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License Nos. CPP-91, CPPR-92

Tennessee Valley Authority
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Gentlemen:

SUBJECT: MEETING SUMMARY - WATTS BAR UNIT 1 AND UNIT 2

This letter refers to the meeting conducted in the NRC Region II office in Atlanta, Georgia, on November 16, 1992. The purpose of the meeting was to discuss lessons learned from preoperational testing of system 211 and NRC's concern about recent problems in Engineering and Design. A list of attendees and a copy of the TVA handout are enclosed.

It is our opinion that this meeting was beneficial and provided a better understanding of TVA's activities.

Should you have any questions concerning this letter, please contact me.

Sincerely,

(Original signed by J. Johnson)

Ellis W. Merschoff, Director
Division of Reactor Projects

Enclosures:
1. List of Attendees
2. Presentation Summary

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IA3

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NOV 27 1992

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ENCLOSURE 1

LIST OF ATTENDEES

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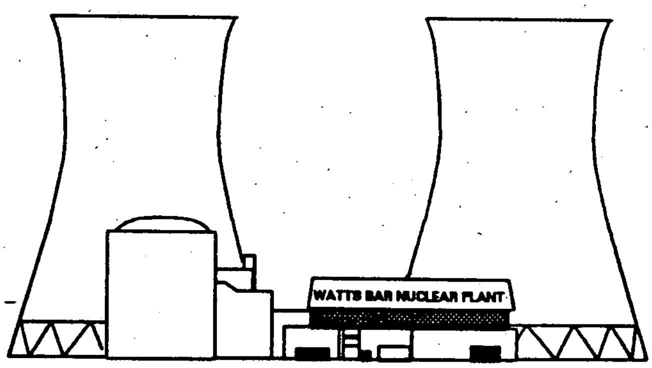
A. Gibson	Director, Division of Reactor Safety, RII
B. Wilson	Branch Chief, Division of Reactor Projects, RII
K. Barr	Section Chief, Division of Reactor Projects, RII
G. Walton	Senior Resident Inspector, Watts Bar
G. Humphrey	Resident Inspector, Watts Bar
C. Julian	Engineering Branch Chief, Division of Reactor Projects, RII
V. Nerses	Deputy Director, Projects Directorate II-4
J. Lara	Resident Inspector, Watts Bar
P. Tam	Senior Projects Manager, NRR
TVA Staff	
W. Elliott	Engineering Manager, Watts Bar
N. Kazanas	Vice President, Completion Assurance
D. Moody	Plant Manager, Watts Bar
B. Museler	Vice President, Watts Bar Site
D. Nunn	Vice President, Nuclear Production
G. Pannell	Site Licensing Manager, Watts Bar
H. Weber	Engineering and Modifications Manager, Watts Bar
J. Christensen	Site Quality Manager
M. Bellamy	Start-up Manager

ENCLOSURE 2

NRC/TVA MEETING

NOVEMBER 16, 1992

ATLANTA



NRC MEETING
NOVEMBER 16, 1992

AGENDA

I. INTRODUCTION

II. STARTUP TEST PROGRAM

III. OTHER ISSUES

- Cable Calculations
- Instrument Line Support Walk downs
- Security
- Drawing Control
- Master Fuse List

IV. QUALITY ASSURANCE EFFECTIVENESS

V. WBN MANAGEMENT ACCOMPLISHMENTS

VI. SUMMARY

I. INTRODUCTION

II. STARTUP TEST PROGRAM

- WATTS BAR MANAGEMENT COMMITTED TO REGULATORY GUIDE 1.68 REV 2 IN ORDER TO ACCOMPLISH THE FOLLOWING GOALS:

✓ **Assure Completeness and Accuracy of System Design**
✓ **Demonstrate Adequacy of Construction Process**
✓ **Ensure Equipment Performs Within Design Limits**
✓ **Turnover Safe-Reliable Systems to Operations**

- GOAL ACCOMPLISHMENT INDICATED BY:

  - Component test results (2328 of 33,570 complete)
  - Acceptance test results (8 of 85 complete)
  - Preop test results (1 of 122 complete)
  - QA oversight of approximately 5000 hours
  - NRC oversight of approximately 680 man-hours
  - Internal and external formal assessments

CONCLUSION:

- WBN Startup test program is sound and meets regulatory requirements
- Watts Bar experience to date similar to other startups experienced by the WBN team
- System 211 testing:
  - **Thorough,**
  - **Excellent test results**
  - **Performed by highly qualified personnel**

III. OTHER ISSUES

- CABLE CALCULATIONS

Original Findings

- Computer Program was missing engineering review requirement of correction factor (.8 X Allowable)
- Misunderstanding of how to enter data (Cable O.D. Values, Number and Type of Cables)

Initial Corrective Actions

- Manual calculations with nuclear engineering review
- Train personnel in use of computer program
- Correct computer program

Deficiencies Reoccurred

Incident investigation performed and presented to NRC Resident Inspectors

Final Corrective Actions:

- Setup calculation group under Nuclear Engineering
- Improve work area conditions
- Corrected computer program
- Self-checking training conducted
- Roll down meetings conducted
- Checklists established for field calculations
- Program under quality review pipeline

Results:

- No cables pulled using wrong pull tension since restart
- In process calculation problems reduced from 50% to under 1%
- QA assessment satisfactory

III. OTHER ISSUES (cont.)

- INSTRUMENTS LINE SUPPORT WALKDOWNS

Original Commitment:

- 1986 55e report WBRD-50-390/86-22
- Inspect ALL typical instrument line supports for conformance to typical drawing 47A051-35/35A

Sequence of Events:

- Inspections Begun per commitment
- 342 ≈ 1300 Supports Completed (Not Random Sample)
- Discrepancies found within 342 and other samples Dispositioned Use-As-Is
- Meeting Held July 30, 1992, in NRC Resident's office to discuss sampling approach and resulting records for supports

- SCAR corrective action rewritten in a manner that could be interpreted as decision had already been made to close with sampling
  - -- Poor Wording
  - -- Connection to 55e Commitment was Never Lost
  - -- No Intent to Close or Change Commitment Without Informing NRC of Random Sample Results

Conclusion:

- NRC concern understandable
- TVA should have tied SCAR revision language to 50.55e but **Commitment Would Not Have Been Changed** without communication follow-up with NRC
- Key issue to be resolved is records for as constructed hangers if sampling used

III. OTHER ISSUES (cont.)

- SECURITY

Self (TVA & Contractor) Identified Events

- 1 Fitness for Duty
- 1 Construction Error in Signoff for Rebar Placement
- 3 Safeguards Problems

Corrective Actions:

- RUST site management changed out
- Formal warning issued to RUST corporate management by site V.P.
- Subcontractor removed who performed rebar work
- Limited workscope until performance improves
- Reassess number of personnel that require access to safeguards information
- Improve training for personnel that require access to safeguards
- Additional TVA oversight and control

III. OTHER ISSUES (cont.)

• DRAWING CONTROL ISSUES

Background

- July 6 through September 12, 1992 Inspection
- Inspection Covered System **211** Test Instruction and Supporting Documentation
- Violation on failure to update drawings due to drawing discrepancies

Actions:

- **100%** review of **40** Annunciator points for Systems **211** and **55**, corrected 7 deficiencies
- **100%** review of **83** additional Annunciator points for **12** other near term systems, corrected 4 deficiencies
- A **100% trace** will be done for Annunciator contacts for each safety system

Conclusions:

- **No Violations** of EAI 3.09 (Incorporation of Change Documents)
- None of the discrepancies would have **impacted the As-Constructed Configuration** of the plant or the test acceptance evaluation
- Discrepancies were of **Minor Significance** - (Panel Number Typo, Inaccurate Drawing Reference, Incorrect Wire Number)
- Discrepancies **within scope of existing Program**
- Drawing update program is adequate, **no programmatic changes necessary**

III. OTHER ISSUES (cont.)

- MASTER FUSE LIST

Inspection Dates August 24-28, 1992

Inspection Findings:

- Issued DCN did not include all required changes
- Vendor fuses did not agree with vendor drawings
- Unit 2 fuses required for Unit 1 not on master fuse list
- Discrepancies between master fuse list and calculations

Status to Date

- Discrepancy rate of 2% with 35% of reviews complete
- Of the above discrepancies, one case with fuses having reduced margin

Additional Engineering Reviews Instituted for CAPs/SPs

Master fuse list findings indicate need to improve

- Program process logic
- Interfaces within program
- Interfaces with other programs

Improvements

- Enhanced reviews by line organization
- Guidance plan developed to integrate direction
- Closure Readiness assessment for remaining CAPs & SPs

IV. QUALITY ASSURANCE EFFECTIVENESS

Performance to Date:

- Line is dedicated to doing good work and finding problems
- QA/QC has found most problems not picked up by the line
- NRC Findings are typical for construction plant based on WBN Management Team experience
- We have gone the extra mile with some fairly innovative programs

Quality Activities

- Continuous evaluation of modification work and early Identification of performance problems
- High level of attention to construction, engineering and startup and test program
- Proactive administration and control of current Corrective Action Program

Concerns raised by oversight functions have not indicated significant safety problems or QA program problems

NRC Identified Problems

- We are not satisfied and are striving to do better

Reprioritization of Efforts:

- Increased emphasis on CAP/SP verification
- Increased management involvement in review and critique of CAP/SP verification activities
- Increased use of Vertical Slice Assessments
- More aggressive follow-up and resolution of identified concerns

Effectiveness of oversight activities will identify and resolve serious problems

- Watts Bar management responds promptly and aggressively to problems
- NRC residents kept informed as problems come up and resolutions are developed
- Improvement is being made to ensure early identification of problems by TVA

V. WBN MANAGEMENT ACCOMPLISHMENTS

WBN Management Team has Detailed Involvement in Site Activities

- Ongoing activities discussed daily in morning meeting
- TVA Management proactive in resolving problems (e.g. clearance violations, RUST Eng. Problems,.....etc.)
- Site Management meeting every Tuesday
- Weekly Report provides integrated overview, key problems noted

Improved Communication with NRC

- Problems promptly identified to NRC Resident Inspectors by TVA
- Weekly Site V.P. meeting with Residents
- Regular NRR meetings

Employee Communication Improvements

- Employee Concerns greatly reduced
- Continued emphasis by Watts Bar management on open communication (Employee Info Meetings, Breakfasts, ..etc.)
- Employees comfortable discussing problems with management (Increased walking of workspaces)

VI. SUMMARY

MANAGEMENT ASSESSMENT
of
WATTS BAR NUCLEAR PLANT
TEST PROGRAM PERFORMANCE

<u>ASSESSMENT TEAM</u>

November 13, 1992

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J. Ballowe	Startup and Test
J.A. Crittenden	Quality Assurance
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S.J. Krupski	Plant Maintenance
C.C. Lyke	Nuclear Engineering
W. Skiba	Operations
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I. EXECUTIVE SUMMARY

The WBN preoperational test program has two primary objectives for startup testing in accordance with RG-1.68 Revision 2. These include providing assurance that the facility has been adequately designed and that installation of equipment has been accomplished in accordance with design. Further, the regulatory guidance recognizes that both design and construction deficiencies may be encountered during testing and that modifications may be required to correct these deficiencies. Following completion of the first safety-related system testing at WBN Unit 1, TVA management performed an assessment to ensure that the programs designed to support component testing and preoperational testing were performing as intended. Fifteen hardware items were reported and evaluated through four incident investigations and seven hardware-related test deficiencies (DNs). A number of these had passed through a barrier without notice that was designed to detect that problem (assuming it existed prior). However, all of these problems (with the exception of minor, non-functional walkdown items) were detected by a later barrier proving that the defense in depth design of the program functions as expected.

The assessment team consisted of members from Startup and Test (SUT), Modification, Engineering, Licensing, Quality Assurance, Plant, Maintenance, and Completion Assurance. In addition to the team's review of the results of the four incident investigations, the test deficiencies, and related quality deficiency report data, the team interviewed numerous personnel involved with ownership and implementation of major work processes.

In general, it was observed that TVA management was aggressively reviewing results and making process improvements to address various quality problems. A number of corrective actions were already addressed or in the process of being addressed. It was too early to measure the impact of changes in the following areas:

- Lifted lead logs and second-party verification for startup.
- A new workplanning process for modifications.
- Point-to-point schematic wiring verification on selected circuits during component test.
- New Quality Control Inspection results trending program.

After reviewing these areas along with the repetitive nature of some of the problems identified, the assessment team made recommendations in the following key areas:

- Modifications' second-party verification program needs strengthening, particularly on wiring connections.

- Increased ownership and jurisdictional control over work activities is required by startup testing.

- SUT engineers should review completed workplans to ensure they do not impact tested components.

- Better feedback mechanisms to Modifications and Engineering are required for SUT identified problems.

- DNs should be trended and fedback more frequently during initial stages of testing.

Additionally, the assessment team identified other enhancement areas which although not directly attributing to the problems investigated would improve the testing and turnover process:

- Nuclear Engineering needs to provide additional assistance and training to SUT Engineering, particularly in the drawing system.

- Goals must be established to give higher priority to the useability of secondary drawings for Operations.

- Walkdowns need to be improved to ensure early identification of items which may impact testing.

Overall, the assessment team agrees that safety-related testing is functioning effectively and that testing is finding and correcting problems as designed. The above recommendations are made as enhancements to the process to ensure efficiency and earlier identification of potential problems. Line management reviewed the recommendations made in this assessment and provided corrective action plans for each of the areas mentioned. These plans are included with the associated recommendations. WBN is early in their SUT program. The timely incorporation of these recommendations will go a long way to ensure a quality startup effort.

II. INTRODUCTION

The first safety-related system was processed through preoperational test from September 25, 1992, through October 17, 1992 on System 211 (6.9 KV Shutdown Power). The system 211 preoperation test (PTI-211.01) is a complex test containing approximately 700 pages with 3,820 individual tests steps. A total of 20 Deficiency Notices (DNs) were issued during the test sequence which is considered normal for testing a system of this complexity. The above is a reaffirmation of the primary design functions for the system in performing its safety-related function. Additionally, a total of two Incident Investigations (IIs) on System 211 and two others on related systems were initiated and completed to evaluate specific problem areas where initial program barriers failed to identify the specific problems.

The purpose of this management assessment was to look at the collective impact of the four IIs, selected DN items, walkdowns which occurred before and after system turnover, and other related problem areas and assess the following:

1. Are there other process improvements and recommendations that can be made which would improve performance and help identify problems more on the front end? This assessment looked beyond those already recommended as a result of the IIs and other means.

2. Should finding these problems as we found them be the expected norm for the balance of safety-related startup testing? Are the barriers with their defense in-depth philosophy working as designed?

3. Are we in general satisfied that other corrective action and improvement programs that are in place are doing the job of self improvement and oversight?

III. APPROACH

Assessment Team - The Management Assessment was performed using a Team approach. Team members consisted of engineering, supervisory, and management personnel (See Team Composition List) with various areas of expertise representing major WBN organizations: Nuclear Engineering, Modifications, Startup and Test, Plant Staff, Quality Assurance, Operations (HPES), Completions Assurance, and Licensing. The team was led by the Vice President, Completions Assurance.

Methodology - The team's evaluation methodology consisted of thorough evaluations of the related incident investigations to learn what item, device, process, etc., failed; reviews of related events/problems, etc. as documented in various programs; interviews with managers/owners and participants (implementors) of major work processes at WBN to analyze whether potential collective weaknesses exist; and root cause analysis using barrier concepts. Data collected during the event evaluations and interviews was analyzed to determine whether appropriate process "barriers" existed (or were needed) to prevent or mitigate the subject events. As these processes were analyzed, consideration was given to management initiatives already underway to enhance or address program weaknesses in the various areas (e.g., Design, Modifications, Testing, etc.). Likewise, the assessment reviewed the formal corrective actions developed/planned in response to the four Incident Investigations. Based on this analysis, the assessment team made recommendations to Site Management for improvement and/or enhancement in key program areas. Through discussion with Site Management, the recommendations were formalized and line managers developed action plans to implement the recommendations. These action plans will be tracked in WBN's TROI System by department manager responsible for implementation. Information analyzed by the assessment team was compiled from the following key areas:

1) **Incident Investigations**

II-W-92-19, "Incorrect Wire Terminations"
II-W-92-20, "Vital Battery Board #2 Wiring Terminated to Wrong Fuses"
II-W-92-21, "Failure to Implement DCN/Lifted Conductor"
II-W-92-22, "Lifted Leads Discovered in Panel 6 of the 1A-A Shutdown Board"

2) **Related Issues/Events**

Preop Test Deficiencies PTI-211.01 (6.9 KV Shutdown Power)
Deficiencies/problems encountered during Component and Acceptance Testing
Operations Turnover System 202 - Walkdown Items (FIR WB FIR920087)
Operations Turnover System 211 - Walkdown Items

3) **Interviews** - Interviews were conducted with managers/owners and participants (implementors) of major work processes at WBN to analyze whether potential collective weaknesses exist. The general interview format provided an overview of the process, discussion of weaknesses and potential areas for improvement, and a general question/answer period. Interviews were conducted with managers/owners of the following key processes:

Incident Investigations and Related Corrective Actions
Modifications Program/Modifications Walkdowns (MAI-1.9, SMP-4.0)
Component Test Program
Startup Walkdowns (SMP 4.0)
Startup Work Control Process
NE Drawing Process and Design Change Control
NE SPAE Process
Startup Management Perceptions
Engineering Management Perceptions

Discussions were also held with specific electrical test personnel and crew members in typical work groups to hear their perceptions of how well process implementation occurs in the field and the types of obstacles encountered:

Workplans Process (Workplan writers/Field Engineer)
Startup Test Engineers (System 211 and System 200)
Component Test Group (Electrical)
Construction Completion Team (Craft, Foreman, QC Inspector, Field Engineer)

IV. BARRIER ANALYSIS

The WBN Unit 1 completion and turnover to Operations process consist of a number of activities (i.e. design, modifications, component testing, etc.) as shown on Attachment 1. Attachment 1 shows the typical chronological order of these activities and Attachment 2 provides a brief definition of each activity.

In order to collectively evaluate the startup test activities, selected startup events were charted against the completion and turnover activities as shown on Attachment 3. The events selected were felt to be representative of the problems encountered though not inclusive of all items. Likewise, the items were not categorized by significance. For this evaluation, the activities were considered as barriers for ensuring that management expectations were met.

Review of the System Completion and Turnover Event and Activity Chart, Attachment 3, identified that the failed barriers (denoted as a miss), Hits (problem discovery) and Barriers were clustered in three activities - modification, component test and pre-operational testing. Nine barriers failed during modification activities, four barriers failed and three hits occurred during component testing and eight hits occurred during pre-operational testing. The miss and hits that occurred during/after Operations Turnover Walkdowns consisted of missing screws in terminal blocks at spare points, missing or the wrong size washer, loose screw, missing bulb lens, etc. that do not effect the functionality of the system.

Based on this analysis and specific event information available from incident investigations and DN resolution, the following areas were identified for an in-depth analysis to determine actions required to minimize the hits in pre-operational testing. The areas needing in-depth analysis were:

- Modifications Implementation
- Volume of Change Paper
- Component Test
- Walkdowns
- Overlap of Work Activities
- Threshold on Number of Problems
- Feedback Process

See Section V of this report for the analysis of the above areas.

V. AREAS OF INTENSIFIED REVIEW

V.A MODIFICATION IMPLEMENTATION ACTIVITIES

Expectations of program/procedures

Implementation of modification activities is controlled by the workplan process in which design changes are implemented using planned instructions that include the appropriate technical and quality requirements. These written instructions invoke specific installation procedures and include predetermined verification activities to be performed by either a second party and/or an independent party such as Quality Control (QC). The major steps of the implementation phase for modifications are planning, implementation(which includes second party verification), QC verification, and closure. Other activities performed by Modifications include the performance of work under the maintenance work control process (SSP- 6.02). These activities are controlled in a very similar manner as workplans.

The basis for including multiple verifications in the process is to accommodate the human element associated with implementing non-routine, non-repetitive, complex tasks. This human element will normally result in the occurrence of personnel errors. Due to the nature of design changes, many opportunities exist for errors to be made. The verification activities are intended to minimize the impact of undetected errors by verifying critical attributes defined by engineering specifications and determined to be important to the effective implementation of the design change. The current process includes a means of monitoring quality performance with a specified Acceptable Quality Level(AQL) of 97 percent at first time presentation to QC. The goal desired by Modifications management is 100 percent acceptance and zero deficiencies being identified during subsequent activities. Modifications is continuously seeking methods to improve the rates of acceptance.

Significance of proper implementation

Proper implementation of modification activities is critical to implementation of design changes as well as to the safe operation of the plant.

Review Results

Recent events were reviewed to determine where failures had occurred in the implementation of the modification process as well as to determine if process or program inadequacies existed. These events were documented in several incident investigation reports associated with electrical systems (e.g. 211, 236, 262,etc.) as well as conditions that were known to have occurred and were corrected in process. These events were not discovered until after completion of the modification implementation process and should have been detected prior to acceptance of the modification implementation. The results of this review revealed that all events in which a failure occurred in the modification process was a result of personnel not properly performing their assigned tasks.

Since the review indicated the events were caused by personnel failures, additional reviews were performed of other process indicators, such as QC inspection results, to determine if repetitive implementation failures were occurring and being caused by the same individuals. The results of these additional reviews indicated a current craft workmanship acceptance rate of 99 percent at first presentation for acceptance and that no adverse trends were evident. Quality performance results for the specific work crews also indicated a high acceptance rate. These results substantiate that the events being identified are in fact infrequent isolated occurrences. As such the program was determined to be adequate. However, opportunities do exist to provide improved feedback to increase the probability of identifying future errors during initial verifications in the process. **Therefore, it is recommended that the feedback process to modifications personnel be enhanced to include those deficiencies identified during testing activities.**

Interviews conducted during this collective review raised concern as to whether adequate independence was being maintained by QC during their performance of inspection activities associated with wiring terminations. The current inspection process requires the QC inspector to "witness" the termination. The risk associated with witnessing the activity versus performing a final inspection after craft completion of termination activities is the possibility of the QC inspector being inadvertently misled due to being closely involved during the installation activity. This risk is acceptable, as it relates to safety significance, provided appropriate subsequent verifications are performed within the overall process. In the case of wiring terminations the subsequent verifications (component and preop tests) are designed to detect these types of failures.

Interviews also raised a concern as to whether sufficient understanding existed with the craft and field engineers relative to what was expected during the performance of a second party verification. The interviews indicated that the method being used by the second party verifier is also a "witness" of the actual termination. Here again the risk is identical to that described above for the QC inspection.

Discussions with management relative to the concerns raised during these interviews indicated that while overall quality levels were being met, the expectations are not being met for second party and QC verifications. **Therefore, action needs to be taken to ensure consistent understanding of the expectations by the personnel performing second party and QC verifications.**

Review and analysis of the Incident Investigations indicated that appropriate corrective actions were identified for the specific events. Incident Investigations II-W-92-019,-020,-021, and -022 analyzed the wiring deficiencies and determined that the deficiencies were not considered safety significant and that the wiring deficiencies would have been detected by the energized functional testing which remained to be completed per the WBN Startup Test Program. In addition, appropriate actions were taken with the individuals involved with the personnel errors.

Impact to Quality/Schedule-Program Status

Identification of problems during the test program that should have been detected earlier in the cycle places an undue burden on the SUT organization. The quality of the process is not directly impacted but does become questioned with a high frequency of repeat occurrences.

The schedule is impacted in that rework is required when hardware problems are not detected until the test program. The test program is however designed to detect hardware problems that may have gone undetected during the modification implementation and as such the program did in fact work in the cases of these recent events.

The status of the program was initial stages of implementation when most of these events occurred and these events are not indicative of program problems. The timeframe of the occurrences does coincide with the ramp-up of craft and startup resources. The only importance to this statement is that as new personnel arrive onsite and receive training their learning curve is still continuing after initial assignment to field activities and the potential for error is higher. However, this potential for error generally decreases with time.

Effect of recent changes

During the past few months, numerous improvements have been made to various parts of the modification implementation process. Some of the most recent include the development of an advanced planning function to assist in the development and planning of workplans and the functional reassignment of the field engineers to the Nuclear Engineering organization. Feedback mechanisms have been established to aid in the dissemination of information relative to problem areas. Improved data analysis on QC inspection results has been developed through the establishment of computerized data systems by QC. All of these improvements further enhance our ability to identify, correct and prevent repetitive occurrences.

Conclusions:

The overall modification implementation process is adequate. However several deficiencies were identified during testing activities that should have been identified through initial verification activities. Failure to identify and correct these deficiencies prior to testing activities places an undesired burden on the test program. The barriers designed in the program to detect these conditions failed. These failures were determined to be caused by individuals not properly performing their assigned duties with a contributing factor being personnel responsible for performing second party and QC verifications not fully understanding the expectations associated with the verifications. In addition, opportunities exist to provide improved feedback to Modifications on test identified deficiencies.

Recommendations:

1. Reemphasize purpose and methodology of second party verifications to the appropriate Modifications and Nuclear Engineering field engineering personnel.

2. Reemphasize expectations on QC independence during the performance of QC inspections with appropriate QC personnel. (This action was completed per II-W-92-19 and 21.)

3. Enhance the feedback process to Modifications to include those deficiencies identified during testing activities.

V.B OVERLAP OF WORK ACTIVITIES

Significance of Area:

Proper control of work activities during Startup and Test's Component and Performance Testing will prevent test invalidations.

Review Results:

Due to the compressed schedule at WBN, many activities must be performed concurrently. Of particular concern is the time period leading up to the start of preoperational testing. It is the opinion of the team that concurrent and overlapping activities are acceptable providing adequate tools and proper controls are provided. Interviews with NE field engineers and Modifications work plan performers, along with Startup and Test (SUT) system engineers, indicate some needed tools and controls are not yet in place.

The development of the PT/AT must start at lease three (3) months prior to the scheduled start of testing. This is to allow for development, writing, technical review, review and approval of the test. During this time the system is not in a stable condition. The configuration of the system (drawings) is under varied levels of redesign based on the system itself. The configuration is based on drawings, along with many pages of change paper. The change paper alone on System 211 was reported to be six (6) feet high. Not all of the change paper affects the testing, but all must be reviewed for impact. This review of change paper takes place at lease four (4) times during the development and numerous reviews of the PT/AT. The risk is always there that a DCN will come out that invalidates minor or major portions of the test procedure up to the SPAE I point. No formal composite drawings are maintained for development and review of tests although Startup test engineers reported that they individually and informally developed such composites for their own use to make the process manageable.

Component testing (CT) starts as soon as Modifications and Plant Maintenance has completed enough of the backlog of work plans (WP) and work orders (WO) to free equipment to SUT. This is necessary to meet the schedule and smooth out peak man-loading of future system work. Ongoing design change results in ongoing scope change to field modification. These design changes may have affected components whose testing has been completed. The component testing is controlled by a matrix developed by SUT which lists each component needing testing and has a method for requiring retest when deemed necessary by the SUT system engineer. Presently, controls are in place such that the review of most work on a system is performed and authorized by SUT prior to the commencement of the work. However, work plan reviews prior to the work do not give the SUT system engineer enough information to determine the total scope of work performed. NE field engineers in charge of WP performance have need to change the scope of work or perform additional work to remove interferences and complete the original work scope. Field engineers and craft interviewed stated that they routinely lift cables out of the original scope of the work plan when more than one cable lands on the same terminal point and it must be moved to remove the cable scoped. Other cables may be determinated and pulled back in order to reroute or replace conduit. The retermination of these other cables/wires are controlled by sheets added to the WP. Often these other wires and cables are not in the original system scoped by the work plan and could be in a system or circuit that had been previously tested. WPs routinely defer PMT to component and performance testing. The SUT system engineer does not see the work plan at closure. SUT system engineers interviewed were unaware of these scope changes and therefore could not evaluate the effects on their testing. Field engineers interviewed said they were unaware of any potential effects on SUT system testing created by this practice.

Administrative control over the components is a requirement of Reg. Guide 1.68, revision 2. This control is exercised at WBN by the Plan of the Day (POD) schedule and the reported ownership of systems by SUT with SUT's authorization needed to do work. One purpose of this control is to ensure completed testing is not invalidated without knowledge of the responsible test engineer. It is not apparent that the responsible test engineer is always cognizant of all the work ongoing with his equipment. There is no visible means to alert workers to equipment that has been tested or under test. Although the responsibility of the SUT system engineers is clear to them, their perceived authority to carry out their responsibilities is less understood. During the period of overlapping work activities, ownership of the system down to the component is critical to SUT to ensure testing validity. Mods field people felt that as long as they stayed within their hold order boundary they could do what they needed to complete their work. Permission is not always obtained from the SUT system engineer to enter the equipment. Who has ownership and what ownership means is not understood and practiced in the field.

Effect of recent changes:

SUT has improved the level of component test control by development of a better component test matrix and creating a group to specifically support the system engineer with component testing. This system appears to be adequate to control test and retest requirements if all field work scope would be known to the system engineer. SUT has identified the need to perform reviews of completed work documents; changes to the program are pending.

Conclusion:

Control of work during concurrent field work (Modifications/Maintenance) and testing is weak in areas such as system ownership, knowledge of test status and knowledge of work scope changes.

Recommendations:

1. Strengthen administrative and jurisdictional control for systems under test or previously tested by SUT. Open better lines of communication between the test engineers and field workers. Educate workers, especially NE field engineers, to the issue of test invalidation during work performance.

2. Require SUT system engineers to review all applicable work documents upon completion of field work. They should be sensitized to additional work scope and work which might have affected systems outside of their responsibility. This review should include all applicable work, including minor maintenance.

V.C COMPONENT TESTING

Expectations of program/procedure

The Component Testing program at Watts Bar is intended to satisfy TVA's commitment to the requirements of 10CFR50 Appendix B and NRC Regulatory Guide 1.68 Revision 2, "Initial Test Programs For Water-Cooled Nuclear Power Plants." This Reg Guide defines the scope of testing required to satisfy NRC licensing criteria.

The Watts Bar Component Test program is designed to perform the type of testing referred to in the Reg Guide as "construction testing." This typically includes:

> "items such as initial instrument calibration, flushing, cleaning, wiring continuity and separation checks, hydrostatic pressure tests, and functional tests of components."

The responsibility for this testing is divided between two organizations at Watts Bar Site.

The Watts Bar Modifications organization is responsible for the performance of certain cleaning, hydrostatic pressure testing, and wiring continuity and separation checks. These are accomplished in accordance with approved procedures meeting all requirements of TVA's NQAP.

The Watts Bar SUT organization is responsible for the performance of initial instrument calibration, flushing, and functional testing of components. Controls for flushing and functional testing of components are prescribed in Startup Manual Procedures (SMP's). This latter category of testing (functional component testing) is the subject of this write up.

Component functional testing is intended to verify functional adequacy of the as constructed components. Together with the system level testing performed in the PTI's and ATI's, the entire set of required plant functions are demonstrated.

Significance of proper implementation

Proper definition, control, and implementation of component testing activities ensures the functional adequacy of plant components in their as installed condition.

Review results:

1. Scope of Component Testing (CT)

   The current programmatically required scope of electrical component testing does not include Point-to-Point schematic wiring verification. Prior to component testing of system 211 components, SUT management extended the scope of CT to include Point-to-Point schematic verification. In interviews with the test engineer, it was determined that this level of testing identified deficient conditions that would not have been discovered with the less rigorous functional testing that would normally have been utilized. However, it should be noted that these deficiencies would have been discovered in the Preoperational test for that system. As a direct result of this expanded scope of CT, system 211 Preop Test only encountered 20 DN's during performance of over 700 pages of step by step instructions. This quantity (and nature) of deficiencies was considered by the committee and all persons interviewed to be acceptable and comparable to similar tests conducted at other recent startup plants. **This was a good practice on the part of SUT and should be expanded to include Point-to-Point testing on selected high risk circuits.**

   The fact that electrical schematics and wiring diagrams were excluded from the formal Design Baseline Verification Program (DBVP) also lends support to the need for this type of Point-to-Point verification in the CT program. (See write up "Threshold On Number Of Problems Found During Preoperational Testing" for additional details on both the above issues.)

2. Lifted Leads and Jumpers Control

   The past process and procedures for conduct of CT did not require unique identification of lifted leads and reland verification of each one. Instead, there was a blanket statement signed as a part of each component test that the test engineer had relanded all leads lifted. This weakness did not fully document and ensure that each lifted lead was relanded and could have inadvertently created lifted leads in the circuit after CT was satisfactorily completed. This was possibly the case in two of the evaluated II's. SUT, as part of the corrective actions for II-22, **has required unique lifted lead identification and reland verification documentation be included in the CT generic procedures. This action should preclude any future problems resulting from improperly relanded leads during CT.**

3. <u>Identification And Control Of Retesting</u>

SSP's 7.53 and 6.02 prescribe and control the authorization and closeout of physical work accomplished at Watts Bar. Neither of these procedures requires the involvement of SUT in the review of completed work documents for the identification of testing requirements. SUT is involved in the DCN process at the front end, but this involvement is not the appropriate place to specify retest requirements. SUT need to be in the review of completed work documents (both WO's and WP's) to specify retest requirements. Interviews with MODS personnel and craft workers identified the fact that WP's frequently require revision while in the field. These revisions may change the scope of the WP and can also lift wires not within the original system involved. Out-of-system wire lifts are frequently required in electrical work and are usually just identified on Lift/Reland sheets attached to the WP by the craft. This practice, without SUT knowledge, can compromise the integrity of component and system testing. **Independent of this investigation, SUT was preparing changes to these SSP's to require SUT to review completed work documents for retest requirements. These changes should be implemented as soon as practical.**

In addition, during the earlier stages of the test program, tracking and identification of required component retesting was the sole responsibility of the SUT system engineer. The system engineer created and maintained the component test matrix for their assigned systems.

During the last two months, SUT has created a separate group of component test engineers, functionally reporting to the system engineers, who are responsible for the creation and maintenance of the component test matrices. These individuals, working under the direction of the system engineers, provide significantly increased attention to the tracking and performance of required retesting.

Conclusion:

This evaluation concluded that there were some direct programmatic weaknesses with the existing Component Testing (CT) program as structured. Some of the weaknesses were already being addressed as corrective actions to II's, FIR's, and etc. Others will require actions to strengthen the CT program in the areas noted. Additionally, some other external (non CT) site programs have weaknesses that result in lack of support for the CT program or can directly violate the integrity of component and preoperational testing. Enhancements in all of these areas are warranted.

Recommendations:

1. Formalize SUT intent to perform Point-to-point component testing on selected high risk circuits.

2. Finalize the unique identification and reland verification of lifted leads and jumpers during

component testing and trouble shooting as committed to in II-22. (No additional action should be initiated by this evaluation. The commitment to do this in II-22 is sufficient.)

3. Finalize the requested changes to SSP's 6.02 and 7.53 to include SUT in the review of completed work documents for retest requirements. (This action was initiated by SUT prior to, and independent of this evaluation.)

V.D THRESHOLD FOR PREOPERATIONAL TESTING PROBLEMS

Expectations and Significance of Area

The preoperational testing phase of a Regulatory Guide 1.68 Test Program is generally considered as the "final barrier" to demonstrate, to the extent practical, the capability of structures, systems, and components important to safety to meet performance requirements to satisfy design criteria. Post-fuel load startup testing provides an additional barrier through testing activities that confirm the design bases and demonstrate, to the extent practical, that the plant will operate in accordance with design and is capable of responding as designed to anticipated transients and postulated accidents. Although the regulatory guidance recognizes that preoperational testing has a primary objective of assuring that construction/installation of equipment are in accordance with design and that construction deficiencies may be encountered during testing, TVA considers that such challenges to the test program should be minimized wherever possible.

However, there are two unique historical conditions at WBN which place greater demand (especially for electrical systems) on the Component and Preoperational Test Programs (the "final barrier") to identify electrical configuration errors and past construction installation problems. These conditions (discussed herein) have been formally docketed with the NRC.

Review Results:

The types and number of test deficiencies encountered during System 211 Preop Testing was not unusual according to the System 211 Preop Test Engineer and other SUT personnel, especially considering the complexity and size (over 700 pages and 3820 instruction steps) of the test.

There were 20 test deficiencies documented during testing of PTI-211.01. Their general categories are as follows:

	Test Procedure Inadequacy	- 4 (DNs # 4, 6, 8, 15)
	Configuration/Wiring Problems	- 3 (DNs # 2, 7, 18)
	Hardware/Damage	- 4 (DNs # 9, 10, 11, 12)
*	Design	- 4 (DNs # 14, 17, 19, 20)
	Equipment Status	- 3 (DNs # 3, 5, 13)
	Personnel Error	- 2 (DN # 1, 16)

* Note: It was later determined that all 4 of these issues were non-problems requiring no corrective actions

In the test engineer's opinion, these deficiencies are commensurate with what he has experienced at other facilities. This general opinion was expressed by all of the SUT personnel interviewed. In the case of the category "Hardware/Damage," one item was the result of an incorrect model relay installed and three items were the result of obscure damage that either occurred during the preop test or would not be detectable during program walkdowns: light bulb socket damage, DS relay contacts needed adjustment to make contact, and a bent relay cover which caused pressure on armature contacts. In the category "Configuration/Wiring Problems," items identified included lifted/un-terminated/misplaced conductors and are the subject of Incident Investigations II-W-92-21 and -22.

Although these deficiencies were not considered significant, this is not to suggest that future preoperational testing should expect to see additional examples of improper modifications, failure to implement DCNs, etc. Moreover, it means that if these conditions do exist, we expect the rigor of the Preop test to expose these problems - as it did during PTI-211 testing. During the interviews, SUT personnel expressed that while its important to perform work correctly and that problem areas should be efficiently investigated, WBN would have a difficult time "staying the course" if testing is halted and extensive, resource-intense investigations are conducted each time an incorrect wiring termination is discovered during Preop testing. The decision as to how thoroughly future individual test deficiencies should be investigated/researched beyond resolution of the specific problem, usually depends on management preference. It is not expected that SUT will conduct an II for each wiring deficiency. Instead, current SUT program administrative controls provide the mechanism to evaluate test deficiencies against the criteria of SCARs, PERs, etc., to determine if additional investigation/emphasis should be applied. In addition, with implementation of the SUT DN trending, an opportunity becomes available to periodically evaluate the collective impact of test deficiencies, undesirable trends, etc.

The team also analyzed test deficiency data for four nonsafety-related Acceptance Test Instructions (ATIs) which had been completed in the field. These tests are: ATI 200-01 "6.9KV Common Boards A & B," ATI 205-01 "480V Turbine Building Common Boards A & B," ATI 225-01 "Condenser Circulating Water Pump Station Power System," and ATI 244-01 "Unit 1 Main Startup Transformers." These test instructions are far less complicated in terms of size and test content/methodology than the complex functional and logic circuits evaluated in PTI-211.01. There were 14 test deficiencies encountered during testing of these ATIs, 9 of which were considered hardware issues (burned out lights/resistors, bad breakers/connectors, etc.). One deficiency represented an apparent configuration problem in which a recorder point did not agree with the design or test instruction. Overall, as with deficiencies identified under PTI-211.01, these test deficiencies represent the types of items startup test engineers expect to find during testing. The test deficiency data for ATIs are tabulated below:

ACCEPTANCE TEST INSTRUCTIONS - NO. OF DEFICIENCIES

Category	ATI-200-01	ATI-205-01	ATI-225-01	ATI-244-01	Total
Procedure	1			1	2
Hardware	2	2	1	4	9
Config.			1		1
Equipment Status	1				1
Personnel	1				1

Unique Conditions

TVA recognizes that using testing as a final barrier to identify the types of wiring/configurational errors seen in PTI-211.01 should be minimized. Although such errors have routinely been identified under other Preop Programs (according to personnel interviewed), there are two unique conditions at WBN for which the WBN SUT Program is more heavily relied on to identify electrical configuration errors and past construction installation problems. These issues (WBN's DBVP and NRC Violation 390/86-21 "Inadequate Post-Modification Testing") have each been formally docketed with NRC.

The first condition involves TVA's awareness that disagreements between the actual plant electrical configuration for Unit 1 and as-constructed drawings may exist and that such problems will be identified by the WBN Test Program. Such conditions led to the development of the "Configuration Control" and "Testing" portions of the Design Baseline Verification Program (DBVP) Corrective Action Program (CAP). Under the Configuration Control portion of the DBVP CAP, walkdowns were conducted of primary safety-related portions of systems to provide assurance that Configuration Control Drawings (CCDs)/AC Drawings match the plant functional configuration. However, the CAP took specific exception for conducting walkdowns of Systems and components which could not be confirmed through walkdowns. Chiefly, this excluded walkdowns of electrical circuits depicted on wiring diagrams or schematics. In order to ensure functional performance consistent with the drawings for these electrical systems and components, the DBVP CAP committed to verify these items through the test program or through evaluation of results of previous testing.

The other condition at WBN which relies on testing to identify potential installation errors resulted from failure to perform adequate post-modification testing (PMT) for workplans performed on systems subsequent to original Preoperational Test activities (1982-1985 timeframe). TVA determined this could have affected approximately 5000 workplans on Unit 1 and committed to evaluate these items and perform any required PMTs. However, in a letter of September 17, 1992, TVA informed NRC that the review was not necessary due to TVA's decision to re-perform a Regulatory Guide 1.68 test program for Unit 1. TVA stated "...this new program provides a comprehensive approach to demonstrating the capability of plant equipment to perform its design function, including component testing..." In other words, examples of improper installations (misplaced wires, wrong device, etc.) may have occurred and gone undetected in the past due to not performing adequate PMTs. However, because of the thoroughness of the "new" test program, such items which adversely affect a system or component function would be identified and corrected.

Through conduct of TVA's test program, deficiencies may be encountered as a result of the above conditions. A test program designed and implemented to identify such problems meets TVS's DBVP commitments (approach approved by NRC) and meets regulatory requirements specified in RG-1.68, revision 2. As described in RG-1.68, R2, one of the two primary objectives of a suitable test program includes providing assurance that construction and installation of equipment have been accomplished in accordance with design. Further, the guidance recognizes that both design and construction deficiencies may be encountered during testing and that modifications may be required to correct these deficiencies.

Conclusion:

To date, the WBN SUT Program has identified test deficiencies of a type and number similar to other test programs. Although some of the deficiencies represent construction/installation inadequacies and should be minimized to the extent practical, the unique historical conditions at WBN place a greater emphasis (especially for electrical systems) on the Component and Preoperational Test Programs to be the "final barrier" to identify such problems. A test program implemented in this manner is consistent with the requirements of Regulatory Guide 1.68, revision 2.

The current SUT Program controls for reviewing deficiencies (DNs) against SCAR criteria and trending of DNs, etc., is either in place or under development. Although not tested in this assessment, these processes should be sufficient if applied in a timely manner in the investigation of test deficiencies.

Clearly, TVA is obligated to ensure current modification work is performed correctly and that carelessness/inattention leading to undetected installation problems is eliminated. In the same manner, Component Testing must be carried out such that equipment is restored to its as-constructed configuration depicted on plant drawings. Nonetheless, the problems identified during Preop testing were found because of the "built-in" rigorousness of the Preop Testing process itself demonstrating the effectiveness of this important "barrier." In terms of expectations, TVA does not consider the problems identified during ATI and PTI testing to be unusually excessive.

Recommendations:

1. More frequent trending and/or general determination of causal factors should be conducted for deficiencies encountered during the initial stages of testing. This will have the added benefit of exceeding the quarterly trend interval and providing data upon which decisions may be made regarding any additional evaluation/investigation of adverse trends.

V.E CHANGE PAPER

Expectations of Program/Procedures

The Design Change Notice (DCN) is the controlled document package used for identification and approval of necessary changes or clarifications to engineering documents. The Drawing Change Authorization (DCA) issued as a part of the DCN is the document that depicts authorized changes to a specific design drawing. Document Control Change Management (DCCM) is the on-line computer system for tracking change packages (DCNs), change paper (DCAs), and drawings. All site organizations use DCCM and the DCN process to determine the as-built and as-designed configuration of the plant.

Significance

Working knowledge of the use of DCCM and the DCN/DCA process is critical to the understanding of the approved design and as-built configuration for a component, system, or structure.

Results of Review

A review of Incident Investigations (II) II-W-92-019 through -022 and personnel interviews has revealed the following:

- No II root cause has been tied to the amount of or use of change paper.

- Concern that use of large amounts of change paper leads to inefficiencies and increases the opportunity for error. Examples are that (1) design engineers have to review all the change paper related to a drawing prior to initiating a new design change, and (2) startup test engineers have to review the change paper to identify component/system functional changes prior to writing ATI/PTIs.

- Concern that systems are turned over to the plant with unincorporated change paper against secondary drawings (within the current procedural time limitations) which may hinder maintenance/troubleshooting activities. For three of the five systems turned over to the plant, a review of the ATI developmental reference drawings was completed to determine the extent of unincorporated change paper. The results are:

  System 201 - Four drawings with six DCAs

  System 202 - Ten drawings with 31 DCAs

  System 244 - 12 drawings with 22 DCAs

  For System 245 and 288 there was not an ATI/PTI written and therefore a developmental reference drawing list for these systems does not exist to easily determine the extent of unincorporated change paper.

  By comparison, for System 211 the developmental reference drawings in the PTI were reviewed and there are currently 18 secondary drawings with a total of 85 DCAs unincorporated.

- Change paper was not a problem for System 200, since the major change was due to DCN M-12051 (Common Station Service Transformer Changeout) which primarily issued new drawings as DCAs. DCCM shows 30 DCNs listed against System 200.

- Change paper for System 211 was more extensive. The PTI lists 78 developmental reference drawings. A query of DCCM for these drawings shows that a total of 717 DCAs have been issued against these drawings since the DCN process began. During the May-June 1992 timeframe, during which the PTI was developed, it cannot easily be determined how many DCAs were unincorporated on the drawings during that time interval. Therefore, the amount of change paper that had to be reviewed was something less than 700 DCAs. It must be noted that the DCNs which contained these DCAs also contained other DCAs which did not affect these developmental drawings. DCCM shows approximately 90 DCNs listed against System 211; however, the significant changes were covered by about ten DCNs.

- Questions were raised as to how the experiences from System 200 and 211 can be used to develop an order of magnitude of the amount of change paper that will have to be reviewed during the ATI/PTI development process for the remaining systems. Was System 200 on one end and System 211 on the other end of the spectrum?

  One method to develop relative answers to these questions is to look at PTIs currently under development and by looking at the number of DCNs assigned to each system.

PTIs for Systems 213, 214, and 232 are currently under development. The startup test engineer writing these PTIs estimates that he researched approximately 25 DCNs each for System 213 and 214 and approximately 20 DCNs for System 232. Some of these DCNs are in the 200-300 page range. These DCNs had to be researched initially to determine what were the functional impacts that needed to be addressed in the PTI. The test engineer believes that the actual number of DCAs that affect the PTI will be a small portion of the total DCAs contained within the DCNs.

Secondly, DCCM was queried to determine numbers of open non-F DCNs and non-civil DCNs assigned by system. To use this data, the assumption is that the relative amount of change paper on a system basis is proportional to the amount of DCNs on that system. (200) and (211) indicates the relative position for these systems, although the current DCCM lists only a couple of open DCNs for these systems.

NUMBER OF DCNs	SYSTEMS
200-300	003, 030, 031, 062, 067, 068, 070
100-200	001, 026, 043, 063, 074, 077, 090
50-100	072, 082, (211)
Less than 50	213, 214, 232, All other systems (200)

By reviewing the above, the conclusion can be reached that change paper on System 211 was significantly above average and that there are probably about 15 systems remaining for which the change paper will be more than what was experienced for System 211.

- Concern that startup test engineers are not kept informed of work-in-progress design changes (advance authorized changes under F-DCNs).

Impact to Quality/Schedule

There is no indication that use of the change paper process has resulted in any degradation of quality, nor was change paper a contributing cause in the IIs being assessed.

It is recognized that repeated research of change paper during the design, modification, and testing process takes time. On system 211, the test engineer stated that the system research, procedure development, procedure review, and component testing took over twice sa long as estimated. He stated this was primarily due to the magnitude of change paper. However, there is no quantitative information available to assess impact to schedule.

Effect of Recent Changes

The DCN procedure has recently been revised to require that advance authorized DCNs used to change system logic, function, performance or operation or changes in termination points, setpoints, or protective device ratings be coordinated with the Startup and Test Manager and documented by signature on the AA-DCN.

Conclusion:

It is concluded that maintaining engineering configuration control thru use of change paper is a complex and time consuming process. However, there is no definitive data from the individual II's nor does this collective assessment show that there is a degradation of quality as a result of the large amount of outstanding change paper.

Due to the acknowledged complexity of the change paper process recommendations for enhancements are warranted.

Recommendations:

1. Establish goals for prioritizing the incorporation of design changes on secondary drawings for systems turned over and being turned over to the plant.

2. Identify and implement changes/support that Engineering can implement in the very near future that will benefit SUT.

3. Perform cost benefit study and implement alternatives by Engineering that will benefit SUT long term.

4. Enhance training for newly assigned personnel, such as startup test engineers and procedure writers, to provide a "hands-on" demonstration of the DCN/DCA process and how to use DCCM. This would be in addition to the current self-study requirements.

V.F WALKDOWNS

Expectations of Program/Procedures

The following four walkdowns are performed during the process of turning over permanent plant equipment, systems and areas:

- Damaged, loose, missing hardware (DLMH) walkdown performed by Modifications (MODS) prior to release to Startup and Test (SUT).

- Area walkdown of seismic Category I structures performed by MODS prior to turnover to the Plant Manager.

- System completion walkdown performed by MODS and SUT, with optional support from Operations, Maintenance, and System Engineering approximately 30 days prior to release of the system to SUT.

- System turnover walkdown performed by SUT with support from MODS, Site Engineering, Operations, System Engineering, and Maintenance approximately 30 days prior to turnover of the system to the Plant.

Requirements for DLMH and seismic Category I area walkdowns by MODS to identify DLMH are specified in MAI-1.9 - Damaged, Loose, or Missing Hardware. The requirements of this procedure apply to all safety related structures, systems or components required for Unit 1 operation. The procedure states that the process will be a "hands on" inspection of accessible systems, components, and structures to identify and disposition damaged, loose, or missing hardware. It also states that components will not be opened, and insulation will not be removed to perform these inspections. It provides very specific inspection criteria to be used during the walkdown.

Requirements for system completion walkdowns for release of permanent plant equipment, systems, and areas to SUT are specified in SMP-4.0 - Transfer of Jurisdiction. This procedure very clearly establishes that SUT has jurisdictional control over all transferred equipment, systems and areas. This procedure states that, as a minimum, all accessible features within the walkdown boundary will be inspected in accordance with walkdown guidelines specified in the procedure. The system walkdown guidelines in SMP 4.0 are very specific. For electrical circuit completion, the guidelines state that actual wire numbers should not be verified but the walkdown participants should simply check for completion and obvious problems (loose wires, damaged insulation, evidence of water, broken or cracked terminal blocks, etc.). It also states that sealed junction boxes will not be opened, but panels, logic cabinets, and breaker compartments which are accessible by hinged doors should be opened. The procedure emphasizes that the walkdown is a visual check only.

SMP 4.0 also addresses the walkdown for turnover of permanent plant equipment, systems and areas from SUT to the Plant. As a minimum, all accessible features within the walkdown boundary will be inspected using the same guidelines as the turnover walkdown from MODS to SUT.

Significance of Area

Identification of items listed in the walkdown inspection criteria contained in both MAI-1.9 and SMP-4.0 prior to turnover of the equipment, systems or areas to SUT or to the Plant is critical to the startup schedule. Although the component tests and preoperational tests will identify functional problems, other problems which were not identified during the walkdowns could impact the long term ability of equipment to perform its safety function.

Review Results

The QA Monitoring organization identified several damaged, loose or missing hardware problems with System 202. These problems were documented on WBFIR920087 and should have been identified during walkdowns conducted when the system was turned over to SUT or to the Plant.

The System 211 turnover to the Plant walkdown identified missing, damaged or loose hardware and other items which required correction.

The guidance for identifying DLMH in SMP-4.0 is not in as much detail as the guidance in MAI-1.9.

MODS personnel who performed the initial system completion walkdowns for release of permanent plant equipment/systems to SUT did not have a clear understanding of the SUT or Plant expectations for the inspection level of detail on DLMH walkdowns.

SUT acceptance criteria for systems is primarily focused on problems which could impact functioning of the system rather than identifying all loose, missing or damaged hardware.

Impact on Schedule

For the problems which have been identified, there is no significant impact on the schedule. However, if problems are not identified in a timely manner, an impact of the startup schedule is likely.

Conclusion:

Generally, the walkdown program is satisfactorily defined and implemented. The program is primarily designed to be a visual check for DLMH on accessible features, and there are differences in the level of detail for identifying DLMH in the two procedures which describe walkdown activities. The walkdown program is not designed to reverify MODS installation or original construction activities. Initially, SUT walkdown personnel were more focused on identifying items which could impact the function of the component/system rather than identifying all DLMH. There is no formal feedback loop to inform MODS personnel of problems which are identified later in the process. Customer (Plant) acceptance criteria has not been considered in the turnover of systems to SUT which resulted in the identification of problems later in the process.

Recommendations:

1. SMP-4.0 should be revised to strengthen and clarify walkdown criteria to more effectively reflect plant requirements. This criteria should also be applied to normally unaccessible areas/components when opened for SUT, Maintenance or Modifications activities.

2. Establish feedback loop from SUT to MODS for the results of lessons learned during walkdowns and startup test activities.

V.G Feedback on Lessons Learned

Expectations:

Feedback on lessons learned are expected to be

° timely,
° relevant and
° reach all affected individuals.

Significance:

Effective feedback results in improved personnel performance by preventing the recurrence of the same event. Preventing repeat problems results in increased personnel availability since personnel are not administratively prevented from work by stop work orders and investigation of repeat problems.

Review Results:

Interviews conducted during this assessment identified that lessons learned from previous problems were not always communicated to all the affected individuals. That is, for the incident investigations conducted, the corrective actions were to specifically feedback lessons learned to involved individuals with the general communication of lessons learned dependent on the Nuclear Experience Review (NER) and Training Programs. The NER Program provides information to site management that can be disseminated to their personnel. However, the effectiveness of condensing and communicating the pertinent information is less than desirable in some cases.

Bulletins and supervisory sessions were identified in the 1991 Employee Opinion Survey for WBN as the most accepted communication methods. Feedback on a recent bulletin identified that less than 50% of site personnel directly affected were aware of the bulletin. Supervisory sessions appear to be most effective and accepted means of communication. Such sessions are routinely held by site supervision. However, it is critical that relevant information in the appropriate form is provided to supervisors for dissemination at such sessions. Such information can be provided to supervision through methods established by each organization. For example, Modifications has established an information center and other organizations simply use a mailbox approach. Information provided to supervision on event should be timely, relevant and delineate causes, corrective actions taken and management expectations.

Impact to quality/schedule:

Recurrence of similar problems.

Conclusion:

Methods used to provide feedback of lessons learned to WBN personnel have not ensured timely communication to all affected personnel.

Recommendation:

1. Improve information feedback process that is provided to supervisory personnel on WBN events for dissemination to their personnel.

VI. CONCLUSIONS/RECOMMENDATIONS/ACTION PLAN

The management assessment team concluded that the startup testing program as designed and implemented is consistent with the intent of Regulatory Guide 1.68, revision 2. In particular, the program is designed to confirm the plant design basis and demonstrate to the extent practical that the plant will operate/respond to meet performance requirements to satisfy design criteria. Additionally, the regulatory guidance also recognizes that deficiencies related to design and construction may be found during conduct of the testing and that system modifications and corrective actions may be required to correct these deficiencies. It is WBN management's decision in forming this assessment team to look hard at our programs and determine if recommendations can/should be made which will strengthen early identification barriers. This will ensure that the barriers will provide maximum benefit and as a goal lessen the burden on the test program finding too many problems. In the opinion of this team which included three engineers with startup experience, the number of problems found during System 211 is not excessive, however, some recommendations can be made which will benefit the project. This is particularly timely in that the WBN Project has only completed testing on its first safety-related system. Listed below are the composite recommendations developed by this team after consideration was made for the following:

- The composite effect of all the problems on system 211 and related non-safety systems tested to date.
- Due consideration was given to line management initiatives in self improvement and to specific actions required as a result of the incident investigations.

VI.A Conclusions:

1. The number of problems identified and resolved during component and preoperational systems testing appears to be normal for a construction plant. The basis of this conclusion is established thru interviewing management personnel and test engineers experienced at recently completed NTOL (Near Term Operating License) facilities.

2. In general, the assessment team concluded that management has implemented and/or aggressively pursued process improvements in all areas. Numerous examples are listed in each section of the report and many are based on recent experience resulting from testing conducted to date.

3. The nature of the problems identified during component testing and preoperational testing are consistent with the intent of Regulatory Guide 1.68, revision 2. The twenty (20) deficiencies notices (DNs) (16 were valid) written during System 211 preoperational testing are not excessive considering the size and complexity of the test.

4. The overall modification implementation process is adequate, however isolated personnel failures have occurred. Overview assessment of these individual failures from a collective standpoint indicated that a contributing factor to these events is the lack of consistent understanding of expectations during the performance of second party and QC verifications by the involved parties.

5. Control of work during concurrent field work (Modifications/Maintenance) and testing is weak in areas such as system ownership, knowledge of test status and knowledge of work scope changes.

6. This evaluation concluded that there were some direct programmatic weaknesses with the existing Component Testing (CT) program as structured. Some of the weaknesses were already being addressed as corrective actions to II's, FIR's, and etc. Others will require actions to strengthen the CT program in the areas noted. Additionally, some other external (non CT) site programs have weaknesses that result in lack of support for the CT program or can directly violate the integrity of component and preoperational testing. Enhancements in all of these areas are warranted.

7. To date, the WBN Test Program has identified test deficiencies of a type and number similar to other test programs. Although some of the deficiencies represent construction/installation inadequacies and should be minimized to the extent practical, the unique historical conditions at WBN place a greater emphasis (especially for electrical systems) on the Component and Preoperational Test Programs to be the "final barrier" to identify such problems. A test program designed and implemented in this manner is consistent with the requirements specified in RG-1.68 Revision 2.

8. Clearly, TVA is obligated to ensure current modification work is performed correctly and that carelessness/inattention leading to undetected installation problems is eliminated. In the same manner, component testing must be carried out such that equipment is restored to its as-constructed

configuration depicted on plant drawings. Nonetheless, the problems identified during Preop testing were found because of the "built-in" rigorousness of the Preop Testing process itself demonstrating the effectiveness of this important "barrier." In terms of expectations, TVA does not consider the problems identified during ATI and PTI testing to be unusually excessive.

9. Maintaining engineering configuration control thru use of change paper is a complex and time consuming process. However, there is no definitive data from the individual II's nor does this collective assessment show that there is a degradation of quality as a result of the large amount of outstanding change paper. Due to the acknowledged complexity of the change paper process recommendations for enhancements are warranted.

10. Generally, the walkdown program is satisfactorily defined and implemented. The program is designed to be a visual check for DLMH on accessible features, and there are differences in the level of detail for identifying DLMH in the two procedures which describe walkdown activities. The walkdown program is not designed to reverify MODS installation or original construction activities. Initially, SUT walkdown personnel were more focused on identifying items which could impact the function of the component/system rather than identifying all DLMH. There is no formal feedback loop to inform MODS personnel of problems which are identified later in the process. Customer (Plant) acceptance criteria has not been considered in the turnover of systems to SUT which resulted in the identification of problems later in the process.

11. Methods used to provide feedback of lessons learned to WBN personnel have not ensured timely communication to all affected personnel.

VI.B Recommendations:

1. Reemphasize purpose and methodology of second party verifications to the appropriate Modifications and Nuclear Engineering field engineering personnel. (V.A)

2. Strengthen administrative and jurisdictional control for systems under test or previously tested by SUT. Open better lines of communication between the test engineers and field workers. Educate workers, especially NE field engineers, to the issue of test invalidation during work performance. (V.B)

3. Formalize SUT intent to perform point-to-point component testing on recently modified safety related circuits. (V.C)

4. Finalize the requested changes to SSP's 6.02 and 7.53 to include SUT in the review of completed work documents for retest requirements. (V.B, V.C)

5. Conduct more frequent trending and/or general determination of causal factors for deficiencies encountered during startup testing. (V.D)

6. Establish goals for prioritizing the incorporation of design changes on secondary drawings for systems turned over and being turned over to the plant. (V.E)

7. Identify and implement changes/support that Engineering can implement in the very near future that will benefit SUT. (V.E)

8. Perform cost benefit study and implement alternatives by Engineering that will benefit SUT long term. (V.E)

9. Enhance training for newly assigned personnel, such as startup test engineers and procedure writers to provide a "hands-on" demonstration of the DCN/DCA process and how to use DCCM. This would be in addition to the current self-study requirements. (V.E)

10. Revise SMP-4.0 to strengthen and clarify walkdown criteria to more effectively reflect plant requirements. Apply this criteria to normally unaccessible areas/components when opened for SUT, Maintenance or Modifications activities. (V.F)

11. Improve information feedback process that is provided to supervisory personnel on WBN events for dissemination to their personnel and include results of lessons learned during walkdowns and startup test activities. (V.A, V.F, V.G)

Implementation of the above recommendations will strengthen the barriers in the areas of Modifications, system completion walkdowns, and component test as shown in the shaded regions of Attachment IV.

VI.C ACTION PLAN (Numbering coincides with recommendations)

		Action	Responsible Organization	ECD
	1.	Provide specific guidance on the purpose and methods of performing second party verifications to appropriate Modifications and NE Field Engineering Personnel.	MODS/NE	11/20/92
*	2a.	SUT will conduct a coaching session with test engineers on their responsibility for control of work on their assigned systems.	SUT	12/18/92
*	2b.	SUT will issue a Startup Directive addressing field identification of equipment and systems under SUT jurisdiction.	SUT	12/18/92
*	2c.	Provide specific guidance for NE Field Engineers and Craft explaining the potential for, and ways to avoid, test invalidation during the workplan implementation process.	NE/MODS	11/20/92
	3.	SUT will formalize guidance to test engineers identifying criteria for identification of "high risk" circuits that will require point-to-point testing during component testing.	SUT	12/18/92
*	4.	Revise SSP's 6.02 and 7.53 to involve SUT in the review of completed work documents for retest requirements.	Maint/MODS	12/18/92
	5.	SUT will perform monthly trending of Test Deficiencies during the next three months. After that time, monthly trend reports may be continued (in excess of the quarterly requirement) if warranted.	SUT	12/18/92
	6.	NE will establish goals for prioritizing the incorporation of design changes on secondary drawings for systems turned over and being turned over to the plant.	NE	11/20/92
	7.	NE to identify near term actions to support SUT in ATI/PTI development.	NE	11/20/92
	8a.	NE to provide input for cost benefit study.	NE	11/20/92
	8b.	SUT to perform benefit analysis.	SUT	12/04/92

8c.	NE to develop implementation plan based on cost benefit analysis.	NE	12/18/92
9a.	NE will issue notification to all site organizations on the availability of training sessions covering the DCN/DCA process and the use of DCCM.	NE	11/20/92
9b.	Provide first training session.	NE	12/18/92
10a.	SUT will revise SMP--4.0 to clarify and/or strengthen walkdown criteria.	SUT	12/18/92
10b.	Modifications will review and revise, as necessary, modifications procedures to require documented inspections, against the criteria of SMP-4.0, of normally inaccessible areas that are opened or uncovered during the course of workplan implementation.	MODS	12/18/92
10c.	Maintenance will review and revise, as necessary, maintenance procedures to require documented inspections, against the criteria of SMP-4.0, of normally inaccessible areas that are opened or uncovered during the course of work order or work request implementation.	MAINT	12/18/92
11.	Define responsibilities and designate organizational representative(s) as key point(s) of contact to collect, assemble and disseminate critical information, i.e. lessons learned, to all affected individuals in their organization(s).	ENG & MODS/ PLANT/QA	12/04/92

[signature]
PLANT

[signature]
MODIFICATIONS

W L Elliott
NUCLEAR ENGINEERING

[signature]
STARTUP AND TEST

J. A. Crittenden
for SITE QUALITY

[signature]
ENGINEERING & MODIFICATIONS

* These items required to be completed prior to implementation of next safety-related preoperational test.

VII. INTERVIEWS/DOCUMENTATION

VII.A Team Makeup

Management Assessment Team Members

N.C. Kazanas	Team Lead, Completions Assurance
J. Ballowe	Startup and Test
J.A. Crittenden	Quality Assurance
S.W. Crowe	Quality Assurance
S.J. Krupski	Plant Maintenance
C.C. Lyke	Nuclear Engineering - Electrical
W. Skiba	Operations (HPES)
S.F. Tanner	Modifications
C.W. Touchstone	Licensing

VII.B **Persons Interviewed**

Incident Investigations	- *R. Tolley* - *W. Skiba* - *R. Rieger*
Modifications Program and Walkdowns	- *A. McLemore* - *S. Tanner*
Component Test Program	- *T. Ford* - *R. Nelson*
Startup Walkdowns (SMP-4.0)	- *B. Huffaker*
Startup Work Control Process	- *D. McConnell*
Drawing Process/Design Change Control	- *G. Mauldin* - *D. Osborne*
NE SPAE Process	- *J. Hinman*
Startup Management Perceptions	- *M. Bellamy*
Engineering Management Perceptions	- *W. Elliott*
Workplan Process - Workplan writer - Field Engineer	- *D. Cooper* - *C. Floyd* - *R. Cox*

Startup Test Engineers (System 211)	-	*J. Balitski*
(System 200)	-	*P. Law*
Component Test Group (Electrical)	-	*A. Carpenter*
Construction Completion Team		
Craft	-	*K. Allen*
	-	*B. Smith*
Foreman	-	*D. Parris*
QC Inspector	-	*H. Wood*
	-	*K. Sampler*
Field Engineer	-	*C. Patterson*
	-	*M. Jones*

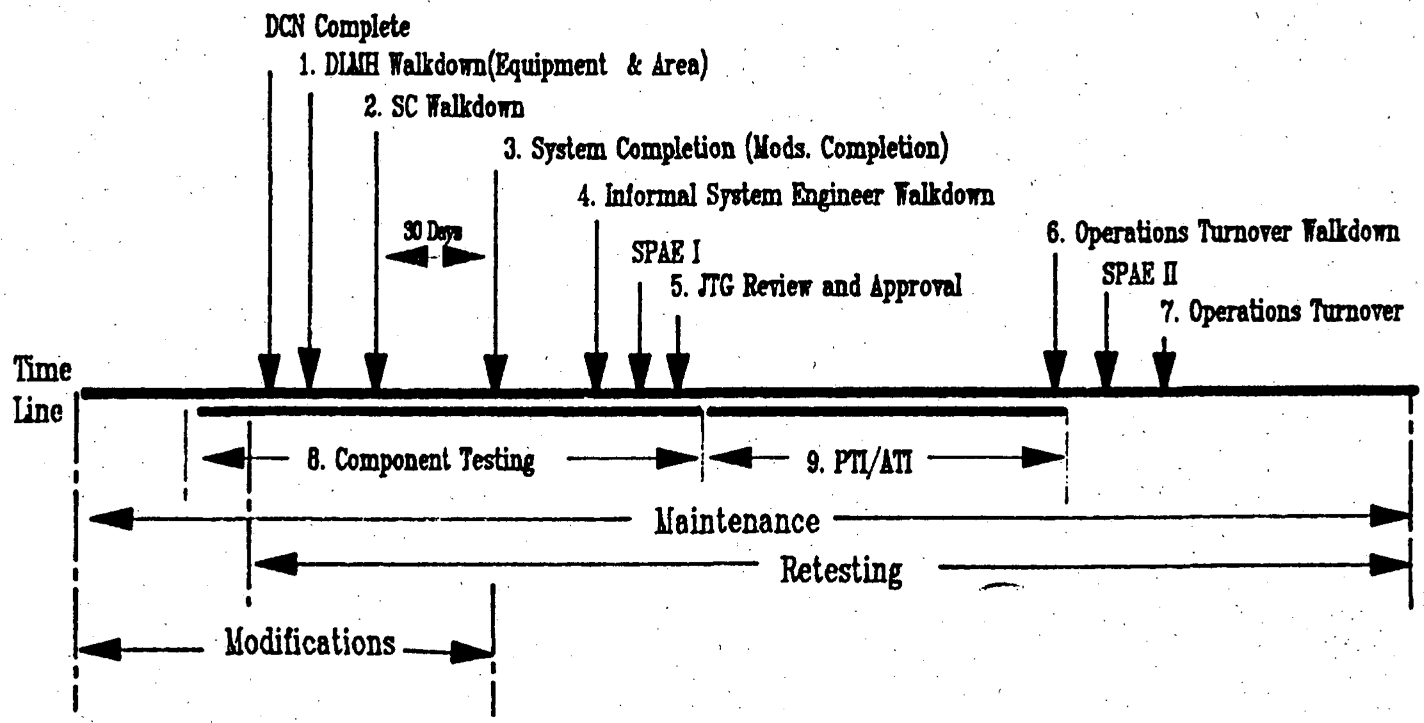
VII.C Supporting Documentation

MAI-1.9, R1	Damaged, Loose, or Missing Hardware
SMP-4.0, R5	Transfer of Jurisdiction
EAI-3.07, R3	System Plant Acceptance Evaluation
SSP-12.09, R6	Incident Investigation and Root Cause Analysis
Sys 211	Test Deficiency Notices
Sys 211	Walkdown Data (SUT to Operations)
WBFIR920087	
RG 1.68, R2	

NRC Inspection Report 50-390/92-32 and 50-391/92-32
Monthly QC Inspection Trend Data
Incident Investigations II-W-92-019 thru 022
Design Baseline Verification Program CAP
Test Deficiency Logs - ATI-200-01, 205-01, 225-01, 244-01

Attachment 1

CHRONOLOGICAL ORDER OF SYSTEM READINESS



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ATTACHMENT 2

DEFINITIONS OF ACTIVITIES

DLMH Walkdowns	Damage, Loose, Missing Hardware walkdowns (equipment and areas) are performed per MAI-1.9 by Modifications. Wiring configuration and labels are not verified.
SC Walkdowns	System Completion walkdown is performed by SUT, Modifications, Operations, Facilities and Technical staff per SMP-4.0. The walkdown looks at everything that is accessible -- visually looks for obvious deficiencies. Single line drawings and checklists are used.
System Completion	This is the point in the process where modifications are complete. A system completion checklist is completed based on previous walkdowns and resolution of MTS items and is signed by involved site organizations.
Informal System Engineer Walkdown	System is walkdown by the system engineer per SMP-9.0 looking for any adverse conditions that could affect pre-operational testing. A test matrix, MTS, MTS exception forms, test procedure and drawing change paper are assembled for presentation to the Joint Test Group (JTG).
Joint Test Group	Multi-organization group that reviews test package and recommends approval to perform pre-operational and acceptance testing.
Operations Turnover Walkdown	Final walkdown of system for turnover to Operations conducted per SMP-4.0.
Operations Turnover	System turnover to Operations.
Component Testing	Performed by functional testing. Hand-over-hand, continuity and point-to-point testing is performed if problems are identified or system is safety related with extensive modifications.

- All components are identified on system component test matrix.
- Generic test procedures are used.
- Completed test packages are reviewed by the system engineer then by SUT management before they are sent to the vault.
- MI's performed after 9/01/91 are valid for component testing.

- SUT looks at work orders and plans upon issue to identify activities that could require retesting.

- DCN review has a retest control form for changes made after pre-operational testing is performed. SUT sees DCNs and implementing workplans; however, may not see FDCNs, AAs and implementing workplans.

Design Nuclear Engineering process for changes to plant systems. Process is performed per approved instructions that require independent peer, management and QC reviews.

SPAE I System Plant Acceptance Evaluation I is a documentation review process performed by Nuclear Engineering per EAI-3.07 to ensure all engineering process for the system is done. Completed for presentation to the JTG for approval for Pre-operational testing.

SPAE II Completion of engineering documentation and drawings as required by EAI-3.07 for system turnover to Operations.

Maintenance Maintenance activities are controlled by approved plant procedures that require 2nd party and QC verifications as appropriate to ensure technical and operating requirements are met.

Modifications Modification activities are controlled by approved plant procedures that require 2nd party and QC verifications as appropriate to ensure technical and operating requirements are met.

Retesting Retesting is controlled as part of design, maintenance and modification activities. Approval of work orders and plans by SUT and use of the component test matrix are barriers to ensure post modification and maintenance testing is performed.

Attachment 3

SYSTEM COMPLETION AND TURNOVER EVENT AND ACTIVITY CHART

Event	DLMH WD	Design	Modification P	Modification I	Modification V	Modification C	SC walk-down	CT	Maint/Mods Followup	SPAE I	PTI	SPAE II	Ops Turnover Walkdown
II-W-92-019				miss*	miss			miss	Hit		Barrier		
II-W-92-020				miss*	miss			miss	Hit		Barrier		
II-W-92-021													
- Lifted lead											Hit		Barrier
- Left circuit			miss*			miss					Hit (no tech impact)		
- Amber lite								miss	miss*		Hit		
II-W-92-022								miss*			Hit		Barrier
Sneak Circuit (in-process)				miss*	miss			Hit			Barrier		
Design Errors		miss*						Hit					
Trip Counter Cam				miss*				Hit					
DNs													
- Damaged Socket											Hit		Barrier
- Bent Contact											Hit		Barrier
- Damaged relay Cover											Hit		Barrier
- Incorrect Relay											Hit		
Walkdowns													
- System 202	miss						miss						miss ---- Hit**
- System 211	miss						miss						Hit

* Denotes when event occurred
Events with no * have unknown time of occurrence
** Denotes hit happen after system turnover
(P = planning, I = implementation, V = verification, C = closure)

miss -- barrier that failed to detect problem
Hit -- problem discovery
Barrier -- an activity that by design should have identified the problem

ATTACHMENT 3

SPECIFIC EVENTS

II-W-92-019

Incorrect wire terminations was caused by the craftsman, 2nd party verifier and QC failing to ensure that the task was correctly performed. The problem was identified during maintenance follow-up activities. The problem was not identified during component testing since SUT did not have an adequate method to track change paper effects on component testing. The problem would have been identified by PTI.

II-W-92-020

Wiring terminated to the wrong fuses was caused by the craftsman, 2nd party verifier and QC failure to ensure the fuses were wired to the correct side of the bus. The problem was identified during maintenance follow-up activities. Component testing did not identify problem. PTI would have identified the problem.

II-W-92-021

Addressed a lifted lead, a relay circuit not removed and an amber light. The cause for the lifted lead was undetermined; however, based on pre-operational testing it was determined that the wire had to be lifted during a maintenance type activity after component testing was performed. During trouble shooting due to the lifted lead, a relay circuit that was to be removed was identified as still in place. The cause of the relay circuit not being removed was failure of the workplan preparer and verifier to ensure all referenced changes were included in the workplan. Component and pre-operational testing were not designed to identify this problem since the relay circuit was to have been removed. The amber light was caused by failure of craftsmen to ensure that the replaced switch was properly wired. The amber light was replaced during pre-operational activities.

II-W-92-022

Two lifted leads were not reterminated after they were lifted during trouble shooting by SUT. The cause was failure to have an adequate method to track which leads were lifted and that they were properly relanded. This problem was identified during component testing.

ATTACHMENT 3

Sneak Circuit

This problem was caused by failure by craftsmen and 2nd party verifier to ensure task was properly performed and verified. The problem was identified during component testing.

Design Errors

These were caused by failure by the designer and independent verifier to ensure the design was correct. The design errors were identified during component testing.

Trip Counter Cam

The trip counter cams were removed and replaced in the opposite position due to failure of the craftsmen to ensure the task was correctly performed. The problem was identified during component testing.

Deficiency Notices

These were identified during pre-operational testing as expected. Two of these problems occurred during the preoperational test; the cause was undetermined for the other two issues (contacts which needed adjustment and the incorrect relay). More extensive component testing may have identified the relay problem and bent contacts.

Walkdowns

System 202 walkdown was performed after turnover to operations. The conditions found varied from missing screws in terminal blocks at spare points to wrong identification labels on wire terminations. The miss labelled wires are an existing condition where point-to-point wire verifications were not performed as part of the startup testing activities.

System 211 walkdown was performed for turnover to operations. The conditions found were minor and varied from a loose screw in a relay cover to missing and wrong size washers.

ATTACHMENT IV

SYSTEM COMPLETION AND TURNOVER EVENT AND ACTIVITY CHART

Event	DLMH WD	Design	Modification P	Modification I	Modification V	Modification C	SC walk-down	CT	Maint/Mods Followup	SPAE I	PTI	SPAE II	Ops Turnover Walkdown
II-W-92-019				miss*	miss			miss	Hit		Barrier		
II-W-92-020				miss*	miss			miss	Hit		Barrier		
II-W-92-021													
- Lifted lead											Hit		Barrier
- Left circuit			miss*			miss					Hit (no tech impact)		
- Amber lite								miss	miss*		Hit		
II-W-92-022								miss*			Hit		Barrier
Sneak Circuit (in-process)				miss*	miss			Hit			Barrier		
Design Errors		miss*						Hit					
Trip Counter Cam				miss*				Hit					
DNs													
- Damaged Socket											Hit		Barrier
- Bent Contact											Hit		Barrier
- Damaged relay Cover											Hit		Barrier
- Incorrect Relay											Hit		
Walkdowns													
- System 202	miss						miss						miss ---- Hit**
- System 211	miss						miss						Hit

Shaded area denote enhanced barriers in activity

* Denotes when event occurred
Events with no * have unknown time of occurrence
** Denotes hit happen after system turnover
(P = planning, I = implementation, V = verification, C = closure)

miss -- barrier that failed to detect problem
Hit -- problem discovery
Barrier -- an activity that by design should have identified the problem