team verified that the deficiencies documented in the abstract blocks of CEB's pipe support calculation cover sheets were reiterated in the CAQRs which CEB prepared, or the SCRs which CEB referenced. The team also confirmed that the supplemental pipe support calculations, which Bechtel prepared, properly addressed the deficiencies which CEB identified in the nonconformance reports.

The team also tracked CEB's internal and external generic reviews for the SCRs and CAQRs that CEB prepared to identify deficiencies in the four pipe support calculations which the DBVP program identified as missing and which CEB regenerated. The team found the generic reviews to be acceptable.

3.4 Review of Additional Calculations

MEB

During this inspection the team reviewed approximately 15 MEB calculations. The calculations reviewed were a mix of flow rate calculations, pump head and NPSH calculations and HVAC calculations. The team determined that calculations reviewed used standard, well established methodology applicable to the purpose(s) of the calculations. In some cases, there were unverified inputs and minor discrepancies similar to those observed in the calculation review program. These will be resolved through MEB's planned 100 percent review of its calculations performed prior to January 1986 and followup corrective action.

In addition to the review of calculations listed in the calculation log, the team asked TVA for calculations and analysis showing that adequate ambient temperature is maintained for essential equipment during a loss of station ac power. The Sequoyah Nuclear Plant FSAR commits to achieve and maintain safe shutdown for a condition of loss of station ac power for a period of two hours. The inspection team was provided with calculations of the transient temperature response in the area of the turbine driven auxiliary feedwater pump. The methodology used in the calculations appears adequate. However, the inputs and boundary conditions of the calculations do not appear to address the two hours loss of station ac power condition. On the basis of the calculations made available to the team, it appears that there is not a set of calculations and analysis that systematically address the loss of station ac power. This is the basis for Observation MEB-10.

NEB

The team selected three calculations to be reviewed. The review concentrated on two aspects of the calculational process which are the technical adequacy of; (1) the calculational approach and (2) the independent verification thereof. The calculational reviewed for technical adequacy of approach was TI-870 (B45-861111-236). This calculation was performed by the radiation protection (RP) section of NEB. The team found that the calculational approach used in the RP calculation was technically sound. This was ascertained by interviewing the preparer of the calculation.

The calculations reviewed for technical adequacy of the independent verification process were B45-870529-427 Rev. 1 entitled, "NPSH Calculations for the RHR and Containment Spray Pumps Operating in the Recirculation Mode for Small LOCA" and B45-870529-429 Rev. 1. entitled, "Effect of Nukon Insulation on Containment Sump Performance." The review of the independent verification process involved interviewing the individuals that performed the verification. One of the verifiers was a TVA employee and the other was employed by a contractor. The team found that the independent verification process for these calculations was adequate with one exception. The exception had to do with recognizing the importance or critical nature of assumptions and thereby identifying the need to have them verified prior to plant restart (see Observation GEN-3).

EEB

The team reviewed 10 newly prepared electrical power design calculations to evaluate the technical and procedural acceptability of the calculations. The results of the review are summarized below.

(1) The 6.9kV and 480V auxiliary power system short circuit calculations are technically acceptable, and properly identify the points in these systems where available short circuit duties exceed the applicable ratings of the protective devices applied.

(2) The cable ampacity calculations are technically acceptable. The methodology for determining derating factors for cables routed in conduit, tray, and fire-retardant coatings and wraps is satisfactory, and the sampling techniques used to select a subset of installed cables to be evaluated for adequate ampacity gives reasonable assurance that all deficient cables have been identified. The various approaches being used to mitigate inadequate ampacity conditions are acceptable.

(3) The essential set of component cooling system (CCS) electrical design calculations (including calculations on short circuit duties, CCS pump motor circuit protective device coordination, pump motor and motor-operated valve (MOV) voltage regulation, and pump motor and MOV cable ampacity) are present, retrievable, and technically acceptable.

(4) Discussions with EEB management and with the preparers and verifiers ("checkers") of a substantial sample of EEB calculations (CCS, 6.9kV and 480V short circuit, and containment penetration calculations) indicated that DNE's independent verification procedure is effective and is applied consistently within the EEB.

(5) The only finding the team had is that, despite the existence of a DNE policy requiring all unverified assumptions used in calculations to be identified, tracked, and verified, and a TVA commitment to verify all such assumptions in "essential restart" calculations before SQNP is restarted, there is no clear and consistent procedure in place to ensure that this actually will occur (see Observation GEN-3).

CEB

No additional calculations were reviewed in the civil/structural area of CEB. However, in the piping area the team reviewed the calculations for four pipe supports in the component cooling water system (CCS) which the DBVP program identified as missing and which CEB regenerated. CEB documented deficiencies in each of the pipe support designs, and Bechtel was contracted to prepare a supplemental calculation for each of the pipe supports to resolve the identified deficiencies. Of the 4 pipe supports reviewed the team had the following two concerns:

CEB's calculation for the pipe support H10-635, dated April 28, 1987 (RIMS No. B25 870429 306) noted that the pipe support anchor bolts failed both CEB's current (restart) and design basis (post-restart)

pipe support design criteria. CEB prepared CAQR No. SQT870540 on April 2, 1987 (RIMS No. S13 870407 841) to document this deficiency. Bechtel prepared calculation No. PDPV-H10-635 on May 25, 1987 to address the deficiency identified in the CAQR, and qualified the pipe support anchor bolts. CEB's calculation for the pipe support demonstrated that the pipe support failed when CEB considered friction forces. CEB's restart pipe support design criteria require 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 (see Observation CEB-13, Item 1 of 2).

CEB's calculation for pipe support H10-1219, dated April 21, 1987 (RIMS No. B25 870422 302) indicated that the pipe support snubber swing angle exceeded the vendor's allowable swing angle, and that the snubber clamp which the vendor re-worked prior to installation to accommodate a second support lacked the vendor's original qualification calculation. CEB used SCR SQNCEB8650, which CEB issued on July 30, 1986 (RIMS No. B25 860807 012) and SCR SQNCEB8665, which CEB issued on November 6, 1986 (RIMS No. B25 861126 019) to track these deficiencies. Bechtel prepared calculation No. PDPV-H10-1219 on May 22, 1987 to qualify the snubber and vendor pipe clamp. CEB did not perform a thermal check on support H10-1219. CEB's restart pipe support design criteria requires post-restart consideration of thermal loads. However, CEB did not note this unverified assumption on the pipe support calculation cover sheet, or on CEB's pipe support calculation log for post-restart resolution (see Observation CEB-13, Item 2 of 2).

The team is concerned that out of four calculations the CEB had redone and reviewed by the team, half of them had deficiencies which are considered to be significant.

3.5 Assess TVA's Planned Corrective Actions and Review the Appropriateness of Pre- or Post-Restart Classification

MEB

Of the corrective actions reviewed by the team in MEB, none were identified as having an inappropriate restart classification. The team is satisfied that MEB is providing adequate guidance to identify restart issues.

NEB

The team found that in all cases the corrective actions were required to be completed prior to restart of the units with one exception. The one exception had to do with the modification of the ice condenser drain lines. Currently the lines have installed rubber flex joints and NEB planned to change them to metallic as part of the corrective action. The change to metallic flex joints is planned for after restart. The reason for needing to make the change is based in being able to meet plant lifetime environmental qualification conditions. Since Sequoyah Unit 2 is relatively early in its operating life, the team agrees with the decision to make this modification a post-restart item.

EEB

For each corrective action reviewed by the team during this inspection, the implementation was designated for accomplishment prior to plant restart. The team found these commitments to be acceptable.

CEB

The team could not properly assess this item since TVA had not yet submitted a detailed CEB corrective action program description as requested in NRC inspection report no. 50-327/87-06 and 50-328/87-06. In order to track this item Observation CEB-17 was created.

3.6 Review Discipline Interfaces Including the Use of the Calculational Cross Reference Information System (CCRIS)

As noted in section 3.2 of the inspection report for CEB, EA Concern A-3 noted a lack of coordination between the four lists of essential calculations which NEB, EEB, MEB and CEB were compiling. To address this concern, DNE created a computer data base entitled "Calculation Cross Reference Information System (CCRIS), which DNE intends to become the official calculation log after the computer software, the indexed calculations and cross-references are all verified. All disciplines have identified the "other discipline" calculations that are relied on as sources of input to their essential calculations for entry into the CCRIS data base. EA has accepted DNE's response to their Concern A-3, pending EA's final review of the CCRIS data base. The team concurs with EA's acceptance of CEB's response to Concern A-3 and recognizes that if CCRIS is properly implemented it could enhance the coordination of interfaces between the various disciplines.

A number of Calculation Cross Reference Information System printouts were requested by the team to determine the effectiveness of discipline coordination. The following NRC observations suggest that the coordination between disciplines could be improved: MEB-3,8,10; EEB-7,8,10,11; CEB-1 item 3; CEB-7, items 1 and 2.

ATTACHMENT A - OBSERVATIONS

GENERAL OBSERVATIONS

(Open) GEN-1 - Substantiated Condition for a CAQ

(Open) GEN-2 - CAQ Operability Determinations

During the inspection, TVA withdrew a recent revision to Nuclear Engineering Procedure (NEP) 9.1, thus the team was unable to reach any conclusion on these two observations since the NEP did not reflect TVA's planned corrective action.

(Open - New Item) GEN-3 - Unverified Assumptions

TVA's policy on unverified assumptions is set forth in Nuclear Engineering Procedure NEP-3.1, which requires all unverified assumptions in calculations to be identified, tracked, and eventually verified. Pursuant to NEP-3.1, the cover sheet of each calculation has a checkoff block to indicate whether the calculation contains unverified assumptions, and responsibility for following up on verification is assigned to the lead engineer on each project. In addition to the written DNE policy, TVA management has agreed that all of the unverified assumptions contained in "essential restart" calculations for SQNP must be verified before the plant can be restarted.

The team is concerned that - notwithstanding the policy and TVA's management commitment to verification - none of the technical branches has any procedure in place for ensuring that the unverified assumptions will be tracked and verified, and the corrected results will be applied to calculations that rely on calculations containing unverified assumptions as a source of input. In discussions with the team, DNE acknowledged this problem, but no solution was immediately available. The absence of a control mechanism for assuring the verification of unverified assumptions in design calculations is a significant issue that should be addressed by TVA in a timely manner.

MEB OBSERVATIONS

(Closed) MEB-1 - MEB Design Calculation Review Scope

Enhancements recommended by the NRC inspection team to the MEB design calculation scope of review were incorporated in the program as documented in a memorandum from the MEB Chief Mechanical Engineer to the Manager of the Site Licensing Staff (refer to memorandum B44870428001).

(Closed) MEB-2 - SI Pump Mini Flow Rate

MEB acknowledged that the design criteria for the safety injection system was in error and that it will be updated to reflect a SI pump minimum recirculation flow of 30 GPM to be in agreement with the associated Westinghouse orifice drawing.

(Open) MEB-3 - Water Hammer

This observation addresses design interfaces between the systems group and the pipe stress analysis group (CEB), specifically the handling of water hammer loadings for the containment spray system and the main feedwater system.

The team noted that CEB has performed a water hammer analysis of the containment spray system which documents and demonstrates that the associated loadings are acceptable (Refer to problem number 0600104-02-01 Appendix A dated May 26, 1987). This documentation closes the containment spray system water hammer portion of this observation.

The generic review of the water hammer issue by the team identified that the main feedwater water system water hammer analysis had been completed but not issued. The team noted that the FSAR loading combination for the faulted condition defined in Table 3.9.2-5 chapter 3.9 requires consideration of stress due to design basis accidents. Further, FSAR Chapter 15.4.2.2 defines feedwater pipe as a limiting fault. A review of internal TVA correspondence revealed the following chronology:

> On January 4, 1979, MEB prepared nonconformance report (NCR) MEB-79-1 (RIMS No. MEB 790112800) to indicate that TVA may not have properly considered main feedwater system water hammer at Sequoyah Nuclear Plant, and that other TVA plants might be involved. The corrective action, which CEB detailed on the NCR, specified completion of an analysis of the main feedwater system for water hammer energy, and an evaluation of the main feedwater check valve with respect to its ability to withstand the calculated closing energy assuming a postulated main feedwater line break upstream of the check valve.
>
> On May 4, 1979, MEB provided NRR with a report on the disposition of NCR MEB-79-1 (RIMS No. MEB 790504379) which indicated that TVA had evaluated the main feedwater check valves for the water hammer transient, and that the main feedwater check valves would maintain their function and integrity following the most severe main feedwater line break postulated.
>
> On August 1, 1979, a TVA memorandum from D. R. Patterson, Chief, MEB to R. G. Domer, Chief, CEB (RIMS No. MEB 790802366) noted that:
>
> > "At a recent meeting with C. R. McFarland (NRC-OIE), W. I. Dothard (TVA) was told that assurance of main feedwater piping integrity would be required in addition to the assurance of feedwater check valve integrity by NRC-OIE prior to closure of this open 10 CFR 50.55(e) item (327/79-12-09; 328/79-07-09). Hence, please perform an evaluation of the main feedwater piping to determine whether or not it is capable of withstanding the water hammer forces associated with a closure of the main feedwater check valves following a postulated break in one leg of the main feedwater system."

On June 17, 1983 a TVA memorandum to R. O. Barnett, Chief CEB from J. A. Raulston, Chief NEB (RIMS No. NEB 830617256) forwarded the final design forcing functions for the feedwater system water hammer to CEB for evaluation.

On August 23, 1983 a TVA memorandum to H. J. Green, Director of Nuclear Power from M. N. Sprouse, Manager of Engineering Design (RIMS No. PWP 830823 003) requested authorization to proceed with the subject analysis since

> "This change should be implemented to resolve NCR SQN MEB 79-1. The design effort will include feedwater pipe analysis and possible hanger modifications."

The team notes that CEB ultimately analyzed the main feedwater system at Watts Bar Nuclear Plants for water hammer loads, using the forcing functions which NEB prepared in 1983 (RIMS No. NEB 830617 256). The analysis yielded snubber water hammer loads approximately 10 times greater than the snubber seismic loads. However, CEB never formally documented a comparable analysis for the main feedwater system at Sequoyah Nuclear Plant.

Observation No. MEB-3 remains open pending (a) CEB's documented evaluation of the main feedwater system at Sequoyah Nuclear Plant with respect to the postulated water hammer forces and (b) TVA's justification for not issuing the feedwater water hammer analysis when it was identified by engineering as a licensing commitment.

(Closed) MEB-4 - Potential Generic Condition Evaluation (PGCE)

The team verified that MEB is reevaluating the generic applicability of MEB initiated SCRs and PIRs for Sequoyah on other plants. Instructions (B44870225002) were issued by the Chief Mechanical Engineer to perform this review. Similar instructions have been issued by NEB (945870312233).

(Closed) MEB-5 - EA's Review of CAQRs

EA is now reviewing CAQRs that have the PGCE checked "no" as well as those checked "yes." The latter is accomplished via procedural requirements (NEP 9.1) for all CAQRs that require a PGCE. The former is accomplished via the EA audit process. TVA memorandum B0587031008 from A. P. Capozzi, Manager of EA, to M. R. Harding, SQN Site Licensing Manager defines EA's audit review of CAQR nongeneric determinations. Additionally, the team reviewed an EA audit checklist and verified that EA was performing the review to determine whether items had generic implications and noted that EA had identified a concern that no justification was provided for some determinations that were deemed to be nongeneric.

(Open) MEB-6 - Component Cooling Water System Design Pressure

In response to the team's initial concern that the design pressure of the component cooling water system did not consider pump shutoff head and surge tank relief valve setpoint, MEB revised the subject calculation (B4487020003) to substantiate the existing 150 psig design pressure. This was accomplished by subtracting frictional losses (due to the flow associated with the Hot Shutdown mode of operation) from the summation of static head, relief valve

setpoint and pump head at this flowrate 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 (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 FSAR for Sequoyah, section 9.2.1.2 states "The design pressure (150 psig) for the reminder 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 since:

   (a) it does not address equipment outages due to maintenance, etc.;

   (b) the total developed head of the CCS pump was converted to psi at 120°F water in lieu of 60°F; the assumption that the CCS water temperature is 120°F is not justified, since the 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 flowrate requirements of 3500 gpm/pump, but was inappropriately derived from a scenario associated with the surge tank relief valve discharging at its maximum flowrate which resulted in a CCS flowrate of 3858 gpm/pump.

   (d) the maximum pressure in train B was not calculated. Since train B maybe operated at flowrates 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.

<u>(Closed) MEB-7</u> - Identification of Controlling Calculations

MEB issued an instruction, "Interim Mechanical Engineering Branch Instruction MEB-123.2, Design Calculations" dated June 4, 1987 regarding the identification memorandum of controlling calculations. Additionally MEB has reviewed and verified the classification of all MEB calculations. The team reviewed ERCW system B44870306021 and B44870331007, which are typical of instruction and verification memos issued for each plant system assigned to MEB. Based on the teams review of these memorandums, this observation is closed.

(Open) MEB-8 - Inconsistent Equipment Qualification Temperature

MEB concurred with the NRC observation. However, since the MEB response identified an incorrect CAQR as the corrective action, this observation remains open.

(Open) MEB-9 - Unverified Heat Load Input

MEB could find no reference for the heat load input data used to size room coolers and determine ambient temperatures. As a consequence MEB reviewed all Sequoyah essential HVAC heat loads. In this review it was found that the Watts Bar motor list was used for the Sequoyah heat load calculations. As a result a CAQR SQNMEB8748R1, dated March 2, 1987, was issued requiring that all essential heat load calculations be regenerated. We find the corrective action acceptable, however, this item remains open pending EA verification of the regenerated calculations.

(Open-New Item) MEB-10 - Loss of Station AC Power Calculation

Sequoyah is committed per the FSAR to achieve and maintain safe shutdown following a loss of station AC power for a period of 2 hours. The project does not appear to have a set of calculations and analysis that systematically show that adequate ambient temperature is maintained for essential equipment during this postulated event.

NEB OBSERVATIONS

(Open) NEB-1 - ECCS Pump NPSH

The team was provided with five recently completed and issued calculations that were intended to resolve NRC concern NEB-1. This concern related to the analysis of the containment sump and ECCS pumps at the time of switchover from the RWST to the recirculation mode. The basis for the concern was threefold; (1) effect of water level on the available NPSH for the ECCS pumps, (2) an unverified assumption regarding the temperature of water in the containment sump following a small break LOCA, and (3) effect of the NUKON insulation on the NPSH available. The team found that the five calculations performed by TVA covered each of these areas of concern separately.

(1) Calculation B45-870506-427 Rev. 2, entitled "Containment Sump Minimum Level at Time of Switchover to Recirculation Mode for a Large LOCA", addressed the sump water level for the large LOCA event. Calculation B45-870529-429 Rev. 2, entitled "Determination of Minimum Level in Containment Sump at Time of Switchover to Recirculation Mode Small LOCA," addressed the sump water level for the small LOCA event. Both of these calculations contained an assumption that the crane wall penetrations (both electrical and mechanical) below elevation 693 feet were sealed. This is a critical assumption because if any penetrations are not sealed or leak, water inventory will be lost and thus be unavailable for ECCS. The results of the water level calculations were used as input for calculations. Calculation B45-870528-429 Rev. 1, entitled "NPSH Calculation for RHR and Containment Spray Pumps in the Recirculation Mode for a Large LOCA" and B45-870529-427 Rev. 1, entitled "NPSH Calculations for the RHR

and Containment Spray Pumps Operating in the Recirculation Mode for a Small LOCA."

(2) The small LOCA calculation contained an unverified assumption regarding the temperature of the water in the sump. The temperature assumed was 190°F which is for the large LOCA event. The large LOCA event produces a high degree of ice melt, thus the 20°F of subcooling is justified. The small LOCA event may not produce significant ice melt and therefore a sump temperature higher than 190°F may result.

(3) Calculation B45-870529-429 Rev. 1, entitled "Effect of NUKON Insulation on Containment Sump Performance" addresses the reduction in NPSH available for the ECCS pumps due to the frictional losses caused by the fibrous insulation (NUKON) partially blocking the sump screens. The calculation used the head loss correlation developed in NUREG-0897 Rev. 1 dated October 1985 which is dependent on screen velocity and thickness of material deposited on the screen. Both of these parameters are in turn a function of screen blockage. The calculation assumed a blockage factor of 30 percent without proper verification.

The team determined that a minor nonconservative change in either the sump temperature for the small LOCA or the screen blockage may result in inadequate NPSH for an ECCS pump. Also the short and long term operability of the ECCS depends on maintaining the water inventory of the containment sump which requires the crane wall penetration seals. These seals need to be capable of withstanding both the normal operating conditions of the plant (prior to the need for the ECCS) as well as the conditions under which the sump and ECCS is expected to function.

Due to the critical nature of the three assumptions; (1) existence of the crane wall penetration seals and their functionality throughout plant life, (2) sump water temperature for the small LOCA, and (3) screen blockage factor, - the team concludes that verification of these assumptions should be performed prior to restart.

(Open) NEB-2 - Wide Range Containment Pressure Transmitters

Several aspects of this observation were discussed with TVA personnel during the inspection. Because TVA has not yet determined which specific actions will be taken, the team was unable to close the following issues: (1) required instrument accuracy, (2) its use in plant emergency procedures, and (3) its possible replacement with a more accurate instrument. The issue of the provision for proper containment isolation will be addressed by NRC's Office of Special Projects.

(Closed) NEB-3 - Essential Setpoint Calculations

In HVAC calculation SQN-APS5-005, one of five criteria provided for determining whether setpoint calculations were essential or not involved a determination of sensor redundancy. TVA revised this calculation to eliminate this redundancy criterion, and determined that this criterion had never been used in any other setpoint calculation. On this basis, the team closed this observation.

EEB OBSERVATIONS

(Open) EEB-1 - Battery and Charger Sizing

This observation was related to the errors in the calculation for sizing of the Class 1E batteries and the battery charger. EEB had failed to address the total loading on the batteries, in rush currents of the loads, and used the connected load of the inverters instead of the inverter's name plate rating.

The team reviewed EEB's revised calculation and noted that it was performed using Sargent & Lundy's validated computer program which considers all the technical attributes stipulated by IEEE-485, and is acceptable to the team. This calculation was performed using the inverter's maximum load on the batteries (17.5 KVA) instead its nameplate rating of 20 KVA. Using an inverter loading of 17.5 KVA, the calculated size of the battery was found to be exactly equal to the installed size. An alternate calculation performed by EEB using the nameplate rating of the inverters demonstrated that installed batteries would be inadequate. EEB informed the team that they intend to establish design and administrative controls to prevent any kind of load increase on the inverters in excess of 17.5 KVA. In addition, EEB committed to reevaluate the sizing calculation for the battery and charger whenever a change in the loading of the DC system occurs. EEB stated that a submittal related to the aforementioned preventive actions will be sent to the NRC. Until the NRC staff reviews the above submittal this observation will remain open.

(Open) EEB-2 - Breaker Coordination

(Open) EEB-3 - 120V AC and DC Solenoid Valve Voltage

Corrective actions related to these observations were not finalized and the related documentation was in a draft stage. Therefore, the team could not perform an evaluation and these observations remain open.

(Closed) EEB-4 - Setpoint Accuracy Calculation for Replacement of Rosemont with Gould Transmitters

The setpoint accuracy calculation for the containment annulus differential pressure transmitters addressed the installed Rosemont transmitters, and had not been updated to reflect their planned replacement with Gould transmitters. EEB revised the calculation to eliminate this ambiguity which satisfactorily resolved the team's concern.

(Closed) EEB-5 - Assumed Value Error for Sensor Measurement and Test Equipment Accuracy

In a TVA calculation for RWST level transmitters, a minor error was noted for the assumed value of test equipment accuracy. TVA corrected the particular calculation to eliminate this error. This observation is closed.

(Open - New Item) EEB-6 - Turbine AFW Time Delay Relay Setpoint

An MEB calculation for the turbine driven AFW pressure switch setpoint (B44 870323 001 Rev. 5) established process safety limits of 50 and 110 psig with a 25 second maximum time delay for the electrical interlock controls. QIR MEB 86021 communicated the 25 second time delay requirement to EEB; however, the

present design provides for a 60 second time delay, which does not satisfy the 25 second time delay limitation. In this instance, a hardware modification appears necessary. TVA initiated a CAQR during the inspection to correct the time delay relay setpoint. This observation remains open pending description of the associated corrective action.

(Open - New Item) EEB-7 - HVAC Temperature and Flow Process Safety Limits

MEB 480 volt board room air handling unit temperature switch setpoint calculation B44 860819 004 Rev. 0 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.

(Open New Item) EEB-8 - Setpoint Accuracies for HVAC Temperature and Flow Instrumentation

MEB HVAC calculation B44 860819004 Rev. 0, which addressed a number of HVAC temperature and flow instrumentation loops, contained predicted accuracies for a number of instruments that did not conform with either the 40 degree minimum or the 104 degree maximum process safety limits. This calculation did not provide any indication that these nonconformances were unacceptable or that additional resolution was required by EEB. This calculation also stated that setpoint calculations were not required for flow switch setpoints used to initiate operation of the backup HVAC train even though these instruments perform a safety-related function.

(Open - New Item) EEB-9 - Containment Electrical Penetration Protection

SCR-SQN-EEB-8676 identified a concern that higher trip settings have been used to protect the circuits of the penetration assemblies Nos. 52 and 53 against continuous overcurrents. The conductor size used for these electrical penetrations was 12 AWG, and the maximum allowed current through these conductors, without damaging the penetration is 16 amps in accordance with IEEE-317-1983. A trip setting of 20 amps will allow the 16 amps limit to be exceeded without the short being detected in the 16 amp to 20 amp range. In addition, the penetration manufacturer recommended the current to be limited to 6 amperes. The team feels that the allowed current, in excess of 16 amps, may result in reduction in the life and/or leakseal capacity of the penetration assembly.

(Open - New Item) - 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.

(Open - New Item) - 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.

CEB OBSERVATIONS

(Closed) CEB-1 - Rigorous Piping Analysis N2-67-8A

To address items 1 and 2 of this observation CEB is revising the piping physical and stress isometric drawings to agree with the as-built dimensions of the 1-inch branch line. CEB has also reanalyzed the branch line to confirm that the piping and associated relief valve meet the required qualification limits, and will revise the rigorous piping analysis to reference the branch line reanalysis. These actions adequately address the team's concern and items 1 and 2 are closed.

Item 3 of this observation noted that the procurement documents for the 1-inch by 2-inch TVA Class C relief valve installed in the 1-inch branch line exempted the valve from the seismic qualification requirements specified for TVA Class B and C valves in the FSAR and TVA design criteria. Item 3 has been transferred to NRC Office of Special Projects (OSP) for review and disposition, and is closed for the purpose of this inspection report.

(Open) CEB-2 - Structural Steel Sizing Calculations

(Open) CEB-3 - Structural Steel Details

(Open) CEB-4 - Platform Steel Calculations and Drawings

(Open) CEB-5 - Revisions to Steel Platform Calculations

(Open) CEB-6 - Seismic Loads for Steel Platforms

Observations CEB-2 through CEB-6 raised various concerns about structural adequacy of the steel platforms at the Sequoyah Nuclear Plant. To account for these concerns, CEB has revised significant condition report SCR SQNCEB8711 to perform reanalysis for various steel platforms. The corrective action stated that five platforms would be selected for reanalysis. This reanalysis would be performed using as-built information obtained from walkdowns. In addition, CEB would perform walkdowns on five randomly selected miscellaneous steel structures and five structural steel features to determine whether there are significant attachments or changes in configuration which were not considered in previous analysis and design. Although the walkdowns had been completed prior to the NRC inspection, the computer reanalysis of the platforms had not been finalized. NRC observations CEB-2 through CEB-6 will be kept open pending CEB's conclusion on the structural adequacy of steel platforms at Sequoyah Nuclear Plant.

(Closed) CEB-7 - Rigorous Piping Analysis N2-67-3A-4

Item 1 noted that CEB had not documented an evaluation of a replacement valve motor operator in revision 1 of the rigorous piping analysis. To address item 1, CEB regenerated the computer analysis study run originally performed to evaluate the valve motor operator change, and will revise the rigorous piping analysis to document the evaluation.

Item 2 noted that the rigorous piping analysis did not correctly evaluate the as-built gap dimension for one of four pipe supports, and did not evaluate the as-built gap dimension for a second pipe support. To address item 2, CEB reevaluated the as-built gap at pipe support HERCW-10 to confirm that the existing clearance is adequate. CEB has revised the rigorous piping analysis to document the reevaulation. CEB has also evaluated the as-built gap at pipe support HERCW-14 and concluded that insufficient clearance exists to accommodate the pipe movement in the unrestrained direction. CEB has revised the calculation for pipe support HERCW-14 and will modify the pipe support as part of the SMI 1-317-24 program prior to Unit 2 restart.

Item 3 noted that the rigorous piping analysis incorrectly documented the qualification documents for two Unit 1 pipe penetrations instead of Unit 2 pipe penetrations. To address item 3, CEB is compiling a complete list of the mechanical penetrations and load data to verify the penetration data documented in rigorous piping analyses. CEB will also document all Unit 2 penetration loads on penetration load tables post-restart. The team considers the aforementioned corrective actions to be adequate and this observation is closed.

(Closed) CEB-8 - Qualification of Seismic Category I Buried Pipe

This observation noted that CEB could not retrieve the seismic qualification documents for the seismic Category I buried ERCW pipe which runs between the ERCW pumphouse and the auxiliary building.

To address this observation, CEB has identified the extent of buried ERCW and Fire Protection pipe at Sequoyah Nuclear Plant which requires seismic qualification, and has documented the qualification of the buried pipe in a CEB calculation entitled "Analysis of Buried Piping Requiring Seismic Qualification" (RIMS No. B41 870326 031). This corrective action closes the team's observation. However, it should be noted that the team did not perform a detailed technical review of TVA calculation due to time constraints.

(Closed) CEB-9 - Reinforcing Bar Cut Evaluation

This observation demonstrated that the evaluation performed for reinforcing bar cuts in CEB calculation PWP 840929 705 failed to consider seismic loads on the slab. In response to this observation, CEB has performed an additional analysis, B25 870519 300, shows that the slab is structurally adequate when seismic loads are considered. Therefore, this observation is closed.

(Closed) CEB-10 - Weld Evaluation for Conduit Support

The team's review of CEB calculation B25 850304 300 for a conduit support design showed that weld evaluations for structural members were not considered. In response to this observation, CEB has performed additional analysis of these welds, as shown in CEB calculation B25 870223 800. This

evaluation showed that the welds are adequate to carry the loads imposed. Therefore, this observation is closed.

(Open) CEB-11 - Pipe Rupture Evaluation for Concrete

The team's review of CEB calculation PWP 840920 705 showed that concrete and reinforcing steel allowable stresses were exceeded for the pipe rupture evaluation. No technical justification was given for this overstress situation. In response to this observation, CEB issued CAQR SQP870183. CEB has already performed a finite element analysis of the slab in question to show that it is structurally adequate to carry the pipe rupture loads. CEB is in the process of conducting a review of the environmental drawings to determine whether other areas are affected by pressure loads. This observation is kept open pending the conclusion of this evaluation by CEB.

(Closed) CEB-12 - Use of Variable Damping of Conduits

The team's review of CEB calculation B41 851105 028 demonstrated that a variable damping value was used to determine the seismic loads for conduit supports as listed in TVA design criteria SQN-DC-V-13.10. The FSAR commitment specifies a constant damping value for all frequencies. Since this observation has been forwarded to NRC Office of Special Projects for resolution, it is considered closed for this inspection report.

(Open - New Item) CEB-13 - Regenerated CEB Pipe Support Calculations

The team reviewed the pipe support calculations which CEB regenerated for pipe supports 1-H10-555, H10-635, H10-680 and H10-1219. These pipe supports are located in the component cooling water (CCS) system.

The team notes the following:

(1) CEB's calculation for pipe support H10-635, dated April 28, 1987 (RIMS No. 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 which Bechtel prepared to address the CAQR.

(2) CEB's calculation for pipe support H10-1219, dated April 21, 1987 (RIMS No. 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 post-restart. However, CEB did not note this unverified assumption on the pipe support calculation cover sheet, or on CEB's pipe support calculation log for post-restart resolution.

(Open - New Item) CEB-14 - Engineering Assurance Acceptance of CEB's Corrective Action Program for Rigorously Analyzed Pipe Supports

EA Observation C-1 of Engineering Assurance audit report 87-09, dated February 10, 1987 (RIMS No. 805 870210 001) noted that CEB could not retrieve many of the pipe support calculations required to demonstrate pipe support adequacy in accordance with design criteria SQN-DV-V-24.1. EA also noted that CEB was generating calculations for modifications to pipe supports which lacked

original calculations. EA accepted CEB's responses to EA Observation C-1, subject to additional EA review. However, the team considers EA's acceptance of CEB's program to identify and regenerate missing pipe supports to be premature, based on the team's review of CEB's pipe support program during the period June 1-5, 1987. The team's review indicated that CEB has not yet documented a corrective action program to address the generic implications of CEB's design verification of 201 of the 791 pipe support calculations which the DBVP project identified as missing and which CEB regenerated.

(Open - New Item) 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 1 feature per drawing. Therefore, the number of features reviewed might be a small percentage of the total number of miscellaneous structural steel features at Sequoyah. The NRC team questions the validity of CEB's conclusion that miscellaneous structural steel is technically adequate without increasing their sample size.

(Open - New Item) 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 9 calculations showed that the analysis performed was incomplete and inadequate, specifically clamps and welds were not evaluated. The findings also demonstrate to the team the contract personnel used to regenerate these calculations lack knowledge about the applicable CEB design criteria and need specific training regarding TVA standard practices.

(Open) CEB-17 - CEB Corrective Action Program Description

This observation was created to track a previously identified NRC request. NRC letter from J. M. Taylor to S. A. White dated March 5, 1987 stated:

> "We await receipt of written information requested during the inspection describing the current calculation review effort scope. In particular we will be concerned with the description of the scope and depth of past reviews (beyond the standard quality or design verification calculation check) that TVA is relying upon to justify not examining civil engineering calculations in the current review program."

Also NRC inspection report 50-327/87-06, 50-328/87-06 forwarded to TVA on April 8, 1987 stated in Section 4.3 for CEB the following request:

> The team noted that the specific CEB program description needs to be formally submitted to the NRC in order that NRC can assess the CEB calculation effort scope of review. One particular concern is the scope and depth of past reviews (beyond the standard quality or design verification calculation check) that TVA is relying upon to justify not examining civil engineering calculations in the current review program. NRC reviewed two calculations in an area which TVA was not planning to review based on the CEB review of previous verification programs. In one of these calculations, the NRC found an unjustified assumption for concrete compressive strength of 6300 psi vs. 4000 psi as stated in the FSAR and that

allowable stress in concrete and steel had been exceeded by 19% and 16%, respectively, also without justification (OBS CEB-1). This observation has given NRC cause to question TVA's methodology for determining which areas in CEB require further review. TVA was requested to provide justification of their rationale for excluding certain areas of CEB design from being reviewed on a sampling basis for technical adequacy. In this regard TVA was also requested to provide descriptions of the scope and depth of previously conducted internal and external reviews that they are using as a basis for not performing current detailed technical reviews of calculations similar to what has been done in the other three technical branches.

ATTACHMENT B

List of Persons Contacted

Name	TVA Organization/Title
Beth Hall	SQN Licensing Engineer
W. Pennell	Manager, Engineering and Technical Services
R. W. Cantrell	Assistant Manager DNE
D. L. Williams	Manager, Knoxville Licensing
R. C. Weir	NEB Chief Engineer
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R. Barnett	CEB Chief Engineering
R. O. Hernandex	CEB Assistant Chief Engineer
K. S. Seidle	CEB Assistant Chief Engineer
W. S. Raughley	EEB Chief Engineer
J. Hutson	EEB Assistant Chief Engineer
A. Capozzi	Manager Engineering Assurance
F. E. Denny	EA
M. P. Berardi	EA
J. P. Little	MEB
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F. Carr	MEB
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S. E. Gibson	MEB
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H. Mayes	MEB
J. B. Hubble	MEB
R. S. McKeehan	NEB
D. G. Renfro	NEB
K. D. Keith	NEB
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ATTACHMENT B

List of Persons Contacted (Cont'd)

Name	TVA Organization/Title
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J. Peyton	CEB
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J. Rochelle	CEB
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