UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

Report Nos.: 50-390/93-31 and 50-391/93-31

Licensee: Tennessee Valley Authority
6N 38A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Docket Nos.: 50-390 and 50-391 License Nos.: CPPR-91 and CPPR-92

Facility Name: Watts Bar 1 and 2

Inspection Conducted: April 5-9, 1993

Inspector: for J. F. Lara, Resident Inspector Construction — Date Signed: 5/3/93

Reviewed by: for G. A. Walton, Senior Resident Inspector Construction — Date Signed: 5/3/93

Approved by: P. E. Fredrickson, Section Chief, Division of Reactor Projects — Date Signed: 5/3/93

SUMMARY

Scope:

This special inspection was performed to review and assess the licensee's implementation of the Master Fuse List (MFL) Special Program (SP). The inspection focused on the program objectives as described in the TVA Nuclear Performance Plan, Volume 4.

Results:

The licensee addressed the deficiencies and concerns identified by the NRC during the previous inspection of the MFL SP (Inspection Report 390,391/92-27). The licensee's Quality Assurance organization performed additional overviews of the MFL SP and self-assessments to address the NRC concern of inadequate overview as part of the Independent Verification Plan. The NRC concluded that TVA had adequately implemented the MFL SP as described in the NPP, Volume 4, Revision 1, as approved by the NRC. This Special Program is closed.

One unresolved item was identified regarding ungrounded 120 Vac control power circuits with no ground detection circuitry (paragraph 9). This item does not affect the conclusion that the MFL SP was adequately implemented.

## REPORT DETAILS

1. Persons Contacted

Licensee Employees

*T. Arney, Senior Quality Project Manager
*J. Barnhart, System Engineer, United Engineers
*J. Ballowe, Startup Support Manager
*R. Bellamy, Startup Manager
*R. Bradley, Startup Electrical I&C
*M. Brickey, Lead Electrical Engineer
*R. Brown, Licensing Engineer
*J. Chardos, Manager of Projects
*J. Christensen, Site Quality Manager
*J. Collins, Project Engineer
*S. Crowe, Quality Assurance Manager
*W. Elliott, Engineering Manager, Nuclear Engineering
*N. Kazanas, Vice President Completion Assurance
R. Keller, Project Manager
*D. Koehl, Technical Support Manager
*R. McCollom, Maintenance Program Manager
*A. McLemore, Modifications Engineering Manager
*R. Milhiser, ESI Project Director
*D. Moody, Plant Manager
*W. Museler, Site Vice President
*P. Pace, Compliance Licensing Supervisor
G. Pannell, Site Licensing Manager
*V. Patuzzi, QA Specialist
*S. Tanner, Support Services Manager
*M. Walsh, Ebasco Engineering

Other licensee employees contacted included engineers, technicians, nuclear power supervisors, and construction supervisors.

NRC Personnel

*G. Walton, Senior Resident Inspector, WBN
*P. Humphrey, Resident Inspector, WBN
*N. Merriweather, Reactor Inspector, RII
*C. Smith, Reactor Inspector, RII
*J. Lara, Resident Inspector, WBN

*Denotes those individuals who attended the exit interview.

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2. Introduction: Master Fuse List Special Program

The purpose of this inspection was to determine whether Tennessee Valley Authority's implementation of the Master Fuse List Special Program was adequate and complete. The MFL SP is described in TVA's Nuclear Performance Plan, Volume 4. The SP was developed to establish a verified design output document in the form of a MFL to provide controls for the application and replacement of Class 1E fuses and to resolve existing design deficiencies.

As stated in the NPP, the MFL SP identified comprehensive corrective actions and recurrence controls to accomplish the following objectives:

- Formulate a Master Fuse List of Class 1E fuses;
- Resolve the misapplication of Bussmann actuator devices as fuses; and
- Resolve deficiencies involving electrical penetration assemblies (EPA) overcurrent protection fuses.

The NRC reviewed the implementation of this SP in August 1992 and documented the results of the inspection in IR 390, 391/92-27. The inspection was performed after TVA concluded that the program was greater than 75 percent complete. The results of the NRC inspection indicated that TVA had failed to adequately resolve the SP technical issues and failed to ensure that the IVP activities thoroughly review and assess the adequacy of the implemented SP corrective actions. One violation and five unresolved items were identified during the inspection. The NRC concluded that the first objective of the MFL SP had not been achieved, the second objective of the MFL SP had been achieved, and could not conclude that the third objective had been achieved. Two of the unresolved items were closed in IR 390,391/92-40.

A TVA letter dated April 2, 1993, notified the NRC that the MFL SP was completed as defined in the Watts Bar Unit 1 Nuclear Performance Plan, Volume 4, Revision 1. In accordance with the NPP, a MFL SP closure report was developed and included in the closure package provided to the NRC prior to the beginning of the inspection. The approach to this inspection was to review the corrective actions taken to resolve the violation, unresolved items, and overall concerns regarding the implementation of the SP. In addition, an additional inspection element included review of TVA's basis for concluding that the MFL SP implementation was complete.

3. MFL Special Program Objective Review (TI 2512-37)

a. MFL SP Objective 1 - Formulate a Master Fuse List of Class 1E Fuses

As documented in IR 390, 391/92-27, the NRC concluded that this first objective of the MFL had not been achieved. This conclusion

was based on the inspection findings which indicated that the licensee had not verified the accuracy of the MFL. In order to verify the licensee's resolution of problems associated with Objective 1, the NRC identified two unresolved items pertaining to fuses installed in vendor-provided equipment and completeness of the MFL.

(1) Vendor Fuses in MFL

At the time of the August 1992 inspection (IR 390, 391/92-27), the licensee had not performed any field verifications to ensure that the as-installed fuse configurations in vendor-provided equipment matched vendor drawings. This was identified as an unresolved item pending the licensee providing additional assurance that fuses installed in vendor equipment were accurately reflected in the vendor drawings, and vendor fuses for which TVA has assumed design responsibility were included in the MFL. This item was tracked as URI 390, 391/92-27-01, Vendor Fuses in MFL. The licensee's evaluation of this URI was documented in calculation WBPEVAR9303001, Master Fuse List Design Basis, Revision 1.

The licensee identified vendor fuses contained in electrical calculations and verified that these fuses were contained in the MFL and that the vendor drawings and installed conditions were in agreement. The licensee also identified other vendor fuses which were considered important to safety. These included fuses which were relied upon for protection of specific vendor-supplied equipment or required for electrical system coordination. For fuses important to safety, the licensee verified that vendor drawings and the installed fuses were in agreement. As a result of this review, the licensee identified fuses which required inclusion in the MFL. Sixteen (16) 120 Vac vital inverter output fuses (two from each of eight inverters) were identified as being important to safety for overall electrical system coordination. These were assigned unique identifiers and incorporated into the MFL per DCN S-23213-B. The inspector reviewed the DCN and verified that the fuses were properly identified for inclusion into the MFL.

Based on the results of the licensee's actions taken to further re-evaluate the adequacy of fuses in vendor supplied equipment, the inspector concluded that unresolved item 390,391/92-27-01 was adequately evaluated and resolved.

(2) Completeness of EMS and MFL

At the time of the August 1992 inspection (IR 390, 391/92-27), the MFL was found to be inaccurate in reflecting the as-designed fuses. The review of calculations indicated

several discrepancies between calculations and the MFL. The discrepancies indicated, and the licensee acknowledged, that calculation results (i.e., analyzed fuses) had not been verified as being properly input into the EMS. This included proper flagging of Unit 2 fuses required for Unit 1. This issue was identified as an unresolved item pending TVA providing additional assurance that Class 1E fuses were accurately and completely incorporated into the MFL and that all Unit 2 fuses required for Unit 1 safe shutdown had been properly input into the EMS. This item was tracked as URI 390, 391/92-27-02, Completeness of EMS and MFL. The licensee's evaluation of this URI was documented in calculation WBPEVAR9303001, Master Fuse List Design Basis, Revision 1.

During this inspection, the inspector reviewed the following calculations to verify the adequacy of the implemented corrective actions.

- WBPEVAR8907013, Master Fuse List For Class 1E Fuses Process Description, Revision 1

- WBPEVAR8903046, Unit 2 Class 1E Cables Required for Unit 1 Operation, Revision 14

- WBN-EEB-MS-TI08-0015, Watts Bar NP Containment Penetration Protection Study, Voltage Level V4 and V5, Revision 16

- WBN-EEB-MS-TI08-0028, LV Electrical Penetration Protection Analysis, Revision 25

- WBPEVAR9303001, Master Fuse List Design Basis, Revision 0

Class 1E Fuses

To address Class 1E fuses which may not be properly included in the MFL, the licensee verified that fuses evaluated in the electrical engineering baseline calculations agreed with the fuses contained in the MFL. The 10 baseline calculations were developed as part of the DBVP CAP. Each fuse in the MFL was also encoded to identify the source baseline calculation. The licensee identified Class 1E fuses which were required to be included in the MFL but which were originally omitted. DCNs S-23213-B and S-23436-A were issued to incorporate these fuses in the MFL and to also delete fuses which were not required to be in the MFL. The corrective actions associated with the above evaluations

were completed prior to this inspection. Inspector activities performed to verify the adequacy of the corrective actions are described in paragraph 5 of this report.

Unit 2 Circuits Required For Unit 1 Safe Shutdown

To address Unit 2 fuses required for Unit 1, but which may not be properly included in the MFL, the licensee reviewed calculation WBPEVAR8903046 and verified that all Unit 2 fuses required for Unit 1 safe shutdown and operation were contained and properly coded in the EMS database. DCNs S-23213-B and S-23436-A were issued to incorporate Unit 2 fuses required for Unit 1 which were required to be included in the MFL but which were originally omitted.

As documented in IR 390, 391/92-27, the inspector had requested and received an EMS printout of Unit 2 fuses which were not flagged as "U1SS" and therefore not in the MFL. These fuses are Unit 2 fuses only which the licensee determined were not required for Unit 1. The printout included several fuses which, from the description, appeared to be required for Unit 1 operation and/or safe shutdown. The licensee evaluated these fuses, and the results of the evaluation are described below.

1) 2-FU-214-A0223/52, 480 V Shtdn Bd Rm 2A Unit Htr: This fuse was determined to not meet the criteria for the MFL fuses and therefore was not added to the MFL.

2) 2-FU-214-A026/52, 125V Vital Battery Rm III Unit Htr: This fuse was determined to be required for Unit 1 and was added to the MFL via DCN S-23436-A.

3) 2-FU-215-A024/41-A, DG 2A-A 480V Bd Rm Exh Fan: Through a review of schematic drawings, a fuse with this identification was determined not to exist and therefore was not included in the MFL.

4) 2-FU-215-B024/41-B, DG 2B-B 480V Bd Rm Exh Fan: Through a review of schematic drawings, a fuse with this identification was determined not to exist and therefore was not included in the MFL.

5) 2-FU-235-0001/F02-D, 120V AC Vit Instr Pwr BD 2-I: This fuse was determined to be within the Unit 1 boundary and was added to the MFL via DCN S-23213-B.

6) 2-FU-235-0002/F3-F, 120V AC Vit Instr Pwr Bd 2-III ALT Supply: Through a review of schematic drawings, a fuse with this identification was determined not to exist and therefore was not included in the MFL.

7) 2-FU-235-0002/F4-F, 120V AC Vit Instr Pwr Bd 2-III NOR Supply: Through a review of schematic drawings, a fuse with this identification was determined not to exist and therefore was not included in the MFL.

The inspector reviewed the licensee's bases for the above fuses and determined that they were not required for Unit 1. The inspector sampled additional Unit 2 only fuses and verified that they were not required for Unit 1 safe shutdown or operation as previously determined by the licensee. This was performed through a review of an EMS printout of those Unit 2 only fuses identified as not required for Unit 1. The fuses evaluated are listed below.

WBN-2-FU-212-A016/1-A, /2-A
WBN-2-FU-212-A018/33-A
WBN-2-FU-212-A026/2-A
WBN-2-FU-212-A028/23-A
WBN-2-FU-214-B023/52
WBN-2-FU-214-B025/52
WBN-2-FU-235-0001/F02-D
WBN-2-FU-238-001/F102
WBN-2-FU-275-R072/F4 through F7

The licensee provided a basis why the above Unit 2 fuses were not required for Unit 1 safe shutdown and therefore not included in the MFL. The inspector reviewed the basis and concluded that these fues were also not required for Unit 1.

The inspector also reviewed the adequacy of procedure EAI-3.22, Equipment Management System, which provides the design control instructions for ensuring that Unit 2 fuses are properly coded in the EMS. The proper coding of Unit 2 fuses is essential to ensure that they are included in the MFL. This procedure was used as an example of inadequate design controls during IR 390, 391/92-27. The adequacy of the procedure is discussed in paragraph 4 (example 4 of VIO 390/92-27-06) of this report. The inspector concluded that unresolved item 390, 391/92-27-02 was adequately evaluated and resolved. Further inspector activities performed to verify the adequacy of the corrective actions are described in paragraph 5 of this report.

In summary, from review of the 10 baseline electrical calculations, the licensee identified approximately 153 fuse deficiencies which required changes to the MFL. This represents approximately a 2.24 percent deficiency error in relation to the total number of fuses reviewed. Further inspector activities performed to verify the adequacy of the corrective actions are described in paragraph 5 of this report. The inspector concluded that objective 1 of the MFL SP had been achieved.

b. MFL SP Objective 3 - Resolve Deficiencies Involving Electrical Penetration Assemblies (EPA) Overcurrent Protection Fuses

A concern was documented in IR 390, 391/92-27 regarding the licensee's established design criteria for overcurrent protection of electrical penetration assemblies. This item was tracked as an unresolved item, URI 390/92-27-03, Adequacy of EPA Design Criteria, pending further NRC review of the criteria. Specifically, the concern pertained to the fact that the licensee was not considering the EPA conductor continuous current rating during the design of electrical penetration overcurrent protection. In addition, licensee procedures also provided conflicting information regarding the established design criteria. This is further discussed as part of VIO 390/92-27-06 (see paragraph 4).

The inspector reviewed the licensee's evaluation of the URI with respect to the adequacy of the existing design criteria established and documented in WB-DC-30-5, Power, Control and Signal Cables for Use in Category I Structures, Revision 7. The licensee had determined that the present design criteria were adequate to meet the NRC regulatory positions described in RG 1.63, Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants, Revision 2. The licensee's position was that the EPA assemblies are designed to withstand the maximum short-circuit current versus time conditions (thereby protecting thermal limits). The inspector verified in IR 390, 391/92-27 that the protective devices provided redundant protection against exceeding the penetration assembly thermal limits.

The licensee does not consider the conductor continuous current rating during the design phase of overcurrent protection since the primary emphasis is the penetration thermal limits which could be exceeded due to short-circuit currents. The protection of conductors for their rated ampacity is addressed through conductor ampacity evaluations. The criteria are based on criteria in design standard DS-E12.6.3, Auxiliary and Control Power Cable Sizing, Up to 15,000 Volts, and in accordance with the National Electric Code requirements for providing overcurrent protection. Further internal NRC review determined that the present design criteria meet the NRC requirements of providing redundant overcurrent protective devices. Therefore, the inspector concluded that the concern identified in URI 390/92-27-03 was adequately addressed and resolved.

IR 390, 391/92-27 also documented the concern that the electrical penetration protection calculations did not follow the instructions specified in EEB-TI-08. The licensee considers these instructions to be guidance. The inspector determined that these instruction are not mandatory provided the design otherwise meets appropriate requirements in applicable design criteria. Since, as

stated in previous paragraphs, the present established design criteria was determined to be acceptable and the inspection results indicate compliance to the criteria, this item is considered acceptable.

Paragraph 3.a.(2) of this report describes the licensee's corrective actions taken to verify the accuracy and completeness of the MFL. During review of the baseline calculations, the licensee identified five (5) electrical penetration circuits which did not have adequate redundant protection. These deficiencies were documented in PER WBPER930036. The inspector performed independent field inspections of corrective actions associated with this PER. Inspector activities performed to determine the adequacy of the corrective actions are described in paragraph 5 of this report. The inspector concluded that objective 3 of the MFL SP had been achieved.

Within the areas inspected, no violations or deviations were identified.

4. Design Controls (TI 2512-37)

As documented in IR 390, 391/92-27, the NRC identified deficiencies associated with established design controls in that control measures failed to ensure that design activities were performed in accordance with regulatory requirements. VIO 390/92-27-06, Design Control Deficiencies, was issued and documented five examples of design control deficiencies. The licensee responded to the Notice of Violation via letter dated October 28, 1992. The inspector reviewed the licensee's corrective actions associated with this violation.

Example No. 1

Electrical system calculation WBN-EEB-MS-TI07-0005 documented the adequacy of KWN 10 A fuses for use in low voltage switchgear close and trip circuits. DCN M-12564-A was issued to implement the replacement of existing KWN 6 A fuses with KWN 10 A fuses. Design Change Notice M-12564-A replaced two (2) of the four (4), 6 A fuses with 10 A fuses for the control circuits for each fan motor 1-MTR-30-92/1-B and 1-MTR-30-80/1-B. The remaining two (2) fuses for each of the motors (a total of four) were not included in the DCN and remained as 6 Amp fuses. Therefore, the design change reflected in DCN M-12564-A was deficient in that it failed to incorporate all the required fuse replacements as specified in the calculation.

The incomplete design output (DCN M-12564-A) was determined to have occurred due to failure to effectively implement the requirements of EAI-3.05, Design Change Notice, which requires design verification and also inadequate management planning associated with the calculation control center site relocation. The relocation resulted in data entry delays to the CCRIS. The licensee also initiated an incident investigation, II-W-92-18, which identified eight (8) additional fuses

in calculation WBN-EEB-MS-TI07-0005 which were not incorporated into the design change notice. These are as follows:

| | |
|---|---|
| 2-FU-211-A003/2-A | 2-FU-211-B003/2-B |
| 2-FU-211-A004/2-A | 2-FU-211-B004/2-B |
| 2-FU-211-A005/2-A | 2-FU-211-B005/2-B |
| 2-FU-211-A006/2-A | 2-FU-211-B006/2N-B |

DCN F-20458-A was issued to correct the first six fuses and DCN F-20810-A was issued to correct the last two fuses. WPs D-12564-06 and D-12564-11 implemented the required changes. The inspector reviewed the above DCNs and completed workplans to verify that the fuses were properly identified and replaced. The II results also indicated other examples where DCNs M-12564-A, M-17941-A and M-18173-A did not contain all of the required fuse changes resulting from calculation WBN-EEB-MS-TI07-0005. An additional 27 deficiencies associated with this calculation and the referenced DCNs were identified. These were corrected by issuance of DCN F-21631-A and implementation of WPs D-12564-07, -08, -09, and -10. The inspector reviewed the completed WP documentation and did not identify any deficiencies.

During the licensee's corrective actions for this example of the violation, it was identified that two undersized fuses (two of the eight discussed above) were in the scheme that protects the normal and auxiliary close circuits for the 6900 Volt shutdown board 2B-B emergency power feeder circuit breaker. This deficiency was reported to the NRC pursuant to 10 CFR 50.55(e) on November 27, 1992 (CDR 50-390,391/92-10, Design Control). These undersized fuses were used in a DG circuit breaker scheme. The corrective actions associated with this deficiency were reviewed and the results of the review documented in IR 390,391/93-01. This deficiency was corrected by incorporating the required change into DCN F-20458-A. As stated in the previous paragraph, completed workplans associated with this DCN were reviewed by the inspector and no deficiencies were identified.

The licensee also reviewed the 10 electrical baseline calculations related to fuse protection to verify that design changes resulting from calculation results were properly identified in DCNs. Other design deficiencies were corrected by issuance of DCNs and these corrective actions will be implemented prior to system turnover to Operations. The inspector concluded that the licensee had adequately implemented the corrective actions for example 1 of violation 390/92-27-06 and CDR 390/92-10. The corrective actions were performed as part of the licensee's effort of verifying the accuracy of the MFL as discussed in paragraph 3.a.

Example No. 2

Electrical system calculation WBN-EEB-MS-TI08-0008 evaluated the adequacy of installed fuses and identified fuses for replacement to provide adequate coordination and protection. Design Change Notice M-

12212-A was issued but failed to identify fuse 0-FU-215-C2/FS1-S for replacement from A4J40 to A4J60 as required by calculation results.

This violation example was determined to be a communication error between the calculation and design change notice preparers. The licensee issued DCN F-20303-A to install the proper fuse model specified in the calculation. The fuse will be replaced prior to system 215 turnover to Operations. As indicated in the above corrective actions for example 1 of the violation, the licensee has reviewed the 10 electrical baseline calculations to verify that design changes resulting from calculation results were properly identified in DCNs. The inspector concluded that the licensee had adequately implemented the corrective actions for example 2 of violation 390/92-27-06. The corrective actions were performed as part of the licensee's effort of verifying the accuracy of the MFL as discussed in paragraph 3.a.

Example No. 3

Calculation WBN-EEB-MS-TI08-0028, LV Electrical Penetration Protection Analysis, Revision 17, analyzed the protection of electrical penetration assemblies based on fuse time-current characteristic curves which were not traceable to their source. In addition, the evaluation used to justify the acceptability of these curves was determined to be deficient in that it used a 50 percent tolerance criteria with no technical basis for such criteria and it only evaluated the fuse time-current characteristics for 10 seconds and not the full range of 1000 seconds.

The licensee determined that the analysis did not meet the requirements specified in NEP-3.1, Calculations. The time-current curves were not drawn concisely and did not have support documentation to verify their accuracy as required by NEP-3.1. The licensee has revised the applicable fuse time-current curves and verified adequate source document references, legibility of curves and adequate technical justifications. The inspector reviewed the calculation and verified that this violation example was adequately addressed. The licensee also reviewed the 10 electrical baseline calculations and verified that calculations which contain fuse and circuit breaker time-current characteristic curves were complete and adequate based on source document references, legibility of curves and adequate technical justifications. The inspector concluded that the licensee had adequately implemented the corrective actions for example 3 of violation 390/92-27-06. The corrective actions were performed as part of the licensee's effort of verifying the accuracy of the MFL as discussed in paragraph 3.a.

Example No. 4

Procedure EAI-3.22, Equipment Management System, Revision 3, which provided the design control measures to ensure that fuses were properly input into the EMS, did not require that Unit 2 fuses required for Unit 1 safe operation or safe shutdown be flagged as such to ensure that the MFL design output drawings were accurate and complete.

The above procedure was revised (Revision 4) to provide requirements that Unit 2 fuses required for Unit 1 be properly flagged in the EMS database. Examples had previously been identified where fuses were not properly input into the EMS due to personnel error. During this inspection, the inspector reviewed the EMS procedure EAI-3.22, Revision 5, and concluded that the revised guidance was not sufficient in that the database had subsequently been revised to include a new data entry field for Unit 2 fuses. Whereas before the fuses were denoted with a "U1SS" entry in the REMARKS field, the new data field no longer requires the "U1SS" entry. The procedure, EAI-3.22, was revised to discuss the new data field but it did not revise the drawing change authorization (Appendix J, EMS Fuse List DCA) to identify the new field. Appendix J provides the change authorization for the EMS as part of the established design control process. Appendix J of this procedure was revised (Revision 6) prior to the end of the inspection and was determined to be acceptable. As discussed in paragraph 3.a, the licensee has reviewed electrical baseline calculations to ensure that Unit 2 equipment (including fuses) required for Unit 1 were identified and included in the EMS. The inspector concluded that the licensee had adequately implemented the corrective actions for example 4 of violation 390/92-27-06.

Example No. 5

Procedures WB-DC-30-5, Power, Control, and Signal Cables for Use in Category I Structures, Revision 6; and WB-DC-40-66, Penetration Assemblies and Seals For Category I Structures, Revision 0, specified design criteria for containment penetration protection but contained different design requirements for electrical penetration assembly protection. Furthermore, WB-DC-40-66 was not referenced in any of the applicable penetration protection calculations.

The licensee has revised WB-DC-40-66 to remove the discrepancy between it and WB-DC-30-5. WB-DC-30-5 presently contains the appropriate design criteria requirements. The inspector concluded that the licensee had adequately implemented the corrective actions for example 5 of violation 390/92-27-06.

Within the areas inspected, no violations or deviations were identified

5. Verification of Corrective Actions (TI 2512-37)

The adequacy of the licensee's corrective actions was evaluated through verification that the actions were adequately implemented. This was performed through verification that analyzed fuses in the selected calculations were properly reflected in the MFL. In addition, the inspector performed field inspections of completed workplan activities to verify adequate implementation and accurate drawings.

The inspector reviewed 165 circuits listed in calculation WBN-EEB-MS-TI08-0028, LV Electrical Penetration Protection Analysis, Revision 25, Attachment 3 (pages 47 - 59). Attachment 3 of the calculation

identifies the electrical penetration circuits by the containment outboard cable identification and the associated fuses. The fuses associated with these circuits were verified to be accurately reflected in the MFL or in outstanding design change documents. To determine the accuracy of the Attachment 3 cable listings, the inspector inspected the electrical containment penetrations (outboard end) listed below to identify a sample of field routed cables.

| Penetration | Cable ID. | Penetration | Cable ID. |
|---|---|---|---|
| 8A | 1-4V-67-712-A | 44A | 1-3V-30-1345-A |
| 8A | 1-4V-67-3210-A | 52B | 1-3V-43-9588-B |
| 8A | 1-4V-67-3096-A | 52B | 1-3V-43-9570-B |
| 35 | 1-4PL-30-454 | 52B | 1-3V-67-802-B |
| 44A | 1-3V-63-2734-A | 52B | 1-3V-74-2152-B |
| 44A | 1-3V-62-4437-A | 52B | 1-3V-43-9561-B |

The above cables associated with each penetration were verified to be accurately identified in the calculation Attachment 3 or applicable outstanding DCNs. At the inspector's request, the licensee was able to retrieve the pull slips for the above cables which documented cable installations which terminated at the above penetrations. The licensee also maintains Conax drawings of each containment penetration including the associated field cables for both the outboard and inboard sides of the penetration. These drawings are maintained and used for design purposes and as design input for the electrical containment penetration calculations. The above cables were also compared against the cables listed in the associated drawings. The drawings listed below were reviewed.

| Penetration | Conax Wire Termination Drawings |
|---|---|
| 8 | WL7429-10001-02-1-8, R904 |
| 35 | WL7429-10002-02-35-1, R903 |
| 44 | WL7429-10002-05-44-1, R911 |
| 52 | WL7429-10001-05-52-1, R910 |

The cables were verified to be accurately identified in the above drawings or, where applicable, had drawing change authorizations posted against the drawings. No deficiencies were identified during this review.

As stated in paragraph 3.b of this report, during the licensee's review of the electrical baseline calculations, five (5) electrical penetration circuits were identified which did not have adequate redundant protection. These deficiencies were documented in PER WBPER930036. The protection provided for the following five circuits were identified as being deficient:

1V66A 1V71A 1V76B 1V96B 1RM13

The corrective actions for the above deficiencies included issuance of DCNs F-23505-A and F-23583-A to revise design output documents and implementation of plant modifications. The inspector reviewed DCN M-09177-A which incorporated the above two DCNs. The inspector reviewed completed workplans which implemented DCN M-09177-A. The following workplans included the circuits identified above and also modified other penetration circuits:

D-09177-01, Provide Adequate Redundant Overcurrent Protection
D-09177-02, Verify Adequate Redundant Overcurrent Protection
D-09177-03, Verify Adequate Redundant Overcurrent Protection
D-09177-04, Provide Adequate Redundant Overcurrent Protection
D-09177-05, Provide Adequate Redundant Overcurrent Protection
D-09177-07, Install Fuses and Internal Wiring

From the completed workplan review, the inspector determined that the modification activities performed were properly documented. In addition, the inspector also performed a field inspection of wiring modifications to verify that the as-built wiring configuration was accurately reflected in the workplan. WP D-09177-07 installed and removed wiring associated with panels 1-R-73 and 1-R-78. The inspector verified the wiring changes associated with workplan steps 22, 23 and 24 were field installed as documented in the workplan. These three steps required the installation and removal of 12 internal panel wires.

Based on the completed workplan reviews and field inspections of completed modifications, the inspector concluded that the licensee had adequately addressed the technical issues and implemented the corrective actions.

Within the areas inspected, no violations or deviations were identified.

6. Quality Assurance Audits (TI 2512-37)

The licensee's NPP, Volume 4 describes the CAP and SP Independent Verification Plan established to provide assurance that the quality activities which are part of the CAPs and SPs are properly implemented. The IVP provides a coordinated method of reviews, monitoring, audits and inspections. During the initial NRC review of the implementation of the MFL SP (IR 390,391/92-27), the NRC expressed a concern about the overall inspection findings because the licensee had failed to resolve the technical issues and failed to assure that the QA reviews, performed as part of the IVP, thoroughly reviewed and assessed the adequacy of the implemented corrective actions. The detail of technical reviews performed by the audit and monitoring groups as part of the IVP was determined to need additional focus. In addition, the reviews performed had been limited to a pre-defined SP boundary. This resulted in a lack of overview of the CAP and SP interfaces.

The licensee's letter dated October 28, 1992 responded to the NRC concerns and stated that the NRC inspection findings indicated the need to review the areas beyond the boundaries of the individual CAPs and

SPs. In addition, interfaces between CAP and SP verification plans needed additional reviews. Self-assessments were performed to further evaluate the effectiveness of the MFL SP verification plan. As a result of the self-assessments, additional areas of review were identified and management critiques of CAPs and SPs are presently being held prior to project management's declaration of greater than 75 percent complete.

The inspector reviewed the assessments and reviews performed as part of the IVP after the initial NRC inspection. The assessments were found to implement the intent discussed in the licensee's October 28, 1992 letter. This conclusion is based on a review of the following QA reviews and assessments performed after the last MFL inspection:

QWB-R-93-0007 - the scope of this review was to evaluate the process being implemented for fuse control after startup testing.

NA-WB-93-0011 - this Quality Engineering assessment was performed to verify the implementation of the corrective actions associated with the NRC findings in IR 390,391/92-27 and to determine the adequacy of the design, installation and control of safety-related fuses.

NA-WB-93-0012 - the scope of this review included review of ECNs and DCNs applicable to the MFL SP and to verify the accuracy of the identified status. Note that two examples of violation 390/92-27-06 pertained to deficiencies associated with DCNs which affected the MFL.

NA-WB-93-0013 - the scope of this review included review of CAQs related to the MFL SP.

QA Status Assessment dated April 1, 1993 - this assessment documented QA's conclusion that a summary of verification activities documents that the MFL SP has been sufficiently and adequately implemented to support closure.

The documented reviews and assessments adequately addressed the NRC concern of IVP reviews being restricted by the CAP and SP pre-defined boundaries.

Within the areas inspected, no violations or deviations were identified.

7. MFL SP Closure Documentation (TI 2512-37)

In a letter dated November 12, 1992, TVA was requested to provide a documentation package for each CAP or SP to support NRC inspections. The package provided documentation to support TVA's conclusion that the CAP/SP implementation was complete and was to address the items listed below. The inspector reviewed the closure package to evaluate the licensee's basis that the SP implementation was complete and outstanding issues did not affect the project's closure.

Documentation Package Attributes

(1) FSAR/Code requirements have been approved and met.

The licensee's letter dated April 2, 1993, notified the NRC of the completion of the MFL SP as defined in the Watts Bar Unit 1, NPP, Volume 4, Revision 1. The enclosure to the letter identified the three punchlist items which are to be completed prior to Unit 1 fuel load in accordance with previous commitments. One of the items pertains to incorporating FSAR changes for penetration protection fuse characteristic curves. The revision to applicable FSAR drawings are to be included in upcoming FSAR change submittals. The proposed changes were determined to not affect the completion of the MFL SP corrective actions and therefore were not required for completion of the SP.

(2) All SER open items have been resolved.

Watts Bar SSER 9 documented the NRC's conclusion that the licensee had resolved the concerns identified in NUREG-1232, Volume 4. The SSER also stated that the NRC program review of the MFL SP was complete.

(3) All commitments made by the CAP/SP have been adequately implemented.

Tab I of the closure package identified 27 NRC commitments which are related to the MFL SP. Five (5) of these were identified as deferred. They pertained to the commitments made to enhance the QA overviews of the CAPs and SPs. These commitments are also applicable to other CAPs and SPs and, therefore, they were deferred. One (1) of these commitments was identified as open and pertained to a previous commitment to revise TVA drawings to remove fuse data to ensure there are no consistency problems. This is to be completed prior to Unit 1 fuel load.

(4) Specific items which formed the basis for the CAP, which were identified in TVA's matrix dated July 13, 1989, have been resolved and field implemented.

The July 13, 1989 letter described the basic documents that make up the requirements for a CAP closure package. The MFL is an SP and not a CAP and therefore no matrix was submitted.

(5) Items such as CAQs, CATDs, NRC commitments, etc., which were identified by TVA (after July 13, 1989) to be resolved by the CAP corrective actions, have been resolved and field implemented and the documentation adequately closed.

NRC commitments are also discussed in item (3) above. Tab J of the closure package identified the CAQ summary status of those CAQs related to the MFL SP. Those issues which were applicable to the MFL were identified as being closed. The listing included those CAQs whose associated corrective actions were reviewed during the NRC MFL SP inspections (IR 390,391/92-27 and 93-31).

(6) Corrective actions for all other OIL items (VIOs, URIs, and IFIs) related to the specific CAP/SP have been completed.

Tab M of the enclosure package identified those NRC OIs which were associated with the MFL SP. These items were identified as being closed or being open pending NRC review of the corrective actions. The inspector verified through a review of the NRC OI listing that any applicable items had been resolved.

(7) All Sargent & Lundy VSR findings related to the CAP/SP are closed.

Tab N of the enclosure package documented the results of the licensee's review of VSR findings. No items were identified which were within the scope of the MFL SP. The inspector reviewed a listing of the VSR items as documented in the Sargent & Lundy Vertical Slice Review Final Report and did not identify any findings which were associated with the MFL SP.

(8) All CATDs related to the CAP/SP are closed.

Tab K of the closure package documented a review of open and closed CATDs during which five (5) CATDs pertaining to fuse/electrical protection were identified. Although none were assigned to the project, they did pertain to the overall design of electrical system protection. The five CATDs are associated with the completion of the long-term Electrical Calculation Program which is to be completed under the DBVP CAP. Paragraph 8 of IR 390,391/92-27, documented the conclusions that the corrective actions for one employee concern (CATD 23702-WBN-03, IN-85-332-001) relating to the adequacy of specific fuses were adequate.

(9) All CDRs related to the CAP/SP are closed.

Tab L of the enclosure package identified those CDRs which were associated with the MFL SP. These items were identified as being closed or being open pending NRC review of the corrective actions. The corrective actions were reviewed during this inspection. The inspector verified through a review of the NRC OI listing that any applicable CDRs had been resolved.

(10) All NRC BUs, INs, TIs related to the CAP/SP are closed.

As stated in item (6) above, the enclosure package identified those NRC OIs which were associated with the MFL SP. These items included applicable INs which were closed. IR 390,391/92-27 documented review of an IN which pertained to fuse issues. The inspector verified through a review of the NRC OI listing that any applicable INs had been resolved.

(11) All issues identified by previous TVA assessments (B&V, NSRS, other contractors) have been resolved.

Tab O of the closure package documented the licensee's review of various assessments during which no outstanding technical issues pertaining to the MFL SP were identified.

(12) All corrective actions related to the area identified by TVA in the ECSP and not a CATD have either been implemented or other action taken to resolve the identified issue.

Tab P of the closure package documented the licensee's review of ECSP Class C concerns which did not result in identifying any concerns within the scope of the MFL SP. Class C concerns are those concerns which were determined to be factual and identified a problem but corrective action for the problem was initiated before evaluation of the issue was undertaken. The inspector reviewed the listing and did not identify any MFL SP related items.

(13) Issues identified in NRR audits have been adequately resolved.

As stated in item (2) above, Watts Bar SSER 9 documented the NRC's conclusion that the licensee had resolved the concerns identified in NUREG-1232, Volume 4. The SSER also stated that the NRC program review of the MFL SP was complete.

(14) All issues identified in the March 30, 1987, TVA to NRC letter have been resolved.

Tab R of the closure package documents the licensee's review of the March 30, 1987 letter which concluded there were no issues identified within the scope of the MFL SP. The inspector reviewed the listing of issues in the letter and verified that it did not contain any issues within the scope of the MFL SP.

(15) All Employee Concerns (post ECSP) related to the area have been closed or evaluated for impact.

Tab Q of the closure package documented the licensee's conclusion that there were no employee concerns which addressed issues related to the MFL SP. As a sample review, the inspector reviewed an April 1993 printout of Employee Concerns for Category EN (Subcategories 30-Electrical Safety Design and 31-Electrical Protection Design) and did not identify any outstanding issues relating to the MFL SP.

(16) Independent Verification Program is complete.

Tab of the closure package included a QA Closure Evaluation documenting the assessments performed as part of the IVP and the resulting conclusion that the MFL SP was adequately implemented to support the project closure.

(17) All other TVA open items on the issue are closed.

As stated in item (1) above, the licensee's letter dated April 2, 1993, notified the NRC of the completion of the MFL SP with the exception of three related punchlisted items. The three punchlist items will be completed prior to Unit 1 fuel load in accordance with previous commitments. One of the commitments has been subsequently implemented, one of the items pertains to incorporating FSAR changes for penetration protection fuse characteristic curves as discussed in item (1) above, and the third item pertains to the commitment to revise TVA drawings to remove fuse data to ensure there are no consistency problems as discussed in item (3) above.

(18) Any issues known to NRC/TVA which are likely to effect closure are resolved.

The closure package did not identify any issues associated with this item. However, Tab G of the closure package did included the MFL SP Records Plan. The various records relied upon have been reviewed by the NRC as documented in IR 390,391/92-27 and in this report.

(19) All applicable PACR items.

Tab J of the closure package identified six (6) PACRs which were associated with the MFL SP. The corrective actions associated with these PACRs have been completed. The inspector reviewed the closure documentation for one of the six PACRs (PACR-0332) and determined that the item was adequately resolved.

The inspector concluded that the licensee's closure package adequately documented and supported the licensee's conclusion that the MFL SP was implemented.

8. Conclusions and Summary

The inspection results indicate that the licensee has adequately resolved the NRC concerns and violation identified in IR 390,391/92-27. The issues identified in that inspection report have been reviewed and closed by the NRC as documented in this report and in IR 390,391/92-40.

The licensee has addressed the issues identified in the NRC letter dated November 12, 1992, with regard to the MFL SP closure package. The licensee's IVP has documented the independent evaluations and basis for concluding that the MFL SP has been implemented. The outstanding SP punchlist items are properly being tracked for closure and do not impact the technical resolution of the MFL SP. A project closure report documenting the basis for considering the project closed has also been generated as specified in the NPP, Volume 4. Therefore, based on the results of this inspection, the NRC concluded that TVA had adequately implemented the MFL SP, as described in the NPP, Volume 4, Revision 1, and as approved in the NRC SER.

9. Ground Detection on 120 Vac Circuits (TI 2512-37)

During this inspection, the inspector identified a concern regarding the penetration protection provided for circuits with ungrounded 120 Vac control power. This was identified as a concern due to the fact that the licensee's penetration protection design uses fuses on each circuit leg as the redundant protection for ungrounded systems. This design is generally acceptable provided that the ungrounded system has a ground detection circuitry. While the 120 Vac vital power is grounded and therefore does not require ground detection, many penetration circuits are ungrounded with no ground detection circuitry. This design is restricted to 120 Vac MCC circuits.

120 Vac MCC circuits typically use a fuse set to serve as the primary and secondary protective devices. That is, the fuse on one leg serves as the primary device and the fuse on other leg serves as the secondary device. In this configuration, a single grounded conductor will not result in a short circuit; thereby allowing continued operation. When both conductor legs are grounded, short circuit currents will flow through both fuses thereby providing redundant overcurrent protection for the penetration circuits. A primary advantage of not grounding a 120 Vac circuit is to provide system reliability in that in the event of a grounded leg, the circuit operation will not be affected and thus reliability is enhanced. However, grounded circuits cannot be identified unless there is some type of ground detection circuitry to alert personnel of grounds. WBN does not employ such ground detection circuitry. Therefore, multiple undetected grounds existing on a particular circuit without any indication of such is of concern.

As stated above, most WBN MCC control power circuits are powered from an ungrounded 120 Vac supply. This includes some 120 Vac electrical penetration circuits. One of the exceptions to this design is the fifth diesel generator MCCs which do contain a grounded 120 Vac secondary.

The 480/120 V MCC control power transformers are typically rated at 100 and 150 VA. The inspector could not conclude during this inspection if the present design meets the NRC requirements with regard to ground detection circuitry for ungrounded control power systems. The primary concern is the existence of undetected multiple grounds existing on Class 1E circuits for extended periods of time and the possible effect on connected equipment (e.g., spurious actuations). This technical issue is an unresolved item pending further reviews by the NRC to determine if the present design meets NRC requirements, URI 50-390,391/93-31-01, Lack of Ground Detection on 120 Vac Circuits.

10. Action on Previous Inspection Findings (TI 2512-37)

a. (Closed) CDR WBRD 50-390/86-47, Redundant Overcurrent Protection for Electrical Penetration Number 36

This item pertains to the discovery that the original design did not provide adequate redundant overcurrent protection for electrical penetration assemblies. This item was previously reviewed by the NRC as documented in IR 390,391/91-15. The recurrence controls were determined to be adequate but this item was left open pending completion of associated corrective actions.

The remaining corrective actions were associated with DCNs M-07663-A, M-10480-A and M-09177-A. The licensee has implemented the specified corrective actions associated with these DCNs. As stated in paragraph 5 of this report, the inspector reviewed six (6) completed workplans and performed field verifications of work associated with one of these workplans. No deficiencies were identified during those reviews.

The inspector verified that drawing 45W1418-4, R11, associated with electrical penetration number 36, contained the required design information to provide redundant overcurrent protection. Calculation WBN-EEB-MS-TI08-0028, LV Electrical Penetration Protection Analysis, Revision 25, identified KTK-15 A fuses and FPE NE/20 circuit breakers as the redundant overcurrent protective devices for penetration number 36 (circuits LS4-10, -11, -12). A field inspection was performed to verify that the as-built configuration conformed to applicable design documents. The inspector verified that the required fuses were installed in junction box 0-JB-228-LS4 as specified in the calculation and drawing. The required circuit breakers were also verified to be installed in Standby Lighting Cabinet LS4 as specified in the calculation and drawing.

The inspector concluded that the licensee had adequately implemented the corrective actions to resolve the identified deficiency and controls were in place to prevent recurrence. Therefore, based on the implemented corrective actions and actions taken by the inspector to verify implementation, this item is closed.

b. (Closed) URI 390, 391/92-27-01, Vendor Fuses in MFL

The licensee's actions to address this item were reviewed and determined to be adequate. The actions taken and NRC results of this review are discussed in paragraph 3.a.(1).

c. (Closed) URI 390, 391/92-27-02, Completeness of EMS and MFL

The licensee's actions to address this item were reviewed and determined to be adequate. The actions taken and NRC results of this review are discussed in paragraph 3.a.(2).

d. (Closed) URI 390/92-27-03, Adequacy of EPA Design Criteria

The licensee's actions to address this item were reviewed and determined to be adequate. The actions taken and NRC results of this review are discussed in paragraph 3.b.

e. (Closed) VIO 390/92-27-06, Design Control Deficiencies

The licensee's actions to address this item were reviewed and determined to be adequate. The actions taken and NRC results of this review are discussed in paragraph 4.

f. (Closed) CDR 390/92-10, Design Control

The licensee's actions to address this item were reviewed and determined to be adequate. The actions taken and NRC results of this review are discussed in paragraph 4.

11. Exit Interview

The inspection scope and findings were summarized on April 9, 1993, with those persons indicated in Paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Dissenting comments were not received from the licensee. Proprietary information is not contained in this report.

| Item Number | Status | Description and Reference |
|---|---|---|
| 390/86-47 | Closed | CDR - Redundant Overcurrent Protection for Electrical Penetration Number 36 (Paragraph 10.a) |
| 390/92-27-01<br>391/92-27-01 | Closed | URI - Vendor Fuses in MFL (Paragraph 10.b) |
| 390/92-27-02<br>391/92-27-02 | Closed | URI - Completeness of EMS and MFL (Paragraph 10.c) |

| | | |
|---|---|---|
| 390/92-27-03 | Closed | URI - Adequacy of EPA Design Criteria (Paragraph 10.d) |
| 390/92-27-06 | Closed | VIO - Design Control Deficiencies (Paragraph 10.e) |
| 390/92-10 | Closed | CDR - Design Control (Paragraph 10.f) |
| 390/93-31-01<br>391/93-31-01 | Open | URI - Lack of Ground Detection on 120 Vac Circuits (Paragraph 9) |

12. List of Acronyms and Initialisms

| | |
|---|---|
| B&V | Black & Veatch |
| BD | Board |
| BU | Bulletin |
| CAP | Corrective Action Program |
| CATD | Corrective Action Tracking Document |
| CCRIS | Calculation Cross Reference Index System |
| CDR | Construction Deficiency Report |
| DCA | Drawing Change Authorization |
| DCN | Design Change Notice |
| DS | Design Standard |
| EAI | Engineering Administrative Instruction |
| ECN | Engineering Change Notice |
| ECSP | Employee Concerns Special Program |
| EMS | Equipment Management System |
| EPA | Electrical Penetration Assembly |
| ESI | Ebasco Services, Incorporated |
| FSAR | Final Safety Analysis Report |
| IFI | Inspector Follow-up Item |
| II | Incident Investigation |
| IN | Information Notice |
| IR | Inspection Report |
| IVP | Independent Verification Plan |
| LV | Low Voltage |
| MCC | Motor Control Centers |
| MFL | Master Fuse List |
| NP | Nuclear Plant |
| NEP | Nuclear Engineering Procedure |
| NPP | Nuclear Performance Plan |
| NRC | Nuclear Regulatory Commission |
| NRR | Nuclear Reactor Regulation |
| NSRS | Nuclear Safety Review Staff |
| OI | Open Item |
| PACR | Potential Areas of Concern/Recommendation |
| PER | Problem Evaluation Report |
| QA | Quality Assurance |
| RG | Regulatory Guide |
| SER | Safety Evaluation Report |
| SSER | Supplemental Safety Evaluation Report |

| | |
|---|---|
| SHTDN BD | Shutdown Board |
| SP | Special Program |
| TI | Technical Instruction |
| TVA | Tennessee Valley Authority |
| URI | Unresolved Item |
| WBRD | Watts Bar Reportable Deficiency |
| VA | Volt-Ampere |
| Vac | Volts - alternating current |
| VIO | Violation |
| VSR | Vertical Slice Review |
| WBN | Watts Bar Nuclear |
| WP | Workplan |