WATTS BAR NUCLEAR PLANT

CABLE ISSUES

CORRECTIVE ACTION PROGRAM PLAN

REVISION 1

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REVISION LOG

REVISION LEVEL	DATE	AFFECTED PAGES	DESCRIPTION OF REVISION
0	12/16/88		Initial Issue.
1		2	Revised to specifically identify those cable issues for which critical case evaluation techniques will be applied
		9	Revised corrective action for splice issue to indicate that certain Class 1E splices will be replaced without further inspection or evaluation.
		10	Revised corrective action for splice issue to indicate that completeness of the splice list for intermediate splices will be verified by a sampling process.
		12 & 13	Revised to correct arithmetic errors in accordance with the March 15, 1989 submittal and provide clarification that cable route verification was done by signal tracing or visual inspection (see section 4.2.1, paragraph 1).
		14	Revised for clarification, route verification was done by signal tracing or visual inspection (see section 4.2.2, paragraph 4).
		18 (Exhibit A)	Revised to reflect verification by site procedure rather than a specific site organization (NQA), since various quality assurance organizations are involved based on the activity being performed.
		1 through 12 (Exhibit A Table)	Remove reference to walkdown of cable splices from Page 8 (see text revision Page 9 above). Removed reference to QC organization's concurrence (See text revision Page 18 above).
		15 (Attachment 1)	Revised to reflect VSR discrepancy report in accordance with the March 15, 1989 submittal and add reference to VSR report DR-213.
		1 & 2 (Attachment 3)	Revised to update progress through May 6, 1989.
		7 (Attachment 2)	Revised to reflect current plan.

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1.0 INTRODUCTION

Various concerns related to cable installation and routing have been identified at Watts Bar Nuclear Plant (WBN) by the Tennessee Valley Authority (TVA) through Employee Concerns, Conditions Adverse to Quality (CAQ), and the Nuclear Regulatory Commission (NRC) findings. The root causes of these concerns are primarily the absence or incompleteness of specific guidance in the development of design input and output documents, and in some instances, the lack of procedural control for the installation of cables. These concerns identify conditions for safety-related cables that are adverse to quality because of a lack of analysis or documentation that would demonstrate their acceptability. However, these conditions alone do not necessarily mean that the cable installations themselves are unacceptable; as-installed cables may still comply with the technical requirements of the applicable codes, standards, and licensing commitments. Attachment 1 provides a complete listing of the Conditions Adverse to Quality Reports (CAQRs) that identify these issues.

There are 12 concerns related to cable installation and cable routing discussed in and addressed by this Corrective Action Program (CAP) plan. Of these, 10 are related to the physical installation of cables, and two are related to the Computerized Cable Routing System (CCRS).

Section 4.0 of this CAP describes the methods that will be used to satisfactorily resolve each group of concerns currently identified. The plans and methods outlined are comprehensive and the plans for resolution of some of the concerns are similar to those previously used successfully at Sequoyah Nuclear Plant (SQN).

2.0 OBJECTIVE

The objective of this CAP is to ensure that the safety-related (Class 1E) cables will perform their intended functions adequately and comply with the licensing requirements and design basis documents. The as-installed cables will either be shown to be adequate or reworked. The following specific objectives have been established:

- Design basis documents and the Final Safety Analysis Report (FSAR) will be revised to ensure consistency and to comply with licensing requirements.

- Resolve design and construction concerns either by qualification (arrived at by test or analysis) or by rework.

- Evaluate the CCRS software, data base, and procedures in light of nonconformances currently identified. Rework CCRS and procedures as necessary to prevent recurrence of CCRS-related deficiencies.

- Revise or develop and implement new cable installation procedures to prevent recurrence of deficiencies.

Licensing commitment changes will be proposed only when technically justified.

3.0 SCOPE

This program addresses the adequacy of safety-related cable installations in the following areas for unit 1:

1. Silicone rubber insulated cables
2. Cable jamming
3. Cable support in vertical conduit
4. Cable support in vertical tray
5. Cable proximity to hot pipes
6. Cable pullbys
7. Cable bend radius
8. Cable splices
9. Cable sidewall bearing pressure
10. Pulling cable through condulet and flexible conduit
11. CCRS data base verification and validation
12. CCRS software verification and validation

4.0 PROGRAM DESCRIPTION

The 12 identified cable issues have been divided into two groups. The first 10 issues are treated as "Cable Physical Issues" and addressed in Section 4.1. The last two issues are treated as "Computerized Cable Routing System Issues" and are addressed in Section 4.2. These sections provide a description of each issue, the planned approach for resolution of the issue, the root cause, and the corresponding actions for preventing recurrence.

In resolving these issues, calculations will be developed where necessary to support the design output. Design output documents will be revised to improve control of subsequent cable installations and to prevent recurrences of previous deficiencies.

A number of the cable issues (issue 1, 2, 3, 6, 7, 9, 10, and 11 above) will be resolved using the critical case evaluation technique which is described in Exhibit A. In order to summarize the program and corrective action for all cable issues, issues 1 through 12 are included in the Exhibit A Table. R1

If, during the resolution of these issues, new deficiencies are discovered, further evaluation or rework will be initiated.

4.1 Cable Physical Issues

4.1.1 Silicone Rubber Insulated Cables

Resolution of this issue requires qualification testing to confirm a 40-year plant life for silicone rubber insulated

cables, both for SQN and WBN. A set of cable specimens aged and irradiated to 15 years is being prepared in the event any anomallies occur with the 40-year specimens.

During high-potential testing of silicone rubber cable at SQN to resolve the cable support in vertical conduit issue, SQN had several cable failures. Analysis of these cable failures indicated that the failures were not the result of inadequate cable support but possibly caused by "impact-induced damage." Silicone rubber cables manufactured by AIW appeared to be more susceptible to "impact-induced damage" than cable from Rockbestos and Anaconda. AIW silicone rubber insulated cables were removed from 10 CFR 50.49 circuits at SQN. SQN then performed simulated loss of coolant accident (LOCA) tests at Wyle Laboratories on aged cables with reduced insulation thickness to simulate an impact condition. The results were acceptable and provided a limited qualified life of 10 years. To qualify the cable for its full 40-year life, TVA and the NRC agreed to additional testing of Anaconda and Rockbestos cables. These tests will be conducted using previously installed WBN cables. AIW silicone rubber insulated cables have not been used and will not be used in Class 1E circuits at WBN.

WBN will initiate the following activities to resolve this issue for Rockbestos and Anaconda cables:

- Identify five critical case conduits located in harsh environments that contain Class 1E Anaconda silicone rubber insulated cables and identify five critical case conduits located in harsh environments that contain 10 CFR 50.49 Class 1E Rockbestos silicone rubber insulated cables.

- Remove the silicone rubber cables from these 10 critical case conduits and subject them to testing to qualify them for 40 years of radiation and thermal aging followed by a LOCA. This testing will assess the ability of the as-installed silicone rubber insulated cables at WBN and SQN to operate during a LOCA at the end of plant life.

4.1.2 Cable Jamming

NRC issued a Technical Evaluation Report (TER) (Reference 1) on January 30, 1987. The TER identified the potential for undetected cable damage since TVA-WBN installation documents did not address the cable-jam ratio. Jam ratio is D/d, d is the cable outside diameter and D is the conduit inside diameter. Where three single conductors with a jam ratio of 2.8 to 3.1 are pulled into a conduit, the cables may align in a flat configuration with resultant jamming.

WBN will initiate the following actions to resolve this issue:

- Class 1E conduit/cables will be reviewed to determine which ones have a jam ratio between 2.8 to 3.1.

- Critical case conduits will then be compared with those conduits identified and successfully tested at SQN for the same issue. If SQN conduits envelop WBN critical case conduits, no cable testing by WBN will be conducted. If SQN conduits do not envelop the WBN conduits, an in situ test will be performed at WBN or the cables will be replaced. If the testing option is selected, any cables found to be unacceptable will be replaced.

The root cause of cable jamming is that Nuclear Engineering (NE) did not implement the manufacturer's recommendation to check for potential cable jamming prior to cable pulling.

The action required to prevent recurrence has been completed with the revision of the cable installation specification and site procedures to ensure that the cable-jam ratio is not between 2.8 and 3.1 prior to pulling in conduits and duct banks.

4.1.3 Cable Support in Vertical Conduit

In the NRC-issued TER for WBN, a concern was expressed that cables in long, vertical conduits were inadequately supported and that "... random failures due to cutting of the insulation and conductor creep may occur during normal service condition, especially silicone rubber cables" (Reference 1).

WBN will initiate the following corrective actions to resolve this issue:

- Identify critical case silicone rubber insulated cable in vertical conduits, using cable bearing pressure occurring at the edge of the condulet as the criteria. This methodology is similar to SQN's.

- Compare WBN critical cases with those identified and tested at SQN. If SQN conduits for the same issue envelop WBN, no cable testing by WBN will be performed. If SQN conduits do not envelop WBN, in situ tests will be performed at WBN or the cables will be replaced. If the testing option is selected, any cables found unacceptable will be replaced.

- To prevent any long-term cable degradation, Class 1E conduits containing cables of all insulation types, will

be evaluated. TVA will establish an acceptance criteria that provides for cable supports to be added for those conduits in which the cable bearing pressure, conductor strength, or resultant loading imparted to the cable insulation, terminations or splices exceed manufacturers limits, as a result of the cable weight from the long vertical distance. All Class 1E cables installed in vertical conduit will be evaluated against this acceptance criteria.

The root cause is that NE did not include industry-recognized cable installation support requirements in the cable installation specification.

The action required to prevent recurrence is to revise the cable installation specification, and site procedures to incorporate cable support requirements for cable installed in vertical conduit.

4.1.4 Cable Support in Vertical Tray

This issue has two parts:

- The first part of this issue is the mechanism to transfer vertical cable loads, both self weight and seismic, to the tray support system. This will be addressed by the Cable Tray and Cable Tray Support CAP.

- The second part of this issue deals with TVA's current construction specification requirement that cables in vertical trays be supported in accordance with the National Electrical Code (NEC) Article 300-19 (Reference 2) to prevent long-term cable damage. The installation specification states that this support may be provided by tie wraps. TVA currently has no basis to verify that cable ties can provide adequate support.

WBN will initiate the following actions to resolve this issue:

- Review Class 1E vertical tray sections to determine if cables with vertical lengths greater than those recommended by NEC Article 300-19 (Reference 2) need additional supports to prevent long-term cable damage. TVA will first evaluate the use of tie wraps as a support system. Should that support system prove to have a limitation, TVA will either show by analysis, similarity to other installations, or testing that no cable damage has occurred or will occur or cable supports will be added for those cables in which the cable bearing pressure, conductor and

insulation strength, or resultant loading imparted to the cable terminations or splices exceed manufacturers' limits, as a result of the cable weight.

The root cause of this issue is that NE did not evaluate the limitation of tie wraps as cable supports.

The action required to prevent recurrence is to revise the cable installation specification and site procedures to identify acceptable methods for support of cables in vertical cable trays should the existing support system prove to be inadequate.

4.1.5 Cable Proximity to Hot Pipes

NRC Information Notice 86-49, highlighted the potential for cable damage resulting from close proximity to hot pipes.

WBN will initiate the following actions to resolve this issue:

- Develop criteria that will detail required clearances between cables/raceways and hot pipes/valves to eliminate impact on the cable's allowable ampacity and qualified life. SQN performance data and corrective action will be considered when developing this criteria.

- WBN will walkdown Class 1E cables against the criteria to ensure that adequate separation exists between cables and hot pipes/valves.

- All deviations will be resolved by analysis, change of pipe insulation, or raceway rework.

The root cause of this issue was that NE did not specify clearance requirements.

The action required to prevent recurrence is to revise the pipe, pipe insulation, cable, and raceway installation specifications and site procedures to include spatial separation requirements between pipes/valves and cables/raceways.

4.1.6 Cable Pullbys

The NRC-issued TER for WBN (Reference 1) concluded that cable damage resulting in cable failure may have occurred due to pullbys which occur when cables are pulled into occupied conduits. The TER stated a concern that ". . . the moving pull rope and cable could have sawed through the insulation of the stationary cable. . ." The potential for circuit failures occurs if the conduit becomes wet from condensation or when exposed to steam.

WBN will initiate the following actions to resolve this issue:

- Prepare and implement an evaluation procedure to identify cable pullby critical cases. The methodology to identify the critical case conduits will be similar to that used at SQN.

- Compare WBN critical case conduits with successfully tested conduits at SQN. If SQN envelops WBN, then no testing by WBN will be performed. If WBN critical case conduits are not enveloped by SQN, an in situ test will be performed at WBN or the cables will be replaced. If the testing option is selected, any cables found unacceptable will be replaced.

The root cause is that NE/Nuclear Construction (NC) and the industry standards did not recognize the potential for cable damage when making cable pullbys.

The action required to prevent recurrence is to revise the cable installation specification and site procedures to incorporate the latest recommendations by Task Force 14-1 "Station Cable Installation," an IEEE/ICC industry committee.

4.1.7 Cable Bend Radius

TVA has identified through nonconforming condition reports (NCRs) and Nuclear Safety Review Staff (NSRS) reports that the minimum recommended cable bend radius was violated during the installations of some cables. The impact on cable performance is that in shielded power cables, a tight radius can cause the metallic shield to cut into the insulation. For coaxial and triaxial cables, improper radius may result in distortion of the shield and dielectric resulting in an unacceptable change in the cable electrical characteristics. For unshielded cables, which are the majority, an excessive bend in the cable can produce high elongation stress in the insulation portion of the cable.

Concerns are separated into the following two categories:

- NE Design and NC Implementation

  Inadequate NE design output and NC installation requirements for cable bend radius limits are of concern for cable installation, including termination locations (e.g., panels, motorboxes, condulets, and junction boxes). Cable inspection may have taken place prior to "stuffing" whatever cable slack there was back into the condulet box or enclosure.

- Cable/Raceway Incompatibilities

  Incompatibilities have been identified between cable bend radius limits and design raceway configurations. This includes: shielded power cable in trays with 12-inch radii, and shielded power cable, triaxial, and coaxial cables inside bend radii at cover openings of condulets. The adequacy of the control cable bend radius limits developed by NE was questioned by the NSRS (Reference 3). These limits were changed. However the changes resulted in control cable bend radius incompatibility with the inside radius of condulets.

Examination of SQN and BFN cable maintenance records and in situ high-potential test results coupled with available LOCA data for over-bent cables indicates that no significant age-related or accident-initiated degradation mechanism exists. In order to provide additional confidence, WBN will initiate the following actions:

NE design output documents and NC implementing procedures for cable installations will be reviewed by NE to determine that proper cable inspection attributes existed for bend radius.

A walkdown will then be made for Class 1E cables to assess that NC installations and QC inspections related to cable bend radius were adequate. A generic program consisting of testing and analysis will be initiated to develop new cable bend radius limits and resolve deficiencies. Those cases found to be unacceptable will be reworked.

With respect to permanent and temporary bend radii, the critical case shielded power, triaxial, and coaxial cables in trays and condulets will be identified. This will be done by reviewing the CCRS records for the cable mark number versus conduit size and tray size. SQN results, which document the potential bend radius that cables can withstand inside condulets, will be used. Laboratory testing and analysis, and consultation with the cable manufacturers will then be used to determine if the critical case conditions are acceptable. It is anticipated that the analysis or test program for shielded power cables may be different from that for the other nonshielded cables, because of differences in failure mechanisms. If testing or analysis shows existing conditions to be unacceptable, cables will be replaced or reworked.

TVA will initiate a test program, evaluate previous tests, or conduct analysis to determine if previously used cable bend radius limits for control cables are acceptable. (One cable manufacturer already recommends bend radius limits

similar to those previously used by TVA). The cable manufacturer's evaluation of this test or analysis will be considered. If previous bend radius values are found to be inadequate, an analysis and a walkdown will be initiated to locate the specific condulets with control cable bend radius deviations. Cables will be replaced or reworked.

The root cause of the deviation from cable bend radius requirements is that NE did not specify industry-recommended cable bend radius limits and NC did not install the cables per the NE design output.

The action required to prevent recurrence has been partially completed by revising the cable installation specification to include manufacturer's and industry-recommended cable bend radius limits. Additionally, site implementing procedures will be revised to conform to revised NE requirements.

4.1.8 Cable Splices

As a result of NRC Information Notice 86-53, TVA's internal review of WBN splicing details and experiences at SQN indicate that the installed splices may not conform with the qualified configurations and materials tested by the vendor (e.g., use of nonqualified materials under the splice, improper selection of Raychem tube, inadequate seal length of the tubing). A splice is used to join two or more field cables together or to join a field cable to equipment pigtails, including the materials and methods utilized. The splice materials used at WBN are Raychem heat shrink tubing, Raychem kits, and a limited number of Scotch 3M taped designs. R1

WBN will initiate the following actions to resolve this issue:

- Develop and document in a calculation a list of Class 1E cable splices in harsh and mild environments, including their locations. Cable end splices will be identified by reviewing equipment qualification binders and construction records to determine which equipment uses pigtails for field cable connection. Intermediate splices will be identified by compiling existing splice cards (called 57 test cards), and the maintenance splice logs.

- WBN will replace all 10 CFR 50.49 harsh environment cable splices and some mild environment cable splices will be reworked. In mild environment areas, cable splices will also be reworked where the environmental conditions exceed the parameters of tape. R1

- WBN will implement a sampling program to verify that the splice list is complete for intermediate splices. R1

The root cause was that NE, NC, and Nuclear Quality Assurance (NQA) did not adhere to the strict installation and inspection requirements established by the vendor of the splice material.

The action required to prevent recurrence is the revision of splice installation instructions and site procedures to conform to existing qualified designs.

4.1.9 Cable Sidewall Bearing Pressure

The July 9, 1985 NSRS Report (Reference 3) stated that cable sidewall bearing pressure (SWBP) was not addressed properly during installation. SWBP is the radial force exerted on the insulation of a cable at a bend point when the cable is being pulled. WBN developed selection criteria, identified 81 critical case conduits, and performed a walkdown. SWBP was calculated for these conduits. Results of the calculation showed that cable SWBP, based on existing limits, was exceeded in some cases. TVA then conducted a test program (Reference 4) to determine more realistic SWBP limits for WBN cables. Test results showed that the existing SWBP limits were conservative and established new, less restrictive limits. Based on these new limits, no cables exceeded their SWBP limits.

A meeting was held with the NRC on July 17, 1986 to report the successful completion of the test report (Reference 5). As requested by the NRC, a third-party review of the report was performed. The review by D. A. Silver & Associates (Reference 6) produced minor comments that did not change the conclusions of the report.

Stone & Webster Engineering Corporation (SWEC), a TVA contractor, issued an evaluation report on November 4, 1987 (Reference 7) indicating that the only action required by TVA to close out this issue was to verify some data used in the critical case conduit calculation, which will not change the conclusions of the report.

The root cause of cable SWBP being exceeded was that NE did not implement cable industry installation guidelines related to cable pulling in conduits.

The action required to prevent recurrence, which has been completed, was to revise the cable installation specification and site procedures to add explicit cable SWBP restrictions to cable pulling limits.

4.1.10 Pulling Cable Through 90-Degree Condulet and Flexible Conduit

In the TER (Reference 1), concerns were expressed that "... considerable damage is likely to occur if cables are pulled under tension around the inside edge of a 90-degree condulet...," and that flexible conduit severely tears the cable jacket and insulation. Even though no evidence of damage was observed, the TER recommended further investigation.

WBN will initiate the following actions to resolve this issue:

- 90-Degree Condulets

  The 90-degree condulet issue will be addressed in the aforementioned Silicone Rubber Insulated Cable Program. Under this program, the cable selection criteria to identify critical case silicone cable insulation requires that, as a minimum, the cable to be evaluated will have two 90-degree condulets within its route. Since silicone rubber insulation is more susceptible to damage than other types of cable insulation, this will envelop all types of insulation at WBN.

- Flexible Conduit

  Identify, by walkdown, flexible conduits installed in midroute of rigid conduits.

Review of cables pulled through midroute flexible conduits will be conducted to resolve this issue. Cables will be examined visually at conduit end points and pull points to determine whether there is visible cable damage.

The action required to prevent recurrence, which has been completed, required the revision of the cable installation specifications to address cable pulling through flexible conduits. Site procedures will also be revised to be in agreement with the NE design output documents.

4.2 Computerized Cable Routing System

Concerns have been expressed and documented in CAQRs, Employee Concerns, and an NRC Inspection Report on SQN about the adequacy of the CCRS.

The planned approach to resolve similar CCRS concerns at WBN is to (1) qualify the computer software, (2) verify the existing data, (3) revise procedures for controlling data entry, revision, and utilization, (4) expand the data base to support other activities, and (5) validate the system.

The computer software has been validated and verified in accordance with TVA QA procedures.

To verify the adequacy of the CCRS data base, data from the WBN review of 4256 EQ cables (10 CFR 50.49) and the review of the 339 Appendix R-related cables will be used. These reviews comprise an evaluation of 4595 cables (this represents 100 percent of existing EQ and Appendix R cables for unit 1) out of a population of 15,000 Class 1E cables for both units 1 and 2. The evaluation will establish a basis for accepting the CCRS data base for Class 1E cable applications or identifying any required corrective actions.

4.2.1 Environmental Qualification Review

The Environmental Qualification (EQ) Review (10 CFR 50.49) examined 4256 cables to confirm that the installed cables matched the design records to prove qualification for Class 1E harsh environment cables. This review checked the as-installed pull cards against the CCRS data base. This review confirmed an exact match on 4012 cables. For the remaining 244 cables, additional investigation was performed which included a document search for subsequent installation documentation or field verification of the installed configuration. There were 110 cable concerns resolved through the document search resulting in data base update in some cases (e.g., illegible pull cards, misaligned card printer, or mismatch of pull card revision numbers, mark number, and routing differences) and 134 cables that required field verification of mark number, contract number, and/or routing. Signal tracing and/or visual inspection of route or specific cable attribute verification confirmed that 100 of these 134 cables matched the CCRS data base.

Inplant inspection has not been performed for two of the remaining 34 cables. Results of inspection for the balance (32 cables), fall into the following categories:

4 Installed mark and contract number could not be determined (replace cables).

9 Mark numbers did not match CCRS but the installed cables are acceptable.

2 Implementation of latest design was not field complete.

3 Due to an undocumented splice, the mark number for one part of the cable was not documented in the CCRS, but the installed cables are acceptable.

4 Although the field splice was documented, the mark number for one part of the cable was not reflected in the CCRS, but the installed cables are acceptable. R1

7 Routing discrepancies. The CCRS is being changed to reflect the as installed cable. The installed cables are acceptable.

1 Appendix R cable not routed per CCRS (replace cable).

2 Multi-phase cable with different mark numbers per phase, installation is acceptable.

As a result of the above 32 cable reviews, 5 cables will be replaced for the following reasons:

- Appendix R violation - one cable. See Section 4.2.2 of this document (identified through field inspection).

- Unavailable contract numbers to support EQ - four cables (results of field inspection).

As a result of the initial EQ review of 4256 cables, seven cables will be replaced for EQ or economical reasons. Therefore, these cables were not included in the above 134 cables requiring additional investigation.

- Qualification indeterminate making EQ binder maintenance uneconomical - two cables.

- Unqualified cable material for harsh environment use - five cables. R1

Therefore, a total of 12 cables will be replaced; 11 were the result of the EQ program and one was an isolated personnel error.

The above inspection data are summarized from TVA's 10 CFR 50.55e Final Reports (Reference 8) and a Nonconforming Condition Report (Reference 9).

4.2.2 Mild Environment Appendix R Cable Record Review

Background

During WBN's EQ review of cable records, it was determined that one Appendix R cable was not routed per NE design output requirements. As a result, WBN took a conservative approach to verify the correct routing of all Appendix R cables, including 339 cables not covered in the EQ effort.

Prior to the EQ effort at WBN, an Engineering Change Notice (ECN) was issued to reroute previously installed cables in

order to meet (at that time) new Appendix R separation requirements. During that time period, Engineering was not required by procedure to list specific cable numbers on the ECN data sheets. Construction normally identified cables to be worked from their Engineering and Construction Monitoring and Documentation computer program, (ECM&D), which reads NE's CCRS files for revised cables. However, in light of the schedule associated with the Appendix R effort, NE agreed to facilitate construction and list the cables to be reworked for Appendix R on ECN data sheets. Because NE failed to list a cable on the ECN data sheet, NC did not rework this cable and closed the ECN.

Neither NE nor NC realized the Appendix R cable had not been repulled as reported in TVA's Appendix R Report until the discrepancy between the design and constructed records was identified during the EQ cable review effort. The oversight is documented within TVA's CAQ Process. The cable will be reworked.

Review Results

NE data base records for 339 mild environment Appendix R cables were reviewed against NC pull cards. Of these, 60 discrepancies were identified. Of the identified discrepancies, 44 discrepancies were resolved by documentation changes or identification of a later issue installation document, which did confirm the accuracy of NE data base records.

For the remaining 16 discrepancies, the cable routing was signal traced and/or visually inspected to determine the accuracy of the NE data base. The mark numbers and routing of 14 of these cables are in agreement with the NE data base (using the instructions given to NC on implementation of the routing node point documentation). R1

Based on the review of the method of documenting conduit entry to tray node points, an additional problem, which will be addressed through the CAQR process, was identified. CAQR WBP880510 has been issued to document this problem. The findings are that the documentation of conduit node entry points for these cases are procedural deviations and do not constitute a significant concern with respect to cable routing attributes.

Two cables were not installed in accordance with NE design output. The installed cables had different cable mark numbers from the CCRS. However, their routing did agree with the CCRS data. The substituted cable mark numbers have the same number of conductors and the same wire size as the NE-specified cable mark number, and were determined to be acceptable as installed.

4.2.3 Conclusion

From the above discussion, it was determined that cable installation discrepancies for unit 1 and common EQ and Appendix R cables were few in number and were random occurrences. Identified discrepancies for these populations are documented and are being corrected. It can be further concluded that if similar discrepancies exist in the remaining Class 1E cables, these will not constitute a safety issue if the discrepancies go undetected. Thus this review reasonably demonstrates that the NE CCRS data base adequately reflects the as-built cable configuration.

4.2.4 Root Cause

The root causes for the CCRS concerns were the lack of adequate procedures to assure a verified data base and the failure to follow procedures that existed when installations were made. These procedures are related to both the engineering/design process and the use of the CCRS software, and its output as used by NC.

4.2.5 Action to Prevent Recurrence

The following actions have been taken or will be taken for short-term recurrence control.

- A construction hold (H-256) was issued to stop installation of safety-related cables until actions can be taken to prevent future recurrence.

- NE's cable routing procedure has been superseded and replaced with a new procedure that clarifies responsibilities and provides rigorous control of cable design and verification of cable pull data prior to releasing the cable to NC for installation.

- The construction hold will be maintained until the NC implementing procedures are revised to properly control the use of NE's revised design output. Once these procedure revisions are complete, the construction hold will be released and safety-related cable installation will be resumed.

For long-term recurrence control, the CCRS software and the CCRS data base will be verified and validated. Also, the NE and NC procedures will be revised to control the verified CCRS.

4.3 Licensing Assessment

Design basis documents and the FSAR will be revised to ensure consistency and to comply with licensing requirements. Licensing commitment changes will be proposed only when technically justified.

5.0 PROGRAM INTERFACES

Program interfaces include coordination with the WBN Design Baseline and Verification Program (DBVP) CAP, which includes electrical calculations (e.g., voltage drop analysis, cable short circuit, coordination analysis, and cable sizing), EQ program, Fire Protection - Appendix R compliance review, and Cable Tray and Conduit Support CAP.

6.0 PROGRAM IMPLEMENTATION

WBN developed work packages to scope and bound the identified deficiencies. NE will implement the tasks as described above to resolve the cable issues identified herein.

Resultant deliverables will be coordinated with NE staff specialists for technical content, adequacy, and consistency between TVA nuclear projects. In addition, Cable Issues Program output will be used as input to the programs identified in Section 5.0 in order to properly interface with other programs. Examples of Cable Issues CAP output include the following:

- Finalize results of the EQ and the Appendix R reviews in a report.
- Verify and validate the CCRS software.
- Verify the CCRS data base.
- Update CCRS data base as defined in Section 4.2.
- Reevaluate Electrical calculations, raceway fill, support loading by using the verified CCRS software and data base.
- Correct identified hardware problems that are beyond the analytical limits via the CAQ and the reportability process.

7.0 PROGRAM DOCUMENTATION

This effort will be documented by issuing or revising calculations, procedures, design output documents, corrective actions for existing CAQs associated with these issues, topical reports and test procedures. In addition, new CAQRs (open items) will be issued if additional CAQs are identified as part of this effort. Walkdown data will be collected and documented in accordance with issued walkdown procedures. CAQs and employee concerns related to cable issues are being tracked to completion through Tracking and Reporting of Open Items (TROI) and the Corporate Commitment Tracking System (CCTS). A final report will be issued upon completion of the CAP activities.

8.0 CONCLUSION

This CAP provides the methods to analyze the cable issues in light of currently identified CAQRs, Employee Concerns, and the NRC findings to implement corrective actions as required, and to invoke controls to prevent recurrence of deficiencies. The plan consists of activities that provide the means to resolve the discrepancies noted in the introduction to this document and will ensure adequacy of existing and future cable installations.

9.0 REFERENCES

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2. National Electrical Code, The National Fire Protection Association, NFPA 70-1987, Quincy, MA.

3. TVA - Nuclear Safety Review Staff (NSRS), "Investigation of an Employee Concern Regarding Cable Routing, Installation, and Inspection at Watts Bar Nuclear Plant." Report I-85-06-WBN, July 9, 1985.

4. Central Laboratories Services Branch, "Cable Sidewall Bearing Pressure Test," Revisions 0, May 1986. RIMS Number E13860604001.

5. NRC letter to TVA, Summary of Meeting with TVA concerning Cable Pulling at Watts Bar, July 28, 1986. RIMS number A02860731017.

6. D. A. Silver and Associates letter to TVA, "Review and Analysis of TVA's Sidewall Bearing Pressure Test Report Dated May 19, 1986," November 21, 1986. RIMS B43861124005.

7. Stone & Webster Engineering Corporation, "An Evaluation Report for Cable Sidewall Bearing Pressure Cable Data Gathering," Revision 0, November 4, 1987.

8. TVA, "Watts Bar Nuclear Plant, Units 1 and 2 Cable Configuration Control. SCR WBN EQP 8628 and Others." 10 CFR 50.55e Final Reports WBRD-50-390/86-61, and WBRD-50-391/87-12 February 9, 1987. RIMS number B26870424020.

9. TVA, Nonconforming Condition Report NCRWBNMEB8107. RIMS number B26870424020.

EXHIBIT A

CRITICAL CASE EVALUATION

Because of the issues identified in this CAP related to the cables and CCRS, TVA will perform critical case evaluations in order to assure that the design and construction of the installed cable are adequate, or proper corrective actions are identified and implemented. Even though specific steps for each issue will vary as shown in the tables of this exhibit, the following general steps apply to the critical case evaluation:

- PROGRAM PREPARATION: This involves the definitions of design and installation requirements, applicable attributes for evaluation, population being evaluated and prescreening for known conditions in the installed cables.

- PHASE 1 - ENGINEERING OVERVIEW: This includes identification of critical cases which represent and bound the applicable population. This is done through a combination of document reviews, walkthroughs and walkdowns. The document reviews will include use of the CCRS and drawings to screen the total population of concern. Such screening will provide for the most efficient utilization of resources during the walkdowns and aid in quickly identifying those areas of concern. This process is proceduralized and personnel are trained. As-built configuration is obtained for critical cases, and verified in accordance with site procedures. R1

- PHASE II - ENGINEERING EVALUATION: During this phase, all critical cases are evaluated by engineering either through analysis or test. If necessary, a program of ranking the critical cases and sampling will be undertaken where similar approaches were used at other TVA plants and accepted by the NRC. Those attributes of the critical cases that are not acceptable will be reviewed against the applicable population. The cables and related hardware will be modified as required and reinspected in accordance with site procedures. R1

Further details on how the critical case evaluation is performed for each of the issues are delineated in the following pages of this exhibit.

WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

CRITICAL CASE EVALUATION PROGRAM	PROGRAM PREPARATION		PHASE I - ENGINEERING OVERVIEW		PHASE II - ENGINEERING EVALUATION (level-I)	(level-II)	(level-III)	PROGRAM CLOSURE
	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(1) SILICONE (SI) RUBBER INSULATED CABLES	1) Yes. Rev cable install spec, procure proced, & site proceds. 2) Yes. ID worse SI 1E harsh environ/contain cables. 3) NA	1) Yes. All class 1E harsh envir. SI cables. 2) Yes. ID all 1E conduits > 40ft. containing SI cables.	1) Yes. Develop plan. 2) Yes. ID as-installed conduits W/d. 3) Yes. Train W/d team.	1) NA 2) Yes. CCRS conduit schedule review. 3) Yes. W/d worse case conduits. 4) Yes. W/d to document as-built configurations.	1) Yes. Calc. SWBP. 2) Yes. ID worse case for test. 3) NA	1) Yes. Worse case analysis. 2) Yes. Test for LOCA.	1) Yes. Review analysis & test. 2) To Be Determined (TBD) 3) TBD	Yes. Branch and project approval of licensing package.

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WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

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	1) Review & revise design reqmt's 2) Establish pre-screen attributes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, acceptables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy-sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen-sing pkg.
(2) CABLE JAMMING	1) Yes. Revise cable install specification. 2) Yes. ID worse case (with critical jam ratio). 3) NA	1) Yes. All class 1E cables with critical jam ratio. 2) Yes. ID 1E conduits containing 3 cables of identical ODs.	1) Yes. Develop plan. 2) NA 3) NA	1) NA 2) Yes. Screen CCRS conduit schedule. 3) NA 4) NA	1) Yes. Calculate Jam ratio. 2) Yes. ID worse case. 3) NA	1) Yes. Worse case analysis. 2) TBD	1) Yes. Review analysis. Testing is TBD. 2) TBD test or replace cables. 3) TBD	Yes. Branch and project approval of licensing package.

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WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

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	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(3) CABLE SUPPORT IN VERTICAL CONDUIT	1) Yes. Revise cable install spec and site procedures. 2) Yes. ID worse case. Also, ID cards requiring additional supports. 3) NA	1) Yes. All Class 1E SI cables in vertical conduits. 2) Yes. ID conduits requiring additional supports.	1) Yes. Develop plan. 2) Yes. W/d procedure. 3) Yes. Train W/d team.	1) NA 2) Yes. Screen CCRS conduit schedule. 3) Yes. W/d all identified conduits. 4) Yes. Collect as-built data.	1) Yes. Calculate bearing pressure. 2) Yes. ID worse case (highest bearing pressure). Also, ID conduits requiring additional supports. 3) NA	1) Yes. Worse/ critical case analysis. 2) TBD	1) Yes. Review analysis. Testing is TBD. 2) TBD. Test, add supports, or replace cables. 3) TBD	Yes. Branch and project approval of licensing package.

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WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

CRITICAL CASE EVALUATION PROGRAM	PROGRAM PREPARATION		PHASE I - ENGINEERING OVERVIEW		PHASE II - ENGINEERING EVALUATION (level-I)	(level-II)	(level-III)	PROGRAM CLOSURE
	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(4) CABLE SUPPORT IN VERTICAL TRAY	1) Yes. Revise cable install spec and site procedures. 2) Yes. ID tray sections requiring analysis (apply) NEC limits). 3) NA	1) Yes. All Class 1E cables in vertical trays. 2) Yes. ID trays exceeding NEC limits.	1) Yes. Develop plan. 2) Yes. W/d procedure. 3) Yes. Train W/d team.	1) NA 2) Yes. Review tray drawings. 3) Yes. W/d trays requiring analysis. 4) Yes. Collect as-built data for further analysis.	1) Yes. Calculate tray lengths without adequate supports. 2) Yes. ID critical trays requiring analysis. 3) NA	1) Yes. Analyze critical tray sections. 2) NA	1) Yes. Review analysis. 2) Yes. Add supports as required. 3) Yes. Add supports as required.	Yes. Branch and project approval of licensing package.

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WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

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	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(5) CABLE PROXIMITY TO HOT PIPES	1) Yes. Revise raceway, cable, and pipe install specs and site procedures. 2) Yes. Establish spatial requirements. 3) NA	1) Yes. All Class 1E cables. 2) Yes. ID area with no hot pipes or Class 1E cables/raceways.	1) Yes. Develop plan. 2) Yes. W/d procedure. 3) Yes. Train W/d team.	1) NA 2) Yes. Review drawings to ID areas with potential cases. 3) Yes. W/d all required 1E cables/raceways. 4) Yes. Collect as-built deviation for further analysis.	1) NA 2) Yes. ID critical cases requiring further analysis. 3) NA	1) Yes. Analyze deviations to spatial requirements. 2) NA	1) Yes. Review analysis. 2) Yes. Rework. 3) TBD. On an individual basis.	Yes. Branch and project approval of licensing package.

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WBNP CORRECTIVE ACTION PLANS - CRITICAL CASES EVALUATION PROGRAM TABLE

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	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(6) CABLE PULLBYS	1) Yes. Revise cable install spec and site procedures. 2) Yes. ID worse case. 3) NA	1) Yes. All class 1E cables. 2) Yes. ID conduits with 12 or more 1E cables and minimum length.	1) Yes. Develop plan. 2) Yes. W/d procedure. 3) Yes. Train W/d team.	1) NA 2) Yes. Screen CCRS conduit schedules and cable pull cards. 3) Yes. W/d worse case. 4) Yes. Collect as-built data for further analysis.	1) Yes. ID worse conduits containing 3 or more PVC jacketed cables. 2) Yes. ID worse case. 3) NA	1) Yes. Worse case analysis. 2) TBD	1) Yes. Review analysis. Testing is TBD. 2) TBD. Test or replace cables. 3) TBD	Yes. Branch and project approval of licensing package.

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	1) Review & revise design reqmt's 2) Establish pre-screen attributes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(7) CABLE BEND RADIUS	1) Yes. Revise cable install spec and site procedures. 2) Yes. ID bend radius requirements. 3) NA	1) Yes. All Class 1E cables. 2) Yes. ID 1E cables exceeding bend radius requirements.	1) Yes. Develop plan. 2) Yes. W/d procedure (when required). 3) Yes. Train W/d team.	1) NA 2) Yes. Review site procedures for bend radius requirements. 3) Yes. W/d 1E cables to ID deviations (when required). 4) Yes. Collect as-built data for further analysis.	1) Yes. Calculate bend radius. 2) Yes. ID deviations. 3) NA	1) Yes. Analyze deviations. 2) Yes. When required.	1) Yes. Review analysis. Testing is TBD. 2) TBD. Test or rework. 3) TBD	Yes. Branch and project approval of licensing package.

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	1) Review & revise design reqmt's 2) Establish pre-screen attribu-tes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, accep-tables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases.	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy -sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen -sing pkg.
(8) CABLE SPLICES	1) Yes. Revise splice install instructions and site procedures. 2) Yes. ID locations of splices. 3) NA	1) Yes. All Class 1E cables. 2) Yes. ID splices to be reworked.	1) Yes. Develop plan. 2) N/A 3) N/A	1) NA 2) Yes. Review EQ binders, splice cards, and maintenance splice logs. 3) N/A 4) N/A	1) Yes. Define splices to be reworked. 2) N/A 3) NA	1) N/A 2) N/A	1) N/A 2) N/A 3) N/A	Yes. Branch and project approval of licensing package.

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	1) Review & revise design reqmt's 2) Establish pre-screen attributes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, acceptables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy-sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen-sing pkg.
(9) CABLE SIDEWALL BEARING PRESSURE	1) Yes. Revise cable install spec and site procedures. 2) Yes. ID critical cases (conduit length vs pull chart length). 3) NA	1) Yes. All Class 1E cables. 2) Yes. ID critical/worse conduits for every voltage level.	1) Yes. Develop plan. 2) NA 3) NA	1) Yes. Team of experienced engineers. 2) Yes. Review CCRS conduit schedule. 3) Yes. W/d worse case conduits. 4) Yes. W/d to document as-built configurations.	1) Yes. Calculate SWBP. 2) Yes. ID worse case. 3) NA	1) Yes. Worse case analysis. 2) Yes. Test to establish new SWBP limits.	1) Yes. Review analysis and test results for new limits. 2) NA 3) NA	Yes. Branch and project approval of licensing package.

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(10) PULLING CABLE THROUGH a) CONDULET and b) FLEXIBLE CONDUIT	1) Yes. Revise cable install spec. and site procedures. 2a) Yes. ID worse case. 2b) Yes. ID flexible conduit in mid route of rigid conduits. 3) NA	1) Yes. All Class 1E cables. 2a) Yes. ID all 1E conduits > 40 ft containing SI cables. 2b) Yes. ID locations.	1) Yes. Develop plan. 2) Yes. W/d procedure. 3) Yes. Train W/d teams.	1) NA 2) Yes. CCRS conduit schedule review. 3a) Yes. W/d worse case. 3b) Yes. W/d for visual inspection. 4a) Yes. W/d to document as-built configuations. 4b) NA	1a) Yes. Calculate SWBP. 1b) NA 2a) Yes. ID worse case. 2b) Yes. ID damaged cables (if any). 3) NA	1a) Yes. Worse case analysis. 1b) Yes. Visual inspection. 2a) Yes. Test. 2b) NA	1a) Yes. Review analysis and test. 1b) Yes. Review visual inspection results. 2) TBD 3) TBD	Yes. Branch and project approval of licensing package.
	NOTE: Pulling Cable Through Condulet issue is being resolved with the Silicone Rubber Insulated Cable issue.							

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	1) Review & revise design reqmt's 2) Establish pre-screen attributes, including CAQ issues. 3) Qualify the known variance	1) Define populat. 2) Prescreen for reworks, acceptables & the questionables, using attribute	1) Develop evalu. plans 2) Prepare proced. (QA) 3) Training	1) Walkthrou to record potential cases with reasons. 2) Review documents to identify potential cases with reasons. 3) Walkdown the selected representative cases which cover all the attributes. 4) Collect as-built data for the potential cases	1) Grouping by comparison & categorization 2) Overview team to screen the case groups for critical cases 3) Review panel rescreen for critical cases and to determine the approach of analysis or by testing	1) Critical cases detailed analy-sis 2) Critical cases actual testing	1) Review analysis or test results for acceptables 2) Determine the approach to fix un-resolved cases 3) Implement corrective action	Project and branches to review and determine final licen-sing pkg.
(11) VERIFY AND VALIDATE COMPUTERIZED CABLE ROUTING SYSTEM (CCRS) DATA BASE	1) Yes. Revise or issue engineering, design, and construction procedures. 2) Yes. ID safety related attributes. 3) NA	1) Yes. CCRS data base. 2) Yes. Review of EQ 1E harsh environment cables and the Appendix R mild environment cables.	1) Yes. Develop plan. 2) Yes. Evaluation procedure. 3) Train reviewers.	1) NA 2) Yes. Review EQ and Appendix R results. 3) Yes. Signal trace selected cables. 4) Yes. Signal trace selected cables.	1) Yes. Group by discrepancy type. 2) Yes. Evaluate critical discrepancies. 3) NA	1) Yes. Analyze critical discrepancies. 2) NA	1) Yes. Review analysis. 2) Yes. Review documentation or rework. 3) TBD.	Yes. Branch and project approval of licensing package.

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(12) VERIFY AND VALIDATE CCRS SOFTWARE	1) Yes. Revise CCRS software program specs. and programs. 2) NA 3) NA	1) Yes. CCRS software programs. 2) NA	1) Yes. Develop plan. 2) Yes. Prepare procedures. 3) Yes. Train personnel using required software.	1) NA 2) NA 3) NA 4) NA	1) NA 2) NA 3) NA	1) NA 2) NA	1) NA 2) NA 3) Yes. Revise software program specs. and programs.	Yes. Branch and project approval of licensing package.

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Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
Cable Proximity to Hot Pipes	10-09-85	Design Study Request No. DSR-011	Indicated that cable insulation could be exceeded near hot pipes.
	03-17-86	Sequoyah Employee Concern No. SQ-CAR-86-03-016	Identified 10 CFR 50.49 cables in the main steam vaults that were damaged by temperatures above the maximum design operating temperatures.
	05-07-86	PIR WBNEEB8644	No criteria exist that address separation of cables from thermally hot piping.
	06-16-86	NRC Information Notice No.86-49	Environmental conditions (heat, water, chemicals, etc.) may induce accelerated aging and subsequent degradation of cables.
Cable Support in Vertical Tray			Cable supports in vertical tray issues were identified by NRC's resident inspector.
Cable Support in Vertical Conduit	08-08-85	NCR W-262-P (Reportable: 10 CFR 50.55(e), W-262-P)	A survey performed on support of conductors inside vertical conduit as specified in N.E.C. revealed that none of the five conduits inspected met support requirements. It appears that G-38 was not revised to include support criteria for at least 4 years after revision to the design guide.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	01-30-86	Technical Evaluation Report No. C-5506-649	Technical evaluation of Watts Bar unit 1 and 2 cable pulling and cable bend radii concerns.
Cable Pullbys and Jamming	08-20-85	NCR 6270 (Not Reportable)	Cable sidewall pressure calcs were not considered in design process. G-38 did not address sidewall pressure.
	01-30-86	Technical Evaluation Report No. C-5506-649	Technical evaluation report on Watts Bar cable pulling and cable bend radii concerns.
	02-26-86	NRC Report No. 390/86-03	NRC inspection report indicating that sidewall pressure calculations do not address pullbys, conduit fill, and pull points in the most conservative manner.
	02-26-86	NRC Report No. 391/86-03	Same as NRC Report No. 390/86-03 except for other unit.
	10-06-86	Employee Concern CATD Number 10900-NPS-01	Allowable limits for cable sidewall pressure, and maximum bend radius have been exceeded.
	12-08-86	Employee Concern CATD Number 19200-NPS-01	Concern regarding the testing at at Central Laboratory on side wall pressure and greater than 360-degree bend violations.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	03-06-87	Employee Concern CATD Number 238.1-WBN-08	No assurance exists that sidewall pressure was not exceeded during installation of Class 1E cables in conduits. There are no indications that the critical case identified in calculation WBPEVAR 8603006 includes considerations for pulling cable in overfilled conduits and pullbys.
Cable bend radius	07-01-82	NCR 4194 (Reportable: 10 CFR 50.55(e), NCR 4194)	Some cables have recommended minimum bend radii greater than 12-inches, but the cable tray system has fittings with 12-inch radii.
	05-09-83	NCR 4274 (Not Reportable)	Minimum bend radius violation in a conduit elbow (LB).
	06-20-83	NCR WBN4933 (Not Reportable)	Suspected minimum bend radius violations at intersections of cable tray fittings.
	07-09-85	Nuclear Safety Review Staff Report No. I-85-06-WBN	Evaluation of employee concerns about cable bend radius problem identification, evaluation, and resolution.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	09-03-85	NCR 6295 (Reportable: 10 CFR 50.55(e), NCR 4194)	Cable terminations in main control room panels violate minimum bend radius.
	10-02-85	NCR WBN6360-S (Not Reportable)	Minimum cable bend radius violated during termination in equipment.
	10-25-85	NCR W-290-P (Reportable: 10 CFR 50.55(e), W-290-P)	Cable terminations using MAI-4 and -5 were not inspected for bend radius conformity.
	03-06-86	NCR WBN6624 (Not Reportable)	Design Standard E12.1.13 R1 was incorrectly used as the reference for minimum bend radius affecting cable pull.
	01-07-87	Problem Identification Report No. PIRWBNEEB86107	Flexible conduit connectors (i.e., 45-degree and 90-degree) do not have sufficient area and thus violate the minimum bend radius of cables.
	01-30-87	Technical Evaluation Report No. TER-C5506-649	A report by Franklin Research Center for the NRC to determine if significant cable abuse occurred during installation.
	04-06-87	Condition Adverse to Quality Report No. CAQR WBP870133 (Not Reportable)	The training radius minimums are violated in Westinghouse R panels.
	04-06-87	Condition Adverse to Quality Report No. CAQR WBP870134 (Not Reportable)	Terminal blocks have insufficient space to terminate the conductors without violating the bend radius.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	04-06-87	Condition Adverse to Quality Report No. CAQR WBP870136 (Not Reportable)	Same as CAQR WBP870134.
	04-06-87	Condition Adverse to Quality Report No. CAQR WBP870140 (Not Reportable)	An excessive amount of cable curled up in cable trays violates cable training bend radius.
	06-26-87	Problem Identification Report No. PIR WBNEEB8720	Failure of TVA Construction Spec G-38, MAI-4, WBNQCP-3.06.3 and QCI 3.06.3 to define the bend radius for Raychem products.
	07-16-87	Condition Adverse to Quality Report No. CAQR WBP870637 (Reportable: 10 CFR 50.55(e), NCR 4194 and 6295; 390/82-80)	Intercell connecting cables do not meet bend radius criteria in battery rooms.
Cable Splice			
	07-25-84	NCR 5769 (Not Reportable)	No official documentation exists for test 57 (inspection of splicing) on cables 2PL5008A and 2PL3914A.
	07-24-85	NCR 6208 (Reportable: 10 CFR 50.55(e), NCR 6208)	Cable terminations in harsh environments and below flood level are not installed in accordance with electrical standard drawings.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	08-01-85	NCR 6224 (Reportable: 10 CFR 50.55(e), NCR 6208)	As a result of NCR6208, there is (thought to be) a high probability that terminations on Class 1E equipment are not installed per design drawings.
	09-20-85	Significant Condition Report SCR WBNEQP8501 (Reportable: 10 CFR 50.55(e), NCR 6208)	G-38 allows use of splicing methods and materials which are not qualified for Class 1E applications in harsh environment.
	12-24-85	Problem Identification Report No. PIR 8586	Sequoyah Nuclear Plant has problems with four of its positioners on Aux Feed Water values. In order to qualify, connections must be covered with Raychem and conduit connections turned down. Watts Bar valves were purchased on the same contract.
	12-19-86	Sequoyah Employee Concern No. SQ-CAR-86-058	Splice problems.
	01-21-86	NCR 6584 (Not Reportable)	The build up shims of shrink material extends between 1/4-inch and 1/2-inch beyond overall sleeve of heat shrink. Drawings specify a minimum overlay of shims by overall sleeve of 1/4-inch.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	02-05-86	NCR 6623 (Reportable: 10 CFR 50.55(e), SCR 6623)	Cable splices and terminations using Raychem prior to 12-2-85 do not meet current requirements for splices in harsh environments.
	02-26-86	NCR W-353-PS (Reportable: 10 CFR 50.55(e), W-353-PS)	The performance of TI-72 identified cable ID tags missing, Raychem end caps missing, Raychem not heat shrunk properly, etc.
	04-08-86	Significant Condition Report SCR WBNEQP8601 (Reportable: 10 CFR 50.55(e), SCRWBNEQP8601)	Required (environmental qualification) information cannot be supplied due to missing or inaccessible valve manufacturer's name plate on valves.
	04-14-86	NCR 6774 (Reportable: 10 CFR 50.55(e) SCR 6623)	Same as NCR 6623.
	06-26-86	NRC IE Notice IN 86-053	Improper installation of heat shrinkable tubing such as improper diameters, improper overlap, tubing not heat shrunk properly, etc.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	11-24-86	Employee Concern CATD No. 30403-NPS-01	Water standing in electrical manholes results in "water-treeing" of insulation.
	01-12-87	Problem Identification Report No. PIR 8707	WBN design criteria requires use of some cables rated for 125-degrees Centigrade or higher but Raychem is only rated for 90-degrees Centigrade.
	01-12-87	Problem Identification Report No. PIR 8708	Unit 2 version of PIR 8707.
	04-09-87	Condition Adverse to Quality Report No. CAQR WBP870163 (Not Reportable)	There is a potential that nonqualified Class 1E terminations have been made using Scotch tape as a filler under Raychem sleeves. Furthermore, certain non-Class 1E cable needed for shutdown may not be qualified.
	06-11-87	Problem Identification Report No. PIR 8720	TVA has failed to define bend radius limitations for Raychem products. Also Raychem heat shrinkable tubing improperly heated during installation.

Attachment 1

BASIS FOR CAP

CABLE PHYSICAL ISSUES

Issue	Date	Identifying Document	Description
	10-29-87	Condition Adverse to Quality Report No. CAQR WBP871109 (Not Reportable)	G-38 requires Raychem type N sleeves for all splices in Category A and B environments and states that this equipment is listed in 10 CFR 50.49 list. However, this list does not contain all CAT A and B equipment.

Attachment 1

BASIS FOR CAP

COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
04-28-87	SCR WBNECB8601 R0 (Not Reportable)	The allowable cross-sectional area fill quantities for cable trays have been violated on several occasions. This was due to the program coordinator being able to manually raise the fill limit without justifying the overfill.
06-27-86	SCR WBNECB8602 R0 (Not Reportable)	(This SCR is closed. See B42 870218 008.) The system data files and certain programs have no protection from deliberate/inadvertent deletion.
06-27-86	SCRWBNECB8603 R0 (Not Reportable)	WBEP-EP 43.19 R0 has no requirement for verifying conduit schedule input sheets against the issued conduit drawings. It also does not require any QA record to be generated or maintained to document this process.
06-27-86	SCRWBNECB8604 R0 (Not Reportable)	WBEP-EP 43.13 does not require any verification of cable design and/or routing before the designs are released to Nuclear Construction (NC).
06-10-86 and 09-25-86	SCRWBNEQP8628 WBNEQP8648 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628; WBRD-50-390/86-61)	In some cases, no installation documentation could be found for comparison of records.

Attachment 1

BASIS FOR CAP

COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
09-25-86	SCR WBNEQP8648 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628)	Installation documentation is not in accordance with the design documentation and no evidence exists of a field change request. Cable test revision levels were not revised when computer-generated holds were manually released.
06-10-86 06-10-86 09-25-86	SCR WBNEQP8625, WBNNEQP8628, WBNEQP8648 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628)	Reel number recorded on cable pull card does not correspond to required cable mark number.
06-10-86	SCRWBNEQP8625, WBNEQP8628 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628)	Portions of installation sheets and pullslips were hand-written or typed, instead of computer generated, and contain errors involving essential data.
06-10-86	SCRWBNEQP8624 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628)	There was a failure to ensure printer alignment that resulted in missing/obliterated data. There was a failure to control cable revision levels.
06-10-86	SCRWBNEQP8627 (Reportable: 10 CFR 50.55(e), SCR WBNEQP8628)	There was a failure to adequately document "extension wiring" used to extend field cables.

Attachment 1

BASIS FOR CAP

COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
04-07-87	CAQR WBF870030 (Not Reportable)	Computer software is not verified or controlled. (This CAQR was previously identified under NCR WBNECB8501.)
04-07-87	CAQR WBT870152 (Not Reportable)	Computer data used to produce design output is not verified (e.g., cable mark numbers, cable and conduit data, and cable tray network data). (This CAQR was previously identified under NCR WBNECB8501.)
12-27-85	SCRWBNEEB8589 and WBNEEB8590 (Reportable: 10 CFR 50.55(e), SCR WBNEEB8589)	Values for cable weights and outside 12-27-85 diameters used in the CCRS are not quality assured. (WBN unit 1 and 2 respectively.)
10-15-85	NCR W-283-P (Not Reportable)	Temporary cables added to trays without proper load calculations being done.
03-12-87	NCR W-590-P (Superseded by by CAQR WBQ871051) and SCR7132	Medium voltage power cables (6900 volts) (Larger than 2/1) are not spaced properly.
04-08-87	CAQR WBP870174 (Not Reportable)	No control over cable tray penetration fill level.
03-06-87	238.01-WBN-01	There is no assurance that current records of raceway fills agree with the actual installation. Possible overfill on some trays and tray penetrations were observed. This potential raceway overfill may result in noncompliance with FSAR commitments.

Attachment 1

BASIS FOR CAP
COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
03-02-87	238.01-WBN-02	Maximum tray fills listed in three current WBN cable schedules do not agree in all cases with the maximum allowable values established by calculations (526 360825 047)
03-02-87	238.01-WBN-03	No corrective action was identified to demonstrate adequacy of raceway supports, resulting in current raceway fill and cable weight uncertainties.
03-09-87	238.01-WBN-05	WBEP-EP-43.13 does not include all the necessary requirements to ensure that adequate control or raceway fill and cable routing will exist in the future.
03-02-87	238.01-WBN-10	No documents were identified that define allowable cable fill in penetrations. Also, effectiveness of firestops and pressure seals for overfilled trays at wall and flow penetrations needs verification.
03-06-87	239.00-WBN-01	There is no procedure for engineering to extract the installed cable lengths entered into the ECM&D data file for review and verification of cable length used in calculations.

Attachment 1

BASIS FOR CAP

COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
03-02-87	239.00-WBN-02	The cable schedule computer program has not been properly verified to assure that it performs its intended functions (e.g., divisional separation of redundant cables, voltage level separation, and calculation of cable tray fill). Adequacy of the as-built installed cables cannot be confirmed until the program and data have been verified.
03-02-87	239.00-WBN-03	The cable schedule computer program is deficient in the areas of controlling documents for system maintenance and program usage procedures as required by ECB Procedure ECB-EP28-01.
03-02-87	239.00-WBN-05	The verified cable data (D.A., weight, etc.) have not been entered into the CDCP. Similarly, completeness of records for all abandoned cables could not be verified.
03-02-87	239.00-WBN-06	TVA has stated that current programs directed at resolving raceway overfills have been initiated. However, no evidence could be found that actual raceway fills identified as part of these programs will be included in the raceway fill tracking system for future use.

Attachment 1

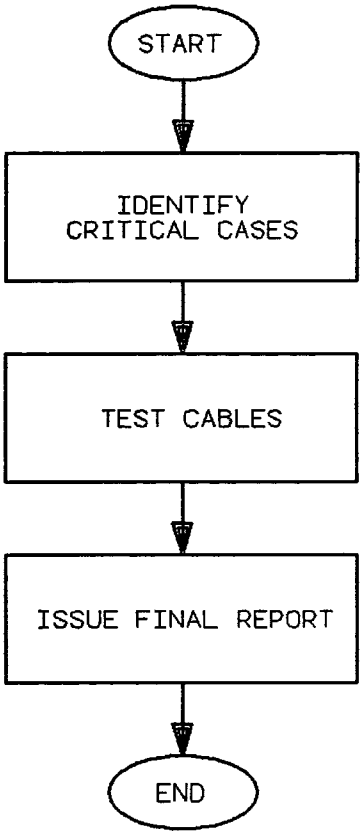
BASIS FOR CAP

COMPUTERIZED CABLE ROUTING SYSTEM ISSUES

Date	Identifying Document	Description
03-02-87	239.00-WBN-07	The Engineering-Construction Monitoring and Documentation (ECM&D) program has not been properly verified to assure that it performs its intended functions (e.g., print of Class 1E pull slips which indicate the cable routing, the to-from location, and the type of cable used). No procedure is available for verifying the ECM&D program. Adequacy of the as-built installed cables cannot be confirmed until the program has been verified.
03-02-87	239.00-WBN-08	No procedure exists for the implementation of the security system used in the ECM&D User's Guide, R0, 01-01-87.
03-02-87	239.00-WBN-09	The current engineering practice of re-using cable identifiers of deleted cables on new cables resulted in two pull slips with the came cable identifier number.
03-02-87	239.00-WBN-10	Current engineering practice is to assign one cable identifier number to a spliced cable. This may result in the installation of incorrect cable sizes for the different segments of a spliced cable, and therefore, impacts circuit ampacity and raceway fill calculations.
03-03-87	240.00-WBN-02	No program for implementing the direction given in the memo by W. S. Raughley to Those listed (B43 861008 909) was identified for WBN. Also, no specific requirements are identified in this memo for evaluation of overfilled raceways.
08-18-88	Discrepancy Report (DR) -01, DR-03, DR-213	Concerns related to the Computer Cable Routing System (CCRS) Software and Data Base (design output) not being verified and validated per the requirements of ANSI N45.2.11. R1

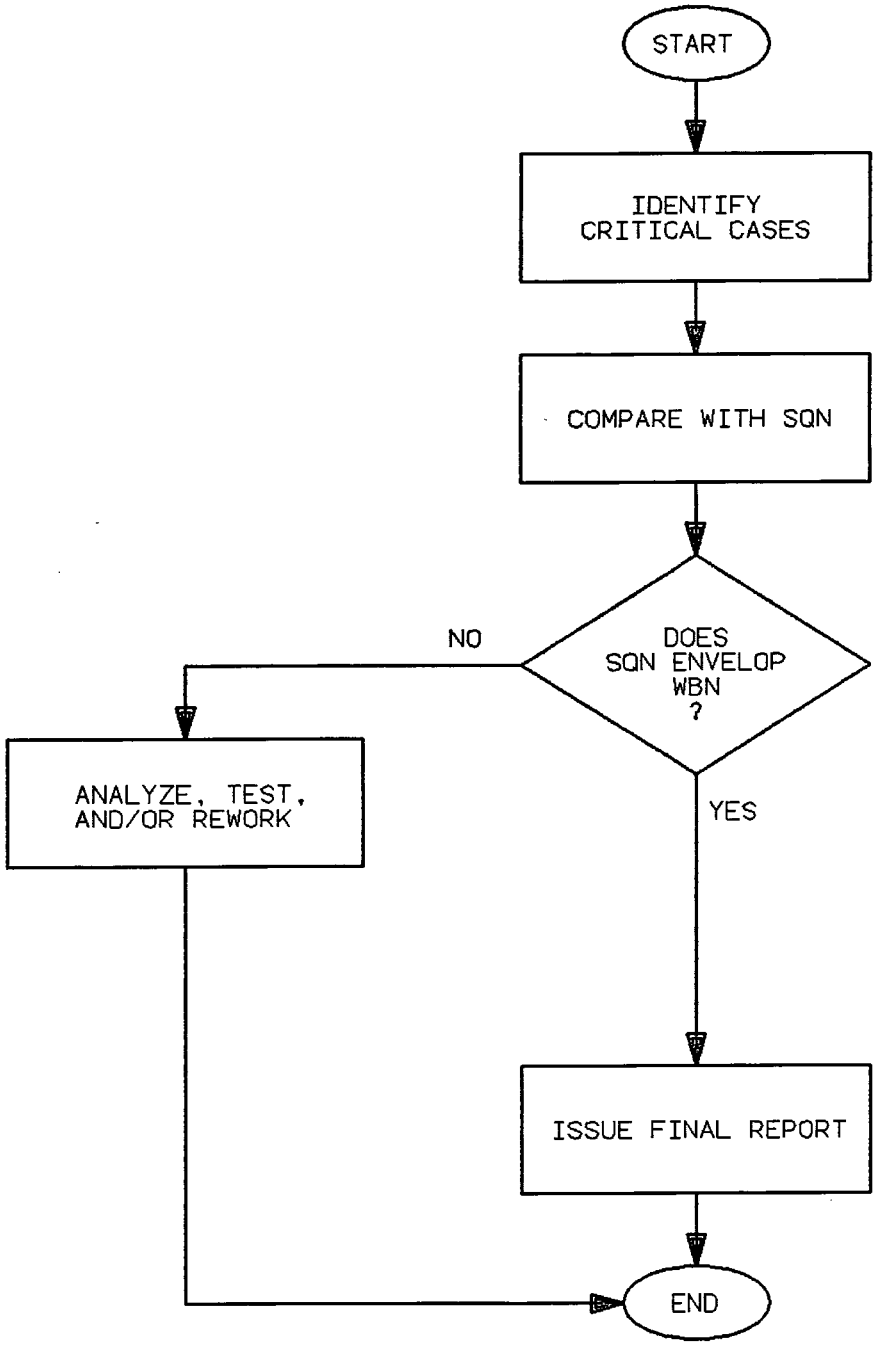
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

SILICONE CABLE AND 90-DEGREE CONDULET



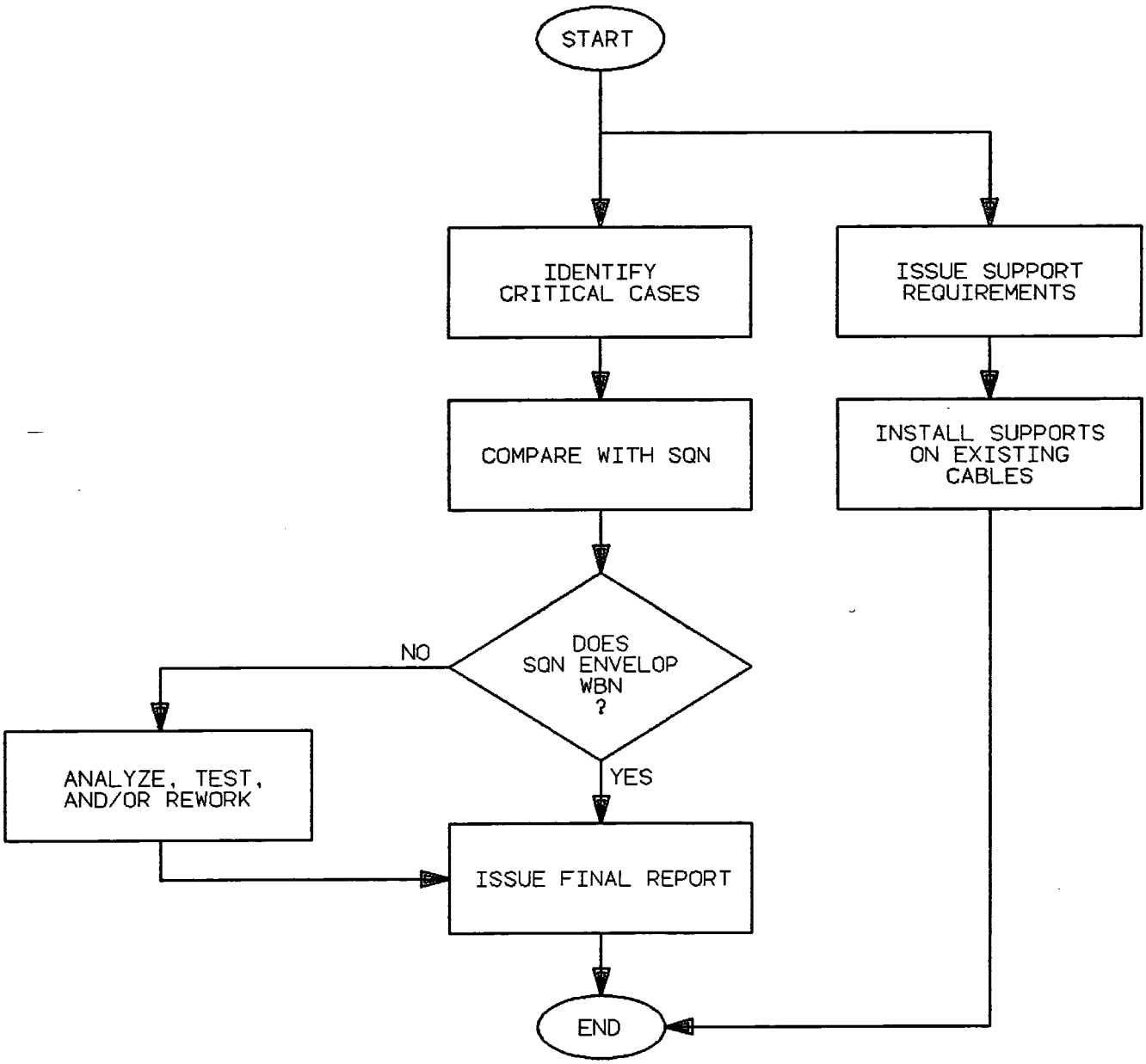
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

CABLE PULLBYS & JAMMING



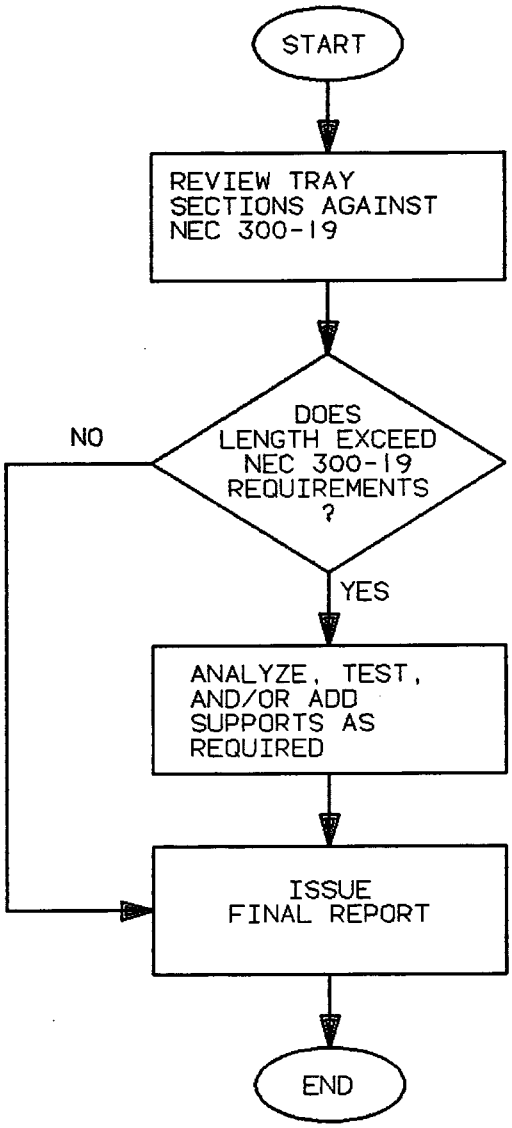
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

CABLE SUPPORT IN VERTICAL CONDUIT



CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

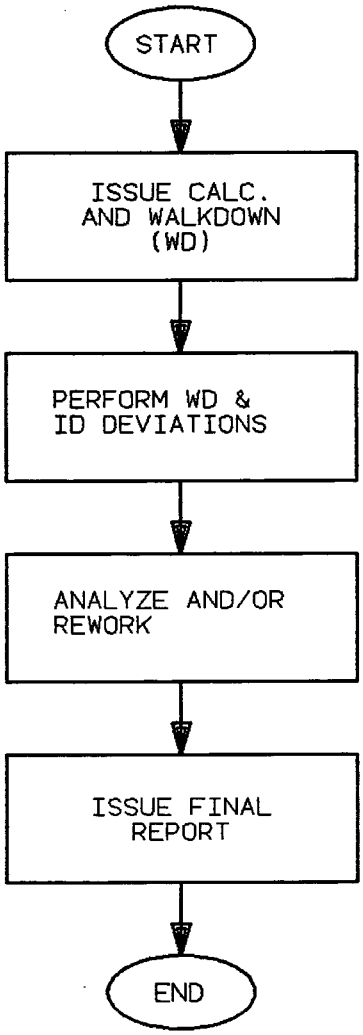
CABLE SUPPORT IN VERTICAL TRAY



FLOW CHART FOR ECN REVIEW

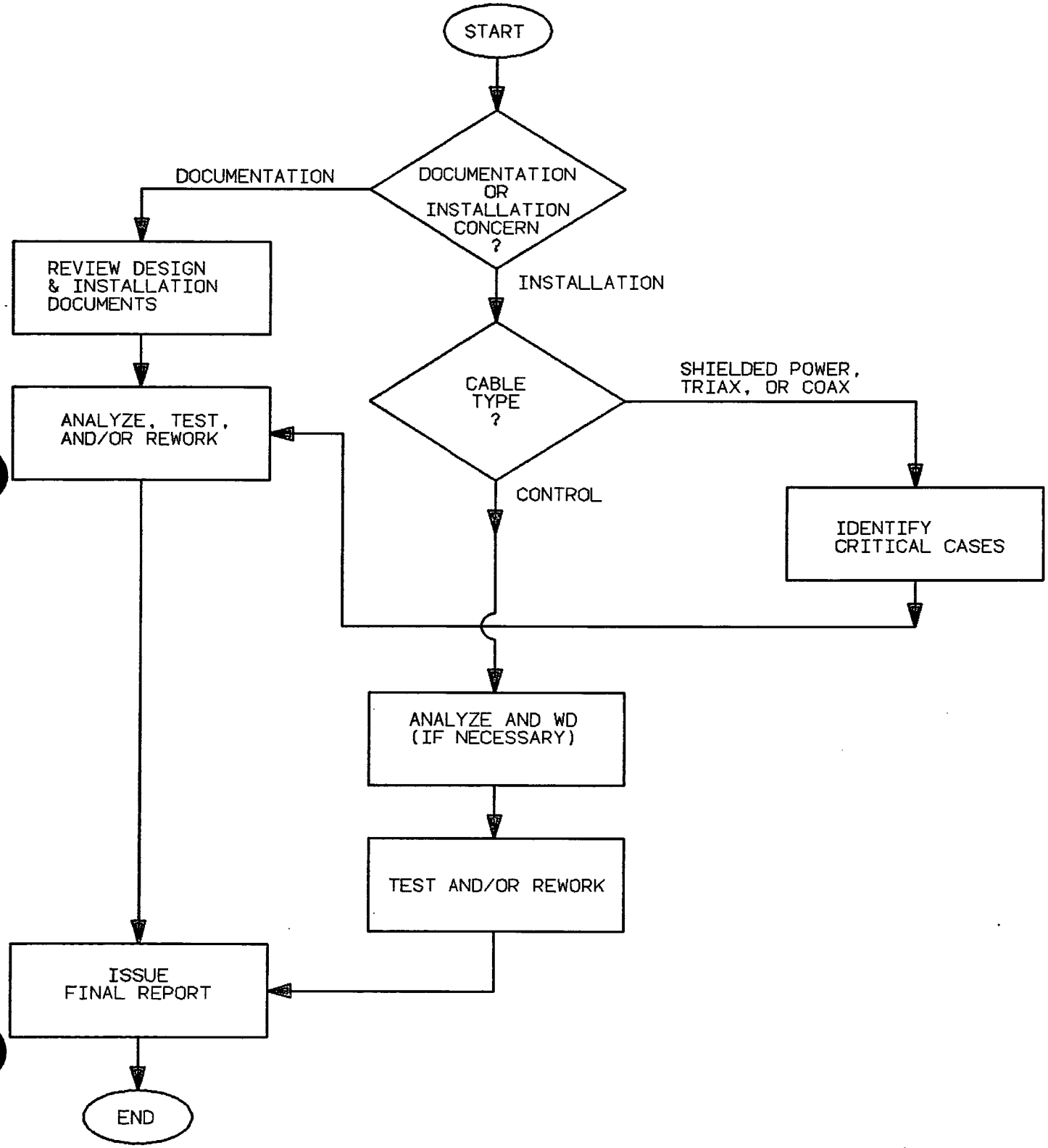
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

CABLE PROXIMITY TO HOT PIPES



CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

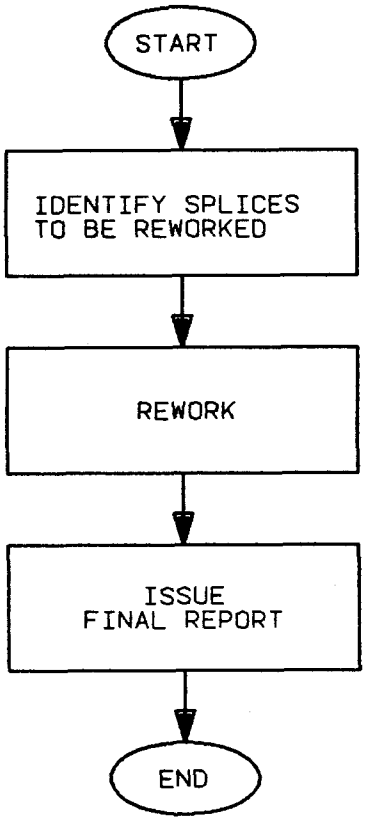
CABLE BEND RADIUS



CABLE PHYSICAL ISSUES FLOW CHART

CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

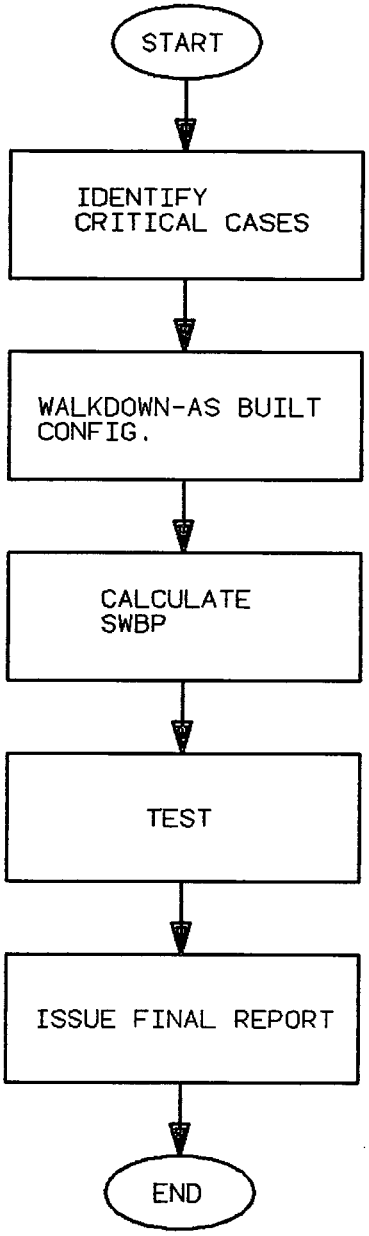
CABLE SPLICES



R1

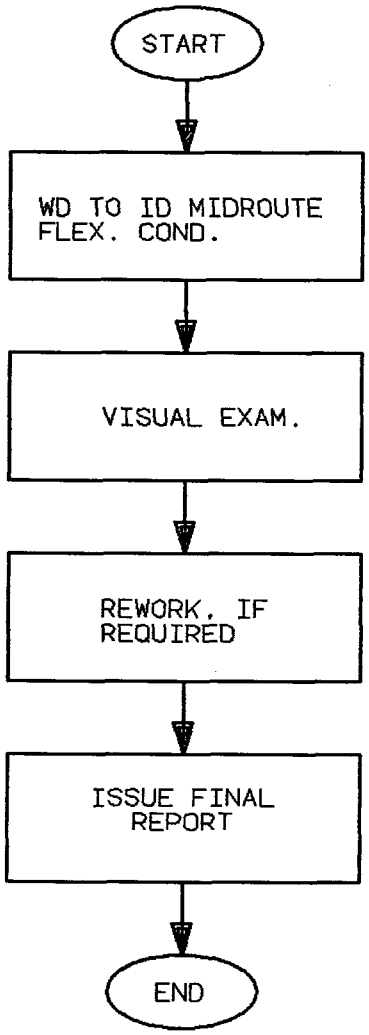
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

CABLE SIDEWALL BEARING PRESSURE



CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

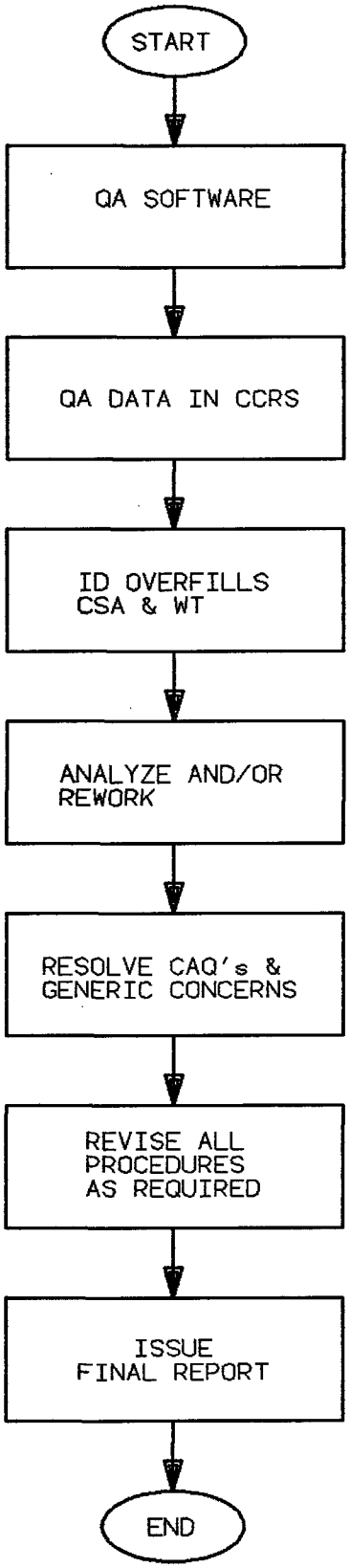
PULLING CABLE THROUGH FLEXIBLE CONDUIT



CABLE PHYSICAL ISSUES FLOW CHART

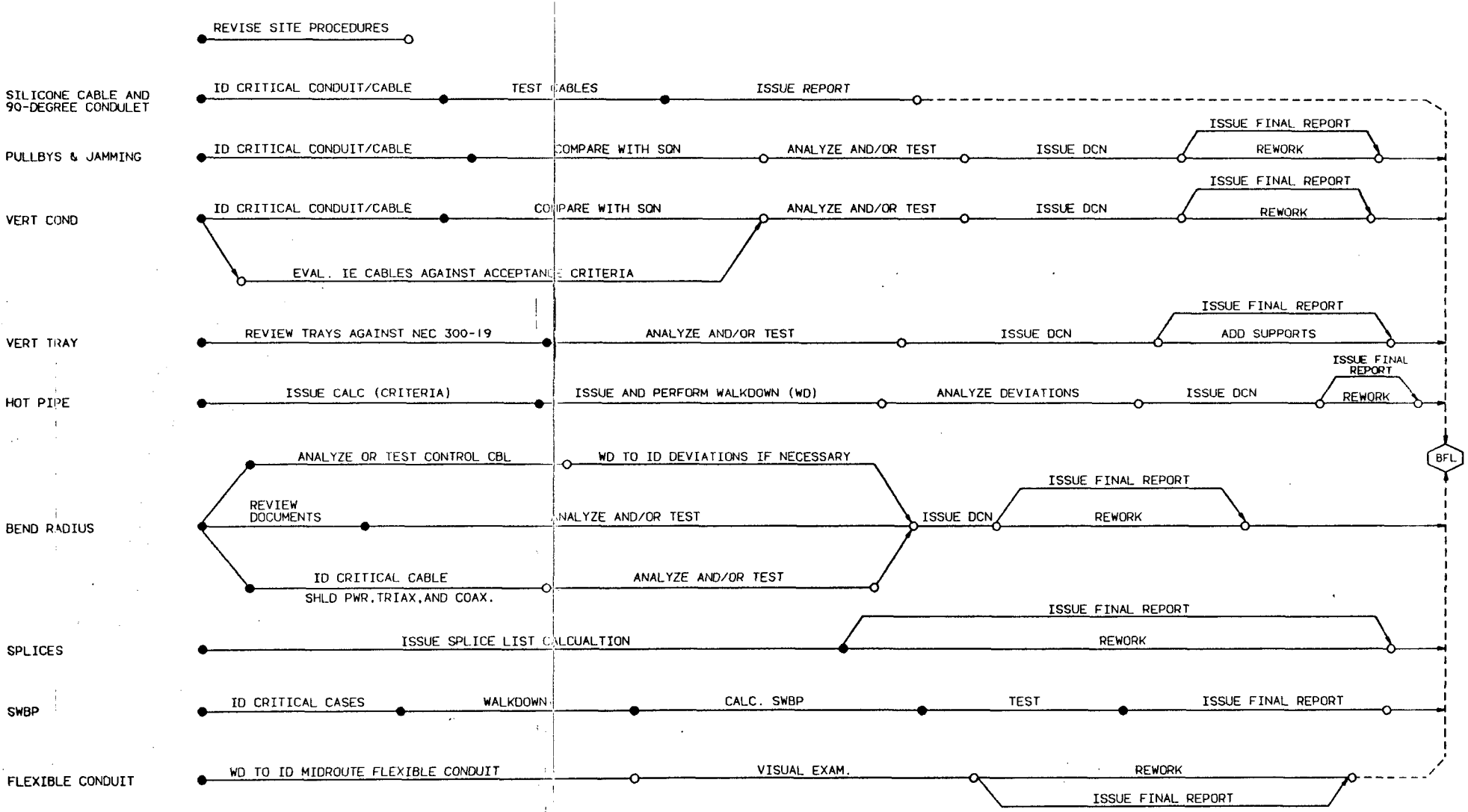
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 2 - FLOW CHART
CABLE PHYSICAL ISSUES

CCRS DATABASE AND SOFTWARE



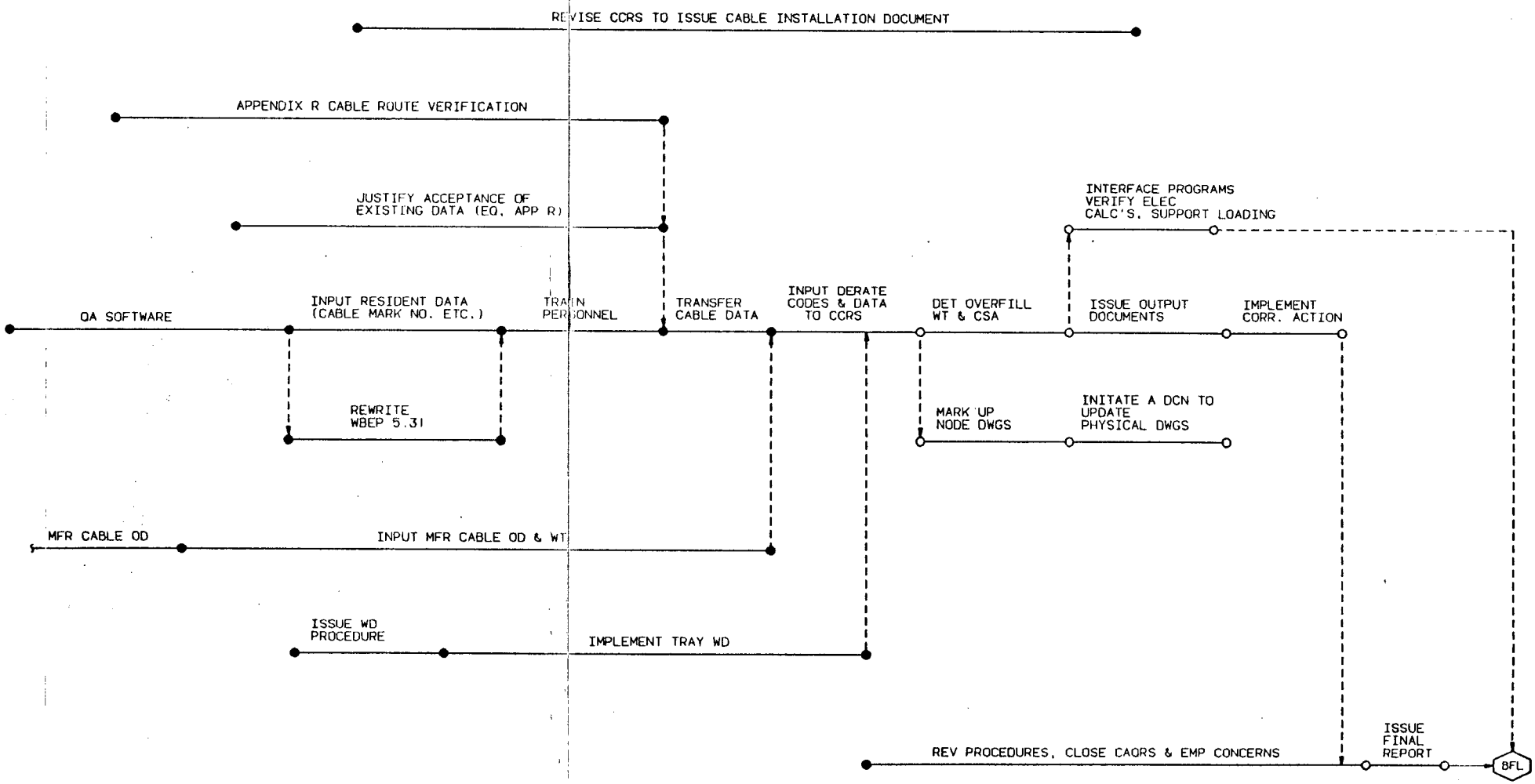
CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 3 - FRAGNET
CABLE PHYSICAL ISSUES

R1 THROUGH 5-6-89



CABLE ISSUES
CORRECTIVE ACTION PROGRAM PLAN
ATTACHMENT 3 - FRAGNET
COMPUTERIZED CABLE ROUTING SYSTEM

R1 THROUGH 5-6-89



ENCLOSURE 2

The following is a listing of commitments made in this submittal:

- Design basis documents and the Final Safety Analysis Report (FSAR) will be revised to ensure consistency and to comply with licensing requirements.

- Resolve design and construction concerns either by qualification (arrived at by test or analysis) or by rework.

- Evaluate the Computerized Cable Routing System (CCRS) software, data base, and procedures in light of nonconformances currently identified. Rework CCRS and procedures as necessary to prevent recurrence of CCRS-related deficiencies.

- Revise or develop and implement new cable installation procedures to prevent recurrence and deficiencies.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT

SEISMIC ANALYSIS

Corrective Action Program Plan

Revision 1

0865g