3.2.8 WBN NCRs and SCRs (continued)

3.2.8.34 NCR 5744, Revision 0, dated July 9, 1984. The NCR dealt with lack of QC inspection for partial QA cables.

3.2.8.35 NCR 5761, Revision 0, dated July 19, 1984. The NCR dealt with unacceptable cable interactions (improper separation and location within 20 feet of combustibles).

3.2.8.36 NCR 5769, Revision 1, dated August 22, 1984. The NCR dealt with lack of documentation for splicing.

3.2.8.37 NCR 5832, Revision 0, dated October 5, 1984. The NCR dealt with cables pulled with an out of tolerance dynamometer.

3.2.8.38 NCR 5840, Revision 0, dated October 18, 1984. The NCR dealt with outdated cable pulling information.

3.2.8.39 NCR 5874, Revision 0, dated December 2, 1984. The NCR dealt with lugs which were mistakenly removed.

3.2.8.40 NCR 5903, Revision 0, dated January 14, 1985. The NCR dealt with cable damage during installation.

3.2.8.41 NCR 5917, Revision 0, dated January 25, 1985. The NCR dealt with overfilled conduit.

3.2.8.42 NCR 5955, Revision 0, dated February 19, 1985. The NCR dealt with routing QA cables through non-QA penetrations.

3.2.8.43 NCR 5979, Revision 0, dated March 1, 1985. The NCR dealt with no documentation for crimp tool number on several termination slips.

3.2.8.44 NCR 6001, Revision 0, dated March 13, 1985. The NCR dealt with cables pulled without the presence of a QC inspector.

3.2.8.45 NCR 6076, Revision 0, dated May 13, 1985. The NCR dealt with the used of PIDG lugs on solid copper conductors.

3.2.8.46 NCR 6127, Revision 0, dated June 12, 1985. The NCR dealt with a cable pull back which was performed without the presence of a QC inspector.

3.2.8 WBN NCRs and SCRs (continued)

3.2.8.47 NCR 6137, Revision 0, dated June 17, 1985. The NCR dealt with a cable pull back which was performed without the presence of a QC inspector.

3.2.8.48 NCR 6162, Revision 0, dated July 2, 1985. The NCR dealt with the installation of cable without the presence of a QC inspector.

3.2.8.49 NCR 6163, Revision 0, dated August 20, 1985. The NCR dealt with a cable pull back which was performed without the presence of a QC inspector.

3.2.8.50 NCR 6208, Revision 0, dated July 24, 1985. The NCR dealt with inadequate terminations in harsh environments. This was a unit 2 NCR.

3.2.8.51 NCR 6224, Revision 0, dated August 15, 1985. The NCR dealt with the same subject as NCR 6208 except that it was written for unit 1.

3.2.8.52 NCR 6255, Revision 0, dated August 15, 1985. The NCR dealt with a cable pull back which was performed without the presence of a QC inspector.

3.2.8.53 NCR 6270, Revision 0, dated August 20, 1985. The NCR dealt with lack of SWP calculations.

3.2.8.54 NCR 6295, Revision 0, dated September 3, 1985. The NCR dealt with violations of MBR in the MCR.

3.2.8.55 NCR 6347, Revision 0, dated September 26, 1985. The NCR dealt with conduit which had greater than 360 degrees between pull points.

3.2.8.56 NCR 6360, Revision 0, dated October 2, 1985. The NCR dealt with lack of application of MBR requirements to equipment pigtail extensions.

3.2.8.57 NCR 6441, Revision 0, dated November 4, 1985. The NCR dealt with cable splicing which was conducted without the presence of a QC inspector.

3.2.8.58 NCR 6459, Revision 0, dated November 11, 1985. The NCR dealt with QA cables which were pulled without cable pull packages.

3.2.8 WBN NCRs and SCRs (continued)

3.2.8.59 NCR 6504, Revision 0, dated December 10, 1985. The NCR dealt with violations of MBR at two feedwater valves.

3.2.8.60 NCR 6531, Revision 0, dated December 17, 1985. The NCR dealt with violations of MBR and lug installation.

3.2.8.61 NCR 6535, Revision 0, dated December 19, 1985. The NCR dealt with the improper preparation of the pulling eye for cable pulling.

3.2.8.62 NCR 6536, Revision 0, dated December 16, 1985. The NCR dealt with improper connectors for 6.9-KV splices.

3.2.8.63 SCR 6542, Revision 0, dated February 2, 1986. The SCR dealt with the wrong size screws terminating on Potter Brumfield type MDR-131-1 relays.

3.2.8.64 NCR 6609, Revision 0, dated January 29, 1986. The NCR dealt with overfilled conduits.

3.2.8.65 NCR 6623, Revision 1, dated March 6, 1986. The NCR dealt with splices and terminations using Raychem products made before December 2, 1985. They did not meet present requirements. This NCR was written for unit 2.

3.2.8.66 NCR 6641, Revision 0, dated February 7, 1986. The NCR dealt with an undocumented termination.

3.2.8.67 NCR 6678, Revision 0, dated February 21, 1986. The NCR dealt with violations of MBR in a junction box.

3.2.8.68 NCR 6774, Revision 0, dated April 8, 1986. The NCR dealt with the same subject as NCR 6623 except that it was written for unit 1.

3.2.8.69 NCR W-182-P, Revision 0, dated July 3, 1984. This NCR dealt with improperly sized lugs.

3.2.8.70 NCR W-283-P, Revision 0, dated October 15, 1985. This NCR dealt with improper routing of cables (improper documentation of temporary cables).

3.2.8 WBN NCRs and SCRs (continued)

3.2.8.71 NCR W-290-P, Revision 0, dated September 25, 1985. This NCR dealt with the fact that MAI-4 and 5 had no requirements to inspect for MBR.

3.2.8.72 NCR W-305-P, Revision 0, dated November 13, 1985. This NCR dealt with an improper cable splice.

3.2.8.73 NCR W-345-P, Revision 0, dated January 30, 1986. This NCR dealt with improper routing of cable.

3.2.8.74 SCR WBNEEB8537, Revision 0, dated August 14, 1985. This SCR dealt with the misapplication of AMP PIDG terminal lugs.

3.2.8.75 SCR WBNEEB8589, Revision 0, dated December 27, 1985. This SCR dealt with the use of nonauditable cable weights and ODs to determine cable tray and conduit fill. This was a unit 1 SCR.

3.2.8.76 SCR WBNEEB8590, Revision 0, dated December 27, 1985. This SCR dealt with the same subject as SCR WBNEEB8589 except that it was written for unit 2.

3.2.9 Memorandums

3.2.9.1 Memorandum from J. C. Standifer to G. Wadewitz dated March 14, 1986. Discussed overfill of conduit (B26 860314 001).

3.2.9.2 Letter from TVA to H. R. Denton (NRC) dated March 20, 1986. Established TVA's corporate position to the NRC on 10 CFR 50 Appendix B (L44 860320 811).

3.2.9.3 Letter from Okonite Company to TVA dated November 15, 1982. Relaxed minimum bend radius factors (EEB 821118 002).

3.2.9.4 Letter from Rome Cable Corporation to TVA dated January 3, 1983. Relaxed minimum bend radius factors (EEB 830106 013).

3.2.9.5 Letter from Colyer Insulated Wire to TVA dated January 24, 1983. Relaxed minimum bend radius values (EEB 830202 040).

3.2.9 Memorandums (continued)

3.2.9.6 Letter from Anaconda - Ericson, Incorporated to TVA dated November 19, 1982. Relaxed minimum bend radius values (EEB 821119 021).

3.2.9.7 Memorandum from W. C. Drotleff to R. L. Gridley dated April 17, 1986. Updated TVA's corporate position on 10 CFR 50 Appendix B (B45 860417 251).

3.2.9.8 Memorandum from J. C. Standifer to G. Wadewitz dated October 14, 1983. Discussed reinspection of cables for violations of minimum bend radius (EEB 831014 936).

3.2.9.9 Informal Memorandum from Roy D. Anderson to WBN Files dated May 4, 1982. Discussed use of incorrect lubricant in pulling asbestos braided cable type WP.

3.2.9.10 Informal Memorandum from J. D. Selewski dated January 22, 1982. Additional information was discussed on the use of incorrect lubricant in pulling asbestos braided cable type WP.

3.2.9.11 Memorandum from J. C. Standifer to D. W. Wilson dated March 12, 1986. Discussed NCR 6623 concerning splicing in harsh environments (B26 860312 006).

3.2.9.12 Memorandum from J. C. Standifer to G. Wadewitz dated February 18, 1986. Discussed NCR 6536 on 6.9-KV splices (B26 860218 147).

3.2.9.13 Memorandum from J. C. Standifer to D. W. Wilson dated March 12, 1986. Discussed NCR 6224 (B26 860312 006).

3.2.9.14 Letter from the Nuclear Regulatory Commission dated October 15, 1984. Discussed removing cable coatings (A02 841018 009).

3.2.9.15 Letter from TVA to the Nuclear Regulatory Commission dated November 14, 1984. Provided TVA's response to the NRC concerning removing Vimasco (A44 841114 807).

3.2.9 Memorandums (continued)

3.2.9.16 Memorandum from J. S. Wigington to the Electrical Engineering Branch files dated January 21, 1986. Provided TVA's reply to the NRC concerning NSRS report I-85-569-WBN (B43 860121 947).

3.2.9.17 Letter from Black and Veatch Company to J. A. Raulston dated January 25, 1984. Discussed analysis of tray loading, Vimasco, and bundling of cable.

3.2.9.18 Memorandum from W. S. Raughley to J. A. Kirkebo dated June 11, 1986. Discussed minimum bend radius issues and plant restart.

3.2.9.19 Memorandum from R. W. Cantrell to C. C. Mason dated December 2, 1985. Evaluated the adequacy of installed Class 1E cables (B43 851203 915).

3.2.9.20 Memorandum from Thomas G. Hughes to the EEB Files. Discussed Construction Specification G-38 concerns of cable installation requirements (B43 850826 914).

3.2.9.21 Memorandums from F. W. Chandler to N. R. Beasley dated July 9 and September 9, 1985. Evaluated NCR 6208 at BFN (B43 850809 934 and B22 850903 004).

3.2.9.22 Memorandums from E. Chitwood to H. C. Rutherford dated February 21 and March 7, 1986. Evaluated NCR 6536 at BFN (B43 860224 905 and B22 860307 011).

3.2.9.23 Memorandum from N. R. Beasley to R. L. Lewis and J. H. Rinne dated March 7, 1986. Evaluated NCR 6536 at BFN (B22 860307 012).

3.2.9.24 Memorandum from N. R. Beasley to G. R. Hall dated November 15, 1985. Established DNE's corrective action for SCR BFNEQP8501, Revision 0 (B43 851115 941).

3.2.9.25 Memorandums from E. Chitwood to H. C. Rutherford dated March 31 and April 14, 1986. Evaluated NCR 6623, Revision 1, at BFN (B43 860331 913 and B22 860414 018).

3.2.9 Memorandums (continued)

3.2.9.26 Memorandum from W. S. Raughley to the Electrical Engineering Branch Files dated July 8, 1986. Summarized cable sidewall pressure issues (B43 860710 905).

3.2.9.27 Memorandum from W. C. Drotleff to R. K. Seiberling dated June 13, 1986. Discussed DNE's sidewall pressure action plan (B43 860609 927).

3.2.9.28 Memorandum from H. A. Taff to W. S. Raughley dated June 4, 1986. Transmitted sidewall pressure report (E13 860604 001).

3.2.9.29 Memorandum from W.S. Raughley to Those listed dated June 23, 1986. Provided guidelines to determine the adequacy of Class 1E cables with respect to sidewall pressure (B43 860626 931).

3.2.9.30 Memorandum from W. R. Scogin to Brown's Ferry Nuclear Project Files dated August 8, 1986. Summarized cable pulling issues and resulting action items list (B22 860808 010).

3.2.9.31 Memorandum from D. F. Faulkner to W. S. Raughley dated July 14, 1986. Provided schedule for determining if sidewall pressure limits had been exceeded (B22 860714 202).

3.2.9.32 Memorandum from J. P. Stapleton to W. S. Raughley dated July 7, 1986. Established new cable ratings below 90 °C (R01 860626 803).

3.2.9.33 TVA informal 45D memorandum from Ed West to J. R. Sissom dated July 24, 1986. Discussed effect of new cable ratings below 90 °C.

3.2.9.34 Memorandum from J. P. Stapleton to R. L. Lewis dated July 7, 1986. Established policy on cable coating activities (B22 860707 014).

3.2.9.35 Memorandum from N. R. Beasley to G. R. Hall dated July 26, 1985. Described cable coating problem (B43 850826 911).

3.2.9 Memorandums (continued)

3.2.9.36 Memorandum from N. E. Beasley to G. R. Hall dated June 28, 1985. Discussed CAR-81-350 on cable tray loading (B22 850628 012).

3.2.9.37 Memorandum from J. P. Stapleton to E. P. Schlingler dated May 30, 1986. DNE's response to DR 86-0120 (B22 860530 009).

3.2.9.38 Memorandum from L. S. Cox to R. M. Hodges dated November 15, 1984. Provided commitment tracking record BLN-E212 (BLN 841105 301).

3.2.9.39 Letter from Babcock and Wilcox to TVA dated October 23, 1981. Recertified Makeup and Decay Heat Pumps (NEB 811027 605).

3.2.9.40 Memorandum from R. M. Hodges to L. S. Cox dated December 23, 1983. Provided DNE's response to NCR 2494.

3.2.9.41 Memorandum from R. R. Hoesly to L. S. Cox dated February 18, 1986. Discussed the cause of thermocouple damage to the Makeup and Decay Heat Pumps (B45 860218 251).

3.2.9.42 Memorandum from R. M. Hodges to W. R. Dahnke dated November 13, 1979. Upgraded NCR 1087 to significant.

3.2.9 Memorandums (continued)

3.2.9.43 Letter from TVA to the Nuclear Regulatory Commission dated December 21, 1979. Provided first interim report on NCR numbers 1087 and 1101.

3.2.9.44 Memorandum from R. W. Dibeler to E. G. Beasley dated November 18, 1980. Upgraded NCRs 1087 and 1101 to significant (OQA 801124 007).

3.2.9.45 Memorandum from G. F. Dilworth to L. M. Mills dated October 9, 1980. Provided interim report number 4 on NCR numbers 1087 and 1101 (NEB 801009 267).

3.2.9.46 Letter from Westinghouse to TVA dated October 27, 1981. Certified inspection and testing was complete on the Makeup and Decay Heat Pumps (NEB 811027 605).

3.2.9.47 Memorandum from L. S. Cox to J. P. Darling dated March 24, 1986. Response to certain generic K-forms at BLN (C20 860325 683).

3.2.9.48 Memorandum from J. C. Standifer to G. Wadewitz dated April 23, 1985. Requested investigation of the use of PIDG lugs on solid wire (B43 850425 948).

3.2.9.49 Memorandum from J. C. Standifer to G. Wadewitz dated June 17, 1985. Dispositioned NCR 6076 on the use of PIDG lugs on solid wire (B26 850617 004).

3.2.9.50 Memorandum from L. S. Cox to J. P. Darling dated April 18, 1986. Response to certain generic K-forms at BLN.

3.2.9.51 Memorandum from R. M. Hodges to L. S. Cox dated July 12, 1984. Established sampling program for NCR 2987 (EEB 840717 902).

3.2.9.52 Letter from the Nuclear Regulatory Commission dated March 11, 1986. Discussed investigation of sidewall pressure problems at BLN concerning report numbers 50-438/86-01 and 50-439/86-01.

3.2.9 Memorandums (continued)

3.2.9.53 Memorandum from J. H. Rinne to J. P. Stapleton dated June 2, 1986. Document contained the potential generic applicability evaluation of NCR 6536 at BFN (R07 860602 929).

3.2.9.54 Memorandum from R. W. Cantrell to J. E. Wilkins dated May 18, 1981. Document contained the revision to the DNE response to Design Information Request E-9 (EEB 810519 938).

3.2.9.55 Memorandum from T. B. Northern to R. M. Pierce dated April 30, 1979. Document asked for interpretation of cable bending radii values (WBN 790430 114).

3.2.9.56 Memorandum from R. M. Pierce to T. B. Northern dated May 25, 1979. Document was the DNE response to Design Information Request E-9 (SWP 790522 045).

3.2.9.57 Memorandum from W. S. Raughley to Those listed dated September 2, 1986. The memorandum gave advance direction concerning the project specific actions necessary to resolve concerns for MBR of Class 1E cables (B43 860903 904).

3.2.9.58 Memorandum from M. L. Rayfield to D. M. Lake dated August 8, 1986. The memorandum described the disposition to NCRs 6623 and 6774 (B26 860808 181).

3.2.9.59 Memorandum from J. A. Kirkebo to J. Q. Webb dated September 9, 1986. Request for personnel services contract to provide an independent review of TVA's Cable Sidewall Pressure Test Report (B43 860904 903).

3.2.9.60 Memorandum from W. S. Raughley to Those listed dated September 8, 1986. 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 ratings.

3.2.9 Memorandums (continued)

3.2.9.61 Memorandum from John R. Lyons to Those listed (draft copy) entitled "Sampling Procedure For Cable Ampacity (WBEP-SEP 86-05) Review." Draft copy of the proposed cable ampacity walkdown procedure.

3.2.9.62 Letter from Westinghouse to TVA dated May 24, 1985. Supported the use-as-is disposition of NCR 6076 on the misapplication of AMP PIDG terminal lugs (B45 850524 614).

3.2.9.63 Informal memorandum from R. C. McKay to the PMO Files dated August 7, 1985. Supported the use-as-is disposition of NCR 6076 because of telephone interviews which revealed no failure history for the misapplication of AMP PIDG lugs.

3.2.9.64 Memorandum from E. Gray Beasley to F. W. Chandler and J. A. Raulston dated December 17, 1985. The memorandum consisted of a QA surveillance report S86-01 on the verification of corrective action taken because of NSRS report I-85-101-WBN on the misapplication of AMP PIDG terminal lugs (B05 851217 003).

3.2.9.65 Memorandum from H. G. Parris to K. W. Whitt dated September 13, 1985. The memorandum contained the proposed corrective action for the recommendations of NSRS report I-85-101-WBN (A02 850904 010).

3.2.9.66 Memorandum from F. W. Chandler to N. R. Beasley dated September 23, 1985. Asked for the generic applicability of SCR WBNEEB8537 to BFN (B43 850923 917).

3.2.9.67 Memorandum from N. R. Beasley to F. W. Chandler dated October 17, 1985. Response to DNE in Knoxville of the generic impact of SCR WBNEEB8537 to BFN (B22 851017 004).

3.2.9.68 Memorandum from N. R. Beasley to G. R. Hall dated October 17, 1985. Advised ONP that SCR WBNEEB8537 might be generic to BFN (B22 851016 002).

3.2.9.69 Memorandum from F. W. Chandler to J. C. Standifer dated September 23, 1985. Asked for the generic applicability of SCR WBNEEB8537 to BLN (B43 850923 915).

3.2.9 Memorandums (continued)

3.2.9.70 Memorandum from J. C. Standifer to F. W. Chandler dated October 22, 1985. Response to DNE in Knoxville of the generic impact of SCR WBNEEB8537 to BLN (B21 851022 004).

3.2.9.71 Memorandum from F. W. Chandler to J. P. Vineyard dated September 23, 1985. Asked for the generic applicability of SCR WBNEEB8537 to SQN (B43 850923 916).

3.2.9.72 Memorandum from J. P. Vineyard to F. W. Chandler dated October 8, 1985. Response to DNE in Knoxville of the generic impact of SCR WBNEEB8537 to SQN (B25 851008 015).

3.2.9.73 Memorandum from F. W. Chandler to J. A. Raulston dated October 4, 1985. This memorandum provided input for the 10 CFR 50.55(e) report on SCR WBNEEB8537 (B26 851004 001).

3.2.9.74 Letter from AMP Products Corporation to TVA dated April 3, 1985. The letter stated that AMP PIDG terminal lugs were not to be used on solid copper wire (B43 850408 021).

3.2.9.75 Letter from TVA to the Nuclear Regulatory Commission dated October 17, 1985. The letter contained the final 10 CFR 50.55(e) report on SCR WBNEEB8537 (L44 851017 801).

3.2.9.76 Memorandum from H. G. Parris to Those listed dated September 13, 1985. The memorandum gave a brief description of how the corrective action asked for in NSRS report I-85-101-WBN was to be completed at WBN and SQN (A02 850905 009).

3.2.9.77 Preliminary memorandum from D. W. Wilson to P. R. Wallace dated October 24, 1986. Response from DNE to ONP on the reasons for changing the PIDG lugs on arc suppression circuits for solenoid valves.

3.2.9.78 Letter from United Technologies Essex Group to TVA dated June 17, 1983. Letter relaxed manufacturer's MBR values (EEB 830620 001).

3.2.9 Memorandums (continued)

3.2.9.79 Letter from The Okonite Company to TVA dated June 7, 1983. Letter relaxed MBR values for NCR 5062 (EEB 830610 014).

3.2.9.80 Memorandum from R. M. Pierce to K. W. Whitt dated July 8, 1985. Memorandum was a DNE response to NSRS report I-85-06-WBN (F01 850708 604).

3.2.9.81 Memorandum from E. R. Ennis to G. Wadewitz dated June 21, 1985. Memorandum emphasized which procedures were to be used to breach fire barriers (T10 850618 908).

3.2.9.82 Letter from TVA to the Nuclear Regulatory Commission dated February 7, 1986. Letter contained the final report on the applicability of NCRs W-290-P and 6295 to 10 CFR 50.55(e) (L44 860207 810).

3.2.9.83 Memorandum from E. R. Ennis dated November 21, 1985. Memorandum contained corrective action for the recommendations of NSRS report I-85-362-WBN (T14 851121 800).

3.2.9.84 Memorandum from H. H. Mull to J. E. Wilkins dated March 26, 1982. Memorandum outlined the duties of a subjourneyman (DOC 820329 003).

3.2.9.85 Memorandum from T. B. Northern to R. M. Pierce dated April 30, 1979. This memorandum contained Design Information Request E-9 on the tie down values for cable (WBN 790430 114).

3.2.9.86 Memorandum from J. E. Wilkins to R. W. Cantrell dated April 27, 1981. Memorandum transmitted Design Information Request E-55 to DNE asking about the acceptability of bunching V1, V2, and V3 level cables (WBN 810427 101).

3.2.9.87 Memorandum from R. W. Cantrell to J. E. Wilkins dated May 27, 1981. This memorandum contained the DNE response to Design Information Request E-55 (SWP 810527 069).

3.2.9 Memorandums (continued)

3.2.9.88 Memorandum from J. E. Wilkins to R. W. Cantrell dated July 29, 1981. This memorandum transmitted Design Information Request E-56 to DNE asking whether V4 or V5 level cables could be bunched (WBN 810729 162).

3.2.9.89 Memorandum from R. W. Cantrell to J. E. Wilkins dated September 2, 1981. This memorandum provided the DNE response to Design Information Request E-56 (SWP 810902 028).

3.2.9.90 Memorandum from D. E. McCloud to Those listed dated October 20, 1986. This memorandum provided TVA's interim response to the NRC's August 29, 1986 letter regarding cable pulling practices at SQN (L33 861020 800).

3.2.9.91 Memorandum from B. M. Patterson to R. A. Sessoms dated February 7, 1986. This memorandum asked for an evaluation of the torquing sequence that was provided with ECN 6207 (S01 860207 956).

3.2.9.92 Memorandum from R. A. Sessoms to B. M. Patterson dated March 4, 1986. This memorandum was the reply to the Patterson to Sessoms memorandum dated February 7, 1986 (B70 860304 005).

3.2.9.93 Telecopy from J. Cvetkovski to R. Mills dated February 26, 1986. This telecopy gave the Conax Buffalo Corporation position on the use of past revisions of IPS-725 torquing sequences (B70 860226 100).

3.2.9.94 Memorandum from R. W. Olson to D. C. Craven dated March 26, 1986. This memorandum presented the corrective action for SQ-CAR-86-02-005 (S02 860326 862).

3.2.9.95 Memorandum from J. A. Raulston to L. M. Mills dated February 24, 1981. This memorandum provided interim report number 5 on NCRs 1087 and 1101 (NEB 810224 275).

3.2.10 SQN Generic Concerns Task Force Reports

3.2.10.1 "Overtensioning and Minimum Bend Radius Violation of Cable Due to Improper Cable Installation

3.2.10 SQN GCTF Reports (continued)

Methods," Revision 1, dated May 28, 1986. The GCTF report on issues evaluated in this report under the Cable Pulling subsection.

3.2.10.2 "Thickness of Fire Protection Coating on Cable," Revision 1, dated May 20, 1986. The GCTF report on issues evaluated in this report under the Fireproofing subsection.

3.2.10.3 "Triaxial Cable Not Supported," Revision 1, dated May 17, 1986. The SQN GCTF report on issues evaluated in this report under the Cable Pulling subsection.

3.2.11 SQN DNC Procedures

3.2.11.1 SQN Inspection Instruction number 28, "Cable Pulling Inspection," Revision 4, dated May 3, 1979. The DNC cable pulling inspection procedure.

3.2.11.2 DNC Electrical Procedure number E-6, "Cable Storage and Installation," Revision 0, dated January 10, 1973; Revision 1, dated December 20, 1973; Revision 2, dated June 7, 1974; Revision 3, dated November 19, 1974; Revision 4, dated April 24, 1975; Revision 5, dated April 14, 1976; Revision 6, dated October 4, 1977; and Revision 7, dated December 27, 1979. Provided instructions for routing cable in cable trays. |R3

3.2.11.3 SQN Inspection Instruction number A4, "Inspection of Electrical Penetration Seals and Firestop Barriers," Revision 1, dated October 6, 1978 and Revision 6, dated September 20, 1979. Provided inspection requirements for Flamemastic.

3.2.11.4 SQN Inspection Instruction Number 10 (called Construction Test Instruction for Revision 0 to 5 and Construction Inspection Instruction for Revision 6), Revision 0, dated August 8, 1973; Revision 1, dated September 10, 1973; Revision 2, dated March 28, 1974; Revision 3, dated June 4, 1975; Revision 4, dated January 22, 1976; Revision 5, dated April 22, 1976; Revision 6, dated December 27, 1976; Revision 7, dated May 26, 1977; Revision 10, dated March 28, 1978; Revision 11, dated April 16, 1979; and Revision 12, dated October 22, 1979. Instruction for termination inspection. |R3

3.2.11 SQN DNC Procedures (continued)

3.2.11.5 Standard Operating Procedure, SOP number 104, "Electrical Cable Installation," Revision 1, dated October 18, 1979. Established cable routing requirements.

3.2.12 SQN ONP Procedures

3.2.12.1 Modifications and Additions Instruction, M&AI-04, "Control, Power and Signal Cables," Revision 0, dated October 30, 1979; Revision 1, dated April 19, 1980; Revision 2, dated June 1, 1981; Revision 3, dated February 11, 1982; Revision 4, dated August 12, 1982; Revision 5, dated November 19, 1982; Revision 6, dated August 17, 1983; Revision 7, dated March 15, 1984; and Revision 8, dated December 31, 1985. Established the guidelines for pulling cable.

3.2.12.2 Surveillance Instruction, SI-233.1, "Visual Inspection of Penetration Fire Barriers - Mechanical," Revision 0, dated October 2, 1985. Established and delineated the inspection of mechanical fire barrier penetrations.

3.2.12.3 Surveillance Instruction, SI-233.2, "Visual Inspection of Penetration Fire Barriers - Electrical," Revision 0, dated October 2, 1985. Established and delineated the inspection of electrical fire barrier penetrations.

3.2.12.4 Physical Security Instruction, PHYSI-13, "Fire," Revision 48, dated May 5, 1986. Provided instructions for breaching fire barriers.

3.2.12.5 Modifications and Additions Instruction, M&AI-13, "Electrical Pressure Seal, Firestop Barrier, and Flame Retardant Cable Coating," Revision 6, dated January 28, 1985. Provided requirements for application of Flamemastic and breaching cable tray fire barriers.

3.2.12.6 Special Maintenance Instruction, SMI-0-317-32, Revision 0, dated January 24, 1986. Established walkdown procedure for identifying SWP violations in conduits with multiple bends in the Auxiliary Building.

3.2.12 SQN ONP Procedures (continued)

3.2.12.7 Modifications and Additions Instruction, M&AI-7, "Cable Terminations, Splicing, and Repairing of Damaged Cables," Revision 7, dated February 5, 1986 and Revision 11, dated June 19, 1987. Determined cable splicing methods and repair. Also described cable termination inspection. |R3

3.2.12.8 Special Maintenance Instruction, SMI-2-317-25, Revision 0, dated January 24, 1986. This procedure provided for the replacement or soldering of all AMP PIDG lugs on solid conductors because of NSRS report I-85-101-WBN.

3.2.12.9 Modifications and Additions Instruction, M&AI-19, "Installation of Conax Connectors," Revision 1, dated July 26, 1985. ONP procedure which provided guidelines for initial field installation of electrical Conax connectors for SQN.

3.2.13 BFN ONP Procedures

3.2.13.1 BFN Mechanical Maintenance Instruction, MMI-75, "Installation and Repair of Penetrations and Fire Stops," Revision 1, dated August, 1986. Established the requirements for documentation of the repair of fire barriers.

3.2.13.2 Modifications and Additions Instruction, MAI-13, "Installation of Insulated Cable Rated up to 15,000 Volts," Revision 1 (4th draft). Provided instructions for installing cable.

3.2.14 BFN Significant Condition Reports

3.2.14.1 SCR BFNEEB8518, Revision 1, dated December 18, 1985. Established a new SCR at BFN in response to WBN generic NCR 6208 (B43 851218 913).

3.2.14.2 SCR BFNEQP8501, Revision 0, dated September 16, 1985. SCR written against Construction Specification G-4 for the methods used to splice cable in a harsh environment (B?? 850924 002).

3.2.14.3 SCR BFNEEB8631, Revision 0, dated June 27, 1986. SCR written against Construction Specification G-4 concerning SWP (B22 860703 004).

3.2.14 BFN Significant Condition Reports (continued)

3.2.14.4 SCR BFNEEB8634, Revision 0, dated June 27, 1986. SCR written against Construction Specification G-4 for not providing installation guidance in establishing MBR (B22 860703 007).

3.2.15 BLN DNC Procedures

3.2.15.1 BNP-QCP-3.34, "Electrical Cable Installation (Pulling)," Revision 3. The present procedure for pulling cable.

3.2.15.2 BNP-QCP-3.4, "Electrical Cables and Jumpers Installation (Pulling) and Preparation (Terminating)," Revision 4, dated June 10, 1981; Revision 5, dated August 23, 1982; Revision 6, dated June 7, 1983; Revision 7, dated November 14, 1983; and Revision 8, dated March 27, 1984. The procedure described the inspection and documentation methods used by EQC in the installation (pulling) and preparation (terminating) of insulated control, signal, or power cables.

3.2.15.3 BNP-QCP-5.18, "Fire Stops, Moisture, Pressure, and Radiation Seals," Revision 11, dated September 23, 1985. The procedure described the methods used to inspect and document penetration fire stops, pressure, moisture, and radiation seals.

3.2.15.4 EEU-SOP-229, "Cable Installation Inspection," Revision 2, dated July 10, 1979. The procedure described the methods used by EEU in verifying power, control, and signal cables were properly installed.

3.2.16 BLN Nonconformance Reports

3.2.16.1 NCR 1087, Revision 0, dated October 29, 1979. This NCR dealt with overheated thermocouple leads.

3.2.16.2 NCR 1101, Revision 0, dated November 26, 1979. The NCR dealt with overheated thermocouple leads.

3.2.16.3 NCR 2494, Revision 1, dated October 12, 1983. The NCR dealt with an omitted shim when splicing using Raychem kit NPKV-2-14.

3.2.16 BLN Nonconformance Reports (continued)

3.2.16.4 NCR 2944, Revision 1, dated March 8, 1984. The NCR dealt with cable jacket damage because of the pulling of another cable in the same conduit.

3.2.16.5 NCR 2954, Revision 0, dated March 13, 1984. The NCR dealt with cable jacket damage during termination.

3.2.16.6 NCR 2987, Revision 0, dated March 19, 1984. The NCR dealt with QC acceptance of cable installed using outdated information.

3.2.16.7 NCR 3048, Revision 0, dated April 10, 1984. The NCR dealt with cable jacket damage which was repaired without the presence of a QC inspector.

3.2.16.8 NCR 3071, Revision 1, dated April 17, 1984. The NCR dealt with conductors which were damaged during termination.

3.2.16.9 NCR 3110, Revision 0, dated May 1, 1984. The NCR dealt with damaged conductors in a factory made connector.

3.2.16.10 NCR 3171, Revision 0, dated May 24, 1984. The NCR dealt with damaged conductors in the Solid State Control Cabinets.

3.2.16.11 NCR 3174, Revision 0, dated May 25, 1984. The NCR dealt with damaged leads to a valve operator which were damaged when the cover was replaced.

3.2.16.12 NCR 3188, Revision 0, dated May 31, 1984. The NCR dealt with overheated cable insulation.

3.2.16.13 NCR 3317, Revision 0, dated July 19, 1984. The NCR dealt with damaged conductors.

3.2.16.14 NCR 3346, Revision 1, dated August 1, 1984. The NCR dealt with a damaged wire from a 24-volt power supply to a 24-volt supply breaker.

3.2.16.15 NCR 3365, Revision 0, dated August 10, 1984. The NCR dealt with a broken conductor at the point it entered the terminal lug.

3.2.16 BLN Nonconformance Reports (continued)

3.2.16.16 NCR 3388, Revision 0, dated August 20, 1984. The NCR dealt with cable jacket damage during installation.

3.2.16.17 NCR 3433, Revision 0, dated August 30, 1984. The NCR dealt with conductor damage during installation.

3.2.16.18 NCR 3473, Revision 0, dated September 17, 1984. The NCR dealt with damaged conductors.

3.2.16.19 NCR 3482, Revision 0, dated September 24, 1984. The NCR dealt with cable jacket damage during installation.

3.2.16.20 NCR 4101, Revision 1, dated June 25, 1985. The NCR dealt with cable jacket damage because of rework in the area.

3.2.16.21 NCR 4219, Revision 0, dated May 1, 1985. The NCR dealt with cable jacket damage during installation.

3.2.16.22 NCR 4222, Revision 0, dated May 1, 1985. The NCR dealt with cable jacket damage because of the use of a hook digging tool used to breach fire barriers.

3.2.16.23 NCR 4230, Revision 0, dated May 1, 1985. The NCR dealt with cable jacket damage during installation.

3.2.16.24 NCR 4247, Revision 0, dated May 7, 1985. The NCR dealt with cable jacket and conductor damage during installation.

3.2.16.25 NCR 4254, Revision 2, dated November 4, 1985. The NCR dealt with conduits which had over 360 degrees between pull points.

3.2.16.26 NCR 4255, Revision 0, dated May 8, 1985. The NCR dealt with conductor damage because of construction activities.

3.2.16.27 NCR 4292, Revision 0, dated May 16, 1985. The NCR dealt with conductor damage.

3.2.16.28 NCR 4301, Revision 0, dated May 20, 1985. The NCR dealt with conductor damage.

3.2.16 BLN Nonconformance Reports (continued)

3.2.16.29 NCR 4335, Revision 0, dated May 28, 1985. The NCR dealt with a damaged conductor near a splice.

3.2.16.30 NCR 4404, Revision 0, dated June 18, 1985. The NCR dealt with cable jacket and conductor damage.

3.2.16.31 NCR 4427, Revision 0, dated June 28, 1985. The NCR dealt with cable damage because of improper construction practices.

3.2.16.32 NCR 4526, Revision 0, dated September 12, 1985. The NCR dealt with cable jacket damage.

3.2.16.33 NCR 4544, Revision 0, dated October 1, 1985. The NCR dealt with cable jacket damage because of excessive MPT.

3.2.16.34 NCR 4814, Revision 0, dated March 26, 1986. The NCR dealt with a specific conduit which exceeded 360 degrees of bend between pull points.

3.2.17 Various Documents

3.2.17.1 WBN Allegation Report 1-80, dated April 9, 1980. The report dealt with the use of Yellow 77 cable lubricant on asbestos jacketed cables.

3.2.17.2 BF-CAR-86-0078, dated April 17, 1986. The report referenced overfilled cable trays and excessive Flamemastic cable coating.

3.2.17.3 Conax Buffalo Corporation Table D. This table (obtained from the SQN EQ binder) listed the MBR for each size conductor.

3.2.17.4 Crouse-Hinds Catalog, dated August 1974, page 1P-27. This page gave the cable diameters for those cables to be used with the 480-volt receptacles in the Diesel Generator Building.

3.2.17.5 BF-DR-86-0120, dated March 4, 1986. The DR referenced several cables which were not located in cable trays.

3.2.17.6 BF-DR-86-0397, dated August 11, 1986. The DR was concerned with a change to a Standard Practice which was not reflected in a Modifications procedure on breaching fire barriers.

3.2.17 Various Documents (continued)

3.2.17.7 EEB EP-22.29, Revision 0. This procedure was used to select worst-case conduits for the SWP evaluation.

3.2.17.8 Field Change Number 110, dated September 2, 1980. Change which repaired thermocouple lead damage on the Makeup and Decay Heat Pump motors.

3.2.17.9 FSAR, Amendment 57, dated January 31, 1986. This report gave a description of cable derating, cable tray fill, cable routing, and sharing of cable trays with QA and non-QA cables.

3.2.17.10 IEEE Standard 690-1984, "IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations," dated December 31, 1984. This standard provided direction for the design and installation of safety-related electrical cable systems, including associated circuits, in nuclear plants.

3.2.17.11 Joslyn Corporation Test Number 85-033, "Test Report of the Effect of Flamemastic 71A and Flamemastic 77 Fire Protective Coatings on the Ampacity of a Grouped Power and Control Cable Assembly Tested for the Tennessee Valley Authority, Knoxville, Tennessee," dated February 24, 1986. The report covered the effect of Flamemastic 77 and 71A fire protective coatings on the ampacity of a grouped power and control cable assembly in a filled punch bottom tray with a hot spot temperature of 90°C at various thicknesses (B43 860407 903).

3.2.17.12 PIR BLNEEB8518, Revision 0, dated September 18, 1985. The PIR dealt with the fact that cable SWP calculations were not addressed in G-38, Revision 5 (B43 850927 902).

3.2.17.13 Stop Work Order number 12 dated July 18, 1985. The stop work order written because G-38 did not have provisions for calculating SWP.

3.2.17.14 WP 11043 was the workplan which permanently removed instrumentation for the Condenser Circulating Water gate hoist motors from service.

3.2.17.15 WR 56023 dated September 5, 1986. The WR was written to breach several cable tray penetrations.

3.2.17 Various Documents (continued)

3.2.17.16 PIR GENEEB8605, Revision 0, dated August 6, 1986. The PIR dealt with lack of design calculations to show the adequacy of cable ampacity at BLN.

3.2.17.17 Engineering Report on SCR WBNEEB8537, Revision 0, dated September 9, 1985. The report dealt with the misapplication of AMP PIDG lugs.

3.2.17.18 WB-CAR-85-24 dated April 29, 1985. Report on the lack of breaching control for unit 1 fire barriers at WBN.

3.2.17.19 SQ-CAR-86-02-005 dated February 10, 1986. This CAR was written because Conax connectors had been found with wire bend radii in excess of the allowable limits.

3.2.17.20 WBN ECTG element report 10900, "Cable," dated June 19, 1986. Report on the WBN evaluation of cable concerns. |R3

4.0 FINDINGS

The findings and conclusions relative to the areas contained with each of the seven issues which comprise this subcategory are presented below by issue.

4.1 Cable Pulling

Based on the findings below, the issues addressed by this area were factual.

4.1.1 Discussion

4.1.1.1 Generic

In order to understand the complexity of the cable pulling issues, it is essential for the reader to have a thorough understanding of TVA's past and present requirements concerning the maximum allowable cable pulling forces, i.e. (1) maximum pull tension, (2) sidewall pressure, and (3) minimum bend radius.

4.1.1.1 Generic (continued)

NOTE: BFN was designed and constructed to General Construction Specification G-4 and was not committed to General Construction Specification G-38 until after January 15, 1986. G-4 was applicable to SQN from the beginning of construction until July 25, 1973. From that time until the present, SQN has been committed to G-38. WBN and BLN have always been committed to G-38.

(1) The method for calculating maximum pull tension for multi-cable pulls was not defined in Construction Specification G-38 until September 15, 1985. However, G-38 always included the formula for calculating the maximum allowable pulling force for single cable pulls to ensure conductor damage did not occur during cable pulling. Since August 3, 1978, monitoring of the cable pulling force was required for mechanically assisted or tough cable pulls to assure that the maximum pulling force was not exceeded. Specification Revision Notice SRN-G-38-2, dated October 18, 1983, required monitoring of essentially all cable pulls in conduit with certain noted exceptions.

Monitoring of cable pull tension was primarily done by use of a pull link or dynamometer on the main pulling line. The link was selected such that its breaking strength was equal to or less than 80 percent of the sum of the conductor strength limit of each conductor in the pull. Failure to monitor the maximum allowable pull tension increased the potential for cable damage which was not necessarily detected visibly or through testing.

(2) The calculation of sidewall pressure was never specifically addressed in General Construction Specification G-4. Since January 9, 1973, G-4 required the maximum strain at a bend to not exceed 100 times the radius of curvature in feet. Before January 9, 1973, G-4 had no requirements for SWP. DNC was not required to calculate SWP

4.1.1.1 Generic (continued)

until January 15, 1986. Construction Specification G-38 did not have the requirement to limit the number of degrees of bends in conduit runs between pull points until September 15, 1985. Before January 15, 1986, sufficient information was not given to ensure that the sidewall pressure on cable was within acceptable limits, making existing cable installations suspect and creating uncertainty concerning the ability of cables involved to perform their safety function.

(3) Minimum bend radius requirements for installing cable were provided in Design Standard, DS-E13.1.2, "Cable Bend Radii for Pulling Cable in Conduit" and DS-E12.1.5, "Minimum Radii for Field Installed Insulated Cables Rated 15,000 Volts and Less." In 1979, DNE allowed DNC to permanently bend cables to a radius of one-half of the values, which in 1981, were recognized to be the industry standard for minimum values to which a cable could be permanently bent, thereby forming bends sharper than permitted. Bending cables to values less than the industry standard values had the potential of irreversible adverse effects on the cable spiral wound shield and cable insulation resulting in reduction of the qualified life under normal conditions. Also, bending cable beyond the manufacturer's recommendations could invalidate the environmental qualification of the cable.

In July 1985, NSRS report I-85-06-WBN determined that DNE and DNC's established and documented program was inadequate to accomplish cable pulling activities. The report identified three problem areas:

- The fact TVA did not include sidewall pressure calculations in their cable pull procedure,

4.1.1.1 Generic (continued)

- The way TVA defined their method of calculating maximum pull tension on multi-cable pulls, and
- The way DNE resolved the question of exceeding minimum bend radius.

The report also concluded that such improper installation of cables could potentially invalidate the environmental qualification certification of safety-related cables.

Since the industry considered SWP as the limiting factor for cable pulling activities, the SWP resolution would also determine the resolution to MPT.

SWP concerns were actively being evaluated by DNE. Their position was that installed cable was acceptable and the ongoing evaluation would provide documentation to verify its adequacy. W. S. Raughley's memorandum to J. A. Raulston dated September 2, 1986 provided the following response to the NRC's request for information concerning the methods used by TVA in evaluating the acceptability of SWP exerted on Class 1E cable:

"All Class 1E conduits (approximately 10,400) were evaluated through (1) preliminary screening, (2) field inspection and (3) detailed calculations.

(1) Preliminary Screening was conducted to develop a list of assumed worst-case configurations based on vertical conduit with four 90-degree bends in the pulling end of the conduit. Conservatism was used in the screening method based on the following:

(a) The sidewall bearing pressure criteria was 300 pounds/foot. Test results of 600-1,500 pounds/foot were later reported.

4.1.1.1 Generic (continued)

(b) Four conduit bends were assumed back to back. Using a more typical conduit with bends distributed throughout the conduit could result in pulling tensions 1/2 to 1/4 of those in the screening.

(c) Initial conduit section was assumed to be vertical. This assumption doubled the resultant tension as compared to pulling through a horizontal section which was far more typical.

(2) Field Inspection was conducted and a sample size of 81 worst-case conduits were obtained at WBN for detailed calculations. Approximately 20 conduits were selected per voltage level. The worst-case conduits were selected by visual inspection of 778 conduits using the criteria of multiple bends (>360°), long lengths with elevation changes and conduit fill (>30 percent) (EEB Engineering Procedure 22.29).

(3) Detailed Calculations of the 81 worst-case conduits showed twelve conduits (cables within) exceeding the sidewall bearing pressure limits of 300 pounds/foot or 100 pounds/foot as applicable. These values were based on the assumption that the cables were pulled in the direction that would cause sidewall bearing pressures to be greater."

NOTE: The calculations described above were for the WBN evaluation.

4.1.1.1 Generic (continued)

W. S. Raughley's memorandum dated June 23, 1986 titled, "Cable Sidewall Pressure" provided guidance for each engineering project Lead Engineer to determine the adequacy of the Class 1E cable installations with respect to cable SWP for each project.

> "Each respective engineering project, with the exception of WBN, shall develop, issue, and implement a SWP sampling procedure using EEB EP22.29 as a guide consistent with your restart/fuel load schedule."

Engineering Procedure EEB EP22.29 provided a means to select a sample of conduits which met the worst-case configurations for multiple bends, long lengths, high percentage of cable fill, and elevation changes.

Review of D. E. McCloud's transmittal memorandum dated October 20, 1986 revealed TVA's interim response to the NRC's questions regarding cable pulling practices at SQN. The following response was given concerning pull-bys in which new cable was pulled past cable already in a conduit:

> "The concern of cable "pull-bys" was considered on a generic basis by TVA when preparing its sidewall pressure evaluation program. As it is normal practice to route only one circuit in power-level conduits, pull-bys occur generally in instrumentation and control level conduits only. Typical conductor sizes routed in such conduits are No. 8 - No. 16 AWG. The results of TVA's cable sidewall bearing pressure test indicate that for such conductor sizes, the limiting parameter for installation is not sidewall pressure but rather conductor strength."

At the writing of this report, DNE's evaluation of SWP and MPT was not yet complete. DNE was involved in contract negotiations with a third party engineering company to evaluate the sampling program mentioned above. Final resolution of the SWP and MPT issues for all TVA nuclear plants was to be addressed in DNE's final response.

4.1.1.1 Generic (continued)

MBR concerns were also actively being evaluated by DNE. Review of NSRS report I-85-06-WBN and TVA's response to the NRC question on cable pulling previously mentioned in regards to SWP revealed that during the period of February 28 through April 15, 1985, TVA's Nuclear Safety Review Staff conducted an investigation at Watts Bar Nuclear Plant in regard to the adequacy of cable installation and inspection. A major thrust of this inquiry was the establishment of and adherence to cable bend radius criteria. The report (I-85-06-WBN) identified various areas of potential inadequacies. One of these areas stated that Construction (now DNC) was permitted by Design (now DNE) to bend the cables permanently to a radius of one-half of values which in 1981 were recognized to be an industry standard for minimum values to which a cable can be permanently bent. Violations of industry standards in installation of these cables could potentially invalidate the environmental qualification certification of the cable.

TVA's Electrical Engineering Branch (EEB) had used this report in addition to the manufacturer's requirements to form the basis for its evaluation. Each of the areas of potential concern was being resolved into elements for further analysis. In each case the actual bend radius to which a cable had or could have been subjected was determined. This was accomplished for each Class 1E safety-related cable to which the concern applied. Subsequently, a determination was made of the effects, both short and long term, on the integrity of the cable and its ability to perform it's safety-related function as a result of being subjected to the reduced bend radius. This determination was based on consultations with and recommendations from the cable manufacturers, a review of the cable materials and constructions involved, the particular application of the cable at TVA and a review of TVA and industry environmental qualification testing as it related to cable bend radius. In particular, EEB had identified the elongation stress to which a cable was subjected as the result of a bend as the critical parameter in determining acceptability. The evaluation of the concerns indicated that the minimum bend to which cables could have been subjected was that of one

4.1.1.1 Generic (continued)

times its overall diameter. The resulting elongation stress had been calculated and compared with the cable's corresponding capability following its postulated accident scenario. This information was compiled from the environmental qualification test reports. Preliminary conclusions of the study indicated that this worst case bend did not reduce the cable's available elongation properties below that required for it to perform its safety-related function. The effects of such a potential bend on shielded cables was being evaluated separately. Finally, recommendations were to be formulated which, if necessary, may include cable testing, surveillance inspections or rework, or replacement of the cable in question.

A final report providing a comprehensive detailed analysis of each concern including evaluation results, conclusions and recommendations was to be issued.

W. S. Raughley's memorandum dated September 2, 1986, titled, "Class 1E Cable Bend Radius, " provided direction to each project concerning specific work actions which were necessary to resolve concerns on bend radii of Class 1E cables before each plant restart/fuel load date. The following direction was given for each project:

"The Electrical Engineering Branch has evaluated the adequacy of the bend radius to which Class 1E cables were installed. The basis for the evaluation was the comprehensive investigation conducted by the Nuclear Safety Review Staff on the same subject during February to April 1985. The measures specified herein are expected to comprise the majority of any project specific corrective actions resulting from this investigation. EEB's final report documenting the evaluation and providing conclusions and recommendations based upon an independent review of our evaluation will be issued in September 1986.

Each project should proceed immediately to perform the following inspections, as applicable, and to forward the results to the respective engineering projects.

4.1.1.1 Generic (continued)

The WBN and BLN projects shall inspect the installed bend radius of all class 1E medium voltage power cable furnished by The Okonite Company. The cable shall be verified to be installed to a radius equal to 8 times its outside diameter. This inspection need not address the bend radius in standard conduit bends as this has been addressed generically in PIRGENEEB8605. The inspection of the bend radius in conduits is covered below. Therefore, provided the project establishes that all cable tray fittings were procured with a radius equal to or greater than 8 times the outside diameter of the largest cable in question and that all conduit bends meet the minimum requirements of DS-E13.1.7, this inspection may be limited to cables in free air (transitions from raceway to raceway or raceway to equipment) and to the points of termination.

All installations which do not conform to the specified 8 times factor shall be documented as a nonconformance and forwarded to the respective engineering project for disposition. The documentation shall include the cable and, if applicable, the raceway number, the location of the violation, the actual installed bend radius and the results of a visual inspection noting any discernible stress on the cable jacket in the area of the bend or any cuts or ripples in the cable jacket which could indicate shield deformation.

Effective immediately, the WBN and BLN projects shall take the steps necessary to ensure that all medium voltage power cable furnished by The Okonite Company is installed to a bend radius of 8 times its outside diameter as opposed to the previous direction of DS-E12.1.5. This design standard is being revised accordingly.

4.1.1.1 Generic (continued)

All projects shall perform a field inspection of all conduits containing Class 1E medium voltage power cables for the existence of any straight-through pull box or conduit type (C, ELL, TEE, etc.) raceway fitting or any conduit raceway fitting other than a standard conduit bend around which a cable is bent. The existence of any such fittings, including the raceway number and size, the fitting description, manufacturer (if available) and size, and the location shall be documented as a nonconformance and forwarded to the respective engineering project for disposition.

All projects shall determine the minimum size conduit that the following coaxial, triaxial, and twinaxial cables, if utilized in class 1E applications and routed in conduit, are installed in. If any of these cables are installed in Class 1E applications and in a conduit smaller than indicated below, the project shall perform a field inspection for the existence of conduits of any type (ELL, TEE, etc.) in which the cable is bent. The existence of any such fittings, including the raceway number, and size, the fitting description, manufacturer (if available) and size and the location shall be documented as a nonconformance and forwarded to the respective engineering project for disposition.

The WBN project shall perform a field inspection of all Class 1E coaxial, twinaxial, and triaxial cables which were installed or modified during the period of May 25, 1979 to May 18, 1981, under the guidance of Design Information Request (DIR) number E-9. In addition, all projects shall inspect all class 1E coaxial and twinaxial cables which were installed or modified during the period of September 20, 1983 to April 23, 1986, under the direction of DS-E12.1.5, Revision 0. The cable shall be verified to be installed to a bend radius equal to 8 times its outside diameter. This inspection need not address the bend radius in standard conduit bends as this has been addressed generically in PIRGENEEB8605. The inspection of the bend radius in conduits is covered in item 3 above. Therefore, provided the project establishes that all cable tray fittings

4.1.1.1 Generic (continued)

were procured with a radius equal to or greater than 8 times the outside diameter of the largest cable in question or that the cable was restricted to use in conduit and that all conduit bends meet the minimum requirements of DS-E13.1.7, this inspection may be limited to cables in free air (transitions from raceway to raceway or raceway to equipment) and to the points of termination.

All installations which do not conform to the specified 8 times factor shall be documented as a nonconformance and forwarded to the respective engineering project for disposition. The documentation shall include the cable and, if applicable, the raceway number, the location of the violation, the actual installed bend radius and the results of a visual inspection noting any discernible stress on the cable jacket in the area of the bend or any ripples in the cable jacket which could indicate shield deformation."

At the writing of this report, DNE's final report addressing the evaluation described above was not yet available for review.

4.1.1.2 Site Specific - WBN

Based on the information contained within EX-85-073-001 and IN-85-719-002, the locations of the problems were walked down for evidence of excessive MBR. The cable of concern EX-85-073-001 (2-3V-31-7229) was located in the unit 2 Incore Instrument Room with the aid of a DNC electrician. The cable, as presently oriented, exhibited no evidence of excessive MBR. The concern was worded such that it was construed that the MBR of the cable had been temporarily violated in order to perform a splice. A review of General Construction Specification G-38, Revision 8, step 3.2.1.3.4 on page 3 and 4 revealed that MBR could be temporarily exceeded. Therefore, though there was a possibility that the MBR of the cable was exceeded, no problem was uncovered because a temporary violation of MBR was permitted in DNE procedures. The cables of concern IN-85-719-002 were located in the unit 2 RB over Reactor Coolant Pump number 3. They were

4.1.1.2 Site Specific - WBN (continued)

examined for MBR violations and cable insulation damage by an ONP QC inspector. No evidence of either problem was discovered.

Concerns EX-85-157-002, IN-85-733-001, IN-85-935-001, IN-86-266-006, IN-86-314-N06, and WI-85-100-013 dealt with general MBR problems. The portion of IN-85-935-001 which dealt with cable damage after installation was shared with Construction Subcategory 15100. NSRS report I-85-06-WBN and NCRs 4194, 4274, 4933, and 5062 were reviewed for their relationship to these concerns. The problem associated with the NCRs began in 1979 when Design Information Request E-9 (WBN 790430 114) was sent to DNE requiring interpretation of cable bending radii values. The response (SWP 790522 045) permitted a minimum tie down value of 50 percent of the pulling radii. Two years later, this response was modified (EEB 810519 938) to state that Insulated Cable Engineer's Association values must be used to calculate the minimum training radius. This created situations in which some of the cables which were bent to the original criteria now exceeded the new guidelines. Several NCRs were generated in 1982 through 1983 on this subject. NCR 4194 was written in 1982 and addressed problems with MBR in cable trays. NCR 4933 was written in 1983 identifying MBR problems after a 100 percent walkdown of V5 (6900-volt) level cables. The disposition of these NCRs all depended on relaxed values for training radii given to TVA by various cable manufacturers (EEB 821118 002, EEB 830106 013, EEB 830620 001, and EEB 821119 021). NCRs 4274 and 5062 were written to document problems with MBR in condulets. A walkdown was conducted of suspect conduit. Nine examples in which the MBR had been exceeded (76 percent of the required value) were discovered. They were dispositioned use-as-is based on a letter from the cable manufacturer (Okonite Company). This letter (EEB 830610 014) was written in response to a request to evaluate cables which had been bent beyond given MBR values. These cables had been bent 4.375 times the cable diameter. Using the formula percent lap x tape width equals cable radius of bend to the neutral axis of the cable, the MBR would be 3.153 inches in condulets which only had a possible minimum radii of four inches. This calculation was in a memorandum from R. M. Pierce to

4.1.1.2 Site Specific - WBN (continued)

K. W. Whitt dated July 8, 1985 (FO1 850708 604). Since that time cable ODs have been revised in DS-E12.1.13. Even with the new values, the MBR remained below four inches. With the new value, the problem areas were deemed acceptable because the subject cables could not have been bent beyond the vendor established MBR. The NSRS report criticized the actions taken by DNE to clear these NCRs (see section 4.1.1.1).

There were two open NCRs on the subject of excessive MBR for cables. They were NCR 6295 and W-290-P. NCR 6295 dealt with cables in the MCR panels whose MBR was exceeded. NCR W-290-P dealt with the fact that MAI-4 and 5 did not contain provisions for inspecting cables for MBR problems. A letter from TVA to the NRC dated February 7, 1986 (L44 860207 810) contained the final report on the applicability of NCRs 6295 and W-290-P to 10 CFR 50.55 (e). In this report, TVA maintained that cable failures at five TVA facilities were evaluated and that none of these failures were associated with violations of MBR. It stated that cable failures due to violations of MBR would occur randomly and would not significantly affect plant safety. These NCRs were still open pending a response from DNE.

The listed concerns:

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

reported that most cables had been pulled before the requirements to use break ropes on all cable pulls and that nothing was done about those cables pulled before that time. A review of General Construction Specification G-38, Revision 4, revealed that in 1984 the pulling procedure was changed to include the use of break ropes for most cables (there was an exception for cables which were hand laid in trays or pushed through conduit). There was no evidence of any rework of cables pulled before this time because of the change in procedures. NSRS report I-85-467, 466, 568, 573, 518, 575-WBN was also reviewed because it dealt with concerns IN-86-201-001 and IN-86-259-001. This report verified the concerns because of the comments in

4.1.1.2 Site Specific - WBN (continued)

NSRS report I-85-06-WBN. The report tied corrective action to the actions specified in I-85-06-WBN. This report was extremely critical of the manner in which DNE had defined the method of calculating MPT for multi-cable pulls. It was also critical of the lack of a method of determining SWP values. The report recommended that G-38 be revised to incorporate resolutions to the problems identified above. Subsequently, other DNE, DNC, and ONP procedures were to be revised to reflect the changes to G-38. Finally, the adequacy of cable presently installed was to be evaluated. As part of this evaluation, a SWBP test was conducted. The results were described in section 4.1.1.1 of this report.

The following concerns all dealt with the use of come-alongs and trucks 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.

IN-85-978-001 was also shared with Management and Personnel Subcategory 7060C.

A former knowledgeable WBN EEU engineer was interviewed to determine what specific requirements there were for power assisted pulls. All mechanically assisted pulls were required to have the pull tension monitored by a rope pull device (break rope or dynamometer). There was also a requirement to have an engineer present to monitor the device.

The initial and latest revision of DNC and DNE cable pulling procedures (WBN-QCI-3.05, Revision 0 and 10, WBN-QCP-3.05, Revision 0 and 25, and G-38, Revision 0 and 8) were reviewed for the acceptability of power assisted pulls and any requirements for monitoring pull tension. All documents allowed power assisted pulls as long as the pull tension was monitored.

4.1.1.2 Site Specific - WBN (continued)

Concerns EX-85-086-001, IN-85-978-001, IN-86-266-001, and IN-86-314-001 were all worded such that no problem was uncovered. The concerns stated that cables were pulled with come-alongs and trucks. As stated above, this was an accepted practice onsite which was allowed in DNC and DNE procedures as long as the pull tension was monitored. No mention was made of a lack of a rope pull device in these concerns.

The following concerns were all related to power assisted pulls in which the break rope/dynamometer was not used:

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.

The use of steel chokers was found to be for safety purposes only in an interview with a knowledgeable QC inspector. It was also verified in answering concern number IN-86-262-003 in NSRS report I-85-467, 466, 568, 573, 518, 575-WBN. The choker was to be used when pulling in open areas to prevent a cable from whipping around and hitting personnel in the area if the break rope snapped. However, in the investigation for IN-85-581-001, an abuse of choker use was uncovered. Informal interviews with a present and a former responsible EQC inspector and a knowledgeable electrician were conducted on the subject of the use of trucks to pull the unit 1 Reactor Coolant Pumps motor feed cables without a dynamometer. The inspectors stated that break ropes were used instead of a dynamometer to monitor pull tension. The electrician stated that a truck was used to pull the cables and that there was a choker around the break ropes. He said that the break ropes were invariably broken when they were pulled clear of the conduit. There was no safety reason for having the choker around the break ropes when the cable was being pulled in conduit. Since one abuse had been verified and the other concerns which discussed bypassing break ropes were too vague to adequately evaluate, they were tied to IN-85-581-001 and were also factual. The same was true for those concerns which alleged that there were mechanically assisted pulls with no rope pull monitoring device.

4.1.1.2 Site Specific - WBN (continued)

The concerns were so vague that a meaningful evaluation was impossible. However, informal interviews with a former and a present DNC electrician revealed that break ropes were not being used on non-QA cable pulls (these pulls lack a QC inspector).

Concerns IN-85-046-001, IN-85-533-001, IN-85-774-006, and IN-86-259-004 dealt with a specific incident in which a QC inspector was locked out of a room while electricians were pulling a cable inside the room. IN-85-533-001 was also shared with Management and Personnel Subcategory 70600. IN-85-046-N09 addressed the same subject in QA/QC Subcategory Report 80203. The NSRS report (I-85-467, 466, 568, 573, 518, 575-WBN) did not verify the event had occurred. However, one of the EQC inspectors interviewed was involved in the incident. The action was reported, and the foreman and general foreman were given two weeks off without pay. The cable in question was scrapped, and the matter was considered closed by DNC management.

The following concerns were all general cases of exceeding 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.

The portion of IN-85-935-001 which dealt with cable damage after installation was shared with Construction Subcategory 15100. The PMO report on concern IN-85-201-002 was reviewed. The concern recommended that the cable be pulled to the first outlet before making the pull test on the cable. The DNC response was that the suggestion could not be allowed because it did not agree with General Construction Specification G-38 and WBN-QCI/QCP-3.05. The evaluation agreed with the report. NSRS report I-85-852-WBN was written on concern IN-85-527-001. The concern stated that cables had been pulled without break ropes. Through information received from QTC, the cables in question were identified. These cables had been scrapped in NCR 6001 because QA cable had been pulled approximately 20 feet without the presence of

4.1.1.2 Site Specific - WBN (continued)

an inspector or anyone to monitor pull tension. No further corrective action was deemed necessary in the NSRS report. The remaining concerns were so vague that a meaningful evaluation of each one was impossible. However, because of the problems which were discovered with SWP in NSRS report I-85-06-WBN (see section 4.1.1.1 for details) the concerns were verified.

The following concerns all 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.

IN-85-186-010 was also shared with Management and Personnel subcategory 70200. HI-85-010-001 and IN-85-798-005 were shared with the Intimidation and Harassment Category. IN-85-978-013 was shared with the Intimidation and Harassment Category, Construction Subcategories 10100 and 10200, Material Control Subcategory 40400, Management and Personnel Subcategory 70600, and QA/QC Subcategory 80600. The portion of IN-85-935-001 which dealt with cable damage after installation was shared with Construction Subcategory 15100.

The ERT report on HI-85-010-001 was reviewed. In the course of the investigation, an interview with the concerned individual uncovered no specific instances of sloppy work, and the individual clarified that the remark was directed toward aesthetic rework rather than poor quality of work involving plant safety. Based on these statements, the concern was not found factual. This evaluation agreed with the report.

NSRS report I-85-445-WBN was examined with respect to OW-85-007-012. The report was actually written for another concern. However, the basic problem was the same for OW-85-007-012. This problem was with the use of non-electricians to pull cable. A former and a present EQC inspector were interviewed on the requirements to have only electricians pull cable. There were none. The problem was a disagreement

4.1.1.2 Site Specific - WBN (continued)

between TVA and the International Brotherhood of Electrical Workers (IBEW). The major point discussed in the NSRS report was that if non-electricians performed electrical work, the work would still have to be inspected by a QC inspector if the cables in question were QA cables. The evaluation agreed with the report.

Concern IN-85-318-003 discussed pulling a cable to a unit 2 reactor cooling fan on elevation 703 with a seven to eight inch split in the insulation. The defective cable was pulled because of a tight schedule to pull a certain amount of cable per shift. The assumption was made that the fan described in the concern was a CRDM fan since these fans were the only fans on elevation 703. A review of the pull cards for each cable which ran to each of the four CRDM fans revealed that six EQC inspectors had been involved with the pulls. Five of the inspectors were interviewed about the incident. None of them recalled a cable pull with a defective cable as specified in the concern. All stated they would not have allowed the cable to be pulled. There was one inspector who was no longer with TVA. However, in the timeframe the cables were pulled, a megger test was required for all cables. This test would have revealed any damage severe enough to affect the functional capability of the cable.

WBN-QCI-3.05, Revision 10, WBN QCP-3.05, Revision 25, and G-38, Revision 8 were all reviewed in relation to IN-85-878-X01. The concern stated that QA requirements for pulling cable were silly and stupid and that the individual had never pulled cable this way at any other TVA facility. It was determined that the site procedures were as dictated by G-38 which was based on industry standards and the National Electric Code. This document was the upper level document for all site cable pulling procedures starting with SQN and including BFN modifications.

IN-85-186-010 and IN-86-252-004 both dealt with cables which were potentially damaged and not repaired. The concerns were so vague that it was impossible to locate the cables in question. It was therefore impossible to evaluate the particular

4.1.1.2 Site Specific - WBN (continued)

concerns. However, there were several tests (DNC functional, preoperational test, or surveillance test) which should have located the problem if it existed. IN-86-314-002 discussed inadequate cable pulling procedures. As mentioned in the discussion of IN-85-878-X01, the site procedures were as directed by G-38. Therefore, the adequacy of G-38 was questioned. Review of NSRS report I-85-06-WBN revealed that G-38 was inadequate. Since that time (July 1985), G-38 had been revised three times. Provisions for calculating SWP and the maximum pulling force for multi-cable pulls had been added as well as precautions against having greater than 360 degrees between pull points. From the amount and content of the changes made in the past year, it was obvious that the upper-tier and therefore, site specific procedures were inadequate.

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 reported that the emphasis on pulling was with quantity over quality. Both electricians interviewed discussed the fact that QA cable pulls were as specified by the procedure because of the presence of QC inspectors. The same was not true on non-QA cable pulls. The reason given for this was management emphasis on quantity over quality. In all interviews with the craft, it was noted that no effort had been made to explain the reasoning behind the procedural changes. They saw no need for these new procedures and did not use them unless forced to by a QC inspector. This statement was also made by three QC inspectors when they were asked about inspections in 1978 through 1979. At that time they were watching as many as four pulls at a time.

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.

IN-85-986-X02 and IN-85-933-006 (also shared with QA/QC Subcategory E0200) reported a lack of conduit isometric drawings and SWP calculations because SWP calculations were not a requirement until November 20, 1985 (SRN-G-38-6). The cognizant DNE cable task force leader, EEB group leader, EEB

4.1.1.2 Site Specific - WBN (continued)

section supervisor, WBN EEU engineer, and former EEU-C supervisor were interviewed to determine what had been accomplished by the SWP evaluation program. The program was established at WBN in August 1985. EEB-EP22.29 was written to document the testing procedure and the criteria for picking problem conduit runs. There were to be 50 cases from unit 1 and 50 cases from unit 2. However, only 81 cases meeting the worst-case selection criteria were found in the evaluation. DNC and DNE walked down the runs and made preliminary sketches of them. DNC draftsmen then made composite sketches. The DNC and DNE engineers compared these sketches to their sketches and signed the drawing, if satisfied. EEB performed the SWP calculations. More than three percent (the acceptance criteria of EP22.29) failed in the calculations. Twelve of the conduits contained cables whose SWP values had been exceeded. DNE then determined from EPRI report EL-3333 that some of TVA's values for maximum SWP were four to five times too conservative. EEB developed a test to determine actual maximum SWP values (see section 4.1.1.1 for details of the SWP test). The work was tracked on NCRs 6270 and 6347.

The following concerns dealt with pulling cable in 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.

The responsible WBEP section supervisor and engineer were interviewed to gather information on the subject. A DNE evaluation was initiated on conduit overfill as a result of NCR 6609. In the disposition of this NCR, DNE discovered the cable outside diameters used by the WBEP in their conduit fill program were not auditable. Two SCRs (WBN EEB8589, 8590) were generated to document a plant-wide problem. Samples of different types of cable were sent to Singleton Labs to determine actual average cable outside diameters. The new cable outside diameters were given to the WBEP Computer Methods Branch to place in the conduit fill program. When the data was received from them

4.1.1.2 Site Specific - WBN (continued)

the project engineer was to evaluate the program for conduit overfill problems. If problems were discovered, NCRs were to be generated. There was no timeframe for completion of the project.

Concerns IN-85-300-002, IN-85-506-002, IN-86-268-003, and WI-85-100-020 all reported improper routing of cable. The PMO report on concern IN-85-506-002 was reviewed. The evaluation agreed with the report with respect to the treatment of permanent cable. The report recorded that permanent cables had specific requirements for routing spelled out in WBN-QCI/QCP-3.05. This program specified the cable routing of permanent cables.

NSRS report I-85-570-WBN was reviewed relative to IN-86-268-003. The only part of the report relevant to the concern dealt with separation of cables in cable trays. The other portion of the findings and recommendations not addressed here were covered by the evaluation of IN-86-259-006 in the Engineering Category. The evaluation agreed with the report in that there was only separation criteria for 6900-volt (V5) level cables. A walkthrough conducted by the investigator of V5 level trays verified the separation criteria was followed. The only recommendation made which was applicable to this concern was to resolve NCR W-283-P to improve control over temporary cables and loading of cable trays. Temporary cables were the problem at WBN since there was no established program for handling these cables. NCR W-283-P was written to document a problem with unidentified cables throughout the plant. The corrective action for this NCR was handled by WP NW283P-1 in the Modifications Section. The work consisted of identifying all unidentified cables. All cables not in use were pulled out or (for those covered with Vimasco) spared. Those still in use were marked with red and orange tape along their entire length and placed under the Temporary Alteration Control Form program. This workplan was field complete.

4.1.1.2 Site Specific - WBN (continued)

NSRS report I-85-362-WBN was reviewed in relation to the problem of improper routing of cable. This report had been written for concern IN-85-945-001 in Operations Subcategory 30403. The subject matter of a portion of the NSRS report was applicable to this evaluation. The report dealt with the poor housekeeping of the manholes at WBN. The evaluator entered ten manholes and removed covers from twenty others. Of the five observations made, only one applied to this subcategory. In manhole 18S, nine cables were found routed outside cable trays. Six of these cables were grouped together and had silver tape attached. Cables were noted to be partially out of cable trays in five other manholes.
A review of drawings 46W506-19, Revision 2 and 46W506-22, Revision 7 identified six of the nine cables as temporary security cables which were not supposed to be routed in cable trays. No information was found on the other three cables.

The recommendation was made to determine if all the cables routed outside cable trays were temporary cables. If any were found to be permanent cables, changes were to be made to provide appropriate support for these cables. In response to this recommendation, a memorandum from E. R. Ennis dated November 21, 1985 (T14 851121 800) was issued which stated all manholes and handholes were to be cleaned out which included identifying any cables routed outside cable trays, if temporary, or reinstalling it in the cable tray if permanent. MAI-3 and AI-2.15 (the ONP procedure on Temporary Alterations) were to be revised to include instructions identifying temporary cables.

WP M5515-1 was generated to perform all work. A review of the workplan revealed that the same procedure for identification of temporary cables was used as in WP NW283P-1. MAI-3 had been revised to include steps to identify temporary cables. The workplan was still open pending revision of AI-2.15 by Electrical Maintenance.

4.1.1.2 Site Specific - WBN (continued)

WBN Allegation Report 1-80 and two DNC Informal Memorandums (one from R. D. Anderson to the WBN Files dated May 4, 1982 and one from J. D. Selewski to the WBN Files dated January 22, 1982) were reviewed on the subject matter contained in HI-85-113-N02. The concern accused DNC of using improper cable lubricant (Yellow 77) to pull asbestos braided cables. A review of General Construction Specification G-38, Revision 0, did confirm that it had never been proper to use Yellow 77 on asbestos jacketed cables. An interview with the DNE section supervisor responsible for G-38 revealed that Yellow 77's water content would loosen the asbestos fibers and lessen the dielectric strength of cables. The report and memorandums listed above dealt with cables for the ice condenser air handling unit backdraft damper controls. The use of Yellow 77 on these cables was verified, and the cables were repulled using proper lubricant. In the report, no other cases of misuse of Yellow 77 were discovered for Class 1E cables (the repulled cables were nondivisional and did not require the presence of a QC inspector). However, an interview with a former QC inspector indicated that there was a problem pulling polyethylene jacketed cable using Yellow 77 in conduit which contained asbestos jacketed cable. The individual could give no further information such as cable number, conduit number, location, or timeframe. No further evaluation was possible because of a lack of a location for the cables in question. A review of G-38, Revision 3, dated September 27, 1982, revealed that Yellow 77 had been banned from use. However, a review of the computer program which listed all materials in storage at all TVA plant sites (Materials Management System) indicated this material was still at WBN, BLN, and BFN.

IN-85-009-001 reported pulling improperly sized cables to the 480-volt receptacles in the Additional Diesel Generator Building. In an interview with the responsible EEU engineer, it was discovered that a problem was identified when the cover was removed from one of the 480-volt receptacles in the Additional Diesel Generator Building. The cables for the receptacles were required to be screwed into a slot in the back of the cover. When the cover was removed, it was discovered that the cables were not

4.1.1.2 Site Specific - WBN (continued)

attached to the cover as required but were loose. A potential safety hazard was identified. It was determined that the receptacles were sized for number 4 - number 8 AWG wires while DNE specified a number 2 AWG wire to them. The space in the receptacle was so tight that the cables could not be terminated properly. DNE came onsite and proved it would work in the office (with plenty of room to work in). DNE concluded there was no problem. A former knowledgeable EEU engineer and knowledgeable EQC inspector were interviewed to determine what had been done to receptacles in other buildings. They acknowledged a problem had been identified and corrected in the RB and AB. The correction consisted of splicing a smaller wire to the existing one. The knowledgeable EEU engineer was also asked about pressure by his supervisor to ignore the problem because the schedule had to be met. His supervisor did say this, but the engineer ignored him and continued looking into the problem. The engineer indicated that this was an isolated instance.

A responsible Westinghouse engineer was interviewed as to the requirements for supporting NIS cables in relation to IN-85-120-001. The concern stated that the triaxial cables for the neutron flux detectors were not supported from where they exit a conduit to their terminations on the detectors. The engineer said that the cables were installed as required by Westinghouse. The cables were surrounded by a concrete well with a metal top over it to protect them from outside forces. He stated that there was no reason to protect the cable from itself. Since the area would become so radioactively hot, additional problems would occur if supports were added because crew after crew would exceed their radiation exposure limits trying to work on the detectors.

IN-85-425-004 and IN-85-581-001 dealt with inadequate cleaning of conduit before pulling cable through it. IN-85-581-001 specifically mentioned problems when pulling cable from the Intake Pumping Station to the southeast corner of the Turbine Building and for system 257 cables between the

4.1.1.2 Site Specific - WBN (continued)

Auxiliary Building elevation 737 to elevation 692 in the Control Building. Two former knowledgeable WBN EEU engineers were interviewed about a problem with rocks and water in conduit in the yard as cables were pulled through. Neither of the engineers remembered seeing this problem while cables were pulled. Both mentioned that before pulling the first cable through a conduit, it was required to be cleaned out with verification by a QC inspector. This was a requirement in WBN-QCP-3.05, "Inspection of Cable Installation." A review of the pull cards for system 257 cables revealed the names of three WBN EQC inspectors and a Modifications electrical engineer. They were all interviewed on the subject of rocks and water in the conduit as cables were pulled through them. All of them said that the conduit had been cleaned as required by WBN-QCP-3.05, and no rocks or water had been seen.

4.1.1.3 Site Specific - SQN

The concerns evaluated at SQN were divided into five areas: (1) MPT and SWP, (2) MBR, (3) 480-volt receptacles, (4) NIS cable, and (5) cable routing. Except in those cases where there were individual concerns in an area, the concerns were not evaluated on a case-by-case basis. Instead, the issue in the area was evaluated.

1. The evaluation at SQN in the area of SWP and MPT consisted of reviewing DNE responses to NSRS report I-85-06-WBN, conducting interviews with three cognizant DNE engineers, reviewing two SQN GCTF reports,and conducting an interview with a responsible Modifications engineer on present cable practices.

   NSRS Report I-85-06-WBN was reviewed to determine and evaluate the findings of the report. The report determined that the established program (applicable to SQN) was inadequate to accomplish cable pulling activities, and improper installation of cable could potentially invalidate the environmental qualification of installed cable. Two problem

4.1.1.3 Site Specific - SQN (continued)

areas with MPT and SWP were identified. They consisted of the fact that TVA did not include SWP calculations in their cable pull procedure and the way TVA defined their method of calculating MPT on multi-cable pulls.

DNE was actively evaluating SWP since the industry considered SWP as the limiting factor. There was an initial response in a memorandum from R. W. Cantrell to C. C. Mason (B43 851203 915) in which no problems were foreseen. The memorandum was rejected, and a cable SWP test was conducted at TVA's Chattanooga Central Lab (see section 4.1.1.1 for details of test conduct and results). The intent of the test was to determine SWP limits using a test setup developed through a study of WBN's 81 worst-case conduits. SWP limits were determined to be between 600 and 1500 lb/ft. The test results were generic to all sites.

Informal interviews were conducted with three DNE engineers concerning steps taken by SQN's engineering project to determine the adequacy of installed cables at SQN. A selection of sixteen worst-case conduits was made by a designer who had been involved with the design of most of the conduits in the Auxiliary Building.

The procedure used was SMI-0-317-32 titled "Walkdown Procedure for Identifying Sidewall Pressure Violations in Conduits with Multiple Bends in the Auxiliary Building." The conduit configurations were tabulated, isometric sketches were drawn, and cable pull cards were obtained for SWP calculations. These calculations were to be compared to the values obtained in the SWP test when the prescribed guidelines of G-38 were exceeded. The final report was not yet available for review.

4.1.1.3 Site Specific - SQN (continued)

The GCTF report entitled "Overtensioning and Minimum Bend Radius Violations of Cables Due to Improper Cable Installation Methods" agreed with NSRS report I-85-06-WBN in that cables were potentially damaged in the installation process. It also agreed that G-38 needed to be revised to incorporate resolutions to the discrepancies in the cable program discovered in the evaluation process of I-85-06-WBN and to develop a sampling program to justify the as-installed conditions of installed cables. The evaluation agreed with the report.

The GCTF report entitled "Overfill of Cable Trays and Conduits" revealed that there were no QA records kept on the total cross sectional area fill of cables in conduit. SCR SQNEEB8529 was generated to document conduit overfill of 55 conduits. The SCR was dispositioned use-as-is. The reason given for this was that exceeding conduit fill did not constitute a failure - it was a violation of values given to prevent damage to cable during installation. Tests and inspections were performed on the cables in question, and no damage was revealed. Therefore, the SCR was closed out on January 28, 1986.

However, in the time since then, it was discovered that the cable outside diameters used in the cable fill program were not auditable (see section 4.1.1.2 of the SWP discussion for more detail). The new values were in the process of being added to the conduit fill program to determine if there were any problem conduits. NCRs were to be written on any conduits where SWP values may have been exceeded.

4.1.1.3 Site Specific - SQN (continued)

A discussion was conducted with a responsible Modifications engineer concerning past and present methods for monitoring MPT during cable pulls. MPT had been monitored as at WBN. Mechanically assisted pulls had always had a requirement for MPT monitoring. It was not until 1983 that essentially all pulls were required to be monitored. SWP calculations were not incorporated until 1985. The majority of cable pulled at SQN was pulled under the old requirements. M&AI-4 was reviewed to verify the requirements of G-38 were present. There were requirements for the use of break ropes and SWP calculations. However, non-Class 1E cables were not monitored for SWP or MPT.

2. Three concerns were evaluated for minimum bend radius problems. One of these concerns (JLH-86-002) was a SQN specific concern. This concern specified violations of MBR for Conax connectors. An interview was conducted with the SQN QA supervisor to determine what actions had been initiated as a result of the concern. The supervisor stated that a survey had been conducted as a result. SQ-CAR-86-02-005 had been generated on February 10, 1986 because of the discrepancies found.

   A review of the report gave the discrepancy description as follows:

   "Contrary to the requirements of M&AI-19 and the Conax Vendor Manual IPS-725, not all Conax connectors were installed with wire bend radii within allowable limits. In addition, M&AI-19 is not consistent with the vendor manual revision referenced in the EQ binder. Adherence to these requirements is necessary to maintain equipment environmental qualification."

4.1.1.3 Site Specific - SQN (continued)

The survey conducted due to JLH-86-002 had revealed three problem areas:

1. Two valves were found to have excessive MBR during maintenance activities. These valves had been installed on WP 11077 R1. A review of workplans used to install the Conax connectors revealed that three of them had been field complete before M&AI-19 (the ONP procedure to install Conax connectors) was written. Another workplan was found to have been written and approved before M&AI-19 was issued but was not field complete until after M&AI-19 was issued. No change to this workplan had been initiated to incorporate requirements for wire bend radii.

2. Two work releases had been initiated to sample valves for wire bend radii problems. Five of nine in unit 1 and nine of nine in unit 2 were unacceptable.

3. M&AI-19 had a different torquing sequence with a different final torque value than the Conax Vendor Manual (IPS-725 Revision G) referenced in the EQ binder.

In response to item 3, a memorandum from B.M. Patterson to R.A. Sessoms dated February 7, 1986 (SO1 860207 956) was initiated asking if the torquing sequence found in M&AI-19 was equivalent to the Revision G of IPS-725 found in the EQ binder. The response (B70 860304 005) dated March 4, 1986 stated that the two sequences were equivalent based on information from Conax Buffalo Corporation (B70 860226 100). The vendor stated that the method in M&AI-19 was a longer process for torquing than Revision G.

4.1.1.3 Site Specific - SQN (continued)

A memorandum from R. W. Olson to D. C. Craven dated March 26, 1986 (SQ2 860326 862) gave the corrective action for the CAR. An inspection of all field terminations of Conax connectors was the result. Those connectors whose MBR values had been exceeded were to be reworked.

SMIs 1-363-1 and 2-363-1 had been written to provide walkdown procedures for reinspection of the connectors (these SMIs were initiated by work releases B122261 and B106248). The reinspection was complete. SMIs 1-363-2 and 2-363-2 were initiated for all rework of Conax connectors. The ECTG group for other sites which was evaluating the classical NSRS items interviewed SQN Modifications personnel and discovered all rework was complete. The data packages had been sent to QA for review. They had been rejected because there was no Nuclear Performance Reliability Data System reporting. The packages were still in Modifications.

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 (discussed in sections 4.1.1.1 and 4.1.1.2). An informal interview with a cognizant DNE engineer revealed that walkdowns had been requested as a result of WBN NCRs (see section 4.1.1.2). However, these walkdowns had not yet been initiated. He said that no work was in progress and no work was scheduled even though this was a restart item.

A memorandum from W. S. Raughley dated September 2, 1986 (B43 860903 904), was reviewed. It gave direction to each project of the steps necessary to resolve MBR concerns for Class 1E cables (the specifics of this memorandum were found in section 4.1.1.1).

3. A walkdown was conducted in the Additional Diesel Generator Building in the area dealing with 480-volt receptacles. The evaluator was assisted by two electricians. During the walkdown, the electricians removed covers from two 480-volt receptacles. They were box 4097 (480-volt receptacle - DSL Auxiliary Board C2-S) and box 4100 (480-volt receptacle - DSL

4.1.1.3 Site Specific - SQN (continued)

Auxiliary Board C2-S). Both of the receptacles were Crouse-Hinds model number AEQ 01648. Both of the receptacles were wired with three conductor number 2 AWG wire. Discussions with the Procurement Section Supervisor (DNE) revealed catalog information for the receptacles. Crouse-Hinds catalog number 4700 (catalog page 1P-27) for model number AEQ 01648 stated the cable diameter range for the receptacle was from 0.64 inches to 1.37 inches. A discussion with an Electrical Maintenance engineer revealed the diameter of one number 2 AWG wire is 0.476 inches. By using TVA Cable Splice and Termination drawing number SD-E12.5.8, Revision 3, the evaluator determined that three conductor type WMT wire now being used had a minimum diameter of 1.02 inches and a maximum diameter of 1.30 inches. Therefore, the receptacles were sized to use three conductor number 2 AWG wire and were acceptable. |R3

4. The SQN GCTF report titled "Triaxial Cable Not Supported" was reviewed for adequacy of investigation. The report was written to answer a WBN concern (IN-85-120-001) which related to unsupported NIS cables. The system was found to be of a different design at SQN. The SQN orientation did not have the large distances found between the raceway and the detectors. The evaluation agreed with the report and found the concern not factual.

5. There were concerns which were evaluated on the subject of improper routing of cable. The problem at WBN had been found to be with unidentified temporary cables. NCR W-283-P was reviewed for applicability to SQN (this was the NCR which identified the problem with temporary cables). The NCR was not generic to SQN because the plant was no longer under construction. The cables at WBN were found to be either temporary

4.1.1.3 Site Specific - SQN (continued)

DNC cables or temporary security cables. Informal interviews were conducted with two Electrical Modifications engineers on the removal of temporary cables. According to them, the temporary security cables were removed by workplan because they appeared on design drawings which were then voided. One of the engineers had also worked for DNC and was asked if there had been a procedure for the installation and removal of temporary cables. He stated that there had been no procedure and that the only rule had been not to run temporary cables in a permanent raceway. Attention was then focused on permanent cables.

Informal interviews were conducted with two site DNE engineers on the subject of cables running outside cable trays. Both stated they had seen cables running outside of cable trays but neither of them thought it was a widespread problem or that there was any problem with running cable outside of cable trays.

In a walk-through of 480-volt Shutdown Board Room 2A2, an example of a cable routed outside a cable tray was discovered. The cable tray identified was JAN. SQN Inspection Instruction Number 28, Revision 4, Standard Operating Procedure Number 104, Revision 1, Construction Procedure E-6, Revision 0 through 7, and M&AI-4, Revision 0 through 8 were reviewed for any references to keeping cables in cable trays. M&AI-4, Revision 8, was the only document which specified this (step 6.1.2.1 [b]). This procedure was approved December 31, 1985. Two Modifications electrical engineers were interviewed on the subject of cables routed outside cable trays. They stated that there was no guarantee that the craft kept cables in cable trays before Revision 8 of M&AI-4. They said that the craft had requested conduit jumpers when trays were blocked but again there was no guarantee that the craft approached them every time they encountered a problem. In that case,

4.1.1.3 Site Specific - SQN (continued)

the routing would be up to the discretion of the QC inspector (if it was a QA cable). Both of the engineers realized that there were cables outside cable trays but the interpretation (as with the two onsite DNE engineers) was that G-38 allowed them to do this.

General Construction Specification G-38, Revision 8 was reviewed for information on the subject of cable routing. The only applicable statement was that starting with BLN, cable trays were not to be filled above the side rails except at intersections and where cables enter and exit the tray. An interview with the former knowledgeable DNE engineer for G-38 was conducted. He said the intent of that statement was to allow BFN, WBN, and SQN to build up the side rails of the trays - not to run cables outside of trays. There was a discrepancy between the site and DNE interpretation of the acceptability of running cables outside cable trays.

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.

4.1.1.4 Site Specific - BFN

The concerns evaluated at BFN were divided into four areas: (1) MPT and SWP, (2) MBR, (3) 480-volt receptacles, and (4) cable routing. Since the concerns were determined generic to BFN through the WBN evaluation, they were not evaluated on a case-by-case basis. Instead, the issues in each area were evaluated.

1. The evaluation in the area of SWP and MPT consisted of reviewing DNE responses to NSRS report I-85-06-WBN, site-generated SCRs, applicable memorandums, and interviews with two responsible Modifications and three responsible

4.1.1.4 Site Specific - BFN (continued)

DNE engineering and management personnel. NSRS report I-85-06-WBN was reviewed and, as stated in section 4.1.1.1, two problem areas were identified. They consisted of (1) the 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 BFN, the calculation of sidewall pressure was not addressed in Construction Specification G-4 and G-3 did not limit the number of degrees of bend in conduit runs between pull points. The following was stated in SCR BFNEEB8631, Revision 0, dated June 27, 1986:

> "Sufficient installation guidance was not given to ensure that the sidewall pressures of cables were not exceeded, making existing cable installations suspect and creating uncertainty concerning the ability of the cables involved to perform their safety function."

The cable outside diameters used in the conduit fill program were not auditable (see section 4.1.1.2 on the SWP discussion for more detail). The new values were in the process of being added to the conduit fill program to determine if there were any problem conduits. NCRs were to be written on any conduits where SWP values may have been exceeded.

Informal interviews were conducted with two DNE supervisors concerning program changes. Both indicated BFN was now using the current revision of Construction Specification G-38 to pull cable. All safety-related cable pulls in conduits were now required to use MPT values provided by DNE.

4.1.1.4 Site Specific - BFN (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 power plants.

W. S. Raughley's memorandum dated June 23, 1986 (B43 860626 931), provided guidance for each project to determine the adequacy of 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 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 BFN. DNE was involved in contract negotiations with a third party engineering company to evaluate the sampling program previously conducted at WBN. Final resolution of the SWP issue was to depend on DNE's ongoing evaluation and final report.

2. Three concerns were evaluated at BFN which dealt with 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 (discussed in sections 4.1.1.1 and 4.1.1.2). As a result, SCR BFNEEB8634 was written since Construction Specification G-4 did not provide installation guidance to ensure that cables were installed without violating cable manufacturer's limitations on cable bend radius.

4.1.1.4 Site Specific - BFN (continued)

Discussions with three DNE engineering and management personnel revealed that no onsite work was in progress and no work was scheduled even though this was a restart item. A memorandum was reviewed from W. S. Raughley, dated September 2, 1986 (B43 860903 904), which provided directions to each project for the steps necessary to resolve MBR concerns for Class 1E cables.

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. Data was collected on five receptacles found at the following locations:

Turbine Building

T-12/H-Line/Elevation 586

T-12/F-Line/Elevation 586

T- 6/C-Line/Elevation 617

Control Building

C1-18/ Elevation 593

C1-12/ Elevation 593

All were Crouse Hinds model number AEQ 01648, 3 phase, 60 amp and 3W-4 pole receptacles. The wire leading into each receptacle was identified to be wire size number 4 AWG (600-volt-TVA-CP6-1967). Review of Crouse Hinds catalog page 1P-27 revealed receptacle style number AEQ 01648 was designed to accept a cable diameter between 0.64 and 1.37 inches. Review of Electrical Design Standard DS-E12.1.13 revealed the following outside diameters for number 4 AWG 3/c 600-volt cable:

MFR	Cable O.D. (Inches)
Okonite	1.055
A.I.W.	0.881
P.W.C.	1.118

4.1.1.4 Site Specific - BFN (continued)

All were within the above cable diameter range. Also, the receptacles were observed to have tight electrical connections with no wire slippage.

4. There were concerns which were evaluated on the subject of improper routing of cable.

Review of BFN Modifications and Additions Instruction MAI-13 revealed the following instruction concerning cable routing:

"6.2.3 Installation and Support Cables

A. Cable pull cards or cable schedules specify the route a cable is required to take between points of termination. Measures shall be taken to ensure that this route is followed in installing the cable. If instances occur where cables cannot be installed exactly as indicated on the cable pull card or cable schedule, DNE shall be notified for disposition. Alternate routes shall not be selected by NU CON/ONP without approval of DNE."

Discussions with knowledgeable DNE engineers revealed a recent incident of cables being routed outside of cable trays documented by Discrepancy Report BF-DR-86-0120. Review of this report revealed the following incident:

"While performing cable pull and firestop inspection on workplan 2192-84, there were several cables found not in the cable trays. (Example: Cable tray KAY Rx Building elev. 619, unit 2, R13 S-line) Cables were stretched tight in the elbow and did not physically lay in the tray."

J. P. Stapleton's memorandum to E. P. Schlinger dated May 30, 1986 reported the following in regards to the above mentioned cable tray:

4.1.1.4 Site Specific - BFN (continued)

> "DNE personnel inspected cable outside the siderail of tray KAY-ESI where the tray interfaces with KAZ-ESI (qr 13, elevation 593 RB). The cables were outside the tray for approximately 18 inches but remained near the siderail. The cables were reported not to sag, were coated with flamemastic and the installation was judged adequate."

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 manholes. Problems were found with cable routed outside of cable trays. CATDs had been generated by the Operations group to correct the problems noted.

4.1.1.5 Site Specific - BLN

The concerns evaluated at BLN were divided into four areas: (1) MPT and SWP, (2) MBR, (3) 480-volt receptacles, and (4) cable routing. Since the concerns were determined to be generic to BLN through the WBN evaluation, they were not evaluated on a case-by-case basis. Instead, the issues in each area were evaluated.

1. Note: BNP QCP-10.35-8-5 was a site specific concern which dealt with cables which were pulled too tight and too loose in the Turbine Building. This concern was grouped under the MPT and SWP issue. The concern was not factual in the report written on the subject.

The evaluation in the area of SWP and MPT consisted of reviewing DNE responses to NSRS report I-85-06-WBN, applicable memorandums, PIRs and NCRs, and a stop work action report.

NSRS report I-85-06-WBN was reviewed and, as stated in section 4.1.1.1, two problem areas were identified. They consisted of (1) the