4.1.1.5 Site Specific - BLN (continued)

fact that TVA did not include SWP calculations in their cable pull procedure and (2) the way TVA defined their method of calculating MPT on multi-cable pulls.

At BLN, Problem Identification Report PIR BLNEEB8518 dated September 18, 1985 identified the following conditions and corrective action:

> "Cable sidewall pressure calculations were not considered in the design process and Construction Specification G-38, Revision 5, did not address cable sidewall pressure.
>
> General Construction Specification G-38, Revision 6, effective September 15, 1985, includes SWP calculations requirements. SWP calculations for future cable installations should be made in accordance with G-38."

Review of Stop Work Action Report number SW12 revealed all cable pulling activities governed by G-38 were stopped on July 7, 1985 due to inadequate procedures. The stop work order was released on January 7, 1986 after procedures were revised and personnel were retrained.

Review of NCR 2987, Revision 0, revealed that cables installed from October 14, 1983 until March 1, 1984 were installed and accepted by Quality Control (QC) without using the new break rope requirements as given in General Construction Specification G-38 (SRN-G-38-2). The cause given in the NCR was oversight by personnel to recognize changes in the cable pulling requirements when receiving revisions to G-38 (SRN-G-38-2). Cable pulled during this period was sampled per the instructions in R. M. Hodges' memorandum to L. S. Cox dated July 12, 1984 (EEB 840717 902). No further problems were identified, and the NCR was closed on February 20, 1986.

4.1.1.5 Site Specific - BLN (continued)

DNE was actively evaluating SWP and MPT issues generated as a result of inadequate procedures for cable pulling and inadequate control over conduit overfill. An extensive testing program was undertaken by TVA to determine the maximum allowable sidewall pressure for the worst case cables (see section 4.1.1.1 for test results). The samples tested were representative of cables installed at all of TVA's nuclear power plants. W. S. Raughley's memorandum to the EEB files dated July 8, 1986 (B43 860710 905) stated that DNE anticipated that the existing analytical methodology and test results would substantiate the installed adequacy of all Class 1E cables at TVA's nuclear plants. W. S. Raughley's memorandum dated June 23, 1986 (B43 860626 931) provided guidance for each project to determine the adequacy of their Class 1E cable installations with respect to sidewall pressure. Each project was instructed to form an inspection team to select and sample conduits which met the worst-case configurations. Conduits with multiple bends, long lengths, a high percentage of cable fill, and elevation changes were to be considered. The data was to be collected and submitted to DNE for evaluation.

At the writing of this report, data had not been collected at BLN. DNE was involved in contract negotiations with a third party engineering company to evaluate the sampling program previously conducted at WBN. Final resolution of SWP issues was to depend on DNE's ongoing evaluation and final report.

2. Three concerns were evaluated at BLN for minimum bend radius problems. A review of NSRS report I-85-06-WBN revealed that a comprehensive review of cable bend radius issues from 1979 through 1985 identified several areas of potential inadequacies resulting in excessive cable bends (discussed in sections 4.1.1.1 and 4.1.1.2). A memorandum was reviewed from W. S. Raughley dated September 2, 1986 (B43 860903 904) which provided direction to each project for steps necessary to resolve MBR concerns for Class 1E cables.

4.1.1.5 Site Specific - BLN (continued)

At the writing of this report, the cable bend problems had not been resolved. Discussions with a DNE engineer responsible for preparing the final report addressing minimum bend radius concerns revealed that the final report was not yet available for review.

BLN Quality Control Procedure QCP-3.34 titled, "Electrical Cable Installation" was reviewed to determine if BLN DNC had adequate instruction to comply with the requirements of G-38. The following instructions for inspecting MBR were found in Revision 3:

> (EQC inspector)
> "Monitors the cable pull or pull back to ensure that the minimum cable pulling radius is not violated, the proper pulling direction (if specified) is followed, and that the cable is protected during the installation." (procedure section 6.3.1.2)

A responsible engineer was required to determine the pull bend radius and provide a "cable pull package."

The BLN Quality Control Procedure was determined by the evaluator to be adequate to ensure design criteria (G-38) was met.

3. A walk-through was conducted assisted by an electrician to determine the manufacturer, type, and wire size for 480-volt receptacles found throughout the plant. During the walk-through, the electrician removed covers from three 480-volt receptacles in question. These were identified as follows:

> 1ED-ERCP-007C (Location at A5/T-line);
> 1ED-ERCP-029A (Location at D2/M-line); and
> 2ED-ERCP-29C (Location at D6/H-line).

The first two receptacles were identified as Crouse Hinds model number AEQ 01648 and the third receptacle was Crouse Hinds type AR6-48. All receptacles were observed to be wired with three conductor number two AWG wire spliced to a smaller wire as permitted by TVA drawing number SGW1740-ED-33, Revision 3. Instructions were specified on drawing note number 2 as follows:

4.1.1.5 Site Specific - BLN (continued)

"60 Amp Power Receptacle connector pigtails may be reduced to a minimum of 4 AWG if required."

The 480-volt receptacles were determined to be properly connected because no improper connections were found in the walk-through due to oversized wire connecting directly to a 480-volt receptacle.

4. Concerns IN-85-300-002 and IN-86-268-003 were evaluated on the subject of improper routing of cable. Lonnie S. Cox's memorandum to J. P. Darling dated March 24, 1986 (C20 860325 683) revealed that BLN DNC had looked at cable routing and provided the following response:

"Bellefonte cables are routed by computer, which considers the fill of conduits. The program is written to prevent overfill. Also, field observation indicates this is not a problem at BNP."

NCR 4975, Revision 0, was written due to a particular cable which was not routed properly at the point where the cable transitioned from a conduit to a cable tray. The cause as stated on the NCR was due to:

"Failure of the craft to follow proper cable routing specifications and EQC inspectors for verifying the same."

The NCR was issued August 12, 1986 and had not been closed out. NCR 4249 was also written due to improper cable routing from a cable tray to a conduit. The cause given on the NCR stated that worker and EQC implementation was unsatisfactory. The NCR was not significant. Work release 53,792 was written to pull back and reinstall the cable according to DNE routing, and the NCR was subsequently closed out.

Review of BLN-QCP-3.34, Revision 3, revealed the following instruction for the responsible QC inspector to verify cable routing:

4.1.1.5 Site Specific - BLN (continued)

"6.2.1.3 Verifies that the route of the cable is correct and that the actual pull points to be used by the craft do not exceed 360° of bends between them."

A similar subject was covered in Operations Subcategory 30403. The particular concern (IN-85-945-001) dealt with cables routed outside of cable trays in the manholes. No problems were noted with cables outside cable trays.

4.1.2 Findings/Conclusions

4.1.2.1 Generic

SWP, MPT, and MBR issues were factual and were actively being evaluated by DNE. The program discrepancies were identified in NSRS Report I-85-06-WBN. The Sidewall Bearing Pressure Test results were favorable based upon the conservative approach and SWP limits reported between 600-1500 pounds/foot depending upon the type of cables and configuration tested. Direction was given to each engineering project concerning specific actions to be taken to resolve concerns with SWP and MBR. These included SWP sampling programs, SWP calculations, MBR inspections, procurement reviews, and DNE's final report. The final resolution depended on DNE's completion of the ongoing evaluation mentioned above and the subsequent final response to NSRS report I-85-06-WBN not yet available.

Based on the above findings, DNE had taken the position that installed cable was acceptable and the ongoing evaluation by each plant site would provide documentation to support the adequacy of installed cable.

4.1.2.2 Site Specific - WBN

Several concerns addressed MPT, SWP, and MBR issues. Based upon the information contained in NSRS report I-85-06-WBN, the mentioned interviews and ongoing evaluation by DNE, the past method for calculating MPT and the past methods for pulling and monitoring cables had been determined by the

4.1.2.2 Site Specific - WBN (continued)

evaluator to be inadequate to ensure cable was successfully pulled without insulation damage (see section 4.1.2.1 for the generic conclusion).

Concerns EX-85-073-001 and IN-85-719-002 dealt with specific MBR problems. The areas mentioned in the concerns were located and examined for MBR problems. None were identified, therefore, the concerns were not verified factual. EX-85-157-002, IN-85-733-001, IN-85-935-001, IN-86-266-C06, IN-86-314-N06, and WI-85-100-013 reported general MBR problems. They were found factual because DNE's response to MBR NCRs was questioned in NSRS report I-85-06-WBN. The concerns identified a problem but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

The following concerns dealt with procedural changes which did not require rework of past installations:

EX-85-076-003, IN-85-213-001, IN-85-255-001, IN-85-295-003, IN-85-436-004, IN-85-856-005, IN-86-201-001, IN-86-259-001, and XX-85-094-004.

These concerns were found factual because a review of all revisions of General Construction Specification G-38 revealed that most pulls were not monitored prior to 1984. NSRS report I-85-467, 466, 568, 573, 518, 575-WBN verified the concerns and tied the conclusions to NSRS report I-85-06-WBN. This report was extremely critical of the manner in which DNE had defined the method of calculating the MPT for multi-cable pulls. The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.1.2.2 Site Specific - WBN (continued)

The following concerns dealt with the use of trucks and come-alongs to pull cable:

EX-85-086-001, IN-85-241-N11, IN-85-318-002, IN-85-581-001, IN-85-978-001, IN-86-036-002, IN-86-199-001, IN-86-254-001, IN-86-254-002, IN-86-259-002, IN-86-262-003, IN-86-266-001, IN-86-266-002, and IN-86-314-001.

Several concerns (IN-85-241-N11, IN-85-318-002, IN-85-581-001, IN-86-036-002, IN-86-199-001, IN-86-254-001, IN-86-254-002, IN-86-259-002, IN-86-262-003, and IN-86-266-002) were all found factual because the abuse of steel choker use was verified in I-85-467, 466, 568, 573, 518, 575-WBN and in an interview connected with IN-85-581-001. The concerns presented a problem for which corrective action had been, or was being, taken as a result of an employee concerns evaluation. EX-85-086-001, IN-85-978-001, IN-86-266-001, and IN-86-314-001 were not verified factual because as they were stated there was no problem. Truck and come-along (also termed mechanical assists) use was allowed in site and DNE procedures.

IN-85-046-001, IN-85-533-001, IN-85-774-006, and IN-86-259-004 dealt with a specific incident where the pull tension was exceeded when a QC inspector was prevented from viewing a pull. This event was factual, however, corrective action had already been initiated before the employee concerns evaluation of the concerns was undertaken. This action had consisted of scrapping the cable and disciplining the foreman and general foreman.

The following concerns were general cases of excessive MPT:

IN-85-201-002, IN-85-314-001, IN-85-325-005, IN-85-433-002, IN-85-527-001, IN-85-935-001, IN-86-028-001, IN-86-212-001, IN-86-259-014, PH-85-050-001, WI-85-100-012, and XX-85-008-001.

4.1.2.2 Site Specific - WBN (continued)

IN-85-201-002 was not verified factual because the recommendation could not be used since it was contrary to site procedures and G-38. IN-85-527-001 was found factual due to the findings of NSRS report I-85-852-WBN. The particular cable in question had been previously identified as one whose MPT could not be documented. The cable was scrapped as a result of NCR 6001. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken. The other concerns were factual due to the problems which were discovered with lack of SWP calculations in NSRS report I-85-06-WBN. Corrective action for the problem was initiated before the employee concerns evaluation was undertaken.

The following concerns dealt with poor quality work:

HI-85-010-001, IN-85-186-010, IN-85-295-003, IN-85-318-001, IN-85-318-003, IN-85-733-001, IN-85-798-005, IN-85-878-X01, IN-85-935-001, IN-85-978-013, IN-86-252-004, IN-86-314-002, and OW-85-007-012.

HI-85-010-001 was not verified factual in the ERT report written on the concern due to the fact that a later interview with the concerned individual indicated that the problem was with aesthetic rework and not poor quality work which affected plant safety. OW-85-007-012 was found factual in NSRS report I-85-445-WBN. However, no problem was foreseen with non-electricians pulling cable because safety-related pulls would be inspected by a QC inspector. Therefore, the concern was factually accurate, but what it described was not a problem (i.e., not a condition requiring corrective action by ONP).

4.1.2.2 Site Specific - WBN (continued)

IN-85-318-003 was not verified as factual in interviews with the responsible QC inspectors. No evidence of pulling cable to the CRDM fans with split insulation was discovered. IN-85-878-X01 was not verified as factual because the site procedures were as dictated by G-38. IN-85-186-010 and IN-86-252-004 were not verified as factual because they were so vague they could not be evaluated. Both of these concerns dealt with potential damage to cables. However, the testing program should have located the damage. IN-86-314-002 was found factual due to the findings of NSRS report I-85-06-WBN. The concern identified a problem but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken. IN-85-295-003, IN-85-318-001, IN-85-733-001, IN-85-798-005, IN-85-935-001, and IN-85-978-013 were found factual in interviews with responsible craft and QC inspectors. These concerns stated the policy for pulling cable was quantity over quality. The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

The following concerns reported SWP problems:

IN-85-255-001, IN-85-323-002, IN-85-436-004, IN-85-733-001, IN-85-986-X02, IN-85-993-006, IN-86-199-001, IN-86-212-N03, and IN-86-259-008.

All concerns were factual based on the fact that SWP calculations were not required until 1985. This was noted in NSRS report I-85-06-WBN. The concerns identified a problem but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

The following concerns dealt with overfilled conduit:

IN-85-255-001, IN-85-323-002, IN-85-436-004, IN-85-733-001, IN-86-199-001, IN-86-212-N03, and IN-86-259-008.

4.1.2.2 Site Specific - WBN (continued)

These concerns were found factual due to SCRs WBNEEB8589, 8590. Corrective action was in progress. New cable ODs and weights were in the process of being incorporated into the conduit fill program by DNE. The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

Concerns IN-85-300-002, IN-85-506-002, IN-86-268-003, and WI-85-100-020 were found factual due to the findings of NCR W-283-P and NSRS report I-85-362-WBN. Corrective action consisted of identifying the cables. This had been completed. The cables were placed under the Temporary Alteration Program. However, the Administrative Instruction covering temporary alterations had not yet been revised to provide provisions for identifying temporary cables. The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

HI-85-113-N02 dealt with the use of an improper cable lubricant on asbestos jacketed cable. The use of Yellow 77 was verified to have been used on asbestos jacketed cable. However, corrective action had already been initiated and completed. The cables in question had been repulled. The use of Yellow 77 had since been banned from use on this site. However, quantities of Yellow 77 were located at WBN, BLN, and BFN on the computer program which lists everything in storage at TVA plant sites (Materials Management System). One of the QC inspectors interviewed recalled a problem with the use of Yellow 77 on polyethylene jacketed cable in the same conduit as asbestos jacketed cable. However, the inspector could give no further details. No further investigation could be completed on this concern because of the lack of information. The concern was factual and presented a problem for which corrective action had been, or was being, taken as a result of the employee concerns evaluation.

4.1.2.2 Site Specific - WBN (continued)

IN-85-009-001 reported pulling improperly sized cables to the 480-volt receptacles in the Additional Diesel Generator Building. The concern was found factual in an interview with the EEU engineer responsible for installation of the 480-volt receptacles. The concern presented a problem for which corrective action had been, or was being, taken as a result of an employee concerns evaluation.

IN-85-120-001 was found factual. This concern reported unsupported NIS cables. The cables were not supported from where they exit the conduit to termination on the detectors. However, in conversation with the responsible Westinghouse engineer the configuration was verified as correct. The concern was factually accurate, but what it described was not a problem (i.e., not a condition requiring corrective action by ONP).

IN-85-425-004 and IN-85-581-001 reported inadequately cleaned conduit prior to cable pulling. Neither concern was verified as factual in interviews with responsible EQC inspectors and EEU engineers. A review of site documents revealed there were provisions for cleaning conduit before cable installation.

4.1.2.3 Site Specific - SQN

MPT, SWP, and MBR issues were factual at SQN. Based upon the information contained in NSRS Report I-85-06-WBN, the mentioned interviews, SCR SQNEEB8529, and the ongoing evaluation by DNE, the past method for calculating MPT and past methods for pulling and monitoring cable had been determined to be inadequate to ensure cable was successfully pulled without insulation damage. (See section 4.1.2.1 for generic conclusion.) The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.1.2.3 Site Specific - SQN (continued)

Concern number JLH-86-002 dealt with Conax connectors whose MBR values had been exceeded. The concern was factual. A survey conducted because of this concern revealed several discrepancies. They were documented on SQ-CAR-86-02-005. Corrective action had consisted of examining all field terminations of Conax connectors. Any found unacceptable were reworked. The data packages were in Modifications waiting to have the Nuclear Performance Reliability Data System reporting completed. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

Concern number IN-85-009-001 dealt with installing an improperly sized wire to 480-volt receptacles. These were determined to be properly installed at SQN based upon a walk-through conducted in the Diesel Generator Building, review of the manufacturer's catalog data, and through discussions with an Electrical Maintenance engineer. Therefore, the concern could not be verified as factual.

Concern number IN-85-300-002 dealt with improper routing of cable. Based upon interviews with two Modifications engineers and field observations, the concern was factual and identified a problem for which corrective action had been, or was being, taken as the result of an evaluation.

4.1.2.4 Site Specific - BFN

MPT, SWP, and MBR issues were factual at BFN. Based upon the information contained in NSRS report I-85-06-WBN, the mentioned interviews, SCR BFNEEB8631, and the ongoing evaluation by DNE, the past method of calculating MPT and past methods for pulling and monitoring cable had been determined to be inadequate to ensure cable was successfully pulled without insulation damage. The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.1.2.4 Site Specific - BFN (continued)

Concern number IN-85-009-001 dealt with installing improperly sized wires to 480-volt receptacles. These were determined to be properly installed based upon a walkdown of five 480-volt receptacles, review of the manufacturer's catalog data, and review of TVA Design Standard DS-E12.1.13. Therefore, the concern could not be verified as factual.

Concern number IN-85-300-002 dealt with improper routing of cable. Based upon review of Discrepancy Report number BF-DR-86-0120, cables could be found outside cable trays at BFN. Therefore, the concern was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.1.2.5 Site Specific - BLN

MPT, SWP, and MBR issues were factual at BLN. Based upon the information contained in NSRS report I-85-06-WBN, Problem Identification Report PIR BLNEEB8518, NCR 2987, Stop Work Action Report SW12, and DNE's ongoing evaluation, the past method of calculating MPT and past methods for pulling and monitoring cable had been determined to be inadequate to ensure cable was successfully pulled without insulation damage. (See section 4.1.2.1 for generic conclusion.) The concerns identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken. A particular BLN concern (BNP QCP-10.35-8-5) was not found factual in the BLN report on the concern.

Concern number IN-85-009-001 dealt with installing an improperly sized wire to 480-volt receptacles. These were determined to be properly installed at BLN based upon a walk-through of three 480-volt receptacles in various areas of the plant, review of the manufacturer's catalog data, and review of TVA drawing number SGW1740-ED-33. It should be noted that number 2 AWG wire was observed to be spliced to a smaller wire before connecting to the receptacles. Therefore, the concern was not verified factual at BLN.

4.1.2.5 Site Specific - BLN (continued)

Concern number IN-85-300-002 dealt with improper routing of cable. Based upon a review of NCR 4975, the concern was found factual since BLN had past problems with cable routing due to failure to follow procedure. These problems were corrected and the NCR was closed. BLN had adequate procedures to prevent future occurrences. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.2 Splicing

Based on the findings, the issues raised by the employee concerns were factual.

4.2.1 Discussion

4.2.1.1 Generic

Concern IN-86-314-005 dealt with improper and incorrectly documented splices. Through the WBN evaluation, the resolution of this concern was determined to be tied to WBN generic NCRs 6208, 6224, 6536, 6623, and 6774. NCRs 6208 (unit 2) and 6224 (unit 1) both dealt with splices made with Raychem products in harsh environments which were not made in accordance with SD-E12.5.7-1. The problem noted was that SD-E12.5.7-1 referenced harsh environments but the Environmental Data Drawings were not issued until August 26, 1983. NCR 6536 specified that the incorrect Thomas and Betts connectors were referenced in Construction Specification G-38. NCRs 6623 (unit 2) and 6774 (unit 1) both stated cable splicing and terminations using Raychem heat shrinkable products completed prior to December 2, 1985 did not meet current requirements as listed in DNE Standard Drawings, G-38, and the manufacturer's application guide. Issues raised by these NCRs were reviewed for generic applicability at each site along with actions taken to disposition any findings. For details of each site NCR review, see site specific (sections 4.2.1.2, 4.2.1.3, 4.2.1.4, and 4.2.1.5).

4.2.1.1 Generic (continued)

The Operations Subcategory 30201 dealt specifically with Raychem products in the evaluation of TAK-85-001. The element reports for SQN, BFN, and BLN all reported problems with either the instructions used or the application itself.

4.2.1.2 Site Specific - WBN

Concern EX-85-073-001 dealt with a splice of cable 2-3V-31-7229 which was located in conduit. The 57 test card (cable splice documentation) was obtained on 2-3V-31-7229 and the responsible EEU engineer was interviewed. He stated that the splice was in a condulet fitting. Standard Drawing SD-E12.5.6, note 6A and WBN drawing 45W883-3, Revision 15 were reviewed. They allowed splices in condulets. A field walkdown of the area located the condulet in question. The cover was removed from the fitting, and the splice was located. It was in the condulet as allowed by procedure. |R3

WI-85-028-001 reported that electricians were hired specifically to perform splicing operations and that these electricians were not trained for their job. A specific example was given of a splice which had failed the high potential test, and the individual was concerned that other unacceptable splices might have passed this test. The specific pump named (O-PMP-40-5) was never located. If the pump identifier was correct, the motor cables in question were never high potential tested because they were not 6900-volt cables (only cables which were high potential tested). It was even verified that the cables for this pump did not pass through the manhole in question. Therefore, it was assumed that the incorrect motor identifier was identified on the K-form. There were several spliced 6900-volt cables which passed through manhole number two. The exact splice referenced was never located. A cognizant EEU engineer and EQC inspector were interviewed on the chances of an improperly performed splice passing the high potential test. They stated that the reason this test was conducted was to verify that the splice was acceptable. If a splice was inadequate, the test would catch it. They were also asked if electricians had ever been hired just to perform splices. They stated electricians had not been hired to perform specific jobs.

4.2.1.2 Site Specific - WBN (continued)

Concern IN-86-266-005 dealt with a NRC investigation of splicing at WBN. The concerned individual (CI) had no knowledge of any corrective action. In relation to this concern the DNC NRC open items log was reviewed for items dealing with splicing of cables. No items (except open NCRs which were discussed later in this section) on this subject were identified. The open items were the only items reviewed because all other items had been closed by the NRC indicating all corrective action was complete.

IN-85-720-003 reported bad splices underneath the switchyard which had caused problems. The responsible Electrical Maintenance foreman (who had been working in the switchyard since 1979) was interviewed to determine if splices in the switchyard had given problems. The only splices which he recalled were splices which were installed after two current transformers exploded. There had been no problem with these splices or any others which might have been in the switchyard. A walkdown of the area found it clean and dry. The splices mentioned previously in this paragraph were located. No problem could be detected visually.

Concerns HI-85-113-N02, IN-86-259-014, and WI-85-011-002 all reported splices which were now located inside conduit. The 500KV line referenced in concern WI-85-011-002 did not exist. Therefore, the cable could not be located. The same was true for the other concerns. Procedurally (SD-E12.5.3, Revision 2 and E12.5.6, Revision 6), a splice was not allowed in a conduit or a cable tray. The system engineers would designate the location of the splice on the test card used to document the splice. The precautions of the Standard Drawings (SD-E12.5.6, E12.5.8, and E12.5.3) were to be followed. There was a possibility that there was confusion over the acceptability of splices in condulets as was discovered in the evaluation of EX-85-073-001. Because the specific cables could not be identified from the documentation available, further evaluation of the concerns was impossible.

4.2.1.2 Site Specific - WBN (continued)

IN-86-314-005 was a general concern with splicing whose resolution was tied to NCRs 6208, 6224, 6536, 6623, and 6774. This concern was shared with Management and Personnel Subcategory 70600. NCRs 6208 (unit 2) and 6224 (unit 1) both dealt with splices made with Raychem products in harsh environments which were not made in accordance with SD-E12.5.7-1. The problem noted was that SD-E12.5.7-1 referenced harsh environments but the Environmental Data Drawings were not issued until August 26, 1983. NCR 6536 specified that the incorrect Thomas and Betts connectors were referenced in site procedures and General Construction Specification G-38. NCRs 6623 (unit 2) and 6774 (unit 1) both stated that cable splicing and terminations using Raychem heat shrinkable products completed prior to December 2, 1985 did not meet current requirements as listed in DNE Standard Drawings, G-38, and the manufacturer's application guide.

According to a conversation with the knowledgeable DNC engineer, the disposition of NCR 6208 required rework of the subject splices, but this had not started yet because the site procedures had not been changed to reflect the rework. This rework was to be completed under workplan FC900A. NCR 6224 rework had begun according to the knowledgeable Modifications engineer but was not complete. The rework was being performed using WP N6224-1.

A memorandum from J. C. Standifer to G. Wadewitz dated February 18, 1986 outlined the actions required to disposition SCR 6536-S (NCR 6536 was upgraded to a SCR).

- DNC/ONP were to identify all 6.9 KV splices required for safe operation of the plant.
- DNC/ONP were to inspect these splices. Criteria was given for acceptability from Thomas and Betts.
- All acceptable splices were to be reinsulated according to Standard Drawing SD-E12.5.3. If unacceptable the splices were to be reworked according to SD-E12.5.3. The connectors and die numbers were specified.
- DNE was to revise General Construction Specification G-38 to define the proper connectors to use.

4.2.1.2 Site Specific - WBN (continued)

- DNC was to revise WBN-QCP/QCI-3.06-4 to show the proper materials to be used.

Work required due to NCR 6536 had not yet begun per the knowledgeable Modifications engineer. The workplan (N6536-1) was in the review cycle.

DNE had notified all sites of the proper connectors to be used on 6.9 KV splices with SRN-G-38-10 dated July 16, 1986. The ONP procedure for splicing used by Modifications was MI-57.99 "Standard Electrical Tests." A review of MI-57.99, Revision 9 dated September 24, 1986, revealed that Standard Test 2 "Terminal Lug and Butt Splice Installation" did have the same connectors listed as SRN-G-38-10. A review of WBN-QCI/QCP-3.06-4 revealed that these procedures had not been revised to incorporate SRN-G-38-10. In a conversation with the responsible DNC engineer it was verified that the QCP was in the review cycle. This revision was to update the incorrect tables in the procedure.

NCRs 6623 and 6774 had been dispositioned use-as-is in a memorandum from M. L. Rayfield to D. M. Lake (B26 860808 181). Standard Drawings SD-E12.5.3 and E12.5.8 and General Construction Specification G-38 had been revised to clarify the use of splice materials with respect to plant areas and service applications. The memorandum concluded: (1) existing in-line splices that use an outer sleeve over the breakouts were acceptable, (2) low-voltage "V" type connections that use a nuclear end cap over the breakout were acceptable, (3) multi-conductor cables without a Raychem Nuclear Cable Breakout, with a Nuclear Cable Breakout, or without a breakout and a Raychem WCSF-U oversleeve were acceptable, and (4) unterminated cables with an end cap, without an end cap, or with an end cap and a WCSF-U oversleeve were acceptable. These applications were more liberal than previously allowed. Therefore, previous splices were acceptable. The application range of Raychem HVS-803 high voltage splice kits was specified as acceptable for moisture sealing and insulating 5-8KV cable splices in non-LOCA/HELB environments.

4.2.1.3 Site Specific - SQN

Two concerns were evaluated in the area of splicing at SQN. MAS-85-003 was a SQN specific concern, which dealt with a taped splice. A discussion with a knowledgeable

4.2.1.3 Site Specific - SQN (continued)

engineer in Electrical Maintenance revealed they were aware of a specific case of split insulation on a cable to the Component Cooling System CS pump that had been taped during construction. The concern had been that this cable might still be taped according to earlier procedures rather than meeting SQN Inspection Instruction II-10, Revision 11, which required the use of Raychem for splices. A review of Maintenance Request A561116, which was written to examine the subject cables, revealed that cables 1PL47355 and 1PL47365 were inspected. Cable 1PL47355 had been repaired with Raychem products while cable 1PL47365 was not damaged.

A discussion was conducted with the knowledgeable SQN DNE engineer on the disposition of NCRs 6208/6224, 6536, and 6623/6774 in relation to concern IN-86-314-005. It was determined that 6208, 6224 and 6623, 6774 were to be grouped together because they were NCRs on the same subject with different affected units. The other sites evaluated one NCR on all units. For this reason, the NCRs were grouped together at sites other than WBN. The DNE engineer had information on NCRs 6208/6224 and 6536. The problem defined in NCR 6536 was determined not to exist at SQN because the site did not use the Thomas and Betts 54500 series connectors on 6.9 KV splices (this series was rated to 600V). He referred to ONP for further details on NCR 6208/6224. The NCR was to be handled by the Experience Review Program.

A discussion was conducted with the knowledgeable individual in charge of the SQN Experience Review Program on the disposition of NCRs 6208 and 6224. This program was a method of handling questions generated by NRC bulletins, INPO reports, SCRs, etc. The licensing unit would assign the questions to the appropriate plant sections which would respond as to whether a problem existed onsite. In the case of this NCR, all splices in question were inspected and corrections were made as necessary. The documentation was then sent to the Environmental Qualification Project to become a part of the environmental qualification binder. The NCR was closed on the SQN site.

A discussion was conducted with a knowledgeable DNE Nuclear Licensing Section engineer and a knowledgeable Electrical Engineering Branch engineer on the generic applicability of NCRs 6623 and 6774.

4.2.1.3 Site Specific - SQN (continued)

They had documentation that a potential generic applicability memorandum had been sent to SQN and that a response had been received. As a result, the potential generic applicability memorandum for NCRs 6623 and 6774 was reviewed (B43 860331 913 and B25 860414 001). The NCR was found to be generic and SCR SQNEEB8631 was generated.

A discussion with a SQN DNE engineer and an Electrical Engineering Branch engineer on the disposition of SCR SQNEEB8631 was conducted. The SQN DNE engineer stated that there were three parts to the SCR. They consisted of (1) cable breakouts and end caps were to be used with an oversleeve which was not required in the past, (2) WCSF-N tubing had different applications than present requirements, and (3) Raychem HVS kits were used in the past and were no longer acceptable. The portion of the SCR which dealt with Raychem HVS kits was not applicable because this particular kit was not used onsite in the timeframe noted. The portion of the SCR that dealt with the application ranges of WCSF-N tubing was not applicable because the application range had been broadened. Therefore, previous splices were acceptable. The remaining portion of the SCR was discussed with an EEB engineer. The engineer stated this portion was being dispositioned use-as-is based on a DNE calculation which proved there was no problem with circulating current, which was the cause of concern for cables whose ends were not sealed to keep the shield (or drain) wire separated from the ground. The SCR was dispositioned later in a memorandum from W. S. Raughley to J. A. Raulston and D. W. Wilson (B43 860731 904). The response was the same as in memorandum B26 860808 181 (see section 4.2.1.2). No rework was necessary for this SCR.

4.2.1.4 Site Specific - BFN

WBN generic NCRs 6208, 6224, 6536, 6623, and 6774 identified two issues concerning improper splicing: (1) Raychem products were not applied in accordance with SD-E12.5.7-1 due to the fact that Environmental Data Drawings were not issued until August 26, 1983, and the manufacturer's instructions and (2) Thomas and Betts connectors were inadequately referenced in Construction Specification G-38.

4.2.1.4 Site Specific - BFN (continued)

In regards to Raychem splicing, review of H. C. Rutherford's memorandum to W. S. Raughley dated April 14, 1986 (B22 860414 018) revealed the conditions concerning the use of Raychem identified in SCR 6623 did not exist at BFN based upon the following statement:

> "The subject SCR's source of requirements, SD-E12.5.6 and SD-E12.5.8, were not applicable to BFN until after December 2, 1985. BFN was not committed to General Construction Specification G-38 until after January 15, 1986. Brown's Ferry Nuclear Plant was designed and constructed to General Construction Specification G-4 which did not require the use of Raychem cable breakouts. In discussions with plant maintenance and modifications groups, Raychem cable breakouts were not used at BFN. The installation procedures (MAI-13 for Modifications and Additions and EMI-58 for Electrical Maintenance) used at BFN for splices and terminations of cable are more conservative in the applicable diameter range of the Raychem shrinkable sleeve than G-38."

In regards to Thomas and Betts connectors, J. P. Stapleton's memorandum dated June 2, 1986, (R07 860602 929) revealed the condition concerning the misapplication of Thomas and Betts series 54000 connectors identified by NCR 6536 did not exist at BFN based upon the following statement:

> "A review of the applicable Modification/Addition Instruction (MAI-13) shows no misapplication of Thomas and Betts series 54000, two way (butt splice) connectors. The table for butt splices in MAI-13 lists the connector series with the proper die for 600-volt and below and 601-15,000-volt application."

Review of N. R. Beasley's memorandum to F. W. Chandler dated September 3, 1985, (B22 850903 004) revealed conditions identified by NCR 6208 concerning improper splices in harsh environments below the maximum flood level existed at BFN. As a result SCR BFNEEB8518 was written.

4.2.1.4 Site Specific - BFN (continued)

Review of DNE files on SCR BFNEEB8518, Revision 1, revealed the SCR was closed out and the concern was being handled elsewhere on SCR BFNEQP8501, Revision 0.

SCR BFNEQP8501, Revision 0, revealed the following condition:

> "In intermediate locations as well as at terminations to equipment furnished with pigtails, General Construction Specification G-4 allows the use of splicing methods (such as tapes) which are not qualified for Class 1E applications in a harsh environment. Where the requirements of General Construction Specification G-38 have been imposed on modifications, the same is applicable."

Review of N. R. Beasley's memorandum to G. R. Hall dated November 15, 1985 revealed the following DNE corrective action for SCR BFNEQP8501, Revision 0:

> "TVA General Construction Specification G-4 (dated January 9, 1973) is currently being revised to include TVA Electrical Standard Drawings SD-E12.5.3, SD-E12.5.4, SD-E12.5.5-2, SD-E12.5.6, SD-E12.5.7-1, SD-E12.5.7-2, and SD-E12.5.8. This revision will state that G-4 will apply to existing installations and any maintenance to the existing installations.
>
> TVA General Construction Specification G-38 (R6) is currently being revised through SRN-G-38-6. This revision will state that G-38 will apply to future modifications and their subsequent maintenance activities at Brown's Ferry Nuclear Plant.
>
> Any modifications necessitated by revision of TVA General Construction Specification G-4 and G-38 have been directed to NUC PR. The OE suggested corrective action to NUC PR for SCR BFNEQP8501, Revision 0, is as follows:

4.2.1.4 Site Specific - BFN (continued)

Terminations and splices in harsh environments which are comprised of unqualified materials shall be identified and reworked using qualified materials specified in TVA Electrical Standard Drawings SD-E12.5.3, SD-E12.5.4, SD-E12.5.5-1, SD-E12.5.5-2, SD-E12.5.6, SD-E12.5.7-1, SD-E12.5.7-2, and SD-E12.5.8, TVA General Construction Specification G-4, and TVA General Construction Specification G-38."

Discussions with knowledgeable EQP engineers revealed the EQP was committed to perform walkdowns on all cable termination splices for all safety-related equipment using Standard Practice 9.7 (walkdown procedure) to identify qualification deficiencies. Deficiencies will be corrected as determined by EQP to maintain environmental qualification of equipment as required by the Office of Inspection and Enforcement Notice 7901B.

4.2.1.5 Site Specific - BLN

WBN generic NCRs 6208, 6224, 6536, 6623, and 6774 identified two issues concerning improper splicing (1) Raychem products were not applied in accordance with SD-E12.5.7-1 due to the fact that the Environmental Data Drawings were not issued until August 26, 1983, and the manufacturer's instructions and (2) Thomas and Betts connectors were inadequately referenced in Construction Specification G-38.

Generic NCR 6536 dealt with Thomas and Betts connectors. Thomas and Betts connectors were not used at BLN. Therefore, NCR 6536 did not apply to BLN.

In regards to Raychem splicing kits, review of NCR 2494, Revision 1, revealed the root cause for improper installation was determined to be failure to follow instructions contained in TVA Standard Drawing SD-E12.5.7-1 Revision 2, note 6B and 11. Review of BLN 10 CFR 50.55(e) report on Raychem splicing kits revealed the following safety implications:

4.2.1.5 Site Specific - BLN (continued)

"The Raychem type NPKV-2-14 splice kit was used specifically to terminate solenoid valve cable-to-condulet mounts on walls. It was discovered that the shim was being omitted when the Raychem sleeve (which was intended to be used as a shim) was being used as the lug and bolt cover sleeve. The shim seals the mismatch of connections and has a 'userange' or value that it shrinks to. The terminations cannot be qualified with the shim omitted. Therefore, since the terminations cannot be qualified, it is possible that inadequate or improper splicing could inhibit proper operation of safety-related solenoid valves. Thus, the safe operation of the plant could be adversely affected."

Corrective action was stated as follows:

"TVA has examined a sample of the effected terminations and has determined that the splice does seal properly without the shim being installed. Therefore, all completed class 1E installations with this condition which are located in a mild environment will be used as is. TVA has reviewed terminations made before this condition was identified on class 1E installations located in a harsh environment. These installations are being reworked to the proper configuration. To prevent reoccurrence of this condition, all applicable personnel have been trained to ensure that all future installations using Raychem splice kits comply with the manufacturer's instructions as required by notes 6B and 11 on standard drawing SD-E12.5.7-1, Revision 2."

Review of J. A. Raulston's memorandum to R. M. Hodges dated July 12, 1984 revealed the following resolution per the attached commitment tracking record:

"All class 1E terminations made using the Raychem NPKV-2-14 splice kit have been reworked to the proper configuration per Raychem Installation Manual, SD-E12.5.7-1, Revision 2, Note 11. NCR 2494 is closed."

4.2.1.5 Site Specific - BLN (continued)

Discussions with a knowledgeable Equipment Qualification engineer revealed that Raychem splices installed at BLN without a shim were acceptable for use in Class 1E environments because they were not located in areas where a Loss of Coolant Accident or High Energy Line Break accident could result in exposures to an increase in temperature, pressure, radiation, or caustic spray in excess of the maximum abnormal environmental conditions resulting in damage to the seal. Other methods, such as taping, were acceptable for application in a Class 1E mild environment and were specified in Construction Specification G-38, SRN-G-38-8. As a result of rework performed per NCR 2494, no further actions were necessary for NCRs 6208, 6224, 6623, and 6774.

4.2.2 Findings/Conclusions

4.2.2.1 Generic

The conclusions were handled on a site specific basis for this issue.

4.2.2.2 Site Specific - WBN

EX-85-073-001 dealt with a splice which was located in conduit. The concern was factually accurate because the splice in question was located in a condulet. However, this was considered an acceptable enclosure per WBN drawing 45W883-3, Revision 15 and TVA Standard Drawing SD-E12.5.6, note 6A (i.e., not a condition requiring corrective action by ONP). |R3

WI-85-028-001 reported electricians were hired specifically to perform splices for which they had received no training. One splice they had worked on failed the high potential test and the concerned individual was worried that this test would not detect other unacceptable splices. In conversations with two EEU personnel, no evidence of electricians specifically hired to perform splices was discovered. The same people said that the high potential test would detect a defective splice - that this was the purpose of the test. Therefore, the concern could not be verified as factual.

4.2.2.2 Site Specific - WBN (continued)

IN-86-266-005 reported that the NRC had investigated splicing problems at WBN but that the concerned individual knew of no corrective actions taken. A review of the NRC open items log in the DNC Nuclear Licensing Unit was reviewed and no outstanding items were discovered except open NCR's. Therefore, the concern could not be verified as factual.

IN-85-720-003 dealt with splices under the switchyard which were causing problems. The concern was not verified as factual in an interview with the responsible switchyard foreman and a walkdown of the area.

HI-85-113-N02, IN-86-25S-014, and WI-85-011-002 reported cables which had been spliced and pulled into conduit. Tho concerns were not verified as factual because there was not enough information to perform an evaluation. Procedurally, splices were not to be located in conduits. However, no problem other than the fact that the splice was not easily accessible was noted.

IN-86-314-005 dealt with poor splicing practices at WBN. NCRs 6208, 6224, 6536, 6623, and 6774 identified problems with all splices in harsh environments and all 6.9KV splices. Therefore, the concern was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.2.2.3 Site Specific - SQN

MAS-85-003 reported that a cable routed to the Component Cooling System CS pump had been repaired with tape instead of Raychem. The concern was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken. The splice in question had been reworked using Raychem.

4.2.2.3 Site Specific - SQN (continued)

IN-86-314-005 was evaluated using NCRs 6208, 6224, 6536, 6623, and 6774. NCR 6536 was not generic to SQN because the questionable materials (Thomas and Betts series 54500 butt splice connectors) used at WBN were not used on 6.9KV splices at SQN. NCRs 6623 and 6774 had been dispositioned use-as-is by DNE. NCRs 6208 and 6224 were made generic to SQN but corrective action had been initiated and completed. All splices in question had been examined and reworked, if necessary. This new information had been sent to the Environmental Qualification Project for incorporation in the EQ binder. The concern was factual and identified a problem but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.2.2.4 Site Specific - BFN

With regards to NCR 6536, J.P. Stapleton's memorandum dated June 2, 1986 was reviewed. There was no misapplication of Thomas and Betts connectors at BFN because MAI-13 listed the connector series with the proper die for 600-volt and below and 601-15,000-volt applications.

However, based upon a review of SCR BFNEEB8518 (written in response to WBN NCR 6208), General Construction Specification G-4 was found to have allowed the use of splicing materials (such as tape) which were not qualified for Class 1E applications in harsh environments. Therefore, the concern for improper splicing at BFN was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken. The BFN EQP had committed to walkdowns of the questionable splices.

4.2.2.5 Site Specific - BLN

Based upon a review of NCR 2494, Raychem splicing kits were improperly installed at BLN. The NCR was generated when a shim was omitted by BLN personnel using Raychem NPKV-2-14 splice kits.

4.2.2.5 Site Specific - BLN (continued)

However, hardware problems had been corrected for splices located in harsh environments. Splices in mild environments were not replaced because they were not required to withstand harsh environmental conditions. The modified Raychem kits were equivalent to taping which was acceptable in a mild environment. As a result of the rework performed per NCR 2494, no further actions were necessary for NCRs 6208, 6224, 6623, and 6774. NCR 6536 (which dealt with the misapplication of Thomas and Betts series 54500 butt splice connectors) was not applicable because BLN did not use Thomas and Betts connectors. The concern was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.3 Cable Terminations

Based on the findings below, the issue raised by the employee concerns was factual.

4.3.1 Discussion

4.3.1.1 Generic

The issue of the use of AMP PIDG lugs for terminations of discrete electrical components with solid leads was determined to be a generic problem in SCR WBNEEB8537. The disposition of this problem was discussed in detail in sections 4.3.1.2, 4.3.1.3, 4.3.1.4, and 4.3.1.5.

4.3.1.2 Site Specific - WBN

Concerns EX-85-148-001, IN-85-474-001, IN-85-581-002, IN-85-705-001, IN-85-705-002, and IN-86-238-001 all reported that unqualified personnel were used to terminate cables. IN-85-581-002 and IN-85-705-002 were shared with Management and Personnel Subcategory 71700. IN-85-705-001, IN-86-238-001, and EX-85-148-001 were shared with Management and Personnel Subcategory 70100. IN-85-474-001 was shared with the Intimidation and Harassment Category. Two reports were reviewed in relation to this area. NSRS report

4.3.1.2 Site Specific - WBN (continued)

I-85-445-WBN was written to answer concern IN-85-581-002 in which it was alleged that welders had been used to terminate cables. In the course of several interviews with electrical section personnel, a few instances of non-electricians terminating cables were uncovered. Because of these instances, the NSRS reviewed the inspection process to determine the degree of assurance that any improper terminations would have been corrected. It was judged that if CSSC cable was initially improperly terminated, the electrical engineering unit inspectors would have inspected, identified, and had corrected any cable termination anomaly.

The EKT report written for EX-85-148-001, IN-85-474-001, and IN-85-705-001 was also reviewed. Concerns IN-85-705-002 and IN-86-238-001 were also applied to this report because they dealt with the same subject. The problem stated was that subjourneymen were terminating cables which was a job for which they had not been trained. In the report, there were four areas addressed:

(1) The type of work performed by subjourneymen.
(2) Any violations of the Labor Agreement.
(3) Potential safety hazards posed by subjourneymen performing work for which they had not been trained.
(4) The potential effect on quality posed by subjourneymen performing journeyman work.

The investigation found that subjourneymen were performing work using power tools (considered to be journeyman work). It also uncovered the fact that subjourneymen were performing what was considered skilled tasks (valve repair, cable terminations, etc.) which was contrary to the Labor Agreement.

This agreement classified subjourneymen's duties as the unskilled duties of the craft. The investigator discovered that there was no formal safety training for newly hired employees and that the ninety day construction experience requirement was not always adhered to when hiring subjourneymen. The investigator was convinced that there was a

4.3.1.2 Site Specific - WBN (continued)

potential quality impact with the use of subjourneymen to perform skilled tasks. The reason given for this stance was that subjourneymen were not properly trained to perform skilled jobs.

There were DNC and ONP responses to the ERT findings. In the DNC response, the duties of a subjourneyman were outlined. The position was taken that subjourneymen could act independently while performing unskilled jobs (defined as any task not requiring technical expertise). They could perform skilled work only in a joint effort with a journeyman. This was the interpretation of a memorandum from H. H. Mull, dated March 26, 1982 entitled, "T&L Craft-Unskilled Work Classification" (DOC 820329 003). The response also gave the only reported instance of a subjourneyman performing skilled tasks. The particular task involved was cable terminations. The practice was stopped immediately, all work performed by the subjourneyman was inspected, and both the subjourneyman and journeyman involved were reinstructed in the job responsibilities of a subjourneyman. At the present time, there were no subjourneymen in DNC. However, as a precaution, future employment of subjourneymen was to be preceded by instructions from the project manager to all involved supervisors of the job responsibilities of subjourneymen. There would also be a form for the subjourneymen to sign when hiring in which stated they had been instructed on job requirements, safety, and QA responsibilities.

The ONP response consisted of a review of the accident log for Mechanical Maintenance in the timeframe subjourneymen were used. Only 10 of 176 injuries were sustained by subjourneymen. These accidents were investigated by the responsible general foreman and none were found to be the result of inappropriate action by a subjourneyman. All new employees were given the same basic safety orientation and were assigned to work with experienced personnel if the potential for injury or mistakes was present. It was emphasized that subjourneymen were not hired to replace or be used as a journeyman. Several checks to ensure substandard work did not go undetected were listed. They were:

4.3.1.2 Site Specific - WBN (continued)

(1) Written instructions were provided for all safety-related activities.
(2) Craft were required to follow these instructions or know how to have them changed if they were inadequate.
(3) At critical steps in the procedure there were QC hold points to verify acceptance criteria had been met.
(4) Engineering hold points were on less critical steps to verify the correct performance of the task.
(5) Craftsmen signoffs were given to document the completion of the task.
(6) Post maintenance tests were run after completion of work to verify the equipment would perform its intended function.
(7) The foreman spot checked work.
(8) The completed work package was reviewed by the foreman and General Foreman.
(9) Selected work packages were reviewed by the responsible section engineer.

As with NSRS report I-85-445-WBN, it was impossible to determine which work had been performed by unqualified personnel. However, if the work was associated with safety-related equipment, a QC inspector would have verified the work as adequate.

Concern IN-85-425-001 had specifically named junction box 1918 as a source of bent lug and MBR problems. It was located and inspected for these violations. Problems with bent lugs were identified. The knowledgeable EEU engineer was interviewed to determine what corrective actions would need to be taken. He stated that due to design changes he was working on replacing lugs in this box and several others. He called later to say that on further inspection it was determined that the box installed in the plant was too small according to design requirements and was to be replaced under workplan FR063B-Z. The workplan was field complete and was on hold for inspection.

4.3.1.2 Site Specific - WBN (continued)

The micro-limit switches for concern IN-85-864-001 were located in the unit 2 Fan Room. The concern reported that electricians violated the MBR values to make terminations to micro-limit switches. The cable numbers were retrieved from the cable master summary. Since they were non-QA cables, the termination slips were found in the EEU files. The MBR value on the back of the slips read approximately two times the value obtained after calculations using 47A800 (the TVA drawing which gives actual cable outside diameters for various types of cable). The bend radius of these cables was more than the 0.58-inches allowed and was acceptable.

There were three concerns (IN-85-433-002, IN-85-433-N04, and IN-86-314-003) which reported a lack of megger and continuity tests in the cable installation process. As a result, the requirements for megger and continuity tests were reviewed. This was completed by reviewing MAI-4, Revision 3, IEEE Standard 690-1984, WBN-QCP-3.05, Revision 22, WBN-QCP-3.06-3, Revision 8, and WBN-QCP-3.06-3, Revision 3. MAI-4 (an ONP procedure) required the QC inspector to perform the megger and continuity tests if the cables were safety-related. If the cables were nonsafety-related, the craftsman performed the tests and signed for the QC inspector.

In DNC, the megger test was deleted for safety-related cables on May 1, 1984. Prior to this, all cables were required to be meggered. IEEE Standard 690-1984 did provide for functional testing as an alternative to the megger test. All safety-related cables had their continuity checked (reference WBN-QCP-3.06-3 steps 6.2.2 and 7.2). A knowledgeable DNC QA engineer was interviewed for the reason the megger test was deleted. The QA group onsite had investigated this matter and found that no IEEE standard had a requirement to megger cables. IEEE Standard 690-1984 allowed for either a megger test or a functional test. DNC had been running the megger test as a good construction practice and deleting the test was acceptable because there was no upper-tier requirement. At the present time, one purpose of the functional test was

4.3.1.2 Site Specific - WBN (continued)

to identify damaged cables. It was possible that the concerned individual was not aware that the megger test had been deleted as a requirement for safety-related cables. Non-QA cables were handled under SOP-14, Revision 2. Step 6.5.2 stated that the engineer was to perform testing after installation of equipment was complete. One of the tests mentioned was meggering of power cables. Two former EEU engineers were questioned about SOP-14 and the megger test requirement. None of them had ever heard of this document. They said most engineers ran a functional and a wire check but no megger test or inspection of lugs.

There were six concerns which dealt with the improper placement of lugs. IN-85-993-002 reported recrimping of a lug. General Construction Specification G-38, Revision 8 was reviewed for the authorization to recrimp a lug. Recrimping was allowed as long as (1) the orientation of the recrimp was the same, (2) the crimp tool was calibrated, and (3) the recrimp was compared to a properly performed crimp. If any of the above failed , the lugs were cut off and new lugs crimped on. This inspection would be performed by a QC inspector if the cable was safety-related. IN-85-993-X03 dealt with a widespread problem associated with lugs installed backwards. A knowledgeable EQC inspector was interviewed for information on the subject. The only way it was determined that lugs could be installed backwards would be if the cables were terminated back to back and the lugs were installed such that they were not flush (SD-E12.5.7-1 and E12.5.5-1 were used to illustrate how the problem could occur). He stated that if the lugs were installed this way, the termination would be unacceptable to the inspector and rework would be necessary.

4.3.1.2 Site Specific - WBN (continued)

PH-85-003-N32 and N33, IN-86-314-N06, and I-85-101-WBN dealt with the use of lugs designed for stranded wire on solid conductor wire. IN-86-314-N06 stated that control room diodes and rectifiers were problems. Interviews with the Instrument Maintenance supervisor and a knowledgeable Modifications engineer revealed that the problem found was with the use of PIDG lugs on these components. Therefore, this concern was incorporated into this subsection. PH-85-003-N33 was specifically concerned with a NCR written at WBN on this subject which had never been investigated at SQN. NCR 6076 was reviewed as a result of the investigation into these concerns. The NCR was generated as a result of an investigation requested by DNE in a memorandum from J. C. Standifer to G. Wadewitz dated April 23, 1985 (B43 850425 948). The memorandum requested a review of solid copper wire terminations using AMP Diamond Grip Insulated Terminal Lugs (PIDG). The manufacturer had determined that using these lugs with solid copper wire under any voltage or current condition was unsatisfactory (B43 850408 021). The investigation at WBN revealed the use of these lugs with solid copper conductors on safety-related systems. They were used in the installation of small electronic components. NCR 6076 was dispositioned in a memorandum from J. C. Standifer to G. Wadewitz dated June 17, 1985 (B26 850617 004). In the memorandum, a telephone conference between DNE and AMP representatives was referenced in which the major difference between the PIDG lugs and plasti-grip (recommended for solid conductor wire) lugs was discussed. The plasti-grip lug had a straight sleeve, while the PIDG lugs had dimpled sleeves. The dimpled sleeve would reduce the current capability because of less surface contact with a solid conductor wire. This problem was also discussed with Westinghouse because they still had technical responsibility for the Foxboro instrument racks (an estimated 1200 of these lugs were found in these racks). Westinghouse evaluated the use of the lugs and determined they were good for the life of the plant (B45 850524 614). DNE concurred with this conclusion. The lugs were also located in surge

4.3.1.2 Site Specific - WBN (continued)

suppression filter networks for status monitoring solid state relays and surge suppression networks for solenoid operated valves. DNE decided that in both of these applications the high voltage spikes would be capable of breaking down an air gap (if it existed) and would allow the filter to perform. The NCR was dispositioned use-as-is.

As a result of a WBN employee's concern, a NSRS investigation was conducted on the same subject. NSRS report I-85-101-WBN was written to describe the actions taken in the investigation. The report identified several problems. They included:

- One third of the PIDGs in the Foxboro racks at WBN had been replaced with 50-percent of these replacements due to faulty crimp connections or broken leads.

- The criteria in G-38 which required the selection of terminal lugs to be based on manufacturer's recommendations was ignored.

- WBN-QCP-3.06-3 (the DNC procedure for terminating cables) had no requirement for verification of proper lug type.

- WBN MI-57.99 and MAI-4 (all ONP procedures used in cable terminations) were vague as to the requirements of proper terminal lugs for stranded and solid wire.

- The scope of NCR 6076 was found to be inadequate. In addition to the three uses previously mentioned, three others were discovered. They were in the electro-thermal links for nonsafety fire dampers, in diesel generator alarm circuits, and in strip chart recorder selector switches.

4.3.1.2 Site Specific - WBN (continued)

- Foxboro drawings had referenced Burndy lugs in the process instrumentation racks at WBN but AMP terminal lugs had been used instead.

- Although DNE and DNC personnel realized the same condition as that described in NCR 6076 existed at SQN, no NCR was generated at SQN.

- The Failure Evaluation/Failure Report (FE/FR) for NCR 6076 was released after the timeliness requirements of EP-1.48 (DNE procedure for preparing a FE/FR).

- The individuals preparing the FE/FR did not contact the appropriate operations personnel for information on the failure history of these lugs.

The conclusions reached were:

- Proper type terminal lugs had not been used in terminations of discrete electrical components with solid wire leads at WBN.

- Through personnel interviews and document review, three additional categories of PIDG application were identified. The management personnel involved in the generation of NCR 6076 had been informed of one of these additional uses and had not revised the NCR.

- The personnel involved with preparing the FE/FR on NCR 6076 did not attempt to obtain failure history documents from the appropriate organizations.

- The process of preparing the NCR package for reportability lasted too long for a condition with the potential for safety significance.

- DNE had not established a program to delineate the responsibility for the performance of the generic review of the findings.

- Had DNC management established an effective employee concerns program the corrective action required to resolve the issue would have been reduced.

4.3.1.2 Site Specific - WBN (continued)

- G-38 required clarification relating to the application of the proper type terminal lug for solid and stranded wire. WBN DNC and ONP procedures either did not contain acceptance criteria for verification of the proper type terminal lugs or were ambiguous.

The recommendations were:

- The establishment of a replacement program for all PIDG terminal lugs used for termination of discrete electrical components with solid wire leads at WBN. An alternate method was to solder over existing PIDGs (I-85-101-WBN-01).

- Initiate a NCR that identified all applications of PIDGs used for terminations of discrete electrical components with solid wire leads (I-85-101-WBN-02).

- Develop requirements to forward failure histories of equipment to DNE personnel performing FE/FRs, or require DNE personnel to obtain the failure histories, or have that portion of the FE/FR completed by a person knowledgeable of the failure history (I-85-101-WBN-03).

- The process whereby NCRs were initiated, FE/FRs were prepared, and the determination of reportability should be streamlined to provide timely reporting to responsible managers and regulatory agencies (I-85-101-WBN-04).

- Revise DNE procedures to incorporate an automatic review of findings identified by TVA or any non-TVA organization. This would include determination of generic applicability to other TVA facilities (I-85-101-WBN-05).

- WBN management was urged to establish an employee concern program (I-85-101-WBN-06).

4.3.1.2 Site Specific - WBN (continued)

- Revisions to G-38 and several DNC and ONP procedures to clearly define and require verification of the proper type terminal lugs to be used with solid and stranded wire (I-85-101-WBN-07).

The report disagreed with the disposition of NCR 6076 and reopened the issue.

A memorandum from R. C. McKay to the PMO Files dated August 7, 1985 provided the DNC response to this report. Interviews were conducted with personnel at WBN, SQN, and BLN to determine if there was a failure history for this type lug. At WBN, the evaluator concluded that no failure was identified due to the misapplication of PIDG lugs. The evaluator discovered the existence of a program for soldering lugs in the Foxboro racks when test point resistor failures were identified. It was also verified that Foxboro had used PIDG lugs in the racks but that any solder applied to the lugs was applied by ONP or DNC and not Foxboro. At SQN, the evaluator concluded that no failure was identified due to the misapplication of PIDG lugs. The evaluator discovered that a program for soldering these lugs was established by DNC in 1976 or 1977 and that ONP had continued the program. The evaluator also uncovered the fact that SQN still experienced test point resistor failure. The use of PIDG lugs in the Foxboro racks was verified, but it was also verified that any solder on the lugs was applied by DNC or ONP and not Foxboro. At BLN, no failures were attributed to the misapplication of PIDG lugs. The evaluator concluded that there was no failure history for these lugs and supported the use-as-is disposition of NCR 6076.

However, DNE wrote SCR WBNEEB8537 on August 14, 1985. The corrective action specified was to rework the Foxboro instrument racks, local, and relay panels prior to unit 1 commercial operation. The solenoid valve surge suppression networks, diesel generator alarm circuits, and strip chart recorder selector switches were to be reworked prior to the unit 1 first refueling outage. The status monitoring surge suppression networks and the nonsafety fire damper electro-thermal links were to be reworked on a routine maintenance

4.3.1.2 Site Specific - WBN (continued)

basis. General Construction Specification G-38 was to be revised to specify the types of lugs for solid conductor component leads. WBN-QCP-3.06-3, MAI-4, and MAI-5 were to be revised to require verification of the correct type lug for solid conductor component leads in the termination acceptance criteria. The SCR listed ECNs 5879 and 5880 as the documents which would specify the equipment to be checked.

The engineering report on SCR WBNEEB8537 (B45 850909 260) was written. The report restated that the condition adverse to quality existed due to the fact that AMP PIDG terminal lugs were used on solid conductor component leads against vendor recommendations. An emphasis was placed on the fact that the only failure which had occurred due to the misapplication of the lugs was a broken lead in a nonsafety circuit. However, it was postulated that a failure in the other applications could range from prevention of a safety circuit from operating to a loss of alarm function or a loss of recorded data. The discussion of the consequences of a failure reiterated that only a nonsafety circuit had failed, but it did admit that the reliability of the connection could be improved by adding solder or replacing the lugs with lugs of the appropriate type.

A memorandum from H. G. Parris to Those listed dated September 13, 1985 (A02 850905 009) committed TVA to correcting the misapplication of PIDG lugs. The process at WBN was to be handled through the DNE Significant Condition Report process.

A memorandum from H. G. Parris to K. W. Whitt dated September 13, 1985 (A02 850904 010) outlined TVA's response and corrective actions for NSRS report I-85-101-WBN. In response to the recommendation that a replacement program be implemented at WBN for all PIDG lugs used for termination of discrete electrical components with solid wire leads, SCR WBN EEB8537 was prepared. The corrective action was as specified previously in this section. In addition, it had been suggested that a NCR be initiated to

4.3.1.2 Site Specific - WBN (continued)

incorporate all misapplications of PIDG lugs. This was covered by SCR WBNEEB8537 which incorporated all misapplications. In response to the suggestion that failure histories be forwarded to DNE engineers performing FE/FRs, DNE procedures on corrective action were to be expanded to provide for checking applicable sources where there was a need for failure histories. The finding that the NCR processing process was not timely was also a finding in NSRS report R-85-08-OE/NUC PR and was being handled in that report. There was a recommendation that DNE procedures be revised to incorporate an automatic review of findings identified by TVA or any non-TVA organization. The position taken was that an adequate program existed for corrective action where generic applicability was a consideration. There was a requirement for each SCR to be reviewed for generic applicability to other plants. Any conditions adverse to quality which were determined not significant used problem identification reports to identify, correct, and document the problems. When a condition adverse to quality had significant generic implications, it was upgraded to a SCR. The recommendation to establish an employee concern program had already been carried out. Finally, the recommendation that G-38, WBN-QCP-3.06-3, MAI-4, and MAI-5 be revised to clarify that PIDG lugs were not to be used on solid conductor wire was agreed to.

A memorandum from F. W. Chandler to J. A. Raulston dated October 4, 1985 (B26 851004 001) provided input to the 10 CFR 50.55(e) report. It also stated the order in which the components were to be reworked and gave the schedule of completion for the revisions required in G-38, WBN-QCP-3.06-3, MAI-4, and MAI-5.

The 10 CFR 50.55(e) final report (L44 851017 801) dated October 17, 1985 admitted that TVA had used PIDG lugs on solid conductor component leads at WBN. It was determined that the deficiency resulted from inadequate site procedures for the installation of lugs used in solid conductor component leads. The site procedures did not reflect G-38 section 3.4.2.7.4 which allowed only soldering,

4.3.1.2 Site Specific - WBN (continued)

soldering over a crimped connection, or coiling the leads around a screw for terminating solid conductor component leads. It was determined that this condition could have an adverse affect on the safe operation of the plant because the deficiency could reduce the reliability of the affected components (some of which were Class 1E). The corrective action given was as specified previously in this section.

A memorandum from E. Gray Beasley to F. W. Chandler and J. A. Raulston dated December 17, 1985 (BOS 851217 003) consisted of surveillance report S86-01. This report was to verify that items I-85-101-WBN-01, 02, 03, and 04 had been completed. The review found that OEP-17 had been revised to resolve item I-85-101-WBN-04. The new revision contained adequate requirements concerning timeframes. Training of DNE personnel had been conducted on the new timeframes. A review of the work associated with I-85-101-WBN-01 and 02 revealed the schedule for completion of corrective action. No actions were complete at the time the surveillance was conducted. The investigators did find that no action had occurred as had been proposed by DNE in response to item I-85-101-WBN-03.

It was verified that G-38 had been revised to state that AMP PIDG lugs were to be used on stranded conductors only in Revision 7 dated January 15, 1986 (taken from SRN-G-38-6 dated November 20, 1985). WBN-QCP-3.06-3 had been revised to add verification of the correct type terminal lug in Revision 8 dated November 26, 1985. MAI-4 had been revised (Revision 3) on January 23, 1986, and MAI-5 had been revised (Revision 5) on February 3, 1986 to incorporate provisions that PIDG lugs were not used on solid conductors. MI-57.99 had been revised to limit PIDG lugs to stranded conductors on September 26, 1986.

4.3.1.2 Site Specific - WBN (continued)

A review was made of the two workplans (E5879-1, 2) written due to ECN 5879. All work specified by the ECN was completed. This ECN was written for unit 1 equipment. ECN 5880 was the ECN assigned to complete the work on unit 2 equipment. This ECN was closed by DNE February 27, 1985. However, an interview with the individual responsible for tracking ECNs in DNC stated work was not complete.

A memorandum from J. A. Raulston to J. F. Weinhold dated March 4, 1986 (B45 860304 258) revealed the action that was taken to clear surveillance action I-85-101-WBN-03 in response to QMS surveillance report S86-01. The DNE document responsible for outlining corrective action had been revised to add a note cautioning the preparer of FE/FRs that the applicable failure history should be considered.

The junction box in question was located for concerns IN-86-259-007 and IN-86-259-015 (also shared with QA/QC Subcategory 80200). The concerns dealt with relugging a cable without the proper paperwork. WBN-QCI-1.07, Revision 5 "Work Release" was reviewed to determine what kind of release was required for relugging cables. This would have consisted of a rework release. Per the QCI no rework release was required because the work fell under the jurisdiction of WBN-QCI-3.06-3.

Concern EX-85-157-003 maintained that the motor leads for six or seven unit 2 Reactor Building fans had not been terminated, but the terminations had been documented. A review of the Cable Master Summary revealed that all cables to the Reactor Building fans (except the CRDM fans) had the motor leads terminated. An interview was conducted with 15e responsible Ventilation System DNC MEU engineer to determine if the Reactor Building fans had been balanced (since they were running this would verify the leads had been terminated). He stated the Upper Compartment Coolers were all balanced with package 2-030-RB-BT-TVA4 and the Containment Air Return Fans were balanced on 2-030-RB-BT-TVA6. The balance had not been conducted on the Lower Compartment Coolers - they would be balanced on

4.3.1.2 Site Specific - WBN (continued)

2-030-RB-BT-TVA5. He stated that all four of the coolers had been running to cool the Reactor Building. Observation of the Main Control Room handswitches verified all Lower Compartment Coolers had been operating.

A portion of the concerns also stated that the leads to these fans were frayed and damaged. The Lower Compartment Coolers and the Containment Air Return Fans were all QA fans and were all on the 10 CFR 50.49 list (safety related electrical equipment subject to harsh environmental conditions in the event of an accident). This meant that these terminations were made in the presence of a QC inspector and frayed or damaged leads would had been repaired before acceptance. In addition, since these motors were on the 10 CFR 50.49 list, they each had been field verified by the onsite special maintenance group working on environmental qualification. This work had been completed for the unit 1 fans but had not been completed for unit 2. These terminations were covered with Raychem which was as good as the cable jacket if the leads were frayed.

The Upper Compartment Coolers were not safety-related and were not on the 10 CFR 50.49 list. Therefore, there was no back up verification as with the other fans. The leads for the 2A and 2D fans were examined with the aid of a DNC electrician. The braided covering on the cable was frayed and exposed a rubber-type insulation underneath. However, no damage to the conductors was noted. The 2B and 2C fans were not examined since the frayed coverings were found to be a common problem on the two fans examined. An interview with the inspector responsible for cable inspections stated that this was only a cosmetic problem. The braided covering was cut back to allow for the application of heat shrink. He stated that this covering was trimmed to give a neater appearance if an inspector was present. A review of SD-E12.5.6 verified in step 7D that braided type coverings over insulations were to be removed to assure a minimum seal length underneath the heat shrinkable sleeving.

4.3.1.2 Site Specific - WBN (continued)

EX-85-092-002 and I-85-101-WBN (partially discussed previously in this section) reported poor wiring work and improper electrical termination techniques. The concerns were so vague that a proper evaluation could not be conducted. However, there was an established program for QA cables specified in WBN-QCP-3.06-3, MAI-4, and MAI-5 in which a QC inspector was involved. There was a program for non-QA cables specified in SOP-14 in which the system engineer was involved. The program was verified in interviews with two former EEU engineers. ONP used MAI-4 and MAI-5 for non-QA cables with the craft signing for QC.

4.3.1.3 Site Specific - SQN

As mentioned in the previous section, NSRS report I-85-101-WBN had been written describing the misapplication of AMP PIDG lugs. As part of this investigation, SQN was tied into the report. The evaluator discovered that SQN had experienced test point resistor failures in the Foxboro racks due to crimp failures and that all PIDG lugs in the security system which were crimped on solid wire were replaced with the appropriate type terminal lugs. The evaluation did discover that even though there had been problems with past installations, the present SQN procedure, M&AI-12 "Interconnecting Cable Termination and Insulation Inspection," Revision 7 did note that only AMP Solistrand lugs were to be used on solid conductors. Through interviews with SQN personnel, it was determined that the PIDG lugs used on solid conductors were being replaced and/or soldered on an as-needed basis. The recommendation made by the NSRS was that a formal replacement and/or solder program be implemented for all AMP PIDG lugs used for terminations of discrete electrical components with solid wire leads.

A memorandum from H. G. Parris to K. W. Whitt dated September 13, 1985 (A02 850904 010) described the proposed corrective action for SQN due to the recommendations of NSRS report I-85-101-WBN. Some PIDG lugs on smoke actuated dampers were found to be installed incorrectly. They were to be replaced by August 27, 1985. A memorandum was to be issued from the plant manager to Instrument and Electrical

4.3.1.3 Site Specific - SQN (continued)

Maintenance and the Modifications group to remind them to use the proper type of lug on safety-related equipment. Inspections were in progress to verify the extent of the misapplication of PIDG lugs and to identify all sources of misapplication. SQN engineers were then to evaluate the impact to plant safety of each application. Corrective action and a schedule for rework would follow this.

A review of the potential generic condition evaluation memorandums (B43 850923 916 and B25 851008 015) and a memorandum from H. G. Parris to Those listed (A02 850905 009) dated September 13, 1985 revealed that the condition had been referred to ONP. The H. G. Parris memorandum in particular stated that the problem would be handled by the Experience Review Program at SQN.

An interview with the individual responsible for the Experience Review Program revealed that the item was being evaluated by Electrical Maintenance. An interview with the responsible Electrical Maintenance engineer verified that all work specified in the preceding paragraph which dealt with smoke actuated dampers was complete. It was also verified that all evaluations and rework associated with the misapplication of PIDG lugs was complete except for the rework of lugs on solenoid valve surge suppression networks. The work had been described in SMI-2-317-25. The Compliance Section had been asked to justify not replacing these lugs. The existence of a memorandum to ensure that Electrical Maintenance, Instrument Maintenance, and Modifications used the proper type terminal lug was not verified. However, M&AI-7, "Cable Terminations, Splicing, and Repairing of Damaged Cables," Revision 7 and M&AI-12, "Interconnecting Cable Termination and Insulation Inspection", up until it was cancelled with Revision 8 both specified that AMP Solistrand lugs were to be used on solid conductors. There was also a requirement for the QC inspector to verify the proper type lug was used. Therefore, there was no need for any further actions since the site procedures contained the proper information.

4.3.1.3 Site Specific - SQN (continued)

The individual responsible for resolving the surge suppression issue in the Compliance section stated that the issue had been referred to DNE and that no response had been received. An interview with the EEB engineer resolving the problem revealed he was writing a memorandum requiring that all valves where the solenoid energized to perform its safety function were to have the lugs replaced or soldered over immediately. All others would have to be checked to determine if the lugs were in an acceptable condition. It was going to be recommended that these lugs be reworked.

A preliminary copy of the memorandum referenced in the preceding paragraph (from D. W. Wilson to P. R. Wallace dated October 24, 1985) gave a general description of the use of the arc suppressors. They were "to protect the circuit contacts against pitting and burning caused by arcing associated with breaking the inductive load current of the solenoid valve." The recommendation was made that as a permanent fix the PIDG lugs on Class 1E surge suppressors be replaced or soldered. As mentioned in the previous paragraph, it was required that all PIDG lugs on solenoid valves which energize to perform their safety function be replaced or soldered prior to restart. For those valves which do not energize to perform their safety function, a 10 percent sample was to be verified operable by field measurement of arc suppressor circuit resistance. If any were found open, it was requested that all Class 1E arc suppressor circuits be checked. It was requested that this procedure be repeated periodically until all arc suppressor circuits were permanently fixed.

Concern XX-85-027-012 dealt with a SQN unit supervisor who cut back insulation from terminal lugs to make them appear properly installed. Due to the general wording of the concern, the particular cable in question could not be identified. Since there was limited information, the inspection process for terminations was examined to uncover what was in place to detect a problem of this type. Personnel were interviewed and procedures were reviewed from both DNC and ONP (Modifications). |R3

4.3.1.3 Site Specific - SQN (continued)

ONP procedure M&AI-7 Revision 11 was reviewed. An in process inspection was required for QA cables. An interview with a QA supervisor revealed that in process inspections of QA terminations has always been used. He stated that the cable in question would probably be a number 8 gauge or larger wire since smaller wires used lugs which were crimped on the insulation. He stated that the gap between the insulation and those lugs which required crimping on the conductor was used to inspect for conductor damage. When questioned, he also stated that megger and continuity tests were required on all new installations and had been a requirement from the beginning. He verified that Electrical Maintenance also used M&AI-7 for terminations. When questioned about non-QA cables, he stated that the craft foreman or cognizant engineer would sign for the inspector. DNC procedure II-10 Revision 0 to 7 and Revision 10 to 12 were reviewed for information on the process used by DNC to terminate. This procedure was called a Construction Test Instruction (CTI) for Revision 0 to 5, a Construction Inspection Instruction (CII) for Revision 6, and an Inspection Instruction (II) until the end of construction. Early revisions (Revisions 0 to 3) contained no criteria for inspecting crimps on lugs. The specific information on how to properly perform the crimp was contained in vendor literature. This literature was added to Revision 6 dated December 27, 1976. Early revisions also placed the inspection and testing of terminations with the cognizant engineer. Two former SQN electrical inspectors were interviewed concerning when the inspection group was formed and if the termination inspection was in process since it was not clear from II-10 if low voltage cable termination inspections were in process. One of the interviewees had been an inspector from 1978 until he was transferred to WBN and one had been an inspector from 1975 to 1981. One stated that the inspection was in process but the other one clarified this by saying that all termination inspections were not necessarily in process and that it varied with the situation based on whether or not the QC inspector was in the area when the crimp was performed. Both inspectors stated that they inspected for tightness of connection and performed R3

4.3.1.3 Site Specific - SQN (continued)

megger and continuity tests. One of the inspectors mentioned that a problem had been identified with getting some asbestos fibers under lugs for cables which had asbestos fiber insulation. The problem had been corrected by trimming back a longer distance on the insulation. Both this inspector and a former EEU engineer, stated that the insulation was so tough that it would be difficult, if not impossible, to cut back the insulation and hide an improper termination from QC. From conversations with the EEU engineer and the inspector who had been at SQN in 1975, it was determined that the separate inspection group was organized between 1974-1975. |R3

NOTE: It should be noted that this particular concern was added to the scope of the 10900 subcategory after the SQN element report was submitted to the NRC. Since the issue was not factual, the SQN element report was not updated.

4.3.1.4 Site Specific-BFN

As mentioned in previous sections, NSRS report I-85-101-WBN described a condition concerning the misapplication of AMP PIDG terminal lugs. These lugs, which were recommended for application on stranded wire only, were found installed on solid conductor component leads at WBN. As a result generic SCR WBNEEB8537, Revision 0, was issued. F. W. Chandler's memorandum to N. R. Beasley dated September 23, 1985 (B43 850923 917) titled "Potential Generic Condition Evaluation" was issued to instruct each DNE engineering project to evaluate the concern at sites other than WBN. Review of N. R. Beasley's reply memorandum to F. W. Chandler dated October 17, 1985 (B22 851017 004) revealed the condition was examined at BFN and the initial conclusion was that the condition did not exist. However, DNE notified ONP that a walkdown of related equipment would be required to determine if the condition existed. Discussion with two DNE engineers revealed that BFN Engineering Project was currently in the process of scheduling walkdowns similar to those performed at WBN and SQN. They had completed a review of contracts for Class 1E and non-Class 1E cables which identified three mark

4.3.1.4 Site Specific-BFN (continued)

number types that had solid conductors. These were identified on the Electrical Master Bill of Material as insulated safety mineral cable from section WK issued per TVA contract 75CP-86186, telephone and coaxial cable from section WT, and insulated special cable from section WV for mark numbers WVN, WVO, WVP, and WVP-1 (non-1E cable types). Further BFN Engineering Project evaluation was needed to determine the extent of the use of this wire and other vendor wire supplied along with a piece of equipment which had been used in conjunction with an AMP PIDG terminal lug.

4.3.1.5 Site Specific-BLN

As mentioned in previous sections, NSRS report I-85-101-WBN described a condition at WBN concerning the misapplication of AMP PIDG terminal lugs. These lugs, which were recommended for application on stranded wire only, were installed on solid conductor component leads at WBN. As a result, generic SCR WBNEEB8537, Revision 0, was issued. F. W. Chandler's memorandum to J. C. Standifer dated September 23, 1985 (B43 850923 917) titled "Potential Generic Condition Evaluation" was issued to instruct each DNE engineering project to evaluate the concern at sites other than WBN. Review of J. C. Standifer's reply memorandum to F. W. Chandler dated October 22, 1985 (B21 851022 004) revealed the condition was examined at BLN and "does not exist."

4.3.2 Findings/Conclusions

4.3.2.1 Generic

See sections 4.3.2.2, 4.3.2.3, 4.3.2.4, and 4.3.2.5 for details of the conclusions reached at each site for SCR WBNEEB8537.

4.3.2.2 Site Specific-WBN

IN-85-581-002 reported that welders were used to terminate cables. The concern was found factual in NSRS report I-85-445-WBN. However, it was determined that any safety-related cables would have been inspected by a QC inspector and corrected if there was a problem. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

EX-85-148-001, IN-85-474-001, IN-85-705-001, IN-85-705-002, and IN-86-238-001 were found factual in the ERT report on EX-85-148-001, IN-85-474-001, and IN-85-705-001. The DNC response did acknowledge that there had been an instance where a subjourneyman was terminating cables. All work performed by the subjourneyman was inspected. Presently, there were no subjourneymen onsite in DNC. The ONP response gave the checks present in the system to ensure substandard work was detected. As with I-85-445-WBN, it was impossible to determine which work had been performed by unqualified personnel. However, if the work was performed on safety-related equipment, the work would have been verified by a QC inspector. Therefore, the concerns were factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

IN-85-425-001 reported a particular junction box which was a source of MBR and bent lug problems. The concern was verified in an inspection of the junction box in question. Due to personnel error, the installed box was smaller than design requirements. The box was replaced under workplan FR063B-Z. Therefore, the concern was factual and presented a problem for which corrective action had been, or was being, taken as a result of an employee concerns evaluation. |R3

4.3.2.2 Site Specific-WBN (continued)

IN-85-864-001 dealt with violations of MBR on terminations to micro-limit switches in the unit 2 Fan Room. The concern was verified as not factual. The MBR value given on the back of the termination slips was approximately two times the value calculated for that type cable from 47A800 (TVA drawing which gives ODs for various types of cable). The bend radius of these cables met the revised values.

IN-85-433-002, IN-85-433-NO4, and IN-86-314-003 were factual in the area of a lack of megger tests. The megger test was deleted from DNC site procedures when IEEE standard 690-1984 was issued which allowed a functional test to be used in place of the megger test. Non-QA power cables still had the megger requirement in SOP-14. In conversations with two former EEU engineers, no evidence of conduct of megger testing was uncovered. Therefore, though it was proper not to perform a megger test for QA cables, it was improper to delete this test from non-QA cables because the procedure still required it. ONP meggered all cables pulled by them. No evidence was found of deleted continuity tests. Therefore, the concerns presented a problem for which corrective action had been, or was being, taken as a result of an employee concerns evaluation.

IN-85-993-002 was factual. This concern had reported recrimping of a lug instead of cutting the lug off and crimping on a new one. Recrimping of lugs was an accepted practice in the design document on splicing (G-38). Therefore, the concern was factually accurate, but what it described was not a problem (i.e., not a condition requiring corrective action by ONP).

IN-85-993-XO3 was not verified as factual because no evidence of a widespread problem with lugs installed backwards was discovered. The interview conducted with a responsible QC inspector indicated the termination would be deemed unacceptable by a QC inspector and would not be left with the lugs installed backwards.

4.3.2.2 Site Specific-WBN (continued)

PH-85-003-N32, PH-85-003-N33, I-85-101-WBN, and IN-86-314-N06 were factual due to the findings of NCR 6076 and NSRS report I-85-101-WBN. The use of AMP Diamond Grip Insulated Terminal Lugs on solid copper conductors was verified in a walkdown conducted by DNC. The NCR was dispositioned use-as-is by DNE due to conversations conducted with the AMP Products Corporation and Westinghouse.

NSRS report I-85-101-WBN reopened the issue and made seven recommendations for correcting the problem. As a result of I-85-101-WBN-01-and-02, SCR WBNEEB8537 was issued to inform the NRC of a problem with the application of PIDGs on solid conductor leads. ECNs 5879 and 5880 were issued to replace or solder over the questionable lugs. All unit 1 work was verified complete in WPs E5879-1 and -2. An interview with the individual responsible for tracking ECNs in DNC stated ECN 5880 was not complete. The applicable DNE document had been revised in order to comply with recommendation I-85-101-WBN-03. The applicable DNE documents had been revised and retraining of DNE personnel was complete to comply with recommendation I-85-101-WBN-04. I-85-101-WBN-05 was not accepted by TVA because an adequate program for corrective action when generic applicability was a consideration already existed. The same was true for I-85-101-WBN-06. The employee concern program had just been updated when this recommendation was received and no further action was necessary. The documents requiring revision due to I-85-101-WBN-07 were verified complete in a review of the subject documents. Therefore, the concerns were factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

PH-85-003-N33 was factual because NCR 6076 was not made generic to SQN. However, SCR WBNEEB8537 was made generic to all sites. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.3.2.2 Site Specific-WBN (continued)

Concerns IN-86-259-007 and IN-86-259-015 were not verified as factual. In a review of WBN-QCI-1.07 on work releases, it was determined that a rework release was not required for relugging a cable because the work fell under the jurisdiction of WBN-QCI-3.06-3.

EX-85-157-003 was not verified as factual because all the Reactor Building fans (except the CRDM fans) had been operated using permanent power. The leads for the Upper Compartment Coolers were found to have the braided covering frayed. An interview with a QC inspector revealed this to be a cosmetic problem. The covering was required to be cut back to apply heat shrink. The ends of the covering had just not been trimmed.

EX-85-092-002 and I-85-101-WBN were not verified as factual because there was an existing program for inspecting terminations for inadequacies. Both of these concerns had reported poor wiring work.

4.3.2.3 Site Specific-SQN

As required by I-85-101-WBN and SCR WBNEEB8537, a replacement program for PIDG lugs on solid conductors was developed at SQN. The work was carried out in SMI-2-317-25. Work on the surge suppression networks for solenoid valves had not begun because the Compliance Section had been asked to justify not replacing these lugs. The EEB engineer responsible for resolving the issue stated rework was required for all networks on valves whose solenoids were required to energize to perform their safety function. It was recommended that those which did not energize to perform their safety function be replaced or soldered over. Therefore, the issue was factual and identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.3.2.3 Site Specific-SQN (continued)

The impression given in the interviews pertaining to XX-85-027-012 was that the actions described would be impossible to hide from a QC inspector. Tests (megger and functional) had been required since 1973 while the visual inspection dated from 1975. Since 1976, adequate procedures had been in place to ensure proper termination of QA cables. Before 1976, procedures were inadequate in that no termination criteria was given, but vendor literature was quite specific on how terminations were to be performed. Since the incident was isolated and the procedure/vendor literature was adequate, no further action was necessary. The issue was not factual. |R3

4.3.2.4 Site Specific-BFN

NSRS report I-85-101-WBN described a condition concerning the misapplication of AMP PIDG terminal lugs. According to the manufacturer, these lugs were not intended to be used with solid conductor wire. SCR WBNEEB8537 had been generated as a result. DNE had identified three instances of solid conductor wire purchased for use at BFN per the BFN Electrical Master Bill of Material. Therefore, the concern indentified in the above NSRS report was factual at BFN. Further evaluation was required to determine the extent of PIDG lugs used with solid conductor wire. DNE was in the process of scheduling walkdowns similiar to those conducted at WBN and SQN. The issue identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.3.2.5 Site Specific-BLN

NSRS report I-85-101-WBN and SCR WBNEEB8537 described a condition concerning the misapplication of AMP PIDG terminal lugs. According to the manufacturer, these lugs were not intended to be used with solid conductor wire. As a result of generic SCR WBNEEB8537, Revision 0, a "Potential Generic Condition Evaluation" was conducted and as a result of that evaluation the condition was determined not to exist at BLN. Therefore, the concern was not verified as factual.

4.4 Inspection of Cable

Based on the findings below, the issues raised by this element were factual.

4.4.1 Discussion

4.4.1.1 Generic

The findings were handled on a site specific basis for this issue.

4.4.1.2 Site Specific-WBN

IN-85-433-002 reported that craft were ordered not to wait for QC inspectors at QC hold points. This could be considered true from the number of NCRs (9) generated on bypassed inspection hold points. However, the termination, pull, or splice documentation was not complete until the inspector's signature was present on the back of the slip. This would prevent uninspected work from going undetected.

IN-86-259-004 dealt with an incident in which a QC inspector was locked out of a room while a cable pull was in progress. This portion of the concern was not verified in NSRS report I-85-467, 466, 568, 573, 518, 575-WBN when it was reviewed. An interview with a QC inspector who was used as a witness when this incident occurred verified that a QC inspector had indeed been locked out of the room. The incident was reported, the foreman and general foreman were given two weeks off without pay, and the cable was scrapped.

IN-86-259-015 (also shared with QA/QC Subcategory 80200) reported that QC had inspected the relugging of a cable without any paperwork. An interview with a responsible QC inspector and a review of WBN-QCP-3.06-3, Revision 8 indicated no requirement to have the termination paperwork present while the termination was being performed. The junction box in question was located and the wire numbers in the box were obtained. Cable 1-3V-3-3014-B was the cable in question after reviewing the termination slips for the cables in the box. Therefore, though the concerned individual did not see any termination paperwork, it did exist and was in the records vault.

4.4.1.2 Site Specific-WBN (continued)

IN-86-254-006 (also shared with QA/QC Subcategory 80200) reported that inspections in 1978-1979 were not thorough. Three former EEU engineers and one present EEU engineer were asked about inspections during that time. Those interviewed said they did do a thorough job if they were asked to watch one pull. However, at that time it was permissible to have one engineer responsible for several pulls. One of the engineers interviewed had been responsible for the unit 1 Reactor Building and had been assigned to watch four crews. The engineer was kept so busy that all he could verify was that the right type cable was pulled and that the ends went to the correct places. Another of the engineers had been assigned to one crew but had been asked to view two pulls on occasion. In this case, once again, the type cable was verified and the locations of the cable ends were checked. The other two engineers had never viewed more than one pull at a time. The impression given was that the engineers inspected a pull to the best of their ability when asked to view one pull. It just became impossible to do a thorough job on multiple pulls because it was not possible to be in more than one place at a time.

Present practice did not allow the craft to pull a cable (if safety-related) without a QC inspector's presence and had the inspector view one cable pull at a time.

4.4.1.3 Site Specific-SQN

This issue was not evaluated at SQN.

4.4.1.4 Site Specific-BFN

This issue was not evaluated at BFN.

4.4.1.5 Site Specific-BLN

This issue was not evaluated at BLN.

4.4.2 Findings/Conclusions

4.4.2.1 Generic

The findings were handled on a site specific basis for this issue.

4.4.2.2 Site Specific-WBN

IN-85-433-002 was factual because of a review of NCRs generated on bypassed QC hold points. There were checks in the system to ensure that hold points were not bypassed. For example, the slip (pull, termination, etc.) required a QC inspector signature before it was sent to the vault. Any bypassed hold points would be detected and a NCR would be generated. Therefore the concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

IN-86-259-004 was found factual in an interview with a QC inspector who was used as a witness of the incident. The incident consisted of preventing a QC inspector from watching a cable pull. The corrective action (which consisted of scrapping the cable and giving the foreman and general foreman two weeks off without pay) had already been completed. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

IN-86-259-015 was not verified as factual in an interview with a responsible QC inspector and a review of WBN-QCP-3.06-3 which revealed that there was no requirement to have termination paperwork present while the termination was being performed. The termination slip was located in the vault and dated in the timeframe of the concern therefore proving that paperwork existed at the time of the relugging.

IN-86-254-006 reported that cable pulling inspections in 1978-1979 were not thorough. The concern was found factual in interviews with responsible EEU engineers. The problem identified was the use of one engineer on multiple pulls. Therefore, there was the possibility that damage did occur while the engineer was not present. Today's practices do not allow this to occur. The conclusion for this concern was tied to the DNE response to NSRS report I-85-06-WBN dealing with SWP

4.4.2.2 Site Specific-WBN (continued)

and MPT problems. The concern identified a problem, but corrective action for the problem was initiated before the employee concerns evaluation of the issue was undertaken.

4.4.2.3 Site Specific-SQN

This issue was not evaluated at SQN.

4.4.2.4 Site specific-BFN

This issue was not evaluated at BFN.

4.4.2.5 Site Specific-BLN

This issue was not evaluated at BLN.

4.5 Fireproofing Cables

Based upon the findings below, TVA did not take into account ampacity losses due to the application of cable coatings at SQN, WBN, and BFN. This was not a problem at BLN because cable coatings were not used.

4.5.1 Discussion

4.5.1.1 Generic

DNE was actively evaluating ampacity losses due to cable coatings and other heat insulation sources. W. S. Raughley's memorandum dated September 8, 1986 titled "Corrective Action and Sampling Program For Electrical Cable Ampacity" provided direction on the performance of corrective action, and the establishment of a sampling program to determine the adequacy of electrical cables with respect to their ampacity rating. This activity was tied to fuel load/restart at each respective site. At the writing of this report, a schedule had not been established to finalize this work. See site specific for details on cable coatings at each site.

4.5.1.2 Site Specific-WBN

Concern IN-85-186-002 dealt with incorrect layers of insulation on conduit and cable tray wrap. The ERT report for this concern was reviewed for adequacy of evaluation. The concern was not verified factual. Two installations (INM3305D and INM3311D) were destructively examined in the area given in the concern and were acceptable. Several other discrepancies were noted which had no bearing on the concern for which the report was written.

IN-85-733-002 reported that insulators were inserting cables in penetrations. This concern was also shared with Management and Personnel Subcategory 71600. According to the concern, this job should have been handled by electricians because there was a shock hazard. The PMO report on this concern was reviewed for adequacy of evaluation. The report pointed out that this question involved the international agreement between the insulator's union and the electrician's union concerning electrical penetrations. To comply with this agreement, the following divisions were made at WBN:

A. Breaching and Resealing Cable Tray Penetrations

1. Kaowool boards were removed and access holes were cut using a composite crew of electricians and insulators.

2. The silicone foam in the cable sleeves was breached using insulators.

3. The electricians installed pull ropes and cables.

4. Kaowool boards were reinstalled using a composite crew.

4.5.1.2 Site Specific - WBN (continued)

B. Breaching and Resealing Conduit Fittings

1. A composite crew opened conduits.

2. A composite crew installed damming material except for the installation of the material in explosion-proof conduit fittings which was done by electricians.

3. The dispensing of foam was done by insulators.

In the report, a discussion was conducted with an electrical job steward, an electrical superintendent, and a Nuclear Services Branch general foreman on this subject. None of them knew of any incident where insulators had installed cables.

Concerns IN-86-028-003 and IN-86-259-005 dealt with bunching cables to apply Vimasco cable coating. IN-86-259-005 and OW-85-007-004 stated that the Vimasco coating was applied so thickly that resistance heat could not dissipate. NSRS report I-85-569-WBN was reviewed for adequacy of evaluation. The report found that in WBN Design Criteria WBN-DC-30-5,"Power, Control, and Signal Cables for Use in Category I Structures," that there were five cable tray systems:

Low Level Signal Trays (V1)

Medium Level Signal Trays (V2)

Control Level Trays (V3)

480-volt Trays (V4)

6900-volt Trays (V5)