

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
NUCLEAR QUALITY AUDIT AND EVALUATION
REVIEW REPORT

SEQUOYAH NUCLEAR PLANT
LOOK BACK REVIEW OF CABLE ISSUES

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REVIEW TITLE: Sequoyah Nuclear Plant (SQN) - Review of Cable Issues

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I. INTRODUCTION

Three calculations were prepared in 1987 to support the acceptability of the SQN restart cable testing program. However, it was determined in 1989-1990 that these calculations were not finalized (i.e., reviewed and approved) prior to completion of the cable testing program. As a result, in July 1990 TVA Nuclear Quality Assurance was requested to perform a review of circumstances surrounding the failure to finalize these calculations.

II. PURPOSE

This review of the circumstances surrounding the failure to finalize three calculations which were necessary to support and document the acceptability of the cable testing program for SQN was performed to determine:

- A. The cause or contributing factors that led to the failure to finalize the calculations.
- B. The extent that the condition (failure to finalize necessary calculations) might exist elsewhere.
- C. The adequacy of data input to conduit selection calculation (SQN-CSS-009) which will be used in the new conduit ranking effort.

III. APPROACH

The approach used in this review included:

- A. Evaluation of the adequacy of program controls for calculations at the time of SQN restart and present.
- B. Review of past audit/surveillance reports and evaluation of the calculation population and sub-populations to determine if other instances of failure to complete necessary calculations existed.
- C. The determination of the adequacy of data input to calculation SQN-CSS-009 which will be used in the new conduit ranking effort.
- D. Interviews with personnel involved in the cable issues program to determine their understanding of the circumstances and responsibilities relative to the SQN conduit selection calculation SQN-CSS-009.

IV. RESULTS SUMMARY

- A. Adequate procedural controls were in place during preparation of the subject calculations. These controls address the calculation process including review and approval, design outputs, and the licensing identification and tracking of commitments. Some enhancements could be included in procedures regarding the use of preliminary calculation results and CCRIS to track unapproved calculations but the lack of these enhancements are not considered contributing factors to the failure to finalize these calculations (see Recommendations, Section V.A.8).
- B. Implementation of these procedural controls was not achieved through responsibility assignments and consequently the controls were not followed.
- C. No single apparent cause to finalize the calculations was identified during this review, but the factors which potentially contributed to the failure to finalize the calculations are:
 1. Responsibility assignments between Electrical Corporate and Site Engineering were not clearly established and effectively implemented for these calculations.
 2. There were three different Lead Electrical Engineers at SQN during the months calculation SQN-CSS-009 was being prepared. At one point (approximately July 13, 1987) the acting lead electrical engineer packaged the July 13, 1987 draft of SQN-CSS-009, mailed it to corporate engineering for review, was assigned to a new issue, and a new lead electrical was assigned to SQN.
 3. The intention to document implementation of the conduit selection criteria in a calculation was not identified and tracked as a commitment to NRC.
 4. The calculations were not needed to directly support the design basis (essential calculations) and were not design change calculations. Further, calculation SQN-CSS-009 appears to have been an afterthought for formal documentation of previous work aimed at justifying the cable test program cable selections.
 5. The summary report in 11/20/87 NRC submittal referenced calculations SQN-CSS-009 and -011. Calculation SQN-CSTF-008 was an input to -009. This report was prepared/checked/reviewed/approved leading some personnel to believe the cable issues including the referenced calculations were completely resolved.
 6. United Engineers and Constructors (UE&C) was thought of as an independently managed group reporting directly to lead SQN electrical engineer with no detailed technical oversight performed by TVA for calculations SQN-CSS-009 and -011.

7. Task Package 007 (contract TV-72992A) was closed without ensuring that calculation SQN-CSS-009 was finalized.
 8. The Operational Readiness/SAL closure process failed to ensure calculations were finalized prior to closeout of the cable issue. Responsibilities for closure of the cable issues were outlined, but implementation of these responsibilities did not include ensuring the calculations were reviewed and approved.
- D. Reviews of past audits/oversights/surveillances, documentation supporting other restart programs, status of calculations identified in Calculation Cross Reference Information System (CCRIS) and interviews with engineers in various disciplines responsible for calculations indicate that the failure to finalize required calculations is a limited condition. During the above process, only one additional calculation was identified that was prepared and checked but had not been reviewed and approved. This calculation is being added to the corrective action plan for the existing condition adverse to quality report (CAQR SQP900305) dealing with the failure to finalize the original three cable test program calculations.
- E. Originally this review intended to evaluate the adequacy of the data from calculation SQN-CSS-009 to be used in the new program. However, the results of Nuclear Engineering's evaluation of the data collected by UE&C for the original conduit selection for cable pullbys indicate errors in compiling the raw data. These errors necessitate either re-verification or justification of the data prior to its use in the screening equation and finalizing the calculations. This effort, as well as the resolution of other issues addressed by SQN-CSS-009 (jamming and lack of cable support in vertical conduits) is being evaluated by the QA forward look plan.

V. REVIEW DETAILED RESULTS

A. PROGRAM CONTROLS PAST AND PRESENT

General: A review of applicable program controls in place, prior to SQN restart and present, was performed to determine if any procedural weaknesses existed that may have contributed to the failure to finalize calculations. Following are discussions of the procedures evaluated and the applicability of the procedures to the three cable test program calculations (SQN-CSTF-008, SQN-CSS-009, and -011) which were not finalized. The critical timeframe for the review and approval of the subject calculations was April-September 1987. Therefore the procedure revisions in place at that time were reviewed, as well as present revisions.

1. NEP-3.1, Calculations, Rev 0 issued 7-1-86, Rev 1 issued 9-27-87:

Section 2.5 states that the initiating manager is responsible for generating and issuing calculations. For project calculations this person is the Lead Electrical Engineer. For branch calculations the person is the Assistant Branch Chief. Section 4.1.1 states that the initiating manager determines what calculations are necessary to support the discipline's scope of work, assigns the title, and enters the calculation into CCRIS. Section 4.1.1 also states that CCRIS is maintained to record all new calculations and to track inputs or unverified assumptions requiring later confirmation. For OL plants, section 3.3 permits engineering output documents, that support a modification to be issued prior to actual issuance of mini-calculations, providing the mini-calculation has been reviewed and approved. Section 3.5 and the policy statement of section 2.0 of NEP 3.2 indicates that calculations which are used as support to design input or design output are to be reviewed and approved. Section 4.1.6 indicates that the initiating manager ensures the calculation is satisfactory, conforms to procedural requirements, and is approved and issued. Revision 1 provided added assurance and clarification to the calculation signature sequence, unverified assumptions, and the review process but did not change the requirement for review and approval of calculations.

Calculation SQN-CSTF-008 was initiated by the Electrical Branch personnel in Knoxville. The calculation was prepared and checked by Knoxville engineering personnel and apparently informally transferred to the SQN site for independent review and issue. There is no indication that site personnel accepted responsibility for reviewing, approving, and issuing the calculation. The calculation was formatted and structured to conform to NEP-3.1. The calculation was not entered into CCRIS for tracking.

Calculations SQN-CSS-009 and -011 were initiated by the SQN electrical engineering discipline utilizing contractors from United Engineers & Constructors. Both calculations were prepared and checked by contractor personnel. Both calculations use the format and cover sheet of TVA's NEP-3.1 procedure which indicates intended compliance with TVA's engineering procedures. Calculation SQN-CSS-011 was initialed in the reviewer block by a responsible TVA engineer however no further work toward reviewing, approving, and issuing either calculation was evident. Both calculations were entered into CCRIS with the notation of PENDING.

Calculations SQN-CSTF-008, SQN-CSS-009, and -011 do not directly support the design basis (i.e., they are not essential calculations) and do not support a design modification (and therefore do not fit within the mini-calc definition). However, Nuclear Engineering (NE) chose to define these analyses as calculations. Since the calculations were not finalized, it appears that preliminary calculation results were used in subsequent engineering work (i.e. cable test program). NEP 3.1 does not specifically prohibit the use of preliminary calculation results prior to the actual issuance of the calculation although it is implied in regard to the traceability of output documents to their input sources. (CAQR SQP900305 was initiated by SQN Electrical Engineering to address deficiencies in the implementation of NEP 3.1 for these calculations.)

2. NEP-5.1, Design Output, Rev 0 issued 7-1-86, Rev 2 issued 12-13-89

Section 3.1 states that the design basis of output documents will be traceable to their design inputs. Output documents shall not be approved and issued until directly supporting input documents have been prepared and approved. Section 4.2, added via Rev 1 on 2-11-88, permits the use of unapproved design input due to unusual circumstances providing a variance to the NEP is requested for the specific case (The example given enables earlier initiation of long-lead procurement items). Except for Section 4.2, the design output requirements have not significantly changed between the time the subject calculations were in production stages and the time of this review.

Calculations SQN-CSTF-008, SQN-CSS-009, and -011 serve as input data to the cable test program's special test instructions (STI's) in which the worst case conduit/cables were tested. The calculations were not finalized but results were used in the cable test program. Additionally no variance was requested to permit use of unapproved input data. CAQR SQP900305 was initiated to address this deficiency.

3. NEP-1.3, Records Control, Rev 0 issued 7-1-86, Rev 1 issued 3-8-88: Attachment 1 of the procedure indicates that the Chief Discipline Engineer (Electrical) / Lead Discipline Engineer (Electrical) are the responsible managers for issuing calculations. Revision 1 did not impact calculation responsibilities which were in place at the time these calculations were being produced.

Calculations SQN-CSTF-008, SQN-CSS-009, and -011 were initiated by assigning calculation numbers and work progressed through the prepared and checked process but were never reviewed, approved, and issued.

4. NEP-2.1, Licensing Support, Rev 0 issued December 31, 1986, Rev 2 issued June 23, 1989:

Section 3.3.1 states that when a commitment is made to the NRC which has an effect on NE's scope of work, the commitment will be tracked to closure by the Corporate Commitment Tracking System (CCTS). Section 3.3.5 indicates that upon completion of the commitment, the NE organization responsible for implementation shall prepare a closure package with objective evidence that documents the actions taken for completion to ensure the commitment has been fully implemented. Neither revision 1 nor revision 2 impacted requirements for tracking commitments in place at the time these calculations were being produced.

The July 31, 1987 letter to the NRC (L44870731803) pertaining to "REVISED CABLE TEST PROGRAM" documents in enclosures 2, 3, and 4 that implementation of the cable criteria for pullbys, jamming, and vertical drops from 90 degree condulets will be documented in calculations. However enclosure 6, which documents the Cable Test Program Commitments, did not identify the intention to document implementation of the cable criteria via calculations. As a result the intention to issue calculations was not tracked by CCTS and the commitment closure packages did not require verification of calculations.

5. ONP-STD-6.1.1, MANAGING AND TRACKING NRC COMMITMENTS, Rev 0-C issued 9-21-88 and SQA135 Rev 5(issued 5-6-87), Commitment Management, Tracking, and Closure (current Rev 9 issued 9-14-89):

This standard establishes administrative controls and provides for the process of managing, maintaining, and tracking ONP commitments to NRC using the Corporate Commitment Tracking System (CCTS). Section 2.1.3 of the standard indicates that the originator of a document to the NRC ensures that commitments identified in the document are listed on a separate enclosure and are clear and concise. Appendix D further indicates that commitments are properly determined by referring to their context within the submittal and that if the stated message conveyed to NRC is that an action will be started or completed at a later date, then a commitment has been made. Later revisions of SQA-135 (Revisions 6-9) did not impact requirements for identifying and tracking commitments in place at the time these calculations were being produced.

The July 31, 1987 letter (L44870731803) to the NRC did not identify in enclosure 6 that calculations were to document implementation of the cable criteria. As a result this intention was not tracked and was not addressed by the commitment closure packages. The calculations were not verified to have been reviewed, approved, and issued prior to notifying the NRC of completion of the cable test program.

6. ONP-STD-6.1.4, Managing TVA's Interface With The NRC, Rev 0 issued 3-31-89 and SQA196 Rev 0 issued 4-28-87 (current Rev 6 dated 5-30-90 cancelled):

This standard establishes administrative controls and provides standard methods for managing the licensing interface between the NRC and TVA. Section 2.2.1 of the standard assigns the technical lead to coordinate and prepare responses to the NRC and to document evidence of commitment completion for closure verification. Later revisions of SQA-196 (Revisions 1-6) did not impact requirements for identifying and tracking commitments which were in place at the time these calculations were being produced.

The July 31, 1987 letter to the NRC and the associated commitment closure packages only addressed verifying completion of the cable testing. Since formal issuance of calculations was not identified as a requirement or commitment to support the cable test program, no commitment closure documentation was provided to address these calculations. Finalization of calculations was not noted in enclosure 6 of the letter as a specific commitment and was not being tracked for completion.

7. Conclusion: Adequate procedural controls were in place during preparation of the subject calculations. These controls address the calculation process including review and approval, design outputs, and the licensing identification and tracking of commitments. Essentially the same calculation controls are currently in effect. As outlined in the Results Summary, adequate procedural controls existed for production of calculations, but clear responsibility assignments were not made. Consequently, the calculations were not reviewed and approved.
8. Recommendations: As an enhancement it is recommended that specific restrictions on the use of preliminary calculation results prior to the actual approval of the calculation be incorporated into NEP-3.1. Additionally it is suggested that CCRIS be used to track unissued calculations to ensure timely issue and increase management's attention on overdue, unapproved calculations.

B. DETAILED RESULTS OF EXTENT OF CONDITION

1. Review of Audits/Oversights/Surveillances for Similar Conditions

As part of the review to determine the potential extent of the failure to finalize calculations, prior QA activities (audit/surveillances/oversight reports) were reviewed. The purpose of this review was to determine the type of calculations included and if similar conditions had been previously identified and, if identified, whether appropriate corrective action had been taken.

Table I lists Nuclear Quality Assurance (NQA) and Engineering Assurance (EA) activities that included reviews of calculations. These reviews were conducted at various intervals throughout the pre-restart timeframe and continued after Unit 2 restart. TVA prepared and contractor prepared calculations were included in the reviews. The larger scope reviews mainly addressed the availability and adequacy of calculations necessary to support the essential calculation program and design changes. These reviews did not reveal any instances of failure to review and approve calculations. The calculations prepared to support the SQN cable testing program do not fit the categories of essential calculations or calculations to support design changes. (The calculations prepared to support the SQN cable testing program actually compiled existing data from various plant records such as cable pull cards and documented which physical configurations met the criteria defined in the calculations. The conduit configuration sketches generated during this effort and included in the SQN-CSS-009 calculation did receive QE&C third party verification.)

There was one calculation, System Boundary Calculation (similar to those prepared for cable testing), that was reviewed by EA during EA oversight of DBVP. This calculation had been reviewed and approved as required.

Conclusion: The review of audits/surveillances/oversights indicates that the failure to finalize calculations is limited to special, unique applications and issues (i.e., non-essential calculations, non-design change related calculations).

TABLE I

QA ACTIVITIES REVIEWED

1990 FIRST QUARTER - QA MONITORING

OCT 1989 - NQA&E TECHNICAL AUDIT - SQA89916

JAN 1989 - EA TECHNICAL ASSESSMENT OF ESSENTIAL CALCULATIONS - M88-01

DEC 88 - EA PROGRAM AUDIT - SQE88901 OF SQEP

SEP 88 - MAY 89 - MONTHLY M&PQ SURVEILLANCES OF UE&C TASKS

JUN 88 - M&PQ AUDIT OF UE&C - 88P-35

JAN 88 - M&PQ AUDIT OF UE&C TASKS - 88P-18

APR 87 - EA TECHNICAL AUDIT OF DNE CALCULATIONS - 87-09T

DEC 86 - M&PQ AUDIT OF UE&C TASKS

2. Review of Special Programs

Since the review of the results of prior NQA and EA activities indicated that the use of unapproved calculations is not a problem with essential calculations and design change calculations, a review of special programs, a review of calculation status information in CCRIS and interviews with NE personnel were conducted to further bound the condition.

A sample of electrical issues from the SQN and WBN Nuclear Performance Plans which were applicable to all TVA nuclear plants was selected for review to determine if they made use of unapproved calculations which support engineering test programs and were not related to essential calculations and plant modifications. This sample was selected because it was believed to potentially involve calculations more closely related (in type) to the three calculations known to be unapproved.

The disposition of each issue was reviewed to determine the methods used and if supporting calculations were required. The disposition methods used were discussed with applicable electrical engineering specialists (see Exhibit A) who were involved in the closure of the selected issues. The review team reviewed the status of the calculations to ensure that the required calculations had been approved. No deficiencies were noted. However, the review of CCRIS indicated that Electrical Engineering had 69 calculation numbers assigned in CCRIS for which calculations have not been issued.

The review team initially selected a sample of 10 of these calculation numbers to determine if any represented instances where the results of unapproved calculations had been used. This review identified one unapproved calculation where the results had been used (the other calculation numbers represented instances where the calculation had been issued but CCRIS had not been updated, or the calculation was in process to support an in-process DCN, etc.). The one calculation (SQN-APC-002) was prepared in 1986 to support an NRC request to determine the effect of starting a reactor coolant pump on the 6.9 KV shutdown board voltage during post-accident conditions. (The calculation does not meet the definition of essential calculation, does not support a modification, and does not affect plant operability.)

As a result of the above, a review of all electrical calculation numbers listed in CCRIS as unissued (69 calculation numbers) was performed by the electrical discipline to determine their status with the following results:

12 calculations had been issued but CCRIS had not been updated.

46 calculation numbers had been taken out but not used - calculation not required.

7 calculations were in progress to support in progress DCNs

4 calculations required but not issued.

Of the four calculations listed in CCRIS as required but not issued, three calculations were related to cable testing and known to be unapproved at the time of this review. The fourth calculation is the one identified by the review team during the review as discussed above.

Interviews with lead and senior engineers in the Civil and Mechanical/Nuclear disciplines indicated that these disciplines do not enter calculation numbers into CCRIS until the calculation is issued. Calculations are tracked by responsible section supervisors and the lead engineers until issue. The electrical discipline generally enters calculation numbers into CCRIS when a calculation is determined to be required. In addition, the Civil discipline uses the CAQR process to track and close calculation deficiencies. The personnel interviewed (see Exhibit B) indicated that their respective disciplines have not encountered any unapproved calculation problems similar to those in the Electrical discipline.

To substantiate the above, a CCRIS printout dated 7-18-90 and special sorts of the CCRIS database were reviewed to identify any calculations which had been assigned numbers but not finalized by disciplines other than electrical. The electrical calculations discussed above were the only ones found during the review.

In addition, the SQN and Watts Bar Nuclear Performance Plans was reviewed to determine if disciplines other than electrical had stated commitments or similar issues which required the issuance of calculations outside the scope of the essential calculation program. No similar cases were noted for the above disciplines.

Conclusion: Based on the above, the failure to finalize calculations is a condition limited to the electrical discipline. In addition to the three calculations associated with cable issues only one additional calculation was discovered that had not been finalized.

EXHIBIT A

1. Contact-to contact and coil-to-contact isolation: Discussed with EE Specialist on 8-7 & 8-8-90. A calculation had been finalized for contact-to-contact isolation. A calculations was not necessary for coil-to-contact isolation which was justified based on the original design for SQN using ratings which would withstand the maximum credible voltage on the coils and contacts.
2. Acceptability of inductive load switching devices: Discussed with EE Specialist on 8-7 & 8-8-90. Calculations were not necessary to support this issue. The above was resolved based on SQN having sufficient operational data to support acceptability of devices and any deficiencies would show up under the maintenance program.
3. Devices which must have thermal overload and torque switch bypass capability: Discussed with EE Specialist on 8-7 & 8-8-90. Calculations had been finalized by both EEB and NTB to resolve this issue.
4. Required clearances between cables/raceways and hot pipes/valves: Discussed with EE Specialist on 8-7 & 8-8-90. Electrical calculations were not necessary. Mechanical Engineering color coded drawings to identify hot pipes/valves and plant walkdowns were done per SMI's O-317-46 and O-317-76. Deficiencies were resolved by rework of cables or addition of insulation to reduce temperature to which the cables would be exposed.
5. Acceptable cable bend radius limits: Discussed with EE Specialist on 8-13-90. A calculation was issued to support revision of the Electrical design standard on bend radius. The NRC issued a Technical Evaluation Report (TER) on SQN cable acceptable bend radius limits and accepted cables based on TVA establishment of a long-range monitoring program for failures. The above approach was based on bend radius contributing mainly to long-term degradation of cables.
6. Documentation of 1E cable splices including their location: Discussed with EE Specialist on 8-13-90. SQN documentation of cable splices and location was handled by the Environmental Qualification Program for those splices subject to harsh environments. No specific calculations were required for this issue.
7. Explicit cable sidewall bearing pressure restrictions: Discussed with EE Specialist on 8-13-90. These problems were first identified at WBN where calculations were done on 81 conduits which exceeded manufacturer's recommendations. Special tests were performed to demonstrate that higher SWBP's were acceptable. After the above was completed for WBN, calculations were issued for 20 worst case conduits at SQN to demonstrate acceptability of SWBP.

EXHIBIT B

8-2-90 - Lead Electrical Engineer:

The lead electrical engineer indicated he was not aware that the calculations supporting the cable test program had not been finalized until recently. Most of the associated work had been performed prior to his taking the electrical lead position. The electrical discipline enters calculation numbers into CCRIS as soon as the numbers are assigned for needed calculations and these are shown as pending calculations in CCRIS until they are issued. The electrical CCRIS coordinator was assigned to assist NQA as needed to provide CCRIS printouts and associated information.

8-7-90 - Lead Electrical Engineer:

NQA selected 7 past electrical issues to review for unapproved calculations and discussed these with the Electrical lead engineer. A request was made for Electrical to provide information as to the method used to disposition each issue and define which ones required the issue of calculations not associated with plant modifications. The lead engineer deferred the above to the EEB specialists which were involved with the issues during the applicable timeframes and arranged for these personnel to be available via telecon. Telecons were held on each issue and the results are discussed on Exhibit A. Also, during this meeting, the Electrical lead engineer was informed that the NQA review of CCRIS printout dated 7/18/90 revealed that there were 69 calculation numbers assigned by electrical which had not been finalized. A request was made for the Electrical CCRIS coordinator to provide additional information such as purpose, status, and title of a sample of 10 of the 69 unapproved calculations. Note: a request to provide information for all of the unissued calculations was made to the acting lead on August 13, 1990 and they are addressed in section V.B.2 above.

8-2-90 - Lead Mechanical Engineer:

The Mechanical discipline tracked needed calculations via responsible section supervisor logs and does not enter numbers into CCRIS until calculations are issued. No unapproved calculations similar to the ones in Electrical have been noted by Mechanical. Required Mechanical calculations were system related and included in the essential calculation program. The Mechanical Lead was confident that all required mechanical calculations have been issued.

8-13-90 - Lead Nuclear Engineer:

Nuclear calculations required were tracked via CCTS and TROI and were not entered in CCRIS until they were issued. NPP commitments such as 10CFR50.49, superheat, and DBVP boundary calculations were issued pre-restart. The NPP commitment on MELB is a post-restart issue which is being completed now. Through use of CCTS and TROI the Nuclear discipline feels certain that all calculations committed to have been properly tracked such that they do not have a condition similar to the Electrical discipline

EXHIBIT B (Continued)

8-13-90 - Lead Civil Engineer:

Some essential calculation efforts are still ongoing as approved post-restart activities. The effort to incorporate old Field Change Requests (FCRs) is continuing and the FCR closure process will ensure calculation issue or revision. NPP commitments on thermal effects on steel platforms and miscellaneous steel are post-restart and continuing under the original Significant Condition Reports' (SCRs) corrective action plans. Two employee concerns on thermal effects are in the closure process now. The civil discipline used the CAQR process to identify and track calculation problems such as missing calculations, etc. When a need for a calculation is identified, the responsible section supervisor may assign a number and track it until issue. Civil does not enter calculation numbers into CCRIS until the calculation is issued. The Civil lead is not aware of any calculations similar in nature to the electrical ones and believes that the civil discipline is systematically tracking all required calculations through issue.

Throughout the review engineers and managers familiar with the work accomplished during and after restart were contacted.

C. Adequacy of Inputs Used in Unissued Calculation

An evaluation of the inputs used in the pullby portion of approved SQN-CSS-009 calculation was performed by Electrical Engineering with Quality Assurance oversight. This evaluation was performed by selecting a random sample of conduits and then researching the cable pull card files to verify that the original input data in the calculation was valid. The evaluation found several errors involving incorrect pull dates, cables not identified in conduits, improperly identifying the number of cables in pullbys, and failure to identify all conduits with seven or more cables. Therefore a 95 percent confidence level could not be established by the sample. During the above evaluation, site quality staff personnel noted that the respective revision levels of the cable pull card data used in the calculation had not been documented. This problem was discussed with Electrical Engineering and early evaluations indicated that the contractor which prepared SQN-CSS-009 may have utilized uncontrolled records of the cable pull cards which do not contain cable pulls which were performed after the 1981 timeframe when SQN changed to the modification workplan process. Under the workplan process cable pull information is recorded on data sheets in the workplan package.

Based on the above information, SQN Electrical Engineering has initiated a process to obtain the latest cable pull data from the applicable records, generate field sketches of missed conduits, and verify the acceptability of existing sketches (approximately 450). The above information will be used to rank the conduits for comparison with the originally performed testing. Site quality staff will provide oversight of these recovery efforts.

Additionally it was noted in TVA's letter of July 31, 1987 to the NRC that enclosure 3 states under the cable jamming selection criteria (number 5) "the total length and number of bends between a set of adjacent pull points exceed.....". However, calculation SQN-CSS-009 section 4.2 cable jamming criteria (number 6) states "the total length and number of bends in the conduit (not necessarily between potential pull points) exceed....". The difference in these two approaches were addressed in a meeting between the review team leader and Electrical Engineering's cable specialist.

During the above meeting, six conduits were selected from the cable jamming portion of Calculation SQN-CSS-009 (5 which the calculation indicated exceeded G-38 Appendix F and 1 which did not). The application of the criteria as stated in the calculation was reviewed by determining the conduit lengths and degrees of bend between pull points (except for C-type condulets). The conduit segment containing the most degrees of bend (or one containing a large number of bends) was then selected to determine if it exceeded G-38, Appendix F. For the 5 conduits which the calculation indicated G-38, Appendix F was exceeded and the 1 which the calculation indicated G-38, Appendix F was not exceeded, this review produced the same results for the conduit segments chosen. Electrical Engineering plans include consideration of the cable jamming issue prior to closure of this cable issue. The QA forward look will track engineering's work on the jamming issue.

D. Interviews

Interviews were conducted with eight TVA employees, one former Stone & Webster (S&W) employee, one former United Engineers and Constructors (UE&C) employee, and three current UE&C employees. They were chosen because of their probable involvement with the conduit selection calculation SQN-CSS-009.

A standard questionnaire was developed. It included questions concerning the individuals current job, his job at the time of calculation SQN-CSS-009, his understanding of the quality assurance/administrative controls for calculations and their applicability to the subject calculation, his position on the need for a CAQR on the non-issuance of the calculation, his position on TVA technical ownership for the calculation, his knowledge of whose QA program the calculation would be issued under, his knowledge of any QA reviews of the calculation, and his knowledge concerning the circumstances surrounding the fact that the calculation was unapproved.

Several interviewees responded with "I don't know" or "I cannot recall" answers to some of the questions. For those who could remember, there was general agreement on the following:

1. NEP 3.1 governed the issuance of all calculations, is applicable to the subject calculation, and its requirements were not met in this case.
2. The calculation was to be issued under TVA's QA program.

For those who responded, there was general disagreement on the following:

1. The need for a CAQR.
2. Technical ownership (site engineering versus corporate engineering) of the calculation.

In general, responders could not recall any UE&C or TVA QA oversight of the subject calculation.

From the interviews conducted, clear indications were given of contributing factors leading to unapproval of the conduit selection calculation as follows:

1. Assignment of technical ownership of the calculation was not clearly established as the site project or corporate engineering.
2. Three different site project lead or acting site project lead electrical engineers existed and changed roles during the critical times the calculation was being developed.

3. The UE&C employees were initially brought in to work under a staff augmentation arrangement and some individuals (TVA and Stone and Webster) thought of them as an independently managed site electrical engineering group working directly for the lead electrical engineer. Consequently, there was no detailed technical review of their work by TVA.
4. The documentation of the previously completed conduit selections as a calculation appears to have been an afterthought by TVA to formally document previous conduit selection work which backs up the cable test program.
5. Some individuals believed the 11/20/87 submittal to the NRC with the enclosed test summary report brought complete closure to the cable issue program. For example, the TVA individual closing out Task Package No. 0007 (Contract TV-72992A on completion of cable test program) indicated that boxes and boxes of data provided to TVA by UE&C and the test summary report provided the backup test program documentation needed to close this task package.

The following comments were considered significant and additional reviews were conducted and other interviews addressed them as a result:

The former S&W employee (who was the cable issue technical expert for TVA corporate electrical engineering) indicated he recalled an early July 1987 marathon telecon which involved UE&C, site and project electrical engineering, and himself. He indicated he had comments concerning the fact that the criteria in the calculation he had reviewed did not match that supplied to NRC.

He further indicated he was concerned that the calculation as stated could possibly lead to failure to identify the worst case conduits. He believed it was understood there was technical significance to his comments when someone from UE&C indicated the criteria as stated in the NRC submittal was not exactly how they determined the worst case conduits. (No TVA or UE&C individuals interviewed could confirm this telecon.)

As a result of the above comments, the three versions of calculation SQN-CSS-009 electrical engineering had were reviewed. These were a 7/7/87, 7/9/87, and 7/13/87 version of the calculation. The criteria for the pullby, jamming, and vertical support issues are consistent between these three versions. Based on TVA's current cable specialist's recollection of comments concerning the application of the cable pullby criterion seven, it was reviewed. This criterion is the same among the three versions of the calculation, but the description of its application changes between all three versions. Further, the top 12 ranked conduits are the same for all three versions of the calculation, but conduits ranked 13-20 changed between the 7/9/87 and 7/13/87 versions. The test summary report enclosed with the 11/20/87 NRC submittal on cable issues agrees with the 7/13/87 version of cable pullby conduit ranking and indicates these are the conduits for which cables were tested. (None of the UE&C people interviewed recalled the above changes.)

In addition to the above, the review team compared the cable pullby, jamming, and vertical support criteria from the 4/8/87 and 7/31/87 NRC submittals on cable issues. There is consistency between the criteria in the two submittals. Further the criteria from the submittals is consistent with 7/7/87, 7/9/87, and 7/13/87 calculations criteria with the exception of cable jamming.

The cable jamming criteria in the calculation appears to come from a draft of a 3/24/87 D. W. Wilson to M. R. Harding memorandum. The issued version of the memorandum agrees with the NRC submittals and is referenced in the 7/9/87 and 7/13/87 versions of calculations. The biggest criteria difference is the criterion which involves the length and number of bends in a conduit. The calculation criteria indicates "the total length and number of bends in the conduit (not necessarily between potential pull points)" and the NRC criterion indicates "the total length and number of bends between a set of adjacent pull points" should be used to determine if G-38 requirements are exceeded. As a result of this difference in criteria, the review team leader met with TVA's cable specialist to determine the likelihood of technical significance associated with the difference and there appeared to be none. (This was outlined in section V.C of this report.) (None of the UE&C people interviewed recalled the above differences.)

In addition to the above, the review team reviewed contract task package No. 0007 (TVA Contract Number TV-72992A). This package was initiated 9/17/87. The task objective is give as demonstrating the integrity of installed LE cables subject to potential installation and operation damage. One of the six deliverables listed for the task package is "Test Program (Backup) Documentation." The review team tried to determine what this backup documentation was. There was general agreement from the people interviewed that this should have included calculation CSS-009. The task was closed out 9/22/88 without verifying the calculation was finalized. Further, the Operational Readiness (OR)/Sequoyah Activities List (SAL) closure of cable issues was reviewed. The OR closure criteria for cable issues has five objectives for closure of the item. Objective 4, Criterion 4.1 indicates the project manager was to address calculation packages to ensure they were complete and retrievable. This OR item and SAL item 657 on cable issues were closed out without verifying issuance of SQN-CSS-009, -011 or SQN-CSTF-008.

DOCUMENTS REVIEWED

<u>RIMS NUMBER</u>	<u>SUBJECT</u>
S06880218839	Memorandum from T. D. Knight to RIMS on Operational Readiness Attachment A Intentions
L44900817804	Letter to NRC from E. G. Wallace dated 8/17/90 on SQN Units 1&2 Cable Test Program
S06880223812	Operational Readiness (OR) Attachment A Intentions [#56]
S06880223829	Operational Readiness (OR) Attachment A Intentions [#105]
S06880223813	Operational Readiness (OR) Attachment A Intentions [59]
L17870622802	QA Review of SQN Operational Readiness [cable routing]
S06870608888	SQN U2 Operational Readiness Second Interim Report
S06870620801	SQN U2 Operational Readiness Second Interim Report
S08870311825	QA Review of SQN Operational Readiness Assessment Issues
S08870406805	Operational Readiness Assessment Issues
B05860617004	SQN - Startup Issues
B05870904001	EA Review of SQN - Operational Readiness Issues
B05880210003	EA Review of SQN - Operational Readiness Issues
S08880310869	QA OR Assessments Performed by SQN Site Quality
S08880314829	QA Review of SQN Operational Readiness
B05880210003	SQN - EA Review of SQN Operational Readiness Assessment Items
B05861224016	DNE EA Audit 87-08
B05890613005	Transmittal of EA Surveillance Records
B05870424001	DNE EA Audit 8709(T) - DNE Calculation Review Effort
S08900426872	SQN - QA Assessment of NE Deliverables First Quarter 1990
B05880920005	NE EA Audit 8709(T) - NE Calculation Review Effort - EEB
B05890123010	SQN U1 - EA Technical Assessment of Essential Calculations - M88-01
L19891006803	NQA&E Technical Audit Report SQA 89916 - SQN DBVP
B05881206005	DNE - EA Program Audit SQE88901
B82880930002	SQN - TVA Contract TV-72992A - United Engineers & Constructors
B82870917009	Completion of Task Test Program, Contract Task Package NO.0007
B25870325005	Memorandum from D. W. Wilson to M. R. Harding dated 3/24/87 on SQN Units 1&2 - Response to Cable Pulling Concerns
N/A	Memorandum to SQN QA File from R. E. Alsup on Scope and Intent of Cable Issue Look Back Review
S14880216875	Memorandum from D. F. Kunsemiller to T. D. Knight dated 2/16/88 on Sequoyah Activities List Closure of Operational Readiness Identified Items
L44870731803	Letter to NRC from R. L. Gridley on SQN Revised Cable Test Program dated 7/31/87
L44870408802	Letter to NRC from R. L. Gridley on SQN Cable Test Program dated 4/8/87
L44871120803	Letter to NRC from R. L. Gridley on SQN Cable Test Program Procedures, Data, and Results dated 11/20/87
B25900904011	Memorandum from P. G. Trudel to R. E. Alsup on Resolution of Electrical Engineering CCRIS Pending Calculations

DOCUMENTS REVIEWED CONTINUED

<u>DOCUMENT NUMBER</u>	<u>SUBJECT</u>
N/A	SQN Nuclear Performance Plan dated 5/9/88
N/A	SQA191 - Evaluation of Operational Readiness Prior to Plant Restart
N/A	M&PQ Records for Audits 87P-05, 88P-18, & 88P-35
N/A	WBN Nuclear Performance Plan Volume IV
NEP - 1.3 R1	Records Control
NEP - 3.1 R1	Calculations
NEP - 5.1 R2	Design Output
NEP - 2.1 R1	Licensing Support
ONP-STD-6.1.1	Managing and Tracking NRC Commitments
ONP-STD-6.1.4	Managing TVA's Interface with the NRC
SQA 135 R9	Commitment Management, Tracking, and Closure
SQN-CSTF-008	Unissued Calculation on cable jamming
SQN-CSS-009	Unissued Calculation on cable pullby, jamming & vertical support (7/7/87, 7/9/87 and 7/13/87 drafts)
SQN-CSS-011	Unissued Calculation to support wet testing
N/A	CCRIS printout for Electrical dated 8-8-90
INSIDE NRC	July 2, 1990 article on NRC scrambling to check alleged cable testing flaws at TVA's SQN
CAQRSQP900305	CAQR on technical errors in cable pullby portion of calculation SQN-CSS-009
SQN-APS-002	Unissued calculation on effect of RCP start on 6.9 KV shutdown board - post-accident voltage
SQN-CSS-013 R1	Contact to contact isolation
SQN-CLS-006 R1	Contact to contact isolation
SQN-E5-007 R1	480V AC APS Class 1E load coordination study
SQN-EQP-40 R3	Effects of superheat on 10 CFR 50.49 cables in main steam valve vaults
EEB-CSTF-0006 R0	Cable bend radii for various conduit bodies
SQN-E5-002 R0	Identify 1E medium voltage and 1E coaxial, triaxial, and twinaxial cables in conduits that have fittings that may cause cable bend radius violations
SQN-E5-006 R0	Analysis of Class 1F/CSSC cables and cable splices in underground duct banks
SQN-E2-035 R1	Thermal/seismic qualification of Class 1E flex conduits
SQN-ISL-001 R2	SQ-CAR-87-014 instrument inspection list
SQN-E2-015 R3	Identifying sidewall pressure violations
SQN-E2-031 R1	Sidewall bearing pressure for Class 1E free air drops
SQN-E2-034 R0	Cable sidewall pressure analysis for worst case configuration of conduit jumpers
N/A	Technical justification - TOL heater shorting bar sizing
1-TMR-65-80-A R1	Time delay relays for EGTS pressure switch logic

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