TENNESSEE VALLEY AUTHORITY

NUCLEAR SAFETY REVIEW STAFF

NSRS REPORT NO. I-85-992-SQN

EMPLOYEE CONCERN: XX-85-122-030

FINAL REPORT

SUBJECT: CONTROL OF AC AND DC ELECTRICAL LOADS

DATES OF INVESTIGATION: JANUARY 21-MARCH 31, 1986

INVESTIGATOR: John Mashburn — J. W. MASHBURN — 4/4/86 DATE

REVIEWED BY: D. J. Hornstra — D. J. HORNSTRA — 4/4/86 DATE

APPROVED BY: M. A. Harrison — M. A. HARRISON — 4/4/86 DATE

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I. BACKGROUND

The Nuclear Safety Review Staff (NSRS) conducted an investigation to determine the validity of an employee concern that came anonymously by letter to the Quality Technology Company (QTC)/Employee Response Team (ERT). The concern was given by QTC in the following statement:

> Sequoyah: Inadequate management, control, and status listing of AC and DC electrical loads, including diesel generator loads. This involves inadequate control of or preparation of calculations for loads, and inadequate management and control of load margins, including electrical loads and mechanical loads (heat, BHP, etc.) that translate into electrical loads. CI has no further information. Anonymous concern via letter.

II. SCOPE

A. The concern statement defined the scope of the NSRS investigation.

B. The investigation began with an examination of the requirements in 10CFR50 and the commitments in the FSAR for control of electrical loads, calculations, and margins. It included a search of the records for the past five years on the TROI system (a comprehensive computer data base) for NSRS, QA, or NRC reports on this subject. Interviews were conducted with responsible P&E (Nuclear) design engineers and managers to determine their awareness of problems and the status of work in this area. Current and past procedures, design criteria, engineering reports, nonconforming condition reports, and significant condition reports were examined. Finally, the preliminary results of the Design Basis Task Force chaired by Charles Bowman and the Sargent and Lundy (S&L) project for electrical calculation program assessment were reviewed, and TVA employees once assigned to the Clinch River Breeder Reactor (CRBR) were asked to contrast the TVA electrical design program to the program specially developed for CRBR.

The Design Basis Task Force and S&L reports provide some specific action items for which the Nuclear Engineering Division is responsible. Those specific action items are not included in the scope of this report's recommendations.

III. SUMMARY OF FINDINGS

A. <u>FSAR Commitment Lacking</u>

The SQN FSAR is very weak in the area of electrical design criteria and standards. The listing of criteria (section 8.1.5) is preceded by this disclaimer:

"It is TVA's <u>belief</u> that the design meets the <u>intent</u> of these standards and guides."

The listing of criteria includes some absolutely required items such as 10CFR50 Appendices A and B. There is no list of standards for which full compliance is claimed. The standard to which an SAR should be compared is defined by NUREG-0800, "Standard Review Plan" (formerly 75/087). Relevant paragraphs from chapter 8, section 8.1, are as follow.

> III. Review Procedures - The PSB reviews Section 8.1 of the SAR to be sure the following items are included:
> . . . the design bases, criteria, standards, regulatory guides, and technical positions that will be implemented in the design of the electric power systems, including a discussion describing the extent to which these criteria and guidelines are followed and a positive statement with regard to conformance of the design to each.
>
> III.3. PSB will confirm that the criteria and guidelines identified as being applicable to the design of electric power systems include those listed in Table 8-1. The SAR should include a discussion regarding the applicability of the criteria and guidelines listed and a statement to the effect that the will be implemented (CP) or are implemented (OL) in the design of electrical power systems.

B. Design Implementation and Control

1. Requirements for Design Control

10CFR50 Appendix B Criterion III, "Design Control," requires measures to be established for assuring incorporation of regulatory requirements and design bases into specifications, drawings, procedures, and instructions. This includes incorporation of quality standards and controlling deviations from the standards, as well as identifying design interfaces and coordinating participating design organizations. Design changes must be controlled commensurate with measures used to perform the original design.

10CFR50 Appendix B Criterion V, "Instructions, Procedures, and Drawings," requires that activities affecting quality be prescribed by documented instructions, procedures, or drawings. It requires they include acceptance criteria for determining that important activities have been satisfactorily accomplished.

Regulatory Guide (RG) 1.64 endorses ANSI N45.2.11, and TVA has committed to conform to it in the NQAM, Part IV, Section 2.

qui[redacted]nts for the Design of Nuclear
, "Design Analyses," calls for
ntation of assumptions and
sumptions that must be verified as the
3.2, "Review of Changes," requires
her than the original designer is to
l have access to pertinent background
ated competete in the specific design
an adequate understanding of the
the original design.

ck of Design Control

ews undertaken by EEB core sections,
worked for years producing detailed
closed oversights and omissions that
ering and hardware fixes (for example,
requirements were not properly
gn process of cable sizing"). A
and Lundy is showing a large number of
done or records not kept. EEB
tified causes of these problems to
scriptive procedures and thorough
lculations, maintaining configuration
aintaining margins, identifying and
ect[redacted]ngineering groups, and updating
er, [redacted]re are activities currently
tablishment of a Nuclear Procedures
olem. This is a commitment in Section
orate Nuclear Performance Plan dated

? margin in Electrical Design Standard
relevant to the stated concern:

uences the results of
? performance is the lack
load information at the
;s are set. Experience has
ıl load information is
ıl capacity is added for
eliminary design figures
anticipate this load

power supply systems is advised by
t to the capacity for margin. As the
urement of actual load equipment and
HP[redacted]uirements, etc., the 25
sec[redacted]

Clearly, the process of converting the preliminary design to the ultimate, as-constructed design while maintaining a proper set of calculations is a challenge to the design organization's ability in configuration management, coordination, and thoroughness in every aspect of its activity.

4. Design Basis Has Not Been Documented

The S&L review has shown serious deficiencies in the documented design basis for BFN, SQN, and WBN plants. For example, an excerpt from the February 25, 1986 preliminary results meeting notes reads as follows.

a. Auxiliary Power

Virtually no calculations that are retrievable exist to document the design basis for the following:

- o Unit station service transformers sizing.
- o Common station service transformers sizing.
- o Nonsegrated phase bus duct sizing.
- o 6.9-kV switchgear sizing.
- o Diesel generators sizing.
- o 6900 - 480-volt transformers sizing.
- o 480-volt switchgear sizing.
- o 480-volt motor control centers.
- o Heat generation by electrical equipment for HVAC system sizing.

All calculations that may have been prepared in these areas were informal and are not retrievable. However, none of the above calculations are required for restart.

TVA Standard Design Specifications currently exist which cover the sizing of power cables. However, it cannot be determined if these documents were actually used as a basis for the Sequoyah design or if the Sequoyah design conforms to them. Additionally, calculations for special, large cables (e.g., diesel generator feed, main switchgear feeds) that are not covered by standards are required for restart. These calculations are not available.

System loading calculations have been prepared as a basis for performing the safety-related system voltage calculations. The data in these loading calculations, however, have not been presented in terms of amperes and used to substantiate the current-carrying capability of the transformers, distribution equipment, or cables. This substantiation, in some form, for safety-related equipment is required for restart. It should also be noted that loading calculations for nonsafety-related 480-volt buses are not available. However, these calculations are not required for restart.

Virtually no calculations that are retrievable exist to document the voltages and short circuit currents expected at nonsafety-related 480-volt buses and equipment. All calculations that may have been prepared in this area are either out of date or informal and not retrievable. However, these calculations are not required for restart.

No calculations that are retrievable exist to address bus transfer time. All calculations that may have been prepared in this area are informal and not retrievable. Slow bus transfer does not affect safety-related equipment. Therefore these calculations are not required for restart. However, fast bus transfer does affect safety-related equipment and is required for restart.

b. Control Power

Virtually no calculations that are current and retrievable exist to document the design basis for the following:

- Battery, battery charger, and dc distribution equipment sizing.
- Alternating current (ac) power supply and distribution equipment sizing.
- Voltage, loading, short circuit and protective device selection, and coordination for the nonsafety-related control power system.

All calculations that may have been prepared in these areas were informal and are not retrievable. However, none of the above calculations are required for restart.

No formal calculations exist to document loading on the ac and dc control power systems. These calculations or other documentation are required for restart.

No calculations exist to document the voltage profile of the safety-related batteries during discharge, their ability to supply loads, or the recharge time of the safety-related batteries.

c. In the Area of Cable Derating

(1) Results of manufacturer's tests to determine cable ampacity derating factors due to fire stops and fire coatings were apparently transmitted to project designers for their use. However, documentation was not available to provide evidence that this information was factored into the design.

(2) The effect of cable tray covers on cable ampacity was judged to be negligible. However, no calculations are available to support or document this judgment.

(3) The effects of increased cable tray fill on cable ampacity is handled on an exception basis. However, no documentation was available for review.

Cable derating calculations are required for restart.

The tested fire withstand rating of cable penetration fire stops is influenced by the cross sectional area of cables passing through them. Calculations (or other controls) are required to ensure that the tested configurations envelope designed and installed configurations. No calculations were available in this area. These calculations are required for restart.

No calculations were available to document and control cable tray loading. These calculations are necessary to control and ensure that (1) cable weight loads in trays do not exceed those for which the cable tray system was structurally designed and (2) cable depth of fill does not exceed that on which the cable ampacities were based. These calculations are necessary for restart.

The Division of Nuclear Engineering has concurred in these assessments and is making plans to deal with them. One remaining obstacle for the Division of Nuclear Engineering in correcting design deficiencies at SQN is that budgetary approval for such needed engineering work has not always been given by higher management. Due to the current program improvements in the TVA nuclear program, NSRS assumes this will not be a limitation in the future.

5. Management and Control of Load Margins and Interfaces

As described in section III.B.3, the electrical system calculated data base has not been kept up, including keeping track of margins (excess capacity) throughout the systems. This is illustrated by the statement in the S&L report, "No formal calculations exist to document loading on the AC and DC control power systems."

Additionally, both S&L and the CRBR engineers were aware that the major loads on the electrical system are large motors, typically driving pumps. Such loads are characterized by motor performance curves and pump performance curves, so the actual electrical load is an indirect result of the hydraulic and thermal condition at a point in one of the plant's fluid systems. Thus, electrical design is downstream of and dependent on mechanical design. As noted in section III.B.2, interfaces between groups, especially discipline groups, present a challenge to the Division of Nuclear Engineering's organizational structure.

S&L electrical engineers were accustomed to accounting for the mechanical (actual) demands on the electrical system and made the following recommendations which were deemed outside the scope of their and EEB's work:

Additional Calculations Required to Support Plant Design Basis

a. Large Motor Sizing - Evidence should be in place prior to restart to ensure that Class 1E motors have been appropriately sized to drive the connected equipment. Conditions to be evaluated include maximum connected equipment driving requirements, normal and reduced voltage conditions, starting and continuous duty operation. Evidence could be in the form of calculations, vendor-supplied information, test results, or previous operating experience. In case of the latter two of these items, successful operation under worst case conditions should have been demonstrated.

b. Alternating Current Motor Operated Valves - Evidence should be in place prior to restart to ensure that Class 1E ac motor-operated valves have been appropriately sized to successfully function when required to do so. Conditions to be evaluated include operating time, normal and reduced voltage, starting and running, and torque and limit switch settings. Evidence could be in the form of calculations, vendor-supplied information, test results, or previous operating experience. In the case of the latter two of these items, successful operation under worst-case conditions should have been demonstrated. (A similar statement was made for dc motor-operated valves, but SQN does not have any.)

A recent problem illustrative of the poor interdisciplinary information flow is ECN L5842. A venturi (mechanical element) was changed in ECN L5842, affecting the electrical load of the auxiliary feedwater pump, but affected electrical calculations were not updated because an electrical drawing was not identified for change during ECN development.

Based upon these examples, the Division of Nuclear Engineering has not included sufficient mechanical calculations in their electrical load studies to have control of the actual margins, even though it is recognized in the industry that this is necessary. A discussion of margins of all types is given in the draft report of the Design Basis Task Force, showing the relationship of the various types and what should be captured in a Design Basis Document. The list includes design margins, safety margin (numerical), operating margin, and safety margin with allowance for instrument errors.

6. Configuration Information System Inadequate

The following examples of inadequate configuration information were noted during this investigation.

a. A notable result of the equipment qualification project (EQP) was the discovery that the diesel generator calculations were based on the solid-state exciter design because TVA had bought the solid-state equipment for an upgrade, but had never installed it. This miscommunication as to the configuration meant the plant was operated without calculations for the actual diesel generator system, and the calculations on file were for a system not installed. The information is still not under control however, because it has since been discovered that a nonconforming condition exists in the supplied solid-state cabinets for WBN and the fifth diesel at SQN; but no one remembered that the warehoused exciters at SQN were the same, and so they were overlooked until NSRS questioned their status during an investigation.

b. SQN DCR 1505 was implemented in 1983 to prevent load shedding of the Hotwell pumps upon unit trip, leaving loads on the system that were designed to be removed for this condition. Site management implemented the change, invalidating the electrical analysis; and it was three years before EEB core staff happened to become aware of the change and reacted.

The general weakness in configuration control is becoming recognized. The Manager of Nuclear Power listed this as a key problem in his update to the NRC on TVA's problems March 11, 1986. The Design Basis Task Force recognized the value of strict documentation controls in their draft report: "Although not part of the design basis of the nuclear facility, all detailed engineering drawings and documents derived from the design basis as well as 'as-constructed' and/or 'as-tested' system and physical drawings and documents are required to establish the base line of the facility."

IV. CONCLUSIONS AND RECOMMENDATIONS

The concern was substantiated. There has been inadequate management, control, and status listing of ac and dc electrical loads. While this investigation was limited to SQN, findings in section III about the Division of Nuclear Engineering are generic to all TVA plants.

The investigation showed TVA to be in a period of growing self-awareness involving these issues. The conclusions and recommendations presented here are not contradictory to some of the reports recently and imminently being produced by the Division of Nuclear Engineering and its contractors.

I-85-992-SQN-01, Weak FSAR Commitments in Electrical Area

Conclusion

There are no positive commitments to regulatory guides or industry standards in the SQN FSAR electrical section (section 8). In fact, even the required regulations and standards are not clearly listed as commitments in section 8. Words like "belief" and "intent of" do not convey commitment. The extent to which the Regulatory Guides are met is unclear.

Recommendation

Develop a statement of commitments for section 8 that describes the extent to which the listed Regulatory Guides are met. Review other SQN FSAR sections for similar needs to clarify the extent of commitment. This should become part of the planned annual update activity. [P-3]

I-85-992-SQN-02, Margins Not Controlled and Managed Adequately

Conclusion

There is a consensus among reviewers (Design Basis Task Force, S&L, and this investigator) that the Division of Nuclear Engineering has never adequately focused on management of margins. It is an important subject worthy of a special program, across discipline lines, to establish the margins for the design basis of the nuclear plants. It cannot be adequately done within each discipline because of the interactions, such as pump horsepower requirements on the electrical system.

Recommendation

Establish a program, perhaps by a task force or committee from all disciplines within the Division of Nuclear Engineering, to follow the suggestions on margins of the Design Basis Task Force and those S&L recommendations discussed in section III.5 and develop a formal system for control of margins. [P-3]

I-85-992-SQN-03, Configuration Information System Inadequate

Examples given in section III.B.6 indicate that an effective system for maintaining correct and current information on the disposition of purchased equipment, design changes, and the status of planned modification work would reduce the instances of errors leading to SCRs. Such information must be provided systematically to vendors doing analyses as well as to engineering and modifications groups to achieve the end of reducing errors of omission or oversight about the actual status or disposition.

Recommendation

As part of the current procedures-improvement program, address the method for providing status of ECN implementation, disposition of SCRs, and location of purchased equipment to engineering, modification, and vendor organizations whose work may be affected. If a single procedure or a clearly related set of procedures is not desired, a response to NSRS explaining the alternative chosen would be necessary to close this item. [P2]

DOCUMENTS REVIEWED IN INVESTIGATION I-85-992-SQN
AND REFERENCES

1. Audit deviation report D51-A-84-0006-D01, July 2, 1984, "Inadequate System to Ensure Calculations are Updated to Support Design Changes Made After Plant Operation" (OQA 840801 503)

2. Clinch River Breeder Reactor Plant Specification 3067-12-21, "Diesel Generators, Class 1E," October 1981

3. TVA Electrical Design Standard DG-E2.2.2 dated December 1, 1982

4. OE Procedure OEP-07, "Calculations," April 26, 1985, R0

5. EEB-EP 22.25, "Auxiliary Power Load Information System - Development, Review, Verification, Maintenance, and Use," July 1, 1985 (B42 850702 502)

6. SWP EP-43.13, "Cable Schedule Handling Procedure," April 1, 1982, R5

7. SCR SQNEEB8532, "Voltage at Equipment Terminals Inadequate" (B43 860130 916)

8. SCR SQNEEB8619, unchecked data was provided for vendor-supplied safety-related calculations, February 12, 1986 (B43 860227 939)

9. SCR SQNEEB8605, R1, deficiencies found by APS section design review (B43 860220 909)

10. SCR SQNEEB8607, "Deficiencies Found by APS Section Review," January 22, 1986 (B43 860230 929)

11. Sargent and Lundy Project Plan for Nuclear Plant Electrical Calculation Program Assessment for Sequoyah, Watts Bar, and Browns Ferry, January 31, 1986, R1

12. Sargent and Lundy Meeting Notes - Project No. 7517-01, dated February 25, 1986

13. SQ-DCR-1505, Hotwell Pump Trip Circuits, September 21, 1983 (L58 840812 607)

14. Letter from R. Gridley to NRC-NRR, B. Youngblood, dated February 27, 1986, transmitting the "Electrical Calculations Program for Sequoyah Nuclear Plant" (L44 860227 804)

15. 10CFR50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

16. NRC Regulatory Guide RG 1.64, "Quality Assurance Requirements for the Design of Nuclear Power Plants"

17. ANSI N45.2.11, 1974, "Quality Requirements for the Design of Nuclear Power Plants

18. NUREG-0800, "Standard Review Plan" (formerly NUREG 75/087), 1981

19. Memorandum, S. A. White to Those listed, "Nuclear Procedures Staff," dated March 18, 1986 (A02 860317 007)

20. Letter from S. A. White to NRC dated March 10, 1986, transmitting the revised TVA Corporate Nuclear Performance Plan

21. Nuclear Quality Assurance Manual (NQAM) dated December 31, 1984 (L16 841213 948)

TVA [illegible] (05-9-65) (OP-WP-5-85)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO: James P. Darling, Site Director, Bellefonte Nuclear Plant

FROM: K. W. Whitt, Director of Nuclear Safety Review Staff, E3A8 C-K

DATE: FEB 27 1986

SUBJECT: NUCLEAR SAFETY REVIEW STAFF INVESTIGATION REPORT TRANSMITTAL

Transmitted herein is NSRS Report No. I-85-439-BLN

Subject HUMAN FACTORS CONTROL ROOM DESIGN REVIEW

Concern No. XX-85-122-021

The attached report contains one Priority 3 [P3] recommendation which requires you to take some form of investigative or corrective action within the next four months (July 1, 1986). No formal response is required for this report unless you disagree with the proposed action. Please notify us if actions taken have been completed sooner. Should you have any questions, please contact W. D. Stevens at telephone 6231-K.

Recommend Reportability Determination: Yes ____ No X

Director, NSRS/Designee

WDS:JTH
Attachment
cc (Attachment):
H. L. Abercrombie, SQN
W. C. Bibb, BFN
W. T. Cottle, WBN
R. P. Denise, LP6N40A-C
G. B. Kirk, SQN
D. R. Nichols, E10A14 C-K
QTC/ERT, Watts Bar Nuclear Plant
Eric Sliger, LP6N48A-C
J. H. Sullivan, SQN

WATTS BAR NUCLEAR PLANT SITE DIRECTORS OFFICE
MAR 05 '86

	Note	Action	Reply
Pit Mgr			
Mod Mgr			
SS Mgr			
OS Mgr			
QA			
Personnel			
Finance			
Compliance			
Int Offcr			
XC TO ANMS			
FILES			

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ENCLOSURE 1

INVESTIGATION REPORTS PREPARED BY NUCLEAR SAFETY REVIEW STAFF AND NOT REVIEWED BY THE EMPLOYEE CONCERN TASK GROUP (ECTG)

NSRS REPORT NUMBER:

XX-85-122-030 ✓
SQM-6-009-008
XX-85-122-011 ✓
XX-85-087-001 ✓
I-85-439-BRN ✓
XX-85-027-X08 ✓

TVA 64 (OS-S-65) (OP-WP-5-85)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO : William C. Drotleff, Manager of Engineering, W12A12C-K/RIMS

FROM : K. W. Whitt, Director of Nuclear Safety Review Staff, E3A8 C-K

DATE : APR 7 1986

SUBJECT: NUCLEAR SAFETY REVIEW STAFF INVESTIGATION REPORT TRANSMITTAL

Transmitted herein is NSRS Report No. I-85-992-SQN (Final Report)

Subject CONTROL OF AC AND DC ELECTRICAL LOADS

Concern No. XX-85-122-030 EN

and associated prioritized recommendations for your action/disposition.

WATTS BAR NUCLEAR PLANT SITE DIRECTOR'S OFFICE
APR 09 '86

	Note	Action	Reply
Pit Mgr			
Mod Mgr			
SS Mgr			
QA			
Personnel			
Engrg			
Compliance			
Int Offcr			
AC TO Amss			

It is requested that you respond to this report and the attached Priority 2 [P2] recommendation by May 7, 1986. Should you have any questions, please contact M. A. Harrison at extension 6328-K.

Recommend Reportability Determination: Yes X No ___

for K. W. Whitt

MAH:JTH
Attachment
cc (Attachment):
H. L. Abercrombie, SQN
W. C. Bibb, BFN
W. T. Cottle, WBN
J. P. Darling, BLN
R. P. Denise, LP6N40A-C
G. B. Kirk, SQN
M. L. Martin, IOB-WBN
D. R. Nichols, E10A14 C-K
E. K. Sliger, LP6N48A-C
J. H. Sullivan, SQN (2)

T25 860409 057

RECEIVED
APR 9 1986
EMPLOYEE CONCERNS
TASK GROUP - WBN

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