50-390

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 18, 1995

See Reports

APPLICANT: Tennessee Valley Authority

FACILITY: Watts Bar Nuclear Plant, Unit 1

SUBJECT: TVA MEETING WITH NRC TO DISCUSS THE FACTUAL CONTENT OF NRC DRAFT REPORT ON WATTS BAR QUALITY AND QUALITY ASSURANCE (TAC NO. M91559)

Reference: NRC MEETING NOTICE OF JUNE 16, 1995

On June 20, 1995, the TVA staff met with the NRC staff to brief NRC on the status of its "Reasonable Assurance Assessment" report for Watts Bar; and to discuss TVA's comments on NRC's draft report of June 16, 1995, entitled, "Overall Assessment of Watts Bar Quality and Effectiveness of Quality Assurance." Enclosure 1 is a list of meeting attendees.

TVA briefed NRC on its reasonable assurance assessment for Watts Bar. Enclosure 2 contains the view-graphs provided by TVA in support of its briefing. The report provides TVA's assessment of Watts Bar beginning with the condition of the plant at the time of the NRC staff's letter of September 17, 1985, asking that, pursuant to 10 CFR 50.54(f), TVA provide information about it's nuclear program problems of mid-1985. TVA discussed the status of its corrective actions outlined in its Nuclear Performance Plans, including Corporate Nuclear Performance Plan and Watts Bar Nuclear Performance Plan. TVA indicated that in addition to the corrective actions outlined in its Nuclear Performance Plans; it will also examine five critical activities of design, construction, startup testing, operational readiness, and oversight that are essential for establishing reasonable assurance that Watts Bar, Unit 1, is ready to load fuel. TVA indicated that its report will be completed by June 28, 1995. In response to NRC staff's suggestions, TVA indicated that it will consider seeking comments from past TVA employees.

TVA described its plans to perform a second hot functional test (HFT 2) of Watts Bar, Unit 1 starting in mid-July 1995. HFT 2 is intended to test the systems and components as a "full dress rehearsal," simulating the expected fuel load conditions.

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TVA stated that it has performed a review of NRC's draft report, "Overall Assessment of Watts Bar Quality and Quality Assurance" (Enclosure 3). TVA found the draft report to be comprehensive and factually correct, except for minor items related to the circumstances surrounding its construction "stop work" order of 1990. NRC staff indicated that it will reexamine the draft report and reconcile TVA's comments in the final report.

Original signed by

Mohan C. Thadani, Senior Project Manager
Project Directorate II-3
Division of Reactor Projects-I/II
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosures: 1. Attendees List
2. TVA view-graphs
3. Overall Assessment

cc w/enclosures: See next page

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50-390 TVA WATTS BAR 1

TVA MEETING WITH NRC TO DISCUSS FACTUAL CONTENT OF NRC DRAFT RPT ON QA

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ENCLOSURE 2

NRC/TVA MEETING

JUNE 20, 1995

Rockville, MD.

REASONABLE ASSURANCE ASSESSMENT

AGENDA
NRC/TVA MEETING
REASONABLE ASSURANCE ASSESSMENTS
JUNE 20, 1995

- NRC Opening Remarks
- TVA Opening Remark
- TVA Discussion of Preliminary Results of Draft Assessment
  - Overview of Assessment
  - Assessment of Design
  - Assessment of Construction
  - Assessment of Operational Readiness
  - Assessment of Oversight
  - Assessment of Programmatic Improvement
  - Open Discussion of Other Areas of Assessment
  - Status and Schedule
- Discussion of Factual Content of Draft NRC Assessment
  - NRC Discussion
  - TVA Comments
- Concluding Remarks

ASSESSMENT METHODOLOGY--THREE LEVELS OF REVIEW

Regulatory Review

This element of the assessment methodology (discussed in Section III of the RAAR) provides a "horizontal review" of plant activities -- a more traditional approach to assuring compliance with appropriate NRC regulations and TVA commitments. It begins with the detailed assessment of the condition of TVA and WBN in the wake of the NRC Staff's 1985 10 CFR 50.54(f) request for information and TVA's decision to delay licensing of WBN and shutdown its operating units. These assessments, documented in Volumes 1 and 4 of the Nuclear Performance Plan (NPP), establish the steps necessary to correct TVA's problems and demonstrate WBN's readiness to load fuel and begin operations. Among the key steps specified in the NPPs are correcting identified issues (e.g., CAPs/SPs), fulfilling normal licensing activities, addressing problems identified during the process, and performing specified oversight reviews and operational assessments. The NRC Staff concurred with the NPPs in a number of SERs.

Major Activity Review

This aspect of the assessment methodology, discussed in Section IV of the RAAR and its constituent Enclosures 1 through 5, examines five critical activities necessary to establish reasonable assurance of readiness to load fuel and commence operations: Design; Construction; Startup Testing; Operational Readiness; and Oversight. It seeks to assess separately the readiness of each major activity by focusing vertically on the activity and its components/structure. The depth of review accorded each component is dependent on the nature and scope of problems associated with it. This approach yields greater detail about the critical activities listed above, thus complementing the regulatory approach of Section III.

Significant Program/Issue Review

This final element of the assessment methodology, discussed in Section V of the RAAR and Enclosures 6 through 9, examines in greater detail select generic programs/issues that have been of significant concern in the past at WBN. The scope of this portion of the assessment encompasses Employee Concerns, Corrective Action Program, Closure Assessment, and Programmatic Improvement. Unlike the previous two approaches, this aspect of the assessment methodology is "supportive" in nature and is not intended to be a "stand alone" approach.

OUTLINE OF REASONABLE ASSURANCE ASSESSMENT REPORT

I. EXECUTIVE SUMMARY

II. INTRODUCTION AND BACKGROUND

III. REGULATORY REVIEW ASSESSMENT--ASSESSES ASSURANCE OF COMPLETION OF REQUIRED ITEMS NOTED IN NPP AND SER

- COMPLIANCE WITH REGS. AND COMMITMENTS
- STRUCTURE DOCUMENTED IN VOL. IV AND RELATED STAFF SER
- INCLUDES CORRECTION OF IDENTIFIED ISSUES (E.G., CAPS), FULFILLMENT OF NORMAL LICENSING ACTIVITIES, ADDRESSING NEW PROBLEMS, AND PERFORMING SPECIAL OVERSIGHT REVIEWS AND OPERATIONAL ASSESSMENTS

IV. ACTIVITY ASSESSMENT--EXAMINES CRITICAL ACTIVITIES

- ENCLOSURE 1--DESIGN/ENGINEERING
- ENCLOSURE 2-- CONSTRUCTION
- ENCLOSURE 3--STARTUP TESTING
- ENCLOSURE 4--OPS. READINESS
- ENCLOSURE 5--OVERSIGHT

V. SPECIAL AREA ASSESSMENT--ASSESSES SIGNIFICANT ISSUES--NOT A "STAND ALONE" APPROACH

- ENCLOSURE 6--EMPLOYEE CONCERNS
- ENCLOSURE 7--CORRECTIVE ACTION PROGRAM
- ENCLOSURE 8--CLOSURE ASSESSMENT (TMI ACTION ITEMS)
- ENCLOSURE 9--ASSESSMENT OF PROGRAMMATIC IMPROVEMENTS OVER TIME

VI. CONCLUSIONS

SUMMARY OF CONCLUSIONS

Upon completion of current activities and associated corrective actions, there is reasonable assurance that from a design, construction and operational perspective, WBN will be ready to load fuel and begin operations. Support for this conclusion is compelling and includes the following significant findings:

- The extent of oversight scrutiny at WBN is unprecedented and has resulted in a multi-layered, fine-meshed net of inspection coverage.

- By any reasonable plant-wide standard, the quality of work at WBN has improved steadily and significantly. While there have been some fluctuations in performance over time, they have become narrower and more focused in scope. On a plant-wide scale, current performance is clearly acceptable and continues to improve.

- The operational transition (i.e., from a construction site to an operating plant) is being accomplished using processes, procedures and people that have been proven to be effective at other TVA nuclear sites.

- Further confirmation of WBN's readiness to load fuel will be provided by NA&L's ongoing IDI and the pending HFT 2. Significantly, the RAAR Team has identified areas for additional focus during the IDI, thus refining its focus to better evaluate areas of greater potential problems.

SECTION III
REGULATORY ASSESSMENT REVIEW

SECTION III

REASONABLE ASSURANCE ASSESSMENT REPORT
REGULATORY REVIEW OF THE WBNPP, VOLUME 4 AND PAC/AQ

Background

- From a regulatory perspective, WBNPP Vol. 4 delineates what is necessary to complete the WBN licensing process.

- In response to NRC 50.54(f) request, during 1985-89 TVA conducted detailed reviews of the plant -- Watts Bar Task Force, Watts Bar Program Team.

- As a result of reviews, actions/commitments necessary to confirm WBN design, construction, and operational readiness were documented in WBNPP, Vol. 4, and associated Staff SER.

Overview of Methodology

- Purpose of Section III: Assess completion of: (1) plant actions/commitments described in WBNPP, Volume 4; and (2) oversight activities ensuring closure of Volume 4.

- Examines Key Elements of WBNPP, Volume 4

  - CAPs/SPs
  - VSR Issues
  - Changes to Management and Organization
  - Operational Readiness Program
  - Employee Concerns
  - New Licensing/Technical Issues
  - Oversight Activities (PAC/AQ, IVP)

- Examines Commitments Made in WBNPP, Volume 4

- Examines Oversight Activities

  - Those required by WBNPP, Vol. 4
  - Others (QV, Line Verification, Independent Oversight, NRC)

- Provides Two Case Studies

  - CAPs/SPs
  - Operational Readiness

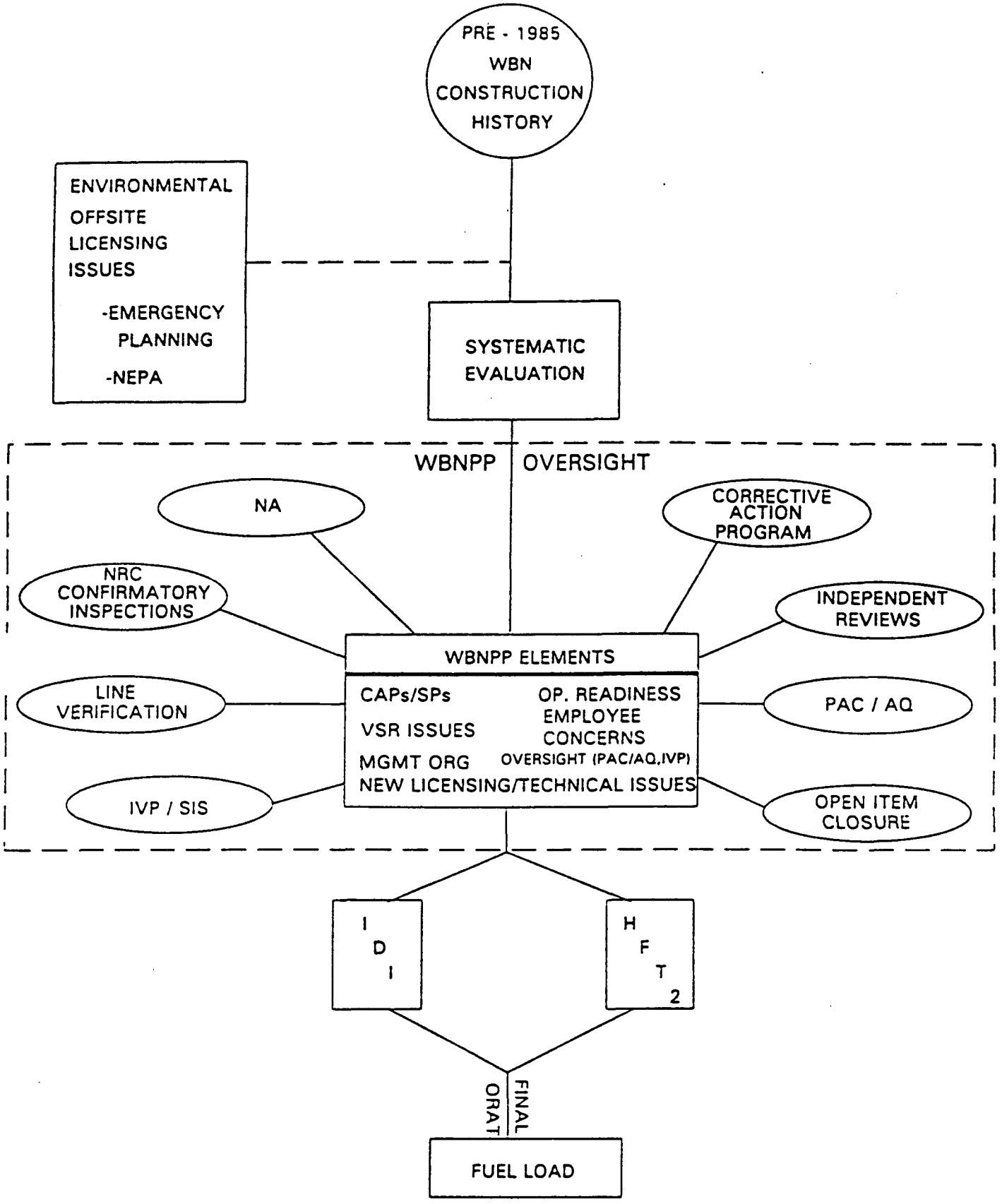


Figure III-1, WBN LICENSING PROCESS

SECTION III

REASONABLE ASSURANCE ASSESSMENT REPORT
REGULATORY REVIEW OF THE WBNPP, VOLUME 4 (Cont'd)

Primary Areas Of Assessment

- WBNPP, Volume 4 Commitments
  - 130 total commitments
  - 116 of 130 WBNPP, Volume 4 commitments have been closed
  - list of open commitments provided below
  - among 14 open commitments, most important is the 144 open DRs resulting from VSR

- 28 CAPs and SPs
  - 10 CAPs/SPs have been closed by NRC (as of 6/9/95)
  - 18 CAPs/SPs remain open
    * 2 program closures by NRC are in process
    * 2 programs undergoing ongoing inspections to address various sub-issues
    * 9 programs currently are ready for inspection
    * 5 programs will be ready for inspection by the end of July

Data Sources Used in Assessment

- Design & Engineering (Enclosure 1 of the RAAR)
- Construction (Enclosure 2 of the RAAR)
- Employee Concerns (Enclosure 6 of the RAAR)
- PAC/AQ (Attachment III-1)
- Operational Readiness Program (Enclosure 4 of the RAAR)
- VSRs
  - 654 DRs identified by S&L
  - 144 open as of 6/8/95

Conclusions

- There is reasonable assurance that the actions/commitments specified in WBNPP, Volume 4 will be effectively closed out prior to fuel load.
  - 116 of 130 WBNPP, Volume 4 commitments have been closed
  - among 14 open commitments, most important is the 144 open DRs (VSR)
- Oversight of WBNPP, Volume 4 provides further support for reasonable assurance determination that the plant has been designed and constructed in accordance with NRC requirements and TVA commitments.
  - Conclusion to be confirmed by HFT 2 and IDI

PROGRAM FOR ASSURANCE OF COMPLETION AND ASSURANCE OF QUALITY (PAC/AQ)

- PURPOSE: PROVIDE TVA SENIOR MANAGEMENT ADDITIONAL ASSURANCE THAT

  - COMMITMENTS ARE KNOWN, CAPTURED, TRACKED AND MET
  - WBN DESIGNED AND CONSTRUCTED AS REQUIRED

- PROGRAM SCOPE--GENERAL

  - OVER 50 MAN-YEARS OF EFFORT
  - CONDUCTED OVER 4-1/2 YEAR PERIOD
  - MULTI-DISCIPLINE REVIEWS BY EXPERIENCED SENIOR PERSONNEL
  - FIELD WALKDOWNS OF HARDWARE

- FIVE PHASE PROGRAM--ALL PHASES SUCCESSFULLY COMPLETED (NRC REVIEWS OF PHASES 1-IV ISSUED)

PROTOTYPE--VERTICAL SLICE REVIEW (VSR) OF THE ESSENTIAL RAW COOLING WATER SYSTEM TO DEBUG THE PROGRAM AND OBTAIN EARLY DATA

PHASE I--IDENTIFICATION OF COMMITMENTS: APPROXIMATELY 13,000 COMMITMENTS IDENTIFIED

PHASE II--MATCHING OF COMMITMENTS TO THEIR IMPLEMENTING DOCUMENTS

PHASE III--TECHNICAL REVIEW OF IMPLEMENTING DOCUMENTS

PHASE IV--IMPLEMENTATION VERIFICATION INCLUDING REVIEW OF PLANT HARDWARE

- IN ADDITION TO PROTOTYPE VSR, 3 ADDITIONAL VSRs WERE PERFORMED
- COMPLEMENTARY HORIZONTAL REVIEWS CONDUCTED AT THE SAME TIME, E.G., SPAE/SPOC PROCESS
- AN IMPROVING TREND WAS NOTED IN THESE REVIEWS (1991-1993)

PHASE V--OVERSIGHT OF OPERATIONAL READINESS REVIEW AND WORK COMPLETION

- 30 MAJOR REVIEWS AND REPORTS ISSUED--IMPROVING BEHAVIORAL TRENDS NOTED
- ROLLUP OF PREVIOUS FOUR PHASES
- PERSONNEL, PROCESSES AND PROCEDURES ARE ADEQUATE TO SUPPORT WBN POWER OPERATIONS

ENCLOSURE 1
DESIGN ADEQUACY

ENCLOSURE 1 - DESIGN ADEQUACY METHODOLOGY

- Three "stand-alone," yet overlapping perspectives; assessment of adequacy of:

  - *Regulatory Approach:* The scope, methodologies and controls for TVA's corrective action and closure processes.

    - Identification of design issues & scoping of corrective actions
    - Implementation of corrective actions including investigatory activities to determine extent-of-condition and causal factors
    - Design verification and closure

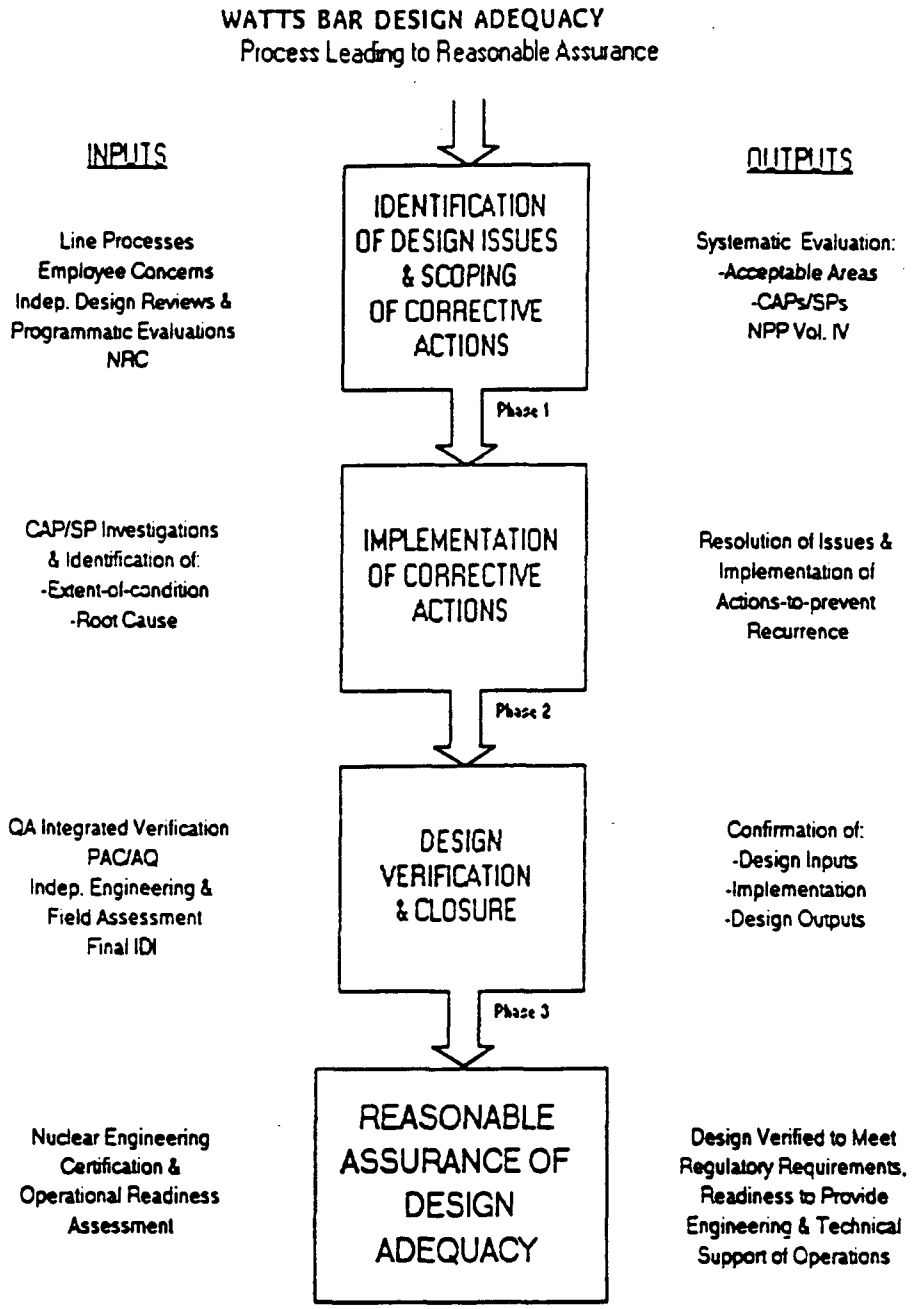
  - *Process Approach:* TVA's current design processes and readiness to provide engineering and technical support of future operational activities.

    - Enhancements of design process, design controls and configuration management
    - Nuclear Engineering 1991 self-assessment
    - Operational readiness activities

  - *Oversight Approach:* Independent oversight results in providing coverage of the Project completion activities and in confirming implementation of corrective actions in accordance with requirements.

    - QA Verification of CAPs/SPs, other QA, PAC/AQ, IE&FA
    - Insights on performance trends
    - Bottom line on design adequacy

METHODOLOGY (continued)



RESULTS

▸ *Regulatory Approach*

Nuclear Performance Plan, Vol. IV Provided Strategic Framework.

- Original Design Issues
  - Inconsistencies between the WBN Final Safety Analysis Report (FSAR) and WBN design documentation,
  - Incomplete and some inconsistent design input information,
  - Missing, incomplete, and out-of-date design calculations and ,
  - Disagreements between the actual plant configuration and the as-constructed drawings.
- Extent-of-Condition; broad, hence Design Baseline & Verification Program (DBVP) programmatic response
- Causal Factors of Past Weaknesses
  - Lack of effective licensing and design change control procedures and databases to ensure that design requirements were maintained consistent with the FSAR and other commitments to the NRC.
  - Insufficient definition of design criteria and system description information at the level of detail needed to control design changes.
  - Lack of complete calculation listings to establish the full scope of calculations needed for WBN and procedures to ensure the calculations are maintained consistent with the WBN design.
  - Lack of an effective definition of drawings to be maintained under configuration control, and an ineffective system for keeping appropriate drawings as-constructed as plant changes are made.

RESULTS (continued)

- Related areas; design interface control, code compliance, thoroughness of implementation, clarity/detail of design specifications, incorp. of design requirements, control of vendor information, design verfication, as-built reconciliation, training, corrective actions

SUMMARY OF TVA's CORRECTIVE ACTIONS

Area	Activities	Approx. No. Verified	Approx.% Re-done or Signif. Revised
Design Commitments	Verification & Capture Within Design Basis Documents	2500	100%
Design Criteria/ System Descriptions	Verification, Revisions & Additions	150	100%
Calculations Civil Electrical/I&C Mechanical/Nuclear	Identification of Required Calcs, Verfication, Revisions, Re-generation & Additions	23,000 900 1,500	95% of Total
Configuration Control Drawings	Verification By Design Review, Walkdowns/As-built Reconciliation & Revisions	1,200	100%
Physical Modifications Civil Electrical/I&C Mechanical/Nuclear	Implementation of Design Changes	2,200 2,600 1,400	N/A

- *Process Approach*

- The design process, design controls and configuration management systems have undergone a continuous process of assessment and improvement since Project inception.

  - Changes have paralleled lessons learned at WBN, TVA and the nuclear industry

  - Industry experience and regulatory expectations have dictated more rigor, particularly through enhanced documentation and reconciliation with the plant and operations.

- Two major changes to the design change control and configuration management processes:

  Design Change Process Improvement Program (1986) - Corporate led effort addressed weaknesses in the quality and documentation of engineering reviews and maintaining consistency between "as-constructed" and "as-designed" documents.

  - Single Design Change Notice (DCN) vs Engineering Change Notices (ECN) and Field Change Requests (FCR)

  - Consolidation of affected documents within a single package, input and approval by affected organizations, drawing changes through Drawing Change Authorizations (DCA) with posting/database tracking against a single drawing of record, time limits for incorporating drawing changes, etc.

Construction Restart Process Improvements (1991) - Process improvement needs were identified from several sources; by the NE Self Assessment resulting from the construction stop work order in December, 1990 and generally from actions associated with WBN Quality Assurance (QA) and regulatory reviews.

- Adoption of a single, integrated Design Change and Modification Configuration Management System.

- Formal review by all organizations required prior to implementation, including identification of any impacts to plant documents.

- Design Change Implementation Package (DCIP) provides the tracking mechanism.

- Document Control/Change Management (DCCM) database provides on-line status of change packages, DCAs and drawings.

- Assessment of Trend of Improved Performance

Several sources of information provide confirmatory evidence that TVA's actions-to-prevent recurrence have been effective:

- Enclosure 9, Significant Event Assessment, analyzed the WBN performance history and concluded that the number of design-related SCARs steadily declined during the period 1985 to the present.

- The PAC/AQ results indicate that the numbers and significance of design discrepancies declined during the period of their VSRs, from early in 1991 through mid 1993.

RESULTS (continued)

- The Assessment of oversight coverage also confirmed a trend of improvement. For three periods of time:

	Deficiency Rate	Signif. Deficiency Rate
Pre-1986	12.6%	9.7%
1986-1991	5.4%	1.7%
1991-present	2.9%	0.07%

Note: Pre-1986 from Sargent & Lundy VSR. All percentages are estimates applicable to the full population, i.e., these are not sub-sets of each other.

Changes in types of deficiencies.

- *Early VSRs:* Indicated weaknesses in commitment control, a lack of (and sometimes missing) supporting information to demonstrate that these commitments had been implemented, deficiencies in technical adequacy and inconsistencies between the design documentation and the as-built configuration.

- *Initial stages of the DBVP through 1991:* Inconsistencies were identified in the reverification/re-constitution of calculations and in the updating of Design Criteria/System Descriptions.

- *Current timeframe:* PAC/AQ & IE&FA confirmed calculations are well prepared. Remaining challenges are in final reconciliation of as-built conditions, configuration control and operational interfacs (typical of similar projects at the stage).

- *Oversight Approach*

Evaluated the results of independent oversight programs, e.g. QA, PAC/AQ, IE&FA and special Project final verification programs, e.g. SPAE to determine adequacy of coverage and the need for any additional assurance.

- Magnitude of Oversight Effort

  - QA verification of CAPs/SPs; over 100,000 man-hours over last 5 years (approx. 70/30 split documentation - field)
  - PAC/AQ; approx. 100,000 man-hours over 4 1/2 years
  - IE&FA; 20,000 man-hours
  - NRC; 50,000 man-hours over last year

- Review of Design Inputs

  Consistency with licensing commitments and integration within implementing documents.

  - FSAR
  - Design Criteria (DC) and System Descriptions (SD)
  - General design standards, guides and specifications

- Review of Implementation

  Use of proper inputs, interfaces and validated methodologies/techniques.

  - Adequacy of design calculations, engineering evaluations & studies
  - Adequacy of technical/administrative instructions and procedures

- Review of Design Outputs

  Consistency of outputs with design criteria & implementation results.

  - Consistency of drawings including as-built reconciliation
  - Consistency of specifications (procurement, installation)
  - Consistency of vendor documentation
  - Consistency of test scoping requirements and testing reconciliation
  - Consistency of operating procedures

- Review of Design Control, Configuration Management and Corrective Action

  Control of inputs/outputs, changes affecting design basis, document control and retrievability.

  - Design interfaces
  - Configuration control
  - Design change process documentation including design change notices (DCNs), drawing and spec changes
  - Corrective action resolution; SCARs/CAQs

- *Conclusion:* Oversight programs have comprehensively addressed the design process at WBN; found an estimated less than 3% deficiencies (deviations from requirements) and less than 0.18% that have potential design significance. Performance has shown progressive improvements over the period of review.

SUMMARY OF COVERAGE AND RESULTS OF SELECTED WBN OVERSIGHT ACTIVITIES

Reviewed Process/ Product	Oversight Coverage & Results				Collect. Signif.	
	Other QA Reviews	PAC/AQ VSRs	CAP/SP Verification by QA	IE&FA '95	% Def.	% Deign. Sig. Def.
Design Inputs						
• FSAR	○	○	●	○	8.7	0
• Gen. specs & design stds.	●	●	●	○	3.4	0
• Design criteria & sys. descr.	◉[4]	◉[1]	◉[1]	●	4.6	1.2
Design Implementation						
• Calcs, Eng. eval. & studies	◉[5]	◉[7]	●	●	5.0	0.64
• Procedures	●	○	◉[1]	●	1.5	0.05
Design Outputs						
• Drawings	●	●	●	○	3.1	0
• Procurement/Specifications	◉[1]	●	○	○	3.6	0.06
• Vendor manuals	○	●	○	○	0.98	0
• Design/Eng classification	○	○	●	○	0.36	0
• Test & accept. criteria	●	●	●	○	8.6	0
• Technical specifications		●	○	○	14.3	0
Design Control Config. Mgmt. & Corrective Action						
• Design interfaces & config control	◉[1]	●	◉[1]		3.4	0.25
• Design change process	●	◉[1]	◉[1]	●	3.2	0.10
• Corrective action	●	○	◉[4]	●	1.0	0.09
Summary by Program & Overall Results	5.4%	5.4%	1.7%	4.1%	3.0%	0.18%
% Def./ % Design Signif. Def.	0.38	0.34%	0.08%	0		

○ = oversight coverage; ● = oversight coverage with identified deficiencies

◉[1] = oversight coverage with design significant deficiencies (superscript indicates number of

CONCLUSIONS

Subject to sustained high levels of performance in completing remaining closeout activities, this assessment concludes that:

- In the aggregate, TVA's corrective action programs and design verification activities provide reasonable assurance that:
  - There will be no undetected and uncorrected safety-significant[1] design deficiencies remaining at Watts Bar;
  - The design will meet regulatory requirements;
  - Design requirements will have been properly implemented;
  - The design will have been documented and will be consistent with the physical configuration; and
  - The design process and controls will be adequate.

- Furthermore, additional assurance will have been provided because:
  - Oversight of design continues to confirm design adequacy.

ENCLOSURE 2
CONSTRUCTION

Enclosure 2

REASONABLE ASSURANCE ASSESSMENT
CONSTRUCTION ADEQUACY

I. INTRODUCTION/CONCLUSION

BACKGROUND/HISTORY

A. CONCLUSIONS

1. Watts Bar Unit 1 is constructed in accordance with design requirements such that structures, systems, and components will perform their intended safety functions. This conclusion is conditional on the successful completion of processes to identify, resolve and implement critical electrical corrective actions; all of these are currently on a path to be adequately completed by full load.

2. Watts Bar Unit 1 Modifications organization, processes, and procedures are adequate and prepared to support future operations.

B. METHODOLOGY

1. REGULATORY APPROACH

Resolution and implementation of licensing commitments and corrective actions included in CAPs/SPs, WBNPP, and other sources, e.g. NRC inspections.

2. PROCESS APPROACH

Validation of key construction processes which produce products/documentation demonstrating compliance with design requirements.

3. OVERSIGHT APPROACH

Collective evaluation of results of field hardware inspections and inspections of construction process documentation.

4. APPROACH INTEGRATION

A review of each event, major activity or series of related activities from each approach perspective to determine the contribution to construction adequacy.

II. RESULTS

A. REGULATORY APPROACH KEYS AREAS

1. CAPs/SPs

a. Electrical-Related Caps - Still Open

Some field work related to cable damage, cable splices, electrical separation and cable supports remains to be completed.

b. DBVP, HAAUP - Positive Results

CCDs (from DBVP) and A-C drawings (from HAAUP) have cleared field verifications and inspections on several occasions with positive results.

2. PAC/AQ - Validation of Commitments

3. Eight 1994 Construction Issues - Positive Results from "Relook"

The Eight 1994 Issues were found to be specific corrective action incomplete closures isolated in time and upon completion of "relook" part of a reasonably small population of deficiencies. Management method root causes were identified and lessons learned follow-up actions have been successfully implemented.

B. PROCESS APPROACH KEY AREAS

1. 1990 STOP WORK ORDER - Major Process Change

The 1990 Stop Work Order was found to entail aspects of several processes, especially work control and documentation issues. Although very little field work was required, all work plans were rewritten to new requirements and critical procedures were rewritten. Since the major overhaul performed as part of the Stop Work recovery, critical process areas have been successfully validated through inspections and assessments.

2. QC INSPECTIONS/TRENDING

Results of QC Trending since restart of Construction following the 1990 Stop Work Order have consistently shown >97% AQL. NA oversight of QC has consistently shown <<1% deficiencies in QC inspection reports.

3. SPAE/SPOC; TESTING; PAC/AQ - Positive Confirmation Results

To date no construction deficiencies have been identified via SPAE/SPOC process; Testing Deficiency Notices have trended at less than 10% due to installation errors. Each completed phase of PAC/AQ has received positive closure.

4. CORRECTIVE ACTION PROCESS

Since construction restart following the 1990 Stop Work Order about 540 corrective actions (FIRs, PERs, SCARs) have been initiated against construction activities; 40 of these were SCARs. Each of these were evaluated; principal open SCARs involve critical electrical cable and separation issues.

C. OVERSIGHT APPROACH KEY AREAS

1. SYSTEMATIC EVALUATION - Benchmark

2. SCOPE & RANGE OF FIELD INSPECTIONS

- Includes 12 VSRs:

- 4 from PAC/AQ (4 systems)

- 4 from QA Audits/Assessments (7 systems)
- 2 from NRC (4 systems)
- 1 from IE & FA '95 (1 system)
- 1 from S&L VSR (6 systems)

-Incorporates QA Records CAP/ASRR field inspections

3. TIME HISTORY - See Graph

4. COLLECTIVE COVERAGE/SIGNIFICANCE ASSESSMENT - See Table, "Evaluation of Field Inspection Data and Results"

D. OPEN AREA - ELECTRICAL/CABLE ISSUES

1. Principal Issues: Cable damage; cable installation (e.g., splices); cable supports; separation.

2. Improvement Trends in Electrical Areas

a. Field Inspection Results - Decrease in rate of deficiencies from 27% to 1 % in past 2+ years and decrease in SCAR-level deficiencies from 8 to 3 in the same period.

b. Progress Within Open Electrical CAPs

- Cable issues CAP - about 80% issues complete (128/156)

- Electrical issues CAP - about 70% issues complete (94/120)

III. MODIFICATION READINESS TO SUPPORT OPERATIONS

A. RESULTS OF SELF ASSESSMENT - ORR/WINDOWS

B. CORPORATE MODEL - SQN

C. PERSONNEL EXPERIENCE; LESSONS LEARNED - SQN & BFN

IV. SUMMARY

A. SATISFACTORY CLOSEOUT OF COMMITMENTS

B. SATISFACTORY CLOSEOUT OF CAPs/SPs AND CAQs - OPEN AREA: Primarily Electrical; Process Improving

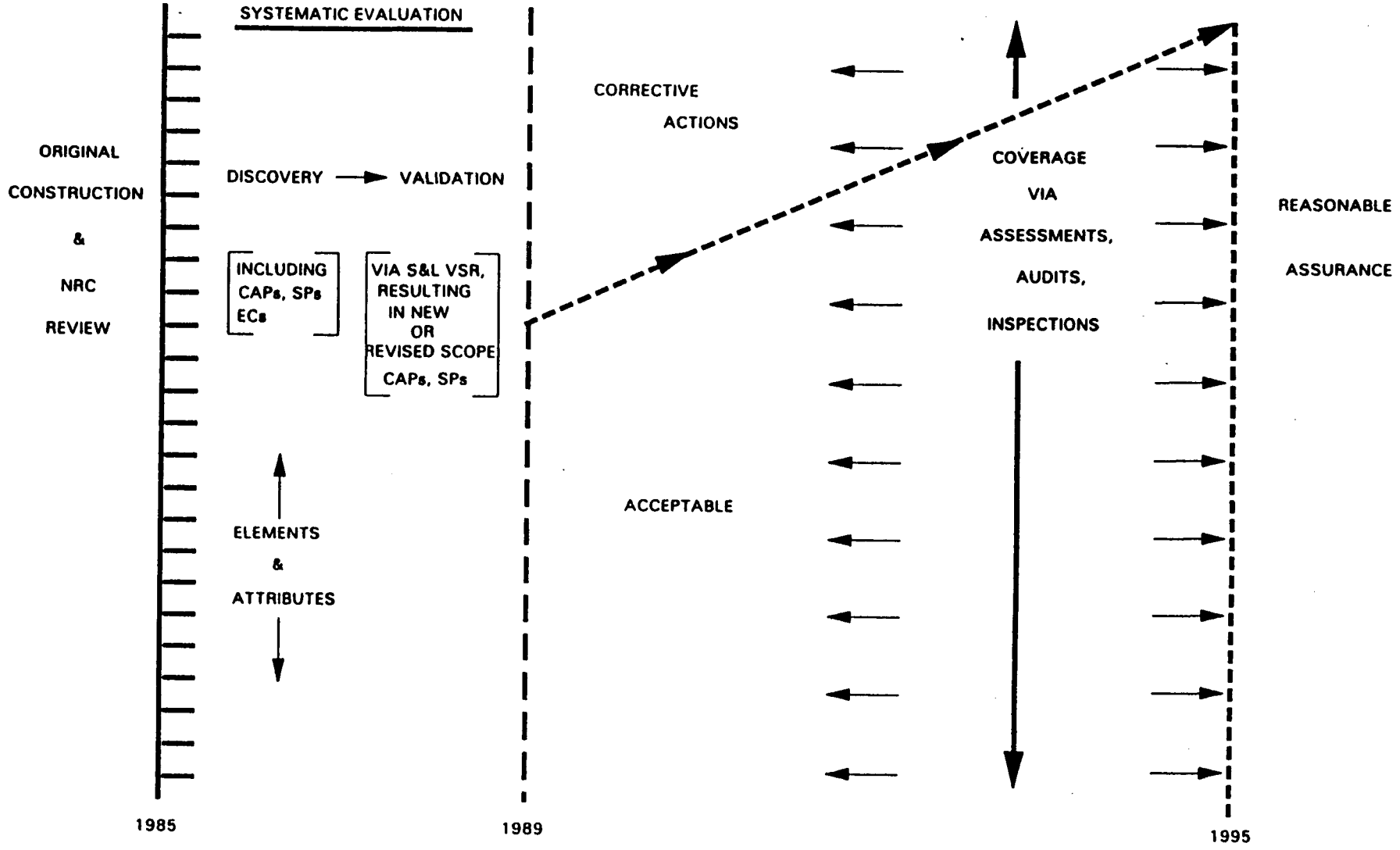
C. COMPLETION OF FIELD WORK - OPEN AREA: Electrical Cable Installation; Process Improving

D. ADEQUATE DOCUMENTATION TO SUPPORT MEETING DESIGN REQUIREMENTS (e.g., CCDs)

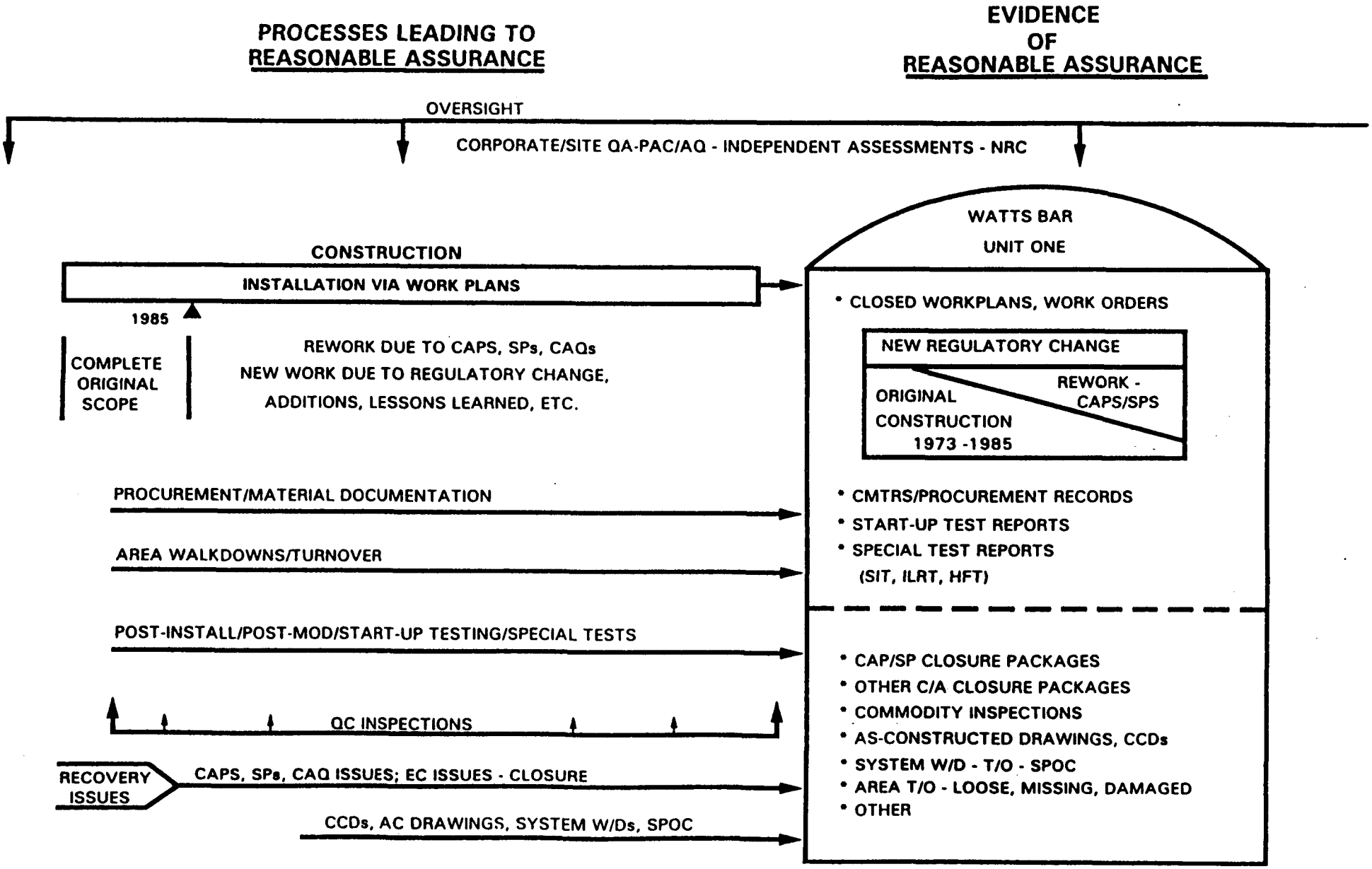
E. SATISFACTORY PROGRESS DEMONSTRATING INSTALLATION & HARDWARE READINESS TO SUPPORT OPERATIONS: SPAE/SPOC, TESTING, AREA TURNOVER

F. SATISFACTORY TRANSITION FROM CONSTRUCTION MODE TO MODIFICATIONS IN SUPPORT OF OPERATIONS

WBN-1 CONSTRUCTION ADEQUACY
FIGURE E2-1
REGULATORY APPROACH



WBN-1 CONSTRUCTION ADEQUACY
FIGURE E2-2
PROCESS APPROACH



WBN-1 CONSTRUCTION ADEQUACY
Table E2-1
OVERSIGHT APPROACH - SUMMARY OF COVERAGE RESULTS

Element / Event/ Period	Syst Eval '85-'89	Assess '89-92	ASRR '91-93	Assess '93-'94	IE&FA '94-95
1.0 Cable	●	○	○	●	●
2.0 Cable raceway (R/W)	●	○	○	○	○
3.0 Cable R/W supports	●	○	○	○	○
4.0 Elect. equipment	○	○	○	○	○
5.0 HVAC duct/equipment	○	○	○	○	○
6.0 HVAC supports	○	○	○	●	○
7.0 Instruments	○	○	○	○	○
8.0 Instr. lines	○	○	○	○	○
9.0 Instr. line supports	●	○	○	○	○
10.0 Large bore pipe	○		○	○	○
11.0 L. B. pipe spts.		○	○	○	○
12.0 Small bore pipe	○	●	○	○	○
13.0 S.B. pipe/tube spts.	●	●	○	○	○
14.0 Valves	●	○	○	○	○
15.0 Mech. equipment	○	○	○	○	○
16.0 Concrete struct.	●		○	○	○
17.0 Foundations	○		○	○	
18.0 Struct./misc. steel	●	○	○	○	○
19.0 Masonry walls	○		○		○
20.0 Coatings	●		○		○
21.0 Processes/trends & Documentation	●	●	○	●	○
21.A Design Impl.	○	●		○	
21.B Constr. Process	●	○	○	●	○
21.C Constr. Install.	●	○			
21.D Constr. Support	○	○	○	○	○

○ = Coverage
● = Significant deficiencies

WBN-1 CONSTRUCTION ADEQUACY
Table E2-2
ASSESSMENT APPROACH MATRIX

ACTIVITY/EVENT	REGULATORY APPROACH	PROCESS APPROACH	OVERSIGHT APPROACH
• Systematic Evaluation	Identified key corrective actions and commitments for completion; validated or modified scope of CAPs/SPs	Assessed products from previous construction activities, e.g., as-constructed drawings, assessed workmanship in all disciplines and design implementation for several of the key elements, e.g., instrument line supports	* Provided a benchmark for identifying acceptable construction; provided comprehensive coverage of system components and technical requirements
• CAPs/SPs	* Represented the principal scope of work for construction completion	• Development of CCDs as part of Design Baseline Verification Package (DBVP) CAP provided a field verified record of acceptable design implementation • Development of as-constructed field-verified drawings for pipe supports provided a record of acceptable design implementation	• Independent assessments of field implementation of CAPs/SPs ensured that corrective actions were properly implemented • QA Records CAP/ASRR assessment provided a statistical sample of field inspections
• Construction Process			
1. Stop Work Order (12-90)	Required NRC approval to restart construction in Nov. 1991	* Represented a significant challenge to the adequacy of the construction process; required several major process improvements for recovery	Significant review of all CAQs, CATDs, NRC violations & issues, QA activities and employee concerns
2. QC Inspection/ Trending	Indirect impact only	*Detailed, in-process assessment of ongoing construction & installation; trending provides insight on quality of construction	Indirect impact only; QC data not evaluated with independent oversight assessment -- QC data assessed as part of construction process
3. Corrective Action Program	• Indirect input; some CAQs resulted from NRC inspections • Direct impact for implementation of field work for CAPs/SPs and other regulatory commitments	* This process within the construction process is critical to lessons learned, recurrence control and validation of completed work	Many of the Corrective Actions resulted from independent assessments of completed field installation/construction

* Key assessment area

WBN-1 CONSTRUCTION ADEQUACY
Table E2-2 (cont.)
ASSESSMENT APPROACH MATRIX

ACTIVITY/EVENT	REGULATORY APPROACH	PROCESS APPROACH	OVERSIGHT APPROACH
• Construction Process (cont.)			
4. SPAE/SPOC	Corrective Actions required for the MODs - complete milestone must be resolved.	* Final clearance of installed components v. design requirements is provided; field verified CCDs used in system walkdown	Input from SPAE/SPOC field verifications provided as input to collective coverage/significance evaluation
• The Eight 1994 Construction Issues	* Evaluated in response to NRC concern over effectiveness of corrective action and related closure process	Although the construction process was challenged no programmatic issues were identified	Site NA&L validated results of assessment of the eight issues and collective significance
• Independent Oversight Activities			
1. QA Assessments	Oversight of CAP/SP closure activities.	Oversight of ongoing construction process, including QC activities.	* Input from field inspections and assessments performed by NA&L are included in the collective coverage/significance evaluation.
2. QA Records CAP/ASRR	Indirect input.	Field verification of workplans and maintenance requests.	* Statistical sample of all key elements via field inspections. Direct input to collective coverage/significant evaluation.
3. Independent Engrg. & Field Assessment - 1995	Small scope of directly related reviews	Small scope of verification of process activities. Major input of sequence of work to minimize damage and improve housekeeping.	* Vertical slice of Residual Heat Removal (RHR) system plus general field assessment data included in collective coverage/significance evaluation.
4. ASME	Indirect input.	*Validates implementation of ASME QA Program	Provides another view and opportunity to identify improvements; no data utilized.

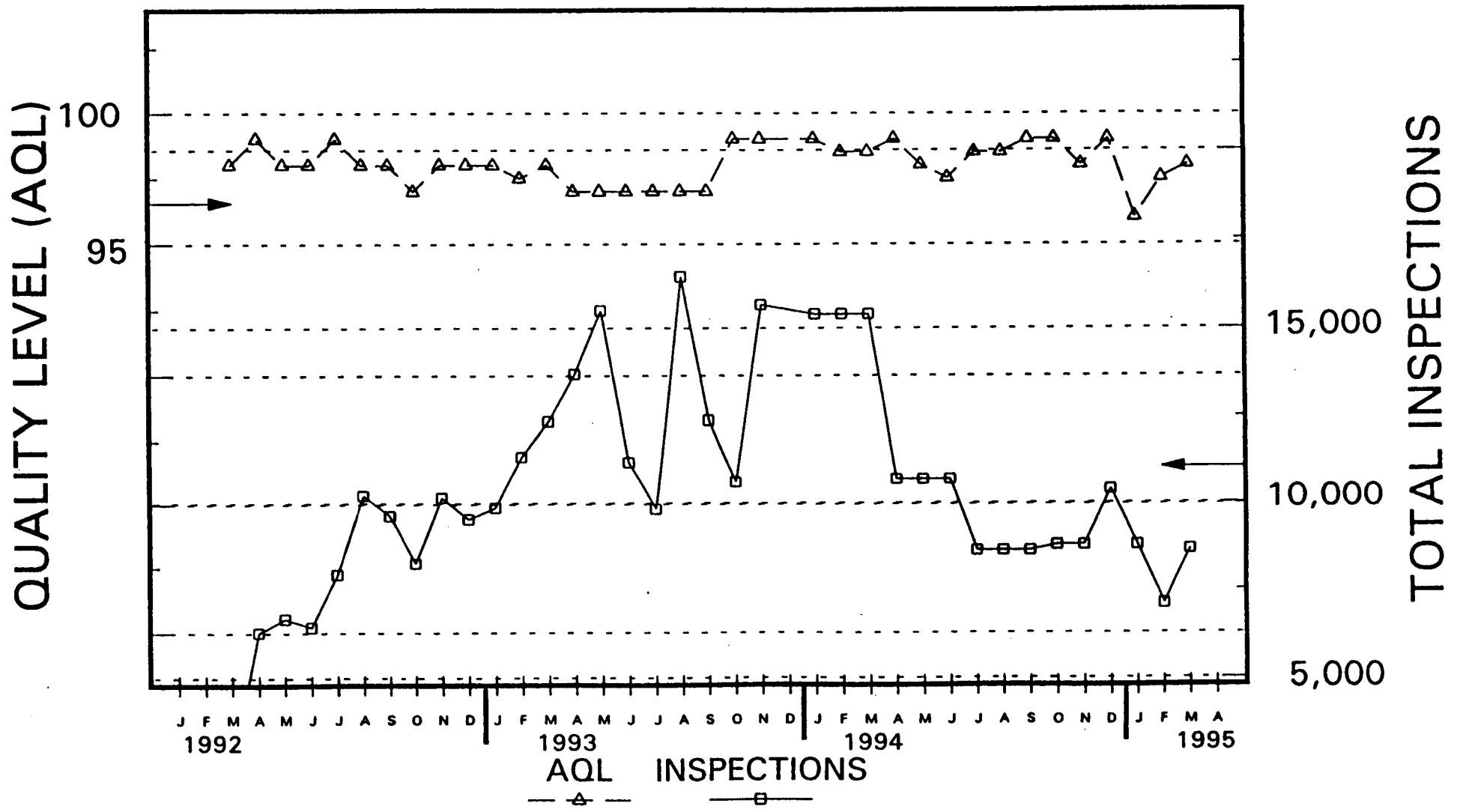
* Key assessment area

WBN-1 CONSTRUCTION ADEQUACY
Table E2-2 (cont.)
ASSESSMENT APPROACH MATRIX

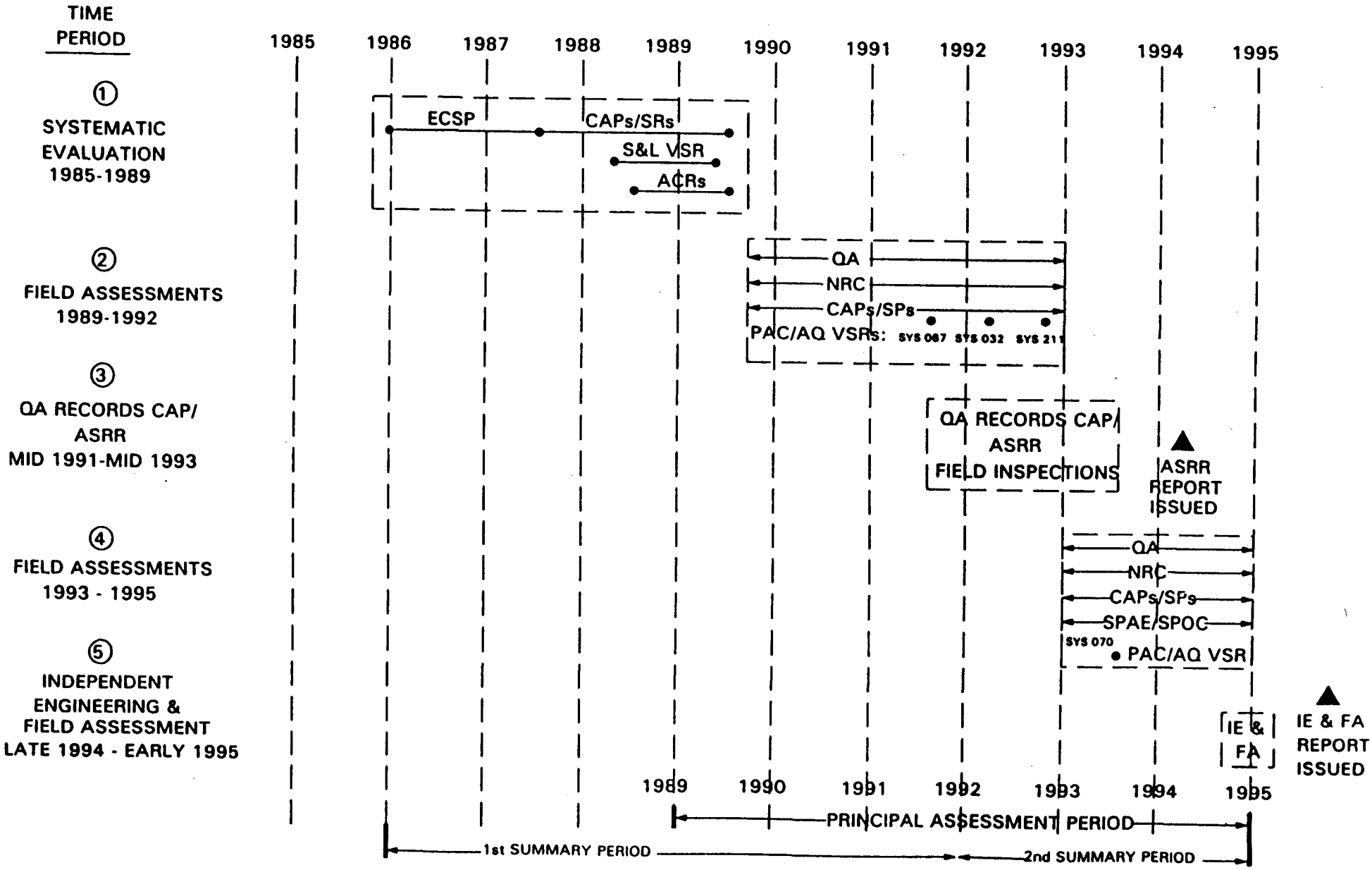
ACTIVITY/EVENT	REGULATORY APPROACH	PROCESS APPROACH	OVERSIGHT APPROACH
• Independent Oversight Activities (cont.) 5. NRC Inspections/ Notices of Violation	* Results of NRC inspections leading to notices of violation are evaluated for impact via review of corresponding CAQs.	Impact on process improvements as a result of NRC inspections is assessed.	Input from NRC field inspections, especially vertical slice reviews, is directly utilized in the collective coverage/significance evaluation.
• Testing/Test Deficiency Notices (TDNs)	Indirect input	* Provides a functional validation of equipment installation and validation of some design requirements.	Indirect input
• WBNPP, Revision 1	Updates NRC on WBN organization changes and progress with CAPs/SPs	Introduced Lessons Learned Program for SQN and BFN input to WBN	Provided information to NRC re: S&LVSR and overall Systematic Evaluation.
• PAC/AQ	* Tracked and evaluated the resolution of corrective actions and licensing commitments	Assessments of process areas and issues were included in scope. VSRs covered specific process activities.	* Data from field assessment associated with 4 VSRs is included in collective coverage/significance matrix.
• Modifications Readiness to Support Fuel Load	Completion of designated commitments and corrective actions is required.	* MODs has solid plan to review procedures and processes to operational mode	Operational Readiness was reviewed by QA and validated.
• Collective Coverage/Significance Matrix	• Includes data from NRC inspections and assessments of compliance to licensing requirements	• Includes data from assessments of construction process areas, (e.g., workplans)	* Captures a significant portion of field inspections from independent oversight against plant hardware elements and critical processes.

* Key assessment area

WBN-1 CONSTRUCTION ADEQUACY
FIGURE E2-8
QC INSPECTION TREND



WBN-1 CONSTRUCTION ADEQUACY
FIGURE E2 (A1)-1
COLLECTIVE COVERAGE AND SIGNIFICANCE - TIME ASSESSMENT



WBN-1 CONSTRUCTION ADEQUACY
Table E2(A1)-4
EVALUATION OF FIELD INSPECTION DATA AND RESULTS

HARDWARE OR PROCESS ELEMENT	SAMPLE SIZE ASSESSMENT		TIME COVERAGE ASSESSMENT	% DEFICIENCIES		% DEFICIENCIES		OVERALL ASSESSMENT	REMARKS
	<1993	1993+		<1993	# SIGN.	1993+	# SIGN.		
1.0 CABLE	G	G	G	19%	3	2%	3	NC	See Section III.B.3 for discussion, se text item 1.
2.0 CABLE RACEWAYS	G	G	G	46%	4	0.5%	0	EXC	
3.0 RACEWAY SPTS.	F	G	G	36%	1	0.2%	0	EXC	See discussion in text under conclus
4.0 ELECT. EQUIP.	G	G	G	16%	0	1%	0	NC	Separation issues for panels/boards a discussed in Section III B.3.
5.0 HVAC DUCT & EQUIP.	F	G	G	27%	0	4%	0	GOOD	See discussion in text, item 2.
6.0 HVAC SUPPORTS	F	G	G	9%	0	1%	1	FAIR	Seven(7) welds involved, see discuss text, item 3.
7.0 INSTRUMENTS	G	G	G	29%	0	0.3%	0	EXC	
8.0 INSTR. LINES	S	G	G	17%	0	2%	0	EXC	
9.0 INSTR.LINE SPTS.	F	G	G	40%	1	5%	0	GOOD	See discussion in text, item 4.
10.0 LARGE BORE PIPE	S	G	G	NA	NA	0%	0	EXC	
11.0 L. B. PIPE SUPPORTS	F	G	G	0%	0	0.6%	0	EXC	
12.0 SMALL BORE PIPE	S	G	G	12%	1	1%	0	EXC	
13.0 S. B. PIPE SUPPORTS	G	G	G	9%	4	0.2%	0	EXC	
14.0 VALVES	F	G	G	21%	1	0.4%	0	EXC	
15.0 MECH. EQUIPMENT	G	G	G	9%	0	0.3%	0	EXC	

[a] Sample size not as relevant since population consists of major installations, e.g., shield building
[b] No specific coverage of a process nature since 1992; coverage is achieved via hardware elements

Legend: G - Good NC - Not conclusive
F - Fair NA - Not Available or Not Applicable
S - Small EXC - Excellent

WBN-1 CONSTRUCTION ADEQUACY
Table E2(A1)-4 (cont.)
EVALUATION OF FIELD INSPECTION DATA AND RESULTS

HARDWARE OR PROCESS ELEMENT	SAMPLE SIZE ASSESSMENT		TIME COVERAGE ASSESSMENT	% DEFICIENCIES		% DEFICIENCIES		OVERALL ASSESSMENT	REMARKS
	<1993	1993+		<1993	# SIGN.	1993+	# SIGN.		
16.0 CONCRETE STRUCTS.	F[a]	G[a]	G	9%	1	6%	0	FAIR	All deficiencies (all 6%) since 1992 w anchor installation procedure violation discussion in text, item 5.
17.0 FOUNDATIONS	S[a]	G[a]	G	24%	0	0%	0	EXC	
18.0 STRUCT./MISC. STEEL	G	G	G	40%	1	0.3%	0	EXC	
19.0 MASONRY WALLS	S[a]	G[a]	G	24%	0	3%	0	GOOD	See discussion in text, item 6.
20.0 COATINGS	S[a]	S[a]	G	NA	1	NA	0	FAIR	Dry Film Thickness persistent issue, recently satisfactorily resolved; see discussion in text, item 7.
21.0 PROCESSES/TRENDS									Refer to subcategories which may be meaningful than a summary
21-A Design Implementation (e.g. CCDs)	G	G	G	0.6%	2	0.7%	0	EXC	
21-B Constr. Process	G	G	G	5%	3	2%	2	GOOD	See discussion in text, item 8.
21-C Constr. Installation	G	NA[b]	NA[b]	4%	1	NA[b]	NA[b]	NC	Coverage is provided by hardware el 1 through 20
21-D Constr. Support	G	G	G	2%	0	1%	0	EXC	

[a] Sample size not as relevant since population consists of major installations, e.g., shield building

[b] No specific coverage of a process nature since 1992; coverage is achieved via hardware elements

Legend: G - Good
F - Fair
S - Small
NC - Not conclusive
NA - Not Available or Not Applicable
EXC - Excellent

WBN-1 CONSTRUCTION ADEQUACY
TABLE E2-4
RESULTS OF ELECTRICAL FIELD ASSESSMENTS

	Systematic Evaluation Plus Field Assessments Before 1993			ASRR Plus Field Assessments Since 1992 Plus IE & FA 1995		
Electrical Hardware	No. Opps	No. Defs	No. Sign	No. Opps	No. Defs	No. Sign
• Cable % Defs	158 19%	30	3	1224 2%	24	3
• Cable Raceways % Defs	134 46%	62	4	3374 0.5%	16	0
• Raceway Supports % Defs	67 36%	24	1	453 0.2%	1	0
• Electrical Equipment % Defs	169 16%	27	0	1238 1%	13	0
Total Electrical % Defs	528 27%	143	8	6289 < 1%	54	3

ENCLOSURE 3

REASONABLE ASSURANCE ASSESSMENT REPORT
STARTUP AND TESTING

Conclusion

There is reasonable assurance that Startup Testing (SUT) is being successfully accomplished at WBN and, to the extent completed, supports fuel load.

Background

- Most SUT activities, including test procedure development and field testing, occurred after issuance of administrative hold by SUT Manager in late 1993.
- Resumption of safety-related SUT activities required process improvements.
- Therefore, historical data (e.g., NA assessments) supporting reasonable assurance assessment of SUT activities dates from early 1995, through the present.

Two Step Assessment Methodology

1. Assessment of global oversight of major startup testing milestones.
    - Integrated Testing Sequence
    - Integrated Leak Rate Testing
    - Open Vessel Testing
    - Hot Functional Testing

Nuclear Assurance performed thorough oversight assessments of each major testing milestone listed above. The overall conclusion derived from these assessments is that, from a general perspective, SUT activities have been successfully implemented at WBN.

2. Assessment of critical SUT attributes providing assurance of Preoperational Testing, Acceptance Testing, and Conduct of Component Testing (See attached Tables)

- Training and Qualification of Testing Personnel
- Pretest Briefing
- Measuring and Test Equipment Control
- Test Prerequisites
- Procedure Compliance
- Test Deficiency Notices
- Review and Approval of Test Results
- Conduct of Component Testing

This approach revealed thorough oversight of each attribute, as indicated in Coverage Matrix, Figure E3-3, attached. Furthermore, the assessment led to the conclusion that activities pertinent to each attribute were performed in a satisfactory manner at WBN. There were minor, but no significant, deficiencies identified as a result of this element of the assessment.

Supporting Information

- Improved processes, procedures, and people following administrative hold in 1993. Reflected in corrective actions, Preoperational Improvement Plan, and SUT organizational changes.
- Thorough oversight by NA of SUT activities.
- Numerous NRC Inspection Reports related to SUT activities.
- NRC Violations/TVA Responses
- Only one SCAR associated with SUT process during assessment period (early 1994 through the present).

Conclusion and Recommendations

- There is reasonable assurance that SUT is being successfully accomplished at WBN and supports fuel load.
    - Assessment of NA assessments of major SUT milestones indicates that, although minor deficiencies were sometimes identified, overall SUT activities were successfully implemented at WBN.
    - Analysis of NA assessments of each SUT attribute, as supported by NRC inspection findings and PAC/AQ review, demonstrate that reasonable assurance of SUT adequacy.
- RAAR Team recommended including additional oversight of TDN process in ongoing IDI or, if necessary, performing an NA assessment.
- Additional confirmation of reasonable assurance finding in this area will be provided by NA oversight of HFT 2.

PARTIAL DATA--PRELIMINARY RESULTS
Figure E3-3, Startup Testing Coverage Matrix
(ALL ATTRIBUTES)

ATTRIBUTES	NA ASSESSMENTS UTILIZED IN ANALYSIS OF EACH ATTRIBUTE	SIGNIFICANT FINDINGS	CLOSURE
Incorporation of requirements and commitments into Test Procedures	6	None	N/A
Review and approval of test procedures	4	None	N/A
Control and review of Drawing Change Paper	5		
Review and Evaluation of Open Items effecting testing	7	None	N/A
Testing personnel training and qualification	5	None	N/A
Pretest briefings	5	None	N/A
Measuring and Test Equipment Control	6		
Test Prerequisites	6		
Procedure Compliance	4	None	N/A
Test Deficiency Notices (TDNs)	6		
Review and Approval of test results	7		
Component Testing	6		

ENCLOSURE 4

REASONABLE ASSURANCE ASSESSMENT REPORT
OPERATIONAL READINESS ASSESSMENT METHODOLOGY

FOUR BASES OF REASONABLE ASSURANCE DETERMINATION:

- **ORP SELF-ASSESSMENT AND OVERSIGHT**
  - Line Organization Self-Assessments Using INPO 90-15
  - Oversight of Operational Readiness
    - ORR Phases I and II
    - INPO NTOL
    - PAC/AQ
    - Confirmation--NRC Mini-ORAT
- **INCORPORATION OF LESSONS LEARNED**
  - SQN Lessons Learned Project
  - BFN SPOC Process
  - WBN Fuel Load Certification Plan
  - South Texas Lessons Learned
- **ASSESSMENT OF TRANSITION TO OPERATIONS MINDSET** **(See next page)**
- **FINAL DEMONSTRATION OF OPERATIONAL READINESS DURING HFT-2**
  - Validate Operating Procedures
  - Resolve HFT-1 Testing Deficiencies

ENCLOSURE 4
OPERATIONAL READINESS

Table E4-1, Coverage Matrix for Operational Readiness

INPO 90-015 ORGANIZATIONAL AREAS	ORR Phase I	ORR Phase II	INPO NTOL Evaluation	PAC/AR Phase V	Nuclear Assurance Oversight of ORP	Coverage
Organization & Administration	✓	✓	✓	✓	✓	Good
Operations	✓	✓	✓	✓	✓	Good
Maintenance	✓	✓	✓	✓	✓	Good
Engineering Support	✓	✓	✓	✓	✓	Good
Training & Qualification	✓	✓	✓	✓	✓	Good
Radiological Protection	✓	✓	✓	✓	✓	Good
Chemistry	✓	✓	✓	✓	✓	Good
Operating Experience Review	✓	✓	✓	✓	✓	Good
Emergency Preparedness						Note 1
Outage Management					✓	Note 2

Table E4-2
OPERATIONAL READINESS REVIEW
Phase 1

INPO 90-015 ORGANIZATIONAL AREAS	CONCERNS	STATUS
Organization & Administration	-Master Operational Readiness Program (I.A)	Open
	-Bow wave of remaining work activities (I.B)	Closed
	-Procedure development (I.D)	Closed
	-Operational Attitude (II.A)	Closed
	-Corrective Action Programs (II.B)	Closed
	-Operational QA Effectiveness (II.C)	Closed
	-Procedure Adherence (II.E)	Closed
	-Key Position Vacancies (IV.B)	Closed
	-Administrative Processes (IV.C)	Closed
	-Personnel Safety (IV.D)	Closed
	-Standardization with Other Sites (IV.E)	Closed
Operations	-Plant Labeling (I.F)	Closed
	-Operations Management Continuity (III.A)	Closed
	-Conduct of Operations (III.B)	Closed
	-Operations Ownership & Control of Plant Equipment (III.C)	Closed
	-Shift Organization (III.D)	Closed
	-Clearance Program (III.E)	Closed
Maintenance	-Area Turnovers(I.E)	Closed
	-Ownership of Major Plant Equipment (ii.D)	Closed
	-Work Coordination and Integrated Schedule (IV.A)	Closed
	-Spare Parts Inventory (V.A)	Closed
	-Maintenance Backlog(V.E)	Closed
	-Non-safety Related Equipment Standards (V.G)	Closed
Engineering Support	-Ownership & Adequacy of Technical Programs (IV.F)	Closed
	-Control of Documentation (V.A)	Closed
	-Equipment Accessibility (V.F)	Closed
Training & Qualification	-Simulator Training Improvements (III.F)	Closed
Radiological Protection	-Conduct of Radiological Controls (V.D)	Closed
Chemistry	-Conduct of Chemistry (V.C)	Closed
Operating Experience Review	-Incorporation of SQN Lessons Learned (I.C)	Closed
	-Operating Experience Program (II.F)	Closed
Emergency Preparedness	Not observed	N/A
Outage Management	Not observed	N/A

NOTE: The ( ) indicates the report concern number

Table E4-3
OPERATIONAL READINESS REVIEW
Phase II

INPO 90-015 ORGANIZATIONAL AREAS	CONCERNS	STATUS
Organization & Administration	-Integrated Schedule (I.A)	closed
	-Operational Readiness Program improvements (I.B)	open
	-Definition of Roles & Responsibilities (I.C)	closed
	-Teamwork & Ownership (I.D)	closed
	-Management Effectiveness (I.E)	open
	-Readiness for Second HFT (I.F)	closed
	-Site Operational Attitude (II.A)	closed
	-Corrective Action Program (II.B)	open
	-Procedure Control and Adherence (II.D)	open
	-Personnel Safety (II.G)	open
	-Operational Quality Assurance (II.H)	closed
	-Control of Documentation (IV. H)	open
Operations	-Equipment Status Control and Clearances (II.F)	closed
Maintenance	-Balance of Plant Standards (II.C)	closed
	-Housekeeping and Cleanliness (II.E)	open
	-Work Control Process-Planning, Scheduling, and Coordination of Work (III.A)	closed
	-Preventive Maintenance Program Effectiveness (III.C)	open
	-Maintenance Performance Indicators (III.E)	closed
	-Coordination of Maintenance Related Activities (III.F)	closed
Engineering Support	-Surveillance Instructions (III.B)	closed
	-Control of Drawing Changes (III.D)	open
	-System Engineers (IV.A)	closed
	-10CFR50.59 Program (IV.B)	open
	-Fueling Preparations (IV.C)	open
	-Reactivity Management (IV.D)	closed
	-Corrosion Programs (IV.E)	open
Training & Qualification	No concerns identified	N/A
Radiological Protection	No concerns identified	N/A
Chemistry	-Conduct of Chemistry (IV.G)	closed
Operating Experience Review	-Use of Operating Experience (IV.F)	closed
Emergency Preparedness	Not observed	N/A
Outage Management	Not observed	N/A

Table E4-5

PAC/AQ REVIEW

Phase V

INPO 90-015 ORGANIZATIONAL AREAS	REVIEW AREAS
Organization & Administration	- Operational Readiness Program Plan - Control Program Configuration - Nuclear Assurance Audits and Assessments Program - Corrective Action Program/Special Program Commitment Completion - Independent Safety Engineering Group (ISEG) - Special Review of the FSAR - Fuse Control/Master Fuse List Program
Operations	- Operations - Unit 1/Unit 2 Interface Program
Maintenance	- Preventive Maintenance Program - Damaged, Loose, or Missing Hardware Program
Engineering Support	- Surveillance Testing Program - Check Valve Program - Cyclic and Transient Limits Monitoring - Design Control Program - Motor Operated Valve Program - Temporary Modifications/Alterations Program - Procedures Upgrade Program - Materials and Procurement Program - Reactivity Management and Power Ascension Test Program - SPAE/SPOC Programs - Nuclear Assurance Assessment NA-WB-94-0109, Modifications Programs for Scaffolding, Welding and Workplans - Nuclear Assurance Corporate Audit SSA94409 - Test Deficiencies - Technical Support NA Assessment Report No. NA-WB-94-0123
Training & Qualification	- Training
Radiological Protection	- Radiation Protection - Health Physics Readiness
Chemistry	- Chemistry - Primary Chemistry
Operating Experience Review	- Nuclear Assurance Corporate Audit SSA94409 - Nuclear Experience Review
Emergency Preparedness	Not observed
Outage Management	Not observed

Table E4-6
OPERATIONAL READINESS REVIEW
Phase V - Operations

PAC/AQ PHASE V	CONCERNS	STATUS
Operations	-Document has 2 different titles in Document Control System (PACR 0423)	closed
	-Failure to monitor Control Room Alarm Operability (PACR 0418)	closed
	-Main Control Room caution order not current (PACR 0423)	closed
	-Operations Procedure not followed (PACR 0433)	closed
	-Excessive ERCW Pump Packing Leakage (PACR 0407)	closed
	-Electrical Safety Hazard (PACR 0411)	closed
	-Maintenance Procedure Technical Content (PACR 0431)	open
	-Invalid WO tags in plant (PACR 0434)	closed
	-Housekeeping Concerns at Intake Pumping Station (PACR 0415)	closed
	-New Fuel Vault/Spent Fuel Pit Housekeeping Concerns (PACR 0424)	closed
	-Procedure Improvement - Reactor Engineering (PACR 0426)	closed
	-Estimated Critical Rod Position Differences (PACR 0427)	closed
	-Degraded Essential Raw Cooling Water Pump (PACR 0416)	closed

TVA'S TRANSITION TO AN OPERATIONS MINDSET AT WBN PROGRESSION ON THIS FRONT

- **COMMONALITY STUDY OF OTHER PLANTS WITH POOR AND GOOD TRANSITIONS**

  - Few Common Threads
  - Plants with Good Construction History Had Poor Startup And Operational Histories, and Vise Versa
  - One Consistent Theme Is Strong Operating Staff
  - Contacted Recent Transition Plants - High Backlog

- **TVA AS AN ORGANIZATION HAS IMPROVED TREMENDOUSLY IN TRANSITIONS FROM CONSTRUCTION TO OPERATIONS**

  - Sequoyah's Transition Versus Browns Ferry's Transition
  - Sequoyah's Improvements In Latest Restart Efforts
  - Lessons Learned Factored Into Watts Bar Efforts

- **TVA IS ORGANIZATIONALLY MORE INTEGRATED SITE TO SITE TO PROVIDE COLLECTIVE SUPPORT**

- **THE WATTS BAR TRANSITION IS BEING ACCOMPLISHED USING PRIMARILY BROWNS FERRY PEOPLE, PROCESSES AND PROGRAMS - A PROVEN SUCCESS TRACK**

  - Browns Ferry Had Similar Problems To Watts Bar
  - Browns Ferry Overcame Problems - Had a Successful Restart
  - Browns Ferry Has Good Operating Record Despite Movement of Personnel Out of Site Organization - A Self Sustaining Organization

- **AT WATTS BAR OPERATING STAFF IS NOT CONSTRUCTION STAFF**

  - Significant Training
  - "Shadow Managers"
  - Good Operational Transition In Progress
  - HFT-2 Is Report Card

ENCLOSURE 5
OVERSIGHT

OVERSIGHT ASSESSMENT METHODOLOGY
SECTION IV, ENCLOSURE 5

MULTI-LEVEL ASSESSMENT

- **ADEQUACY OF THE QUALITY OVERSIGHT EFFORT**
  - **ASSESS ELEMENTS OF OVERSIGHT** - (PROCESS PERSPECTIVE)
    1. PROGRAM: SAME AS AT OPERATING PLANTS, REVIEWED MANY TIMES
    2. PEOPLE: CREDENTIALS, TRAINING AND DIVERSITY
    3. COVERAGE: TREMENDOUS COVERAGE -- BOTH VOLUME AND OVERLAP
    4. IMPLEMENTATION: AUDITS AND RELATIVE CONSISTENCY AMONG OVERSIGHT ORGANIZATIONS
  - **ASSESS PERIODS OF MAJOR EVENTS**- (MAJOR EVENT ASSESSMENT)

    1985 (EMPLOYEE CONCERNS), 1990 (STOP WORK), 1993 (SALP 3) AND 1994 (EIGHT CONSTRUCTION ISSUES)
  - **PAC/AQ OVERSIGHT OF QUALITY** (PAC/AQ OVERVIEW)
    1. CONDUCTED IN 5 PHASES
    2. PROVIDED AN ADDITIONAL LEVEL OF ASSURANCE
- **CAPABILITY OF NUCLEAR ASSURANCE TO SUPPORT FUTURE OPERATIONS**
    1. ORGANIZATION STRUCTURE AND PERSONNEL PREPARATION
    2. OPERATIONAL QA PROGRAM
    3. RECENT PERFORMANCE OF NA ORGANIZATION
- **HFT2 AND THE QA IDI WILL PROVIDE A FURTHER ASSESSMENT OF OVERSIGHT ADEQUACY**

OVERSIGHT COVERAGE

- **AUDITS/ASSESSMENTS**
  - More than 2,900 since 1989
  - More than 200 in last 12 months
- **SWEC QUALITY CONTROL - CONSTRUCTION**
  - More than 450,000 Inspections since construction restart
  - More than 230,000 man-hours per year
  - More than 7,000 Overview Inspections by TVA QC
- **CORRECTIVE ACTION PROGRAM/SPECIAL PROJECTS (CAP/SP)**
  - More than 51 man-years of NA oversight since 1990
- **TVA QUALITY CONTROL - MAINTENANCE**
  - Approximately 3,000 inspections per year
- **DOCUMENTATION REVIEWS**
  - Approximately 6,000 Work Document Reviews per year
  - Approximately 3,000 Procurement Reviews per year
  - Over 450 Corrective Action Document Reviews in last 12 months
- **PAC/AQ**
  - More than 50 man-years of review since 1990
- **NRC**
  - More than 50,000 inspection hours per year

Table E5-2
Coverage Matrix of Oversight Organization
Nov. 1991 - Nov.1992

QUALITY ASSURANCE ACTIVITIES	AUDITS	MONITORING	CAPs/ SPs VERIFICATION	PAC/AQ	QE	QC	CATD VERIFICATION	RECORDS	TECH SUPPORT (QA)
Program Development and Administration	X								
Inspection Activities	X	X		X	X	X		X	
Monitoring	X							X	
Audits				X				X	
Conditions Adverse to Quality Program Review Control, Verification, and Effectiveness	X	X		X				X	X
QA Record Programs - Additional Systematic Records Review (ASRR)	X	X						X	
Training Qualification & Certifications	X	X		X				X	
PAC/AQ		X	X		X				
Trending/Reporting				X					
Reviews (Procedures, Work Plans, Work Orders, Work Requests, etc.)	X	X						X	
Corrective Action Tracking Documents (CATD)							X	X	

X - Indicates Coverage

CONCLUSIONS

ADEQUACY OF THE QUALITY OVERSIGHT EFFORT

PROCESS PERSPECTIVE

- THE NQA PLAN CONTAINS THE APPLICABLE REGULATORY AND MANAGEMENT REQUIREMENTS AND IS THE SAME PROGRAM USED AT THE OTHER TVA OPERATING SITES

- PERSONNEL PERFORMING OVERSIGHT FUNCTIONS ARE QUALIFIED AND CERTIFIED IN ACCORDANCE WITH APPLICABLE REGULATORY REQUIREMENTS

- THE OVERSIGHT COVERAGE AT WBN HAS BEEN UNPRECEDENTED

- VAST MAJORITY OF OVERSIGHT ACTIVITIES HAVE PRODUCED POSITIVE RESULTS

- SIGNIFICANT IMPROVEMENT HAS OCCURRED SINCE 1985 AND IMPLEMENTATION IS CURRENTLY AT AN ACCEPTABLE LEVEL.

MAJOR EVENT ASSESSMENT

- SIGNIFICANT IMPROVEMENT HAS OCCURRED AND THAT THE 1994 ISSUES ARE DRASTICALLY DIFFERENT IN BOTH SCOPE AND SIGNIFICANCE THAN THE PREVIOUS EVENTS

CONCLUSIONS (cont'd)

PAC/AQ OVERVIEW

- OVERSIGHT PERFORMANCE HAS IMPROVED - CONDUCTING BOTH MORE AND BETTER ASSESSMENTS WHICH HAS LED TO FINDING PROBLEMS BEFORE THE REGULATORY GROUPS

- ADDITIONAL LEADERSHIP AND TECHNICAL SUPPORT FROM BFN AND CORPORATE HAS BEEN BROUGHT IN TO TRAIN AND DEVELOP THE ORGANIZATION

- INTERFACE BETWEEN THE LINE ORGANIZATION AND NUCLEAR ASSURANCE HAS IMPROVED

CAPABILITY OF NUCLEAR ASSURANCE TO SUPPORT FUTURE OPERATIONS

SEVERAL RECENT EVALUATIONS OF OVERSIGHT PERFORMANCE INDICATE OPERATIONAL READINESS FOR THE NUCLEAR ASSURANCE ORGANIZATION

- SELF-ASSESSMENTS
- ORMRT
- PAC/AQ
- NRC

IDI AND HFT2 WILL FURTHER SUBSTANTIATE THESE CONCLUSIONS

ENCLOSURE 6
EMPLOYEE CONCERNS

ENCLOSURE 6

REASONABLE ASSURANCE ASSESSMENT REPORT EMPLOYEE CONCERNS

Overview of Report Methodology

- Examines efforts to resolve the large number of concerns raised in the mid-1980s and the actions taken to resolve subsequent concerns in an effective and timely manner.
- Examines the development of the Employee Concerns Programs in TVA.
- Examines the Employee Concern Special Program (ECSP), as well as, the contemporary Employee Concern Program (ECP).

Supporting Data

ECSP

- Approximately 6000 Concerns
- 9 Category Reports
- 107 Subcategory Reports
- NSRS Reports
- 704 Corrective Action Tracking Documents
- Internal/External Reviews
  - OIG
  - NA
  - Lookback
  - NRC

ECP

- TVA ECP (1551 Issues)
- Contractor ECPs (122 Issues)
- Internal/External Reviews
  - OIG
  - NA
  - NRC

REASONABLE ASSURANCE ASSESSMENT REPORT
EMPLOYEE CONCERNS

Conclusions

ECSP

- The ECSP and the CATD closure process has been very effective in resolving and closing pre-February 1986 Employee Concerns. It's acknowledged that the ECSP corrective action resolution process has not operated flawlessly in all respects. Nonetheless, the noted deficiencies do not cast doubt upon the overall effectiveness of the ECSP closure process, especially in the light of the fact that the ECSP has been effectively managing and overseeing the disposition of thousands of concerns and hundreds of corrective action plans over several years. The structured, multi-tiered review process utilized by the ECSP ensures, to the greatest extent possible in matters requiring the exercise of engineering and management judgment, that concerns are dealt with in the best possible manner. This program has been closely scrutinized internally by TVA and externally by the NRC.

- ***Only 37 of the 151 open CATDs out of 704 CATDs remain to be reviewed by the Lookback Project.***

ECP

- TVA's efforts have been responsive to employees' needs.

- Concerns have been, and continue to be resolved in an effective manner.

- Significant progress has been made to reduce the number of concerns expressed outside the management chain and increase the level of communication within the line organizations.

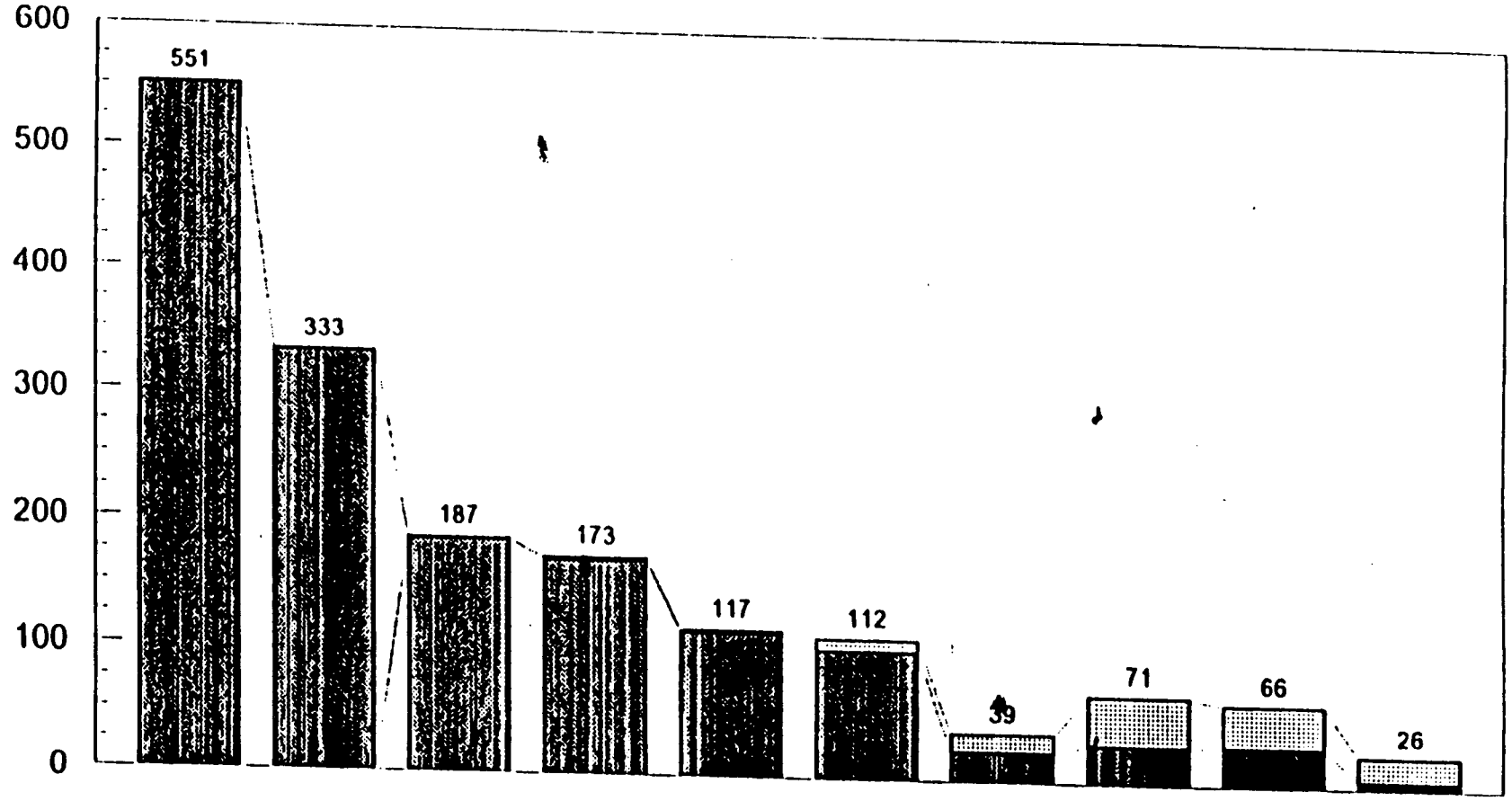
- The number of employee concerns are decreasing and the level of employees' trust in line management to listen and resolve concerns is increasing.

- The level of scrutiny received by the ECP from NRC, as well as, various TVA organizations, along with the positive results it has achieved, gives TVA a high degree of assurance that the ECP is effectively resolving employee concerns.

- ***All but 12 of the contractor ECP issues and 10 of the TVA CRS issues have been resolved and closed.***

Watts Bar

TVA and Contractor Issues Trend



	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995 thru May
TVA Issues	551	333	186	171	115	103	24	31	32	6
Contractor Issues	0	0	1	2	2	9	15	40	34	20

ENCLOSURE 7
CORRECTIVE ACTION PROGRAM

ENCLOSURE 7

REASONABLE ASSURANCE ASSESSMENT REPORT
CORRECTIVE ACTION PROGRAM

Conclusion

There is reasonable assurance that the Corrective Action Program at WBN is sufficient to support fuel load and plant operation.

- Historically, the Program had significant deficiencies in both Program structure and implementation.
- Major changes to the Program between 1987 and 1991 were effective and there is reasonable assurance that the Program itself -- including both its structure and processes -- will support safe fuel load.
- Post-1991 deficiencies have concerned Program implementation. Recent TVA audits/assessments and NRC inspections demonstrate the effectiveness of corrective actions. Implementation of the Program has improved such that it now fulfills its intended purpose.
- Recognizing the need for further improvement, WBN will incorporate the enhanced Corrective Action Program currently used at SQN and BFN.

Assessment Methodology

1. Assessment of Corrective Action Program Structure
2. Assessment of Corrective Action Program Implementation
   - Documentation Deficiencies
   - Extent of Condition, Root Cause Analysis, Recurrence Control
   - Accountability and Ownership
3. Assessment of Enhanced Corrective Action Program

Themes

1. Although the Corrective action Program had deficiencies, the majority of the Program was acceptable.

2. The Corrective action program has undergone significant structural improvement since 1987. As a result, the Program's structure is acceptable.

3. Implementation of the Program has continually improved and is acceptable.

4. Improved implementation also inferred from overall results of the WBN quality program (i.e., the number of significant problems at WBN has decreased significantly over time).

5. There have been few hardware problems since the Program was restructure in 1991.

Supporting Data

A. TVA

1. Audits/Assessments
2. SCARs, PERs, CAQs, CATDs
3. PAC/AQ
4. IDIs
5. NA 100% Review of Corrective Action Closure Package Results
6. WBN Fuel Load Readiness Reports

B. NRC

1. Inspection Reports (including SALPs), NOVs
2. South Texas Project Report

C. Other

1. TVA/NRC correspondence
2. SWEC QC Inspections

FIGURE E7-1: SIGNIFICANT CORRECTIVE ACTION REPORTS SINCE 1985

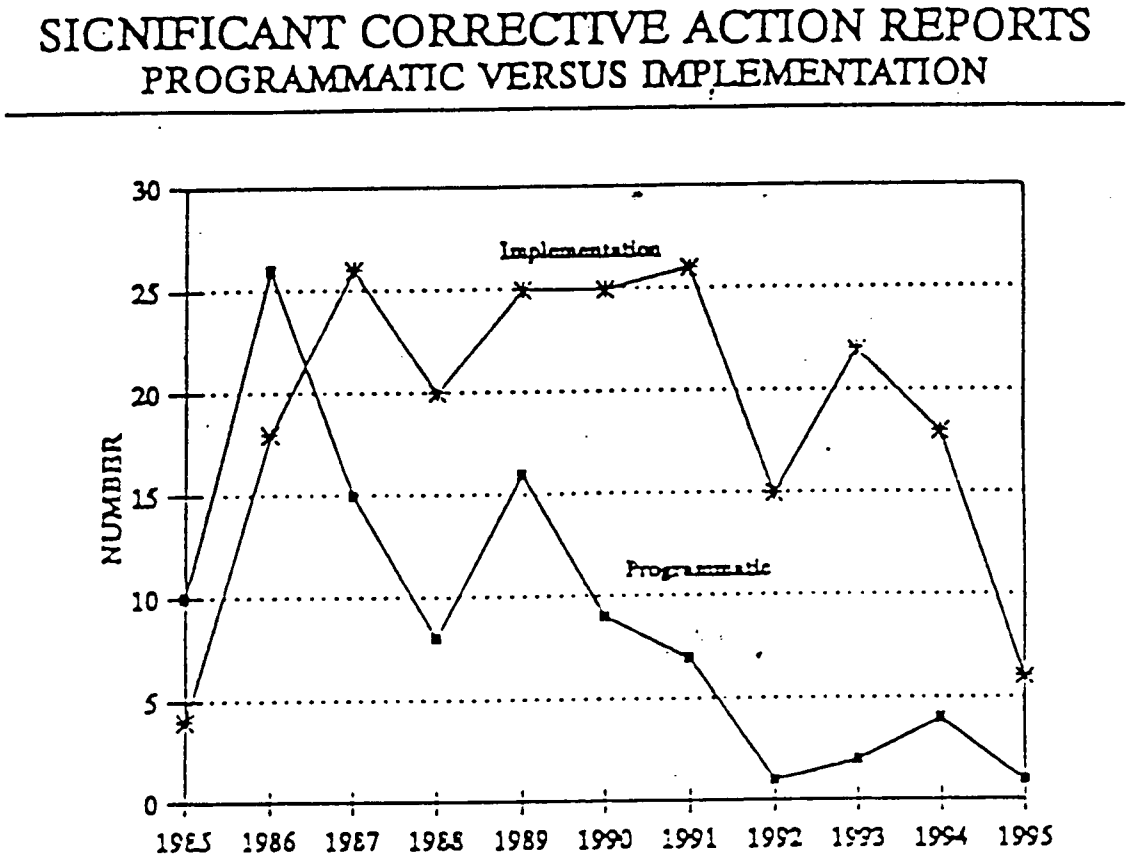
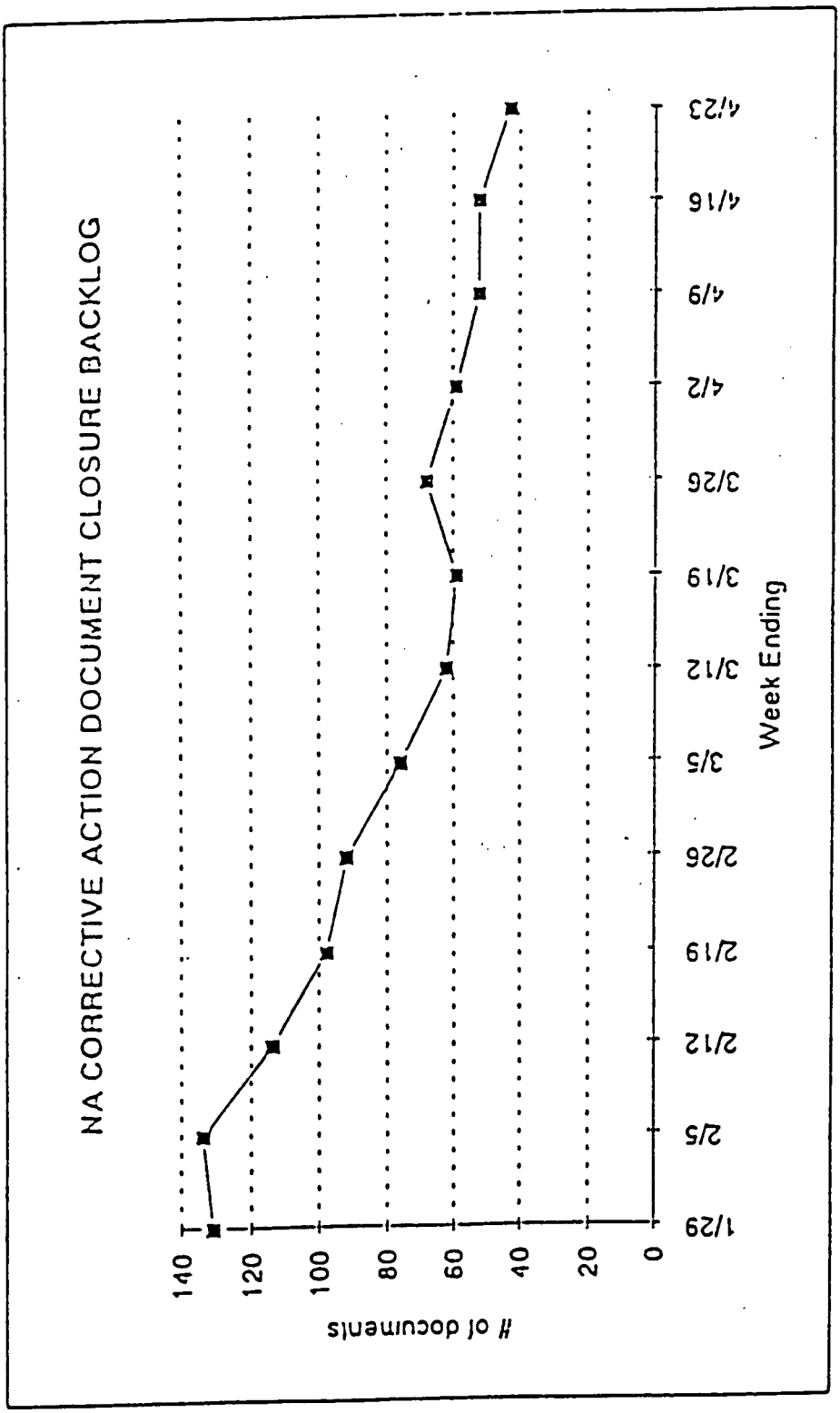


FIGURE E7-5: NA CORRECTIVE ACTION DOCUMENT CLOSURE BACKLOG



ENCLOSURE 8
CLOSURE ASSESSMENT

ENCLOSURE 8

REASONABLE ASSURANCE ASSESSMENT REPORT
CLOSURE ASSESSMENT STATUS

OBJECTIVES TO ACHIEVE REASONABLE ASSURANCE:

- Identify the key issues for which control and resolution must be demonstrated in support of the licensing of Unit 1.

- Demonstrating that the population of issues required for licensing is well defined, controls for resolution of this population and future issues exist, and that the programs and controls have received the appropriate level of review to ensure adequate resolution of the issues is achieved

KEY GROUPS OF ISSUES:

A. NRC Commitments

B. NRC Inspection Issues

C. 10 CFR 50.55(e) Items

D. Part 21 Items

E. Nuclear Experience Review (NER) Items

F. INPO Significant Operating Experience Review (SOER) Items

G. Conditions Adverse to Quality (CAQs)

H. Vertical Slice Review Discrepancy Reports (VSRDR)

ENCLOSURE 8

REASONABLE ASSURANCE ASSESSMENT REPORT
CLOSURE ASSESSMENT STATUS

CONTROL OF ISSUES/DATA SOURCES:

- Principal program used for tracking corrective actions - Tracking and Reporting of Open Items (TROI)
- Each process controlled by a formal administrative procedure.
- Resolution of Significant Operating Experience Review (SOER) issues controlled independently of TROI in an SOER data base.

BASIS FOR REASONABLE ASSURANCE:

- NRC Commitments, NRC Inspection Issues, 10 CFR 50.55(e) Items, and Part 21 Items:
  - Commitments/corrective actions were initially defined and verified as elements of Design Baseline Verification Program (DBVP) and Program for Assurance of Completion and Assurance of Quality (PAC/AQ)
  - Programmatic commitments reverified and source noted under DBVP
  - Site procedures strengthened to ensure proper closure of commitments and control of programmatic commitments

ENCLOSURE 8

REASONABLE ASSURANCE ASSESSMENT REPORT
CLOSURE ASSESSMENT STATUS

BASIS FOR REASONABLE ASSURANCE (continued):

- Nuclear Experience Review (NER) Items, INPO Significant Operating Experience Review (SOER) Items, Conditions Adverse to Quality (CAQs), and Vertical Slice Review Discrepancy Reports (VSRDR):

  - Oversight/assessment by Corporate Operating Experience, INPO, Independent Safety Engineering and Nuclear Assurance

  - Additional oversight of program effectiveness include; NRC inspection activity, and the Operational Readiness Self Assessment

  - Stringent procedural controls exists for each program

ENCLOSURE 9
SIGNIFICANT EVENT ASSESSMENT

ENCLOSURE 9

REASONABLE ASSURANCE ASSESSMENT REPORT
PROGRAMMATIC IMPROVEMENT ASSESSMENT

MULTI-LEVEL ASSESSMENT

- **KEY EVENT ANALYSIS**

  1. DISCUSSION OF 1985 EVENTS
  2. DISCUSSION OF 1990 EVENTS
  3. DISCUSSION OF 1994 EVENTS

- **SIGNIFICANT CORRECTIVE ACTION REPORT ANALYSIS**

  1. ANALYSIS OF TRENDS IN OVERALL SIGNIFICANT CORRECTIVE ACTION REPORTS
  2. ANALYSIS OF SIGNIFICANT CORRECTIVE ACTION REPORTS BY MAJOR PROGRAM AREA

- **ADDITIONAL PERFORMANCE IMPROVEMENT INDICATORS**

  1. DESIGN
  2. CONSTRUCTION
  3. OPERATIONAL READINESS
  4. PAC/AQ
  5. EMPLOYEE CONCERNS
  6. WBN FUEL LOAD READINESS WINDOWS REPORT

TABLE E9-1
MAJOR EVENT ANALYSIS

SIGNIFICANT PROBLEM AREAS DISCOVERED DURING MAJOR REVIEW PERIODS

1985	1990	1994
Cable Issues	Significant Work Control Problems	Cable Cut Issue
Cable Tray and Tray Supports	Changes to two separate databases used for tracking outstanding work activities were not properly controlled	Close-out process during 4-month period of significant change
Welding	Procedural complexity, lack of clarity and non-compliance	Recurrence Control
Containment Cooling	Inadequate controls for both in-process records stored in temporary facilities and QA records stored in the vault	
Design Baseline & Verification Program	Programmatic failure to establish and implement an adequate Corrective Action Program	
Detailed Control Room Design Review	Timeliness of corrective action initiation	
Electrical Conduit & Conduit Support		
Electrical Issues		
Environmental Qualification Program		
Equipment Seismic Qualification		
Fire Protection Program		
Hanger and Analysis Update Program		
Heat Code Traceability		
Heating, Ventilation, and Air Conditioning Ducts & Duct Supports		
Instrument Lines		
Master Fuse List		
Mechanical Equipment Qualification		
Microbiologically Induced Corrosion		
Moderate Energy Line Break		
Prestart Test Program		
QA Records		
Q-List		
Radiation Monitoring System		
Replacement Items Program		
Seismic Analysis Program		
Soil Liquefaction		
Use-As-Is CAQs		
Vendor Information Program		

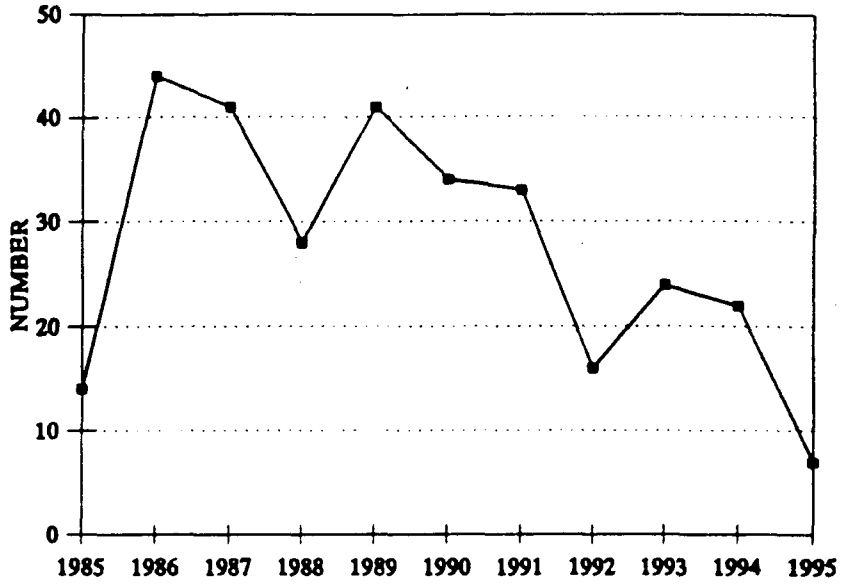
TABLE E9-2

MAJOR EVENT ANALYSIS

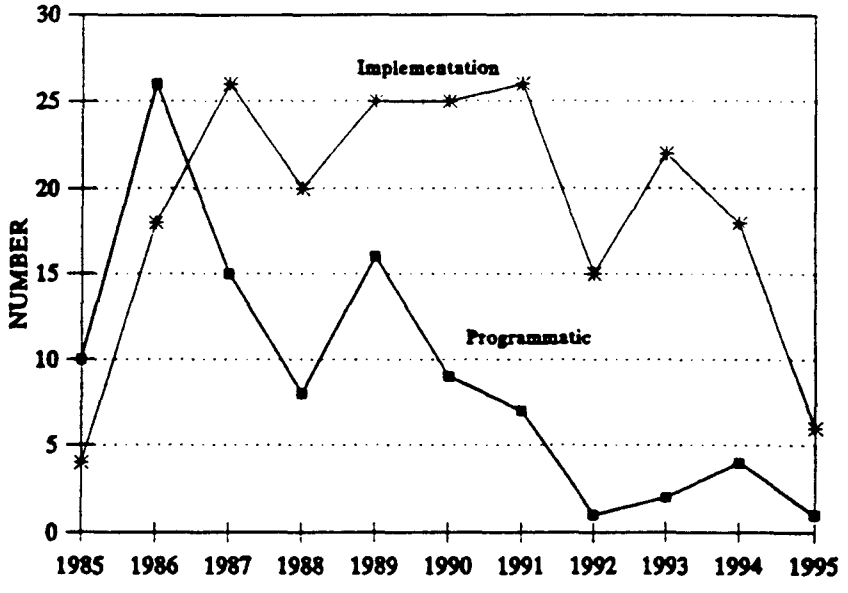
CAUSAL ANALYSIS OF SIGNIFICANT PROBLEM AREAS DISCOVERED DURING MAJOR REVIEW PERIODS

1985	*1990*	*1994*
Absence of effective organizational structure with clear lines of responsibility, authority and accountability	Inattention to detail, supervisory ineffectiveness, procedural lack of clarity, procedural non-compliance, ineffective implementation of QA/QC	Management failed to provide balanced allocation of management attention and resources.
Lack of sufficient numbers of experienced managers to provide necessary leadership & direction	Denial of need for change, failure to implement responsibilities, ineffective follow-through of corrective actions	Management failed to consistently establish expectations and hold personnel individually accountable.
Lack of commitment to and responsibility for achieving excellence in performance	Organizational structure, changing leadership direction, incorrect focus, unclear expectations	
Insufficient follow-up to verify proper implementation of goals and objectives	Inappropriate beliefs regarding personnel, responsibilities and quality; incorrect mind set that "Inspecting in Quality" was appropriate	
Failure to adequately scope, plan and apply resources to emerging problems		
Lack of centralized, established lines of authority, responsibility, and accountability for performance of key design control functions needed to ensure that design integrity is maintained		
Inadequate engineering evaluations, a lack of detail in design output, and the absence of a centralized design input/output		
Use of design and modification control methods that did not provide the coordination among groups required to ensure accurate documentation of plant configuration and performance of effective safety evaluations		

SIGNIFICANT CORRECTIVE ACTION REPORTS
TOTAL SCARS OVER TIME



SIGNIFICANT CORRECTIVE ACTION REPORTS
PROGRAMMATIC VERSUS IMPLEMENTATION



CONCLUSIONS

- **SIGNIFICANT PROGRESS SINCE 1985**
  - PROGRAM DEVELOPMENT
  - PROGRAM IMPLEMENTATION
  - PROBLEMS IN 1990 AND 1994 HAVE BEEN REDUCED SIGNIFICANTLY IN TERMS OF SCOPE, SAFETY IMPACT AND REQUISITE CORRECTIVE ACTIONS

- **SIGNIFICANT CORRECTIVE ACTION DOCUMENT ANALYSIS DEMONSTRATED OVERALL IMPROVEMENT IN BOTH QUANTITY AND SUBSTANCE**

- **BROAD SCOPE IMPROVEMENTS ARE APPARENT IN DESIGN, CONSTRUCTION, OPERATIONAL READINESS, AND EMPLOYEE CONCERNS**

ENCLOSURE 3

UNEDITED DRAFT (INCOMPLETE)

JUNE 16, 1995

OVERALL ASSESSMENT OF WATTS BAR QUALITY AND EFFECTIVENESS OF QUALITY ASSURANCE

CONTENTS

UNEDITED DRAFT (INCOMPLETE)

OVERALL ASSESSMENT OF WATTS BAR QUALITY AND EFFECTIVENESS OF QUALITY ASSURANCE

1. INTRODUCTION

1.1 Purpose

In this supplemental safety report (SSER), NRC examines the significant problems of Watts Bar Nuclear Plant (WBN), Unit 1, construction quality and quality assurance (QA) that resulted in the Tennessee Valley Authority's (TVA) April 1986 withdrawal of its certification that WBN Unit 1 was ready to load fuel, as well as examining the breakdown of its nuclear program in general. It outlines the extensive actions taken by TVA to correct these problems. This report also outlines the improvements made by NRC since the early 1980s to correct the causes of its failure in regulatory oversight to act effectively in a timely manner.

This report assesses TVA's efforts to correct the root causes of its problems with regard to WBN Unit 1 and the success achieved by the NRC in correcting the root causes of the problems in regulatory oversight in the construction quality and quality assurance of WBN Unit 1.

Finally, this report assesses the TVA program for WBN operational readiness to determine whether WBN, if licensed, can be expected to operate safely and not pose an undue risk to public health and safety and the environment.

1.2 Organization of the Report

The report is organized to first describe historical perspective (Chapter 2) and problems identified and addressed between 1985 and 1991. TVA's plans and NRC actions to recover from the problems of breakdown of WBN construction quality and quality assurance programs in mid-1985 are discussed in Chapters 3,4, and 5. Significant regulatory issues, such as employee concerns programs (Chapter 3), welding, electrical cables, and quality assurance records (Chapter 5) are discussed beyond 1991 to maintain cohesion of the material. NRC actions to improve its regulatory oversight are discussed in Chapter 6. The problems of WBN construction and corrective actions that occurred after 1991 restart were of different character than the ones that occurred in 1985 time frame, and are discussed separately in Chapter 7. Chapter 8 discusses TVA's and NRC's integrated approach to assure that present WBN construction quality is acceptable. NRC is closely monitoring TVA's recent activities assess TVA's latest performance and its trend. NRC assessment of the recent performance and its trend is discussed in chapter 9. Chapter 10 describes the TVA's qualifications and readiness to operate WBN, Unit 1. NRC's overall assessment of

this study is provided in Chapter 11.

2. HISTORICAL OVERVIEW OF WATTS BAR CONSTRUCTION PROBLEMS

On January 23, 1973, NRC issued a construction permit for WBN, Unit 1. Twelve years later, on February 20, 1985, TVA certified that WBN, Unit 1 was ready to load fuel. In the February 20, 1985 letter TVA certified that the design, construction, testing, and preparation for operation of WBN, Unit 1 had essentially been completed in accordance with descriptions contained in the FSAR and other licensing documents. During the spring of 1985, a number of TVA employees informed NRC and selected members of Congress of safety concerns, primarily related to WBN. TVA also learned of a large number of employee concerns through its own organization. The concerns indicated that many TVA employees had lost confidence in TVA's nuclear management and its ability to conduct nuclear activities properly. Some of these employees also expressed fear of reprisal from TVA management for voicing concerns. On May 30, 1985, NRC requested that TVA provide a compilation of all reviews which supported TVA's conclusion that the WBN facility met its licensing commitments.

In early 1985, recognizing that its existing programs to resolve employee concerns were not fully effective, TVA implemented the Employee Response Team (ERT) program at WBN to collect and systematically investigate employee concerns relating to the design and construction of WBN specifically and the TVA nuclear power program in general. TVA's independent Nuclear Safety Review Staff (NSRS) was assigned the responsibility for the ERT program. In May 1985 TVA awarded a contract to Quality Technology Company (QTC) to conduct confidential interviews of all TVA employees associated with WBN. QTC also allowed TVA employees from other TVA nuclear sites that had worked at WBN site to provide concerns to the Watts Bar program.

During the 1985 period when these events were happening, NRC conducted the Systematic Assessment of Licensee Performance (SALP) for all the TVA plants. In the September 17, 1985 letter that transmitted the SALP for all TVA sites, NRC identified that TVA had demonstrated ineffective management of its nuclear program by its continued poor performance. In the September 17, 1985, letter NRC concluded that TVA's performance was only marginally acceptable and confirmed TVA's verbal commitment not to restart the operating units without NRC concurrence. NRC requested, pursuant to 10 CFR 50.54(f), that TVA submit information about its plans for correcting programmatic and management deficiencies throughout the TVA nuclear program, for correcting the site specific problems that contributed to each of the SALP areas rated as a "Category 3", and for correcting the lack of confidence in TVA management expressed to NRC by TVA employees regarding the adequacy of construction of WBN.

During late 1985 and early 1986 time frame, employee concerns about the construction of WBN continued to arise. Some of these had come directly to NRC, but many were being expressed to QTC. The NSRS, which was established in the early 1980s, reported directly to the TVA Board of Directors and as a result was independent of the line organization. The NSRS did inspections of the TVA nuclear plants to advise the TVA Board on nuclear safety.

In December 1985, the NSRS staff was asked by an NRC Commissioner to brief him on its perception of Watts Bar's readiness for an operating license. The NSRS staff expressed concerns that collectively and specifically claimed that WBN did not meet the requirements of 10 CFR 50 Appendix B, which is the NRC quality assurance program regulation that is intended to assure that nuclear power plants are properly constructed. The concerns expressed were very significant and as a result in January 1986, NRC requested TVA to address these concerns formally. TVA responded in March 1986 to the "NSRS concerns," and on April 11, 1986, TVA concluded that Watts Bar was not ready for fuel load and confirmed that TVA was not seeking an operating license for Watts Bar at that time.

In January 1986, the TVA Board of Directors contracted (from outside TVA) Steven White (a retired U. S. Navy Admiral) as a new Manager of Nuclear Power to oversee all aspects of the nuclear power program. Admiral White brought in a new management team of contract managers from a number of companies with experience in the design, construction, and operation of nuclear power plants. The initial task was to set up a new employee concerns program in order to regain employee confidence and to develop a revised Corporate Nuclear Performance Plan to address the programmatic and management deficiencies. The new employee concerns program was initiated on February 1, 1986. The revised Corporate Nuclear Performance Plan was submitted to NRC on March 10, 1986. The employee concerns that had been received by QTC at WBN prior to February 1, 1986, were placed into a separate employee concerns program called the Employee Concerns Special Program (ECSP). The Employee Concerns Special Program contained approximately 6000 employee concerns dealing with specific aspects of construction; engineering; operations; material control; welding; intimidation and harassment (I&H), and misconduct; management and personnel; quality assurance; and industrial safety. Most of these concerns were specific to WBN.

On March 19, 1986, TVA established a special Watts Bar Task Force, consisting of senior personnel experienced in nuclear design and construction, to determine the corrective actions to be completed before fuel load. The resulting corrective actions, known as Special Programs, grouped similar or related problems previously identified by NRC, Institute for Nuclear Power Operation (INPO), outside contractors, and various corporate and site quality-assurance processes. The Watts Bar Task Force was the first action taken to consolidate issues and develop corrective actions to address similar issues collectively through an integrated plan. Because previously completed discovery programs found instances of inadequate root cause determinations and inadequate recurrence control for identified weaknesses, questions arose about the degree to which the design and construction of Watts Bar met regulatory requirements. In addition questions arose about the adequacy of records documenting the acceptability of nonconforming design, construction and installation.

To provide reasonable assurance that licensing requirements and TVA's commitments would be met, the Senior Vice President of Nuclear Power established an independent Watts Bar Program Team to perform an integrated systematic evaluation of Watts Bar. The objective of the Program Team was to look beyond the known problems and perform an overall

evaluation of plant design and construction in order to identify all of the corrective actions necessary to license WBN. A key part of the systematic evaluation was the performance of a Vertical Slice Review (VSR) by the Sargent and Lundy Company. The VSR was performed between April 1988 and March 1989 and included an engineering review, a construction review, and a records review. Its purpose was to detect problems that had not yet been identified through previous discovery programs and, at the same time, confirm that the corrective actions planned were adequate to resolve the identified problems. An extensive number of deficiencies were identified by the VSR.

The Program Team developed the Watts Bar Nuclear Performance Plan and recommended 18 Corrective Action Program plans (CAPs) and 11 Special Programs (SPs) to TVA management for approval. The CAPs and SPs did not include all the work necessary to license Watts Bar. They identified those areas where TVA wanted early review and approval by NRC of their proposed approach because NRC's disagreement with TVA's approach was likely to have adverse consequences to Watts Bar licensing. The CAPs are general in nature, and include plans to identify, scope, and resolve technical issues. The resolutions described in CAPs include the revision of the relevant design output documents and procedures; the establishment of corrective actions for items not in conformance with the design output documents; and the installation, modification and inspection of the corrective actions.

In December 1990, TVA voluntarily stopped physical construction work due to work control problems. During the work stoppage, TVA decided to hire a contractor to perform all future construction/modification work. During the work stoppage, TVA significantly upgraded the work control process and reduced its backlog of items necessary to support construction work. All systems were transferred back to the Engineering and Modifications organization, and a decision was made to perform again essentially the entire pre-operational testing program before certifying ready to load fuel. This was to demonstrate and confirm that the safety systems would perform as designed. Limited construction work was restarted in November 1991, with full construction resuming in June 1992. Since construction restart, almost all work performed has been on Unit 1 and those Unit 2 systems necessary to support Unit 1 operation.

3. EMPLOYEE CONCERNS PROGRAMS

3.1 The Employee Concerns Special Program

The Employee Concerns Special Program (ECSP) was established to resolve the approximately 6000 employee concerns received prior to February 1, 1986. Some of the employee concerns received were applicable to other TVA nuclear plants besides Watts Bar. The ECSP included concerns: obtained from the confidential interviews conducted by QTC; NSRS identified concerns that were still open; concerns generated from the SWEC review of

incoming NRC correspondence; and concerns generated by the ECSP evaluators. The concerns were grouped into nine categories (Construction; Engineering; Operations; Material Control; Welding; Intimidation, Harassment, Wrongdoing, or Misconduct; Management and Personnel; Quality Assurance/Quality Control; and Industrial Safety). The concerns in each category were then sorted into 107 subcategories. The subcategories were broken down into elements, which grouped the concerns by issue. Concerns were then investigated by issue. The ECSP investigations found that: some concerns could not be substantiated (Class A); in some cases that concerns were substantiated but did not represent a problem (Class B); in some cases the corrective actions were underway but not completed (Class C); and in some cases corrective action needed to be initiated (Class D and E). The collective results of the investigations for all the plants were published in category reports and subcategory reports, which were submitted to NRC on February 6, 1989.

The ECSP issued Corrective Action Tracking Documents (CATDs) for validated issues in which the ECSP believed that additional corrective actions were needed (Class D and E). Approximately 700 CATDs were issued that were applicable to Watts Bar (approximately 600 in safety-related categories). Corrective actions for the issues identified in the CATDs were developed by the responsible line organization and concurred in by ECSP. These corrective actions were called CATD corrective action plans (CATD CAPs). The program was set up so that when the CATD CAPs are completed the employee concerns will be resolved. An independent verification process was established to ensure that the corrective action plans were properly completed. The independent verification process was usually assigned to the QA organization.

A deviation process was later established to allow for changing the CATD CAPs. The deviation process established a Senior Review Panel to assess changes and determine their acceptability. In addition, the process classified the deviations into three levels based on safety significance and established criteria for when NRC concurrence was needed. Level I deviations were defined as deviations from technical specifications, deviations from the design basis, deviations from FSAR, or deviations that could cause a reduction in safety margins. Level II deviations were those that affected multiple plants, had programmatic areas of weakness, deviated from the techniques or methods established in commitments, or involved organizational changes that directly affect CATD CAP closure. Level III deviations were described as all other changes.

In late 1988, ECSP realized that they had not adequately documented the ties between the Class D/E employee concerns and the CATDs that resolved them. As a result, ECSP initiated the overview process to accomplish a final review to ensure the corrective actions resolved the associated employee concerns. This included making the ties between the employee concerns and the associated CATDs.

3.1.1 NRC Review of Employee Concerns Special Program

The programmatic aspects of the TVA ECSP were accepted by NRC in a letter dated

October 6, 1987. NRC approach was to review the implementation for each plant as the corrective actions were identified and implemented. The results of the investigations for Sequoyah were initially published by TVA in element reports. To support the restart of Sequoyah, NRC documented its reviews of the Sequoyah specific element reports in letters to TVA dated March 11, 1988 and November 11, 1988. This was an initial look at the ECSP implementation since later, the collective results for all the plants were published in category reports and subcategory reports, which were submitted to NRC on February 6, 1989. The initial sample review results for the subcategory reports were published by NRC for Browns Ferry Unit 2 restart (15 of 107) on May 31, 1990. A deviation process to approve corrective action changes was submitted to NRC and accepted by NRC in a letter to TVA dated April 15, 1991.

For Watts Bar, NRC planned to review a sample of the safety-related subcategory reports, as was done for the Browns Ferry review. Because NRC had reviewed all of the 29 WBN CAPs and SPs which included the ECSP corrective actions for those areas, NRC concluded in NUREG 0847 Supplement 9 that its commitment to review the ECSP subcategory reports for WBN was completed.

NRC inspection of the ECSP corrective action implementation at WBN is being accomplished under TI 2512/15. Many of the CATDs reviews are preformed in conjunction with the CAP/SP inspections. Initially NRC inspection was focussed on the CATD process. In mid-1993, these inspections indicated that approximately 10% of the CATD corrective actions had not been adequately accomplished to resolve the associated employee concern(s) and that 15% - 20% of the CATD closure packages contained deficiencies. In addition, NRC inspections indicated that some of the corrective actions which were already in place prior to ECSP investigation but not complete (Class C employee concerns) may not have been completed (IR 390,391/93-24). As a result of NRC inspection findings, TVA initiated the "Lookback Project" discussed below.

3.1.2 Lookback Project

As a result of NRC inspection findings, TVA initiated the Lookback Project to ensure that all employee concern corrective actions (Class C and CATDs) were completed and the employee concerns were adequately resolved. The Lookback Project review of Class C concerns revealed that some Class C employee concern corrective actions were being tracked to closure by CATDs. CATDs were intended by the ECSP to be initiated for Class D and E concerns where no corrective action was in place, not Class C employee concerns. NRC questions about the validity of ECSP classification of concerns and confirmation by the Lookback Project during the Class C employee concern reviews that classification methodology was not always followed resulted in TVA expanding the Lookback Project to also review the classification of Class A and B employee concerns. The Class A and B review results confirmed that the original ECSP classifications did not always meet the classifications described in the subcategory reports. The Lookback Project reclassified the Class A and B concerns into legitimate and not legitimate, upgrading approximately 1/3 of

the unsubstantiated concerns reviewed. The basis for the upgrade was that corrective action for the area that the employee concern addressed was taken as a result of previous corrective action that was completed before the ECSP review, that corrective action was being taken through a similar CATD or Class C concern or that corrective action was initiated after the ECSP reviews were completed. The upgrade allowed Lookback to confirm that the concerns were properly resolved through the already established process being used for the Class C and CATD verification process.

The overall review effort of the Lookback Project has retouched all employee concerns in the ECSP program to ensure that corrective action was being accomplished for those that were determined to need corrective action. Although the original intent of the Lookback project was to address only CATDs and Class C concerns, the program was expanded by TVA to ensure that all employee concerns that needed corrective actions were getting corrective action and were being properly closed. This included a verification through sample review that the post 1986 employee concern program was properly classifying and resolving concerns as well.

Initial NRC inspection of the Lookback Project effort on Class C employee concerns (IR 390,391/93-83) identified a lack of attention to detail, particularly in relation to documentation. However, Lookback Project management had already recognized this weakness and was well along in correcting the problem. Similar reviews were conducted by the Lookback Project for CATDs and the same documentation method was used. A later NRC inspection (IR 390,391/94-10) identified that the level of detail in the CATD documentation was improved compared with that observed in the 93-83 inspection of Class C reviews and was adequate. NRC inspection of the Class A & B review (390/94-30) revealed that some Lookback reviews were shallow in depth and missed the proper classification also. However, no issues were found missed by ECSP since in the cases where classifications were missed other documents (CATDs or Class C concerns) were addressing the same issue. NRC review during the QA Records CAP inspection (IR 390,391/94-40) of some Class A and B concerns indicated that Lookback was having some problems with classification and the links to the associated corrective actions when investigations into wrongdoing were involved. This appeared to be an organizational interface problem due to the sensitive nature of wrongdoing investigations. Later inspections have indicated that this problem was corrected by CRS management.

In late 1994, the Quality Assurance organization began trending CATD closure package quality based on using the QA and Lookback review results as quality indicators. Initial trends indicated less than satisfactory results for the line organization. However, this focussed management attention on improvement and quality indicators now indicate acceptable quality packages.

Since the addition of Lookback to the process, NRC inspections show that the percentage of CATDs that would not have resolved the associated employee concerns dropped from approximately 10% to 3% indicating that Lookback has significantly improved the CATD

verification process.

3.2 Concerns Resolution Program

TVA established the Employee Concerns Program (ECP) for all employee concerns raised after February 1, 1986. Those concerns that were received before that date were contained in the Employee Concerns Special Program discussed in section 3.1 above. This program was a first step in the TVA recovery program to bridge the gap between senior management and employees, and to regain the trust of the employees. The program reported directly to the new Manager of Nuclear Power, bypassing the management chain that the ECSP employee concerns described as being a bottleneck to the identification and correction of problems at Watts Bar. The Employee Concerns Program was retitled Concerns Resolution Program on July 16, 1991. The program did not change its function.

The Concerns Resolution Staff (CRS) is composed of a concerns resolution manager, located at the corporate office in Chattanooga, and a site representative at each of the TVA nuclear sites. Each site and the corporate location have a small staff to take and investigate employee concerns. The Corporate Standard that discusses the Concerns Resolution Program encourages employees to express concerns directly to their supervisors and establishes that one of a supervisor's primary responsibilities is listening to and assisting in the resolution of employee concerns. The Concerns Resolution Program provides an alternate avenue for employees to express concerns, maintaining confidentiality when requested.

In 1986 all employee concerns were investigated independently by the ECP staff. A transition began in 1988 to referring some concerns to line management to investigate, without providing the concerned individual's identity. After 1990, essentially all employee concerns were referred to the line organization for investigation. Certain guidance is given in the Standard for the referral, including independence from the specific line organization involved and consent from the concerned individual. The CRS function then becomes one of monitoring and reviewing the investigation results of the line organization. All correspondence with the concerned individual is handled through CRS unless the concerned individual does not object to talking directly with the line organization.

In 1991 and 1992, TVA began requiring major contractors to have their own employee concerns programs as part of the contract language. CRS performed audits of these contractor programs and closely monitors their performance and the concerns being received. Intimidation and harassment concerns received by the contractors are immediately reported to CRS. In addition, the TVA's Inspector General (IG) audit of the Concerns Resolution Program also reviewed the contractor program implementation.

The number of employee concerns received per year by the program has decreased from 551 in 1986 to less than 75 per year during the past several years.

3.2.1 NRC review of Concerns Resolution Program

NRC reviewed and documented acceptance of the Employee Concerns Program in NUREG 1232 Volume I dated July 1987 (now called Concerns Resolution program). Recent NRC inspections of the program in 1990, 1992, and 1993 indicated that the program was adequately resolving the technical issues raised by the employees. Issues dealing with intimidation and harassment are referred by the CRS to the TVA IG. The 1992 and 1993 inspections determined that the referrals to the TVA IG were being properly made. In a 1994 inspection it was found that not all persons exiting the site were receiving exit interviews with an employee concern representative (either CRS or contractor ECP). This was required by the Corporate and Site procedures. It resulted from misinterpretation of the checkout form by managers and employees. As a corrective action, TVA clarified how to use the checkout form and sent questionnaires by mail to the individuals who had been missed.

In the 1993 inspection a significant number of employees (378) were interviewed by NRC. A very large percentage expressed confidence in the program and the need for it to continue. The inspection also found strong support for the program from the senior managers.

Conclusion:

4. RECOVERY PLAN

4.1 Nuclear Performance Plans

The Nuclear Performance Plans were TVA's response to NRC's September 17, 1985, requesting information pursuant to 10 CFR 50.54(f). In the September 17, 1985 letter NRC stated that TVA had demonstrated ineffective management of its nuclear program by its continued poor performance which was only marginally acceptable. Pursuant to 10 CFR 50.54(f), NRC requested that TVA submit information about its plans for correcting programmatic and management deficiencies throughout the TVA nuclear program, for correcting the site specific problems that contributed to each of the SALP areas rated as a "Category 3", and for correcting the lack of confidence in TVA management expressed to NRC by TVA employees regarding the adequacy of construction of WBN. TVA approached this request by addressing the corporate information requests in Volume I of the Nuclear Performance Plan and the site specific requests in a separate volume of the Nuclear Performance Plan for each site. Volume IV provided the TVA's Nuclear Performance Plan for correcting the WBN construction and other problems.

The Corporate Nuclear Performance Plan addressed the requests for information about actions planned by the TVA Board to remain informed and involved in improving nuclear

plant performance; any management changes made to strengthen regulatory performance, including experience and qualifications of personnel filling new assignments; corporate controls established to ensure that the status of TVA commitments to NRC is tracked; and on the program for escalating action on QA audit findings, to ensure problems are quickly resolved. TVA reorganized to place all nuclear power functions under one manager reporting directly to the TVA Board of Directors. Previously nuclear functions were fragmented under several organizations with engineering, construction, security, and nuclear power under separate managers reporting to the TVA Board, and the quality control function split under many departments. TVA considered part of its problem to be a lack of experienced managers. To correct that problem TVA contracted retired Admiral Steven White to fill the new Manager of Nuclear Power position. Other contract managers were also hired to fill key positions. Other corporate changes under this plan included a new employee concerns program, increasing upper management awareness of nuclear activities, improving management systems and controls, and improving the corrective action program. An important function of the management systems and controls was the corporate procedures system which governed and standardized activities for the Office of Nuclear Power.

The Watts Bar Nuclear Performance Plan (Volume IV) addressed the requests for information relating to the Watts Bar site, specifically with respect to a lack of confidence in TVA management by employees regarding the adequacy of construction at Watts Bar Nuclear Plant. TVA formed an independent Watts Bar Program Team to perform an integrated systematic evaluation of Watts Bar. The objective of the Watts Bar Program Team was to look beyond known problems and perform an overall evaluation of plant design and construction in order to identify the necessary corrective actions. The Watts Bar Program Team developed a program plan with the objective being to perform a systematic evaluation of Watts Bar design and construction, to develop corrective actions, and to prepare the Watts Bar Nuclear Performance Plan.

The systematic evaluation included the development of 80 elements and 3300 attributes which were to be confirmed in compliance with licensing requirements and TVA commitments. The systematic evaluation also included an independent vertical slice review, conducted by the Sargent & Lundy Company, to independently verify that the design and construction of Watts Bar meets its licensing commitments. The systematic evaluation identified a number of nonconforming conditions. However, the most significant result from this effort was the grouping of broad scope, generic, or programmatic issues into Corrective Action Program plans, and the development of Special Programs to address corrective action for other significant issues (discussed below).

The Watts Bar Nuclear Performance Plan documents the Watts Bar Program Team's approach and the results of their reviews. The WBNPP also describes other changes necessary to complete and license Watts Bar. These included implementation, verification, and closure of corrective actions; management and organization changes; management control and involvement changes; lessons learned from the restart efforts at the Sequoyah and Browns Ferry sites; and the Operational Readiness program.

4.1.1 NRC Acceptance of Corporate Nuclear Performance Plan

NRC reviewed the Corporate Nuclear Performance Plan and, in July 1987, issued an SER (NUREG 1232, Volume I) on the TVA: Revised Corporate Nuclear Performance Plan. NRC staff found that TVA's revised Corporate Nuclear Performance Plan (Revision 4) was acceptable. The staff concluded that the organization and staffing of TVA's Office of Nuclear Power and the programmatic improvements in place or underway, if implemented properly, were sufficient to resolve the problems at the corporate level that led to issuance of the 10 CFR 50.54(f) letter dated September 17, 1985, and to support continuing TVA nuclear activities, including plant operations.

4.1.2 NRC Acceptance of WBN Nuclear Performance Plan

NRC reviewed the Watts Bar Nuclear Performance Plan (WBNPP) and issued an SER (NUREG 1232, Volume IV) on the TVA: Watts Bar Nuclear Performance Plan in January 1990. In NUREG-1232 NRC endorsed the general approaches of various corrective actions described in WBNPP, and stated that the endorsement was limited to the approach and general methods. If adequately developed into corrective action programs and implemented thoroughly, the approach and the methods should address the identified deficiencies. A revised WBNPP (Revision 1) was issued in September 1991 but the NRC staff determined that it did not provide any significant changes.

4.1.3 Sargent and Lundy Vertical Slice Review

The Sargent and Lundy (S&L) Vertical Slice Review (VSR) was a principal element of the systematic evaluation contained in TVA's Nuclear Performance Plan. The VSR provided an independent, systematic, structured, and comprehensive evaluation of the adequacy of the design and construction of WBN structures, systems, and components. The VSR was performed by S&L in 1988 and 1989 on the component cooling system and emergency auxiliary power system.

The VSR utilized a top down review approach which was conducted by comparing licensing requirements and design base documents to design output documents (e.g., drawings and construction specifications) and finally to installed hardware and associated QA/QC records for representative elements of the systems selected. The VSR was conducted in accordance with a formal plan that was reviewed by NRC in August 1988. A total of 507 discrepancy reports (DRs) resulted from the VSR.

Each of the open DRs was tracked and controlled in an administrative control program documented by on-site procedures. The objective of the on-site program was to ensure that all corrective actions were accurately identified, tracked and provided with a closure review to ensure that commitments were met.

4.1.4 NRC Inspection of Vertical Slice review

Two NRC team inspections of the VSR effort were conducted by the NRC staff at the S&L corporate office in Chicago, Illinois. The first inspection, conducted November 28 through December 2, 1988, included inspection of the contractor's methodology for assessing the engineering verification portion of the VSR. As a result of that inspection NRC concluded that the methodology for assessing the design adequacy of selected systems was adequate. The inspection results were reported in NRC Inspection Report 390/88-09, issued on February 27, 1989.

The second NRC inspection was conducted on February 13-17, 1989. It included examinations of QA audits, personnel qualifications, 10 CFR Part 21-compliance, internal review committee functions, and review of 36 VSR-documented discrepancies in the areas of records, construction, and engineering. NRC concluded that the methodology for assessing the design adequacy of selected systems was adequate. The inspection results were reported in NRC Inspection Report 390/89-02, issued on May 02, 1989.

The NRC staff continued its evaluation of the VSR by conducting several follow up on-site inspections of TVA's implementation and adequacy of the resolution of VSR DR findings. The results of NRC follow up inspections were reported in NRC Inspection Reports 390, 391/93-40, 93-42, 93-45, 93-51, 93-58 and 94-66.

NRC inspections have revealed some deficiencies in the TVA resolution and closure process of the outstanding VSR DRs. However, generally, the various team inspections and on-going on-site inspections have determined the VSR review performed by S&L was thorough and adequate. Also, TVA has generally adequately resolved the issues identified by the VSR. At present, of the 507 DRs, TVA has 233 remaining to be closed. NRC has an open tracking item to assure that all DRs are closed before fuel load.

4.2 Corrective Action program Plans and Special Programs (CAPs and SPs)

The systematic evaluation conducted by the Watts Bar Program Team resulted in the identification of a number of non-conformance. The broad scope, generic, or programmatic issues formed the basis of the Corrective Action Program plans (CAPs). Other significant issues formed the basis of the Special Programs (SPs). Portions of these issues had been previously identified in the corrective action programs, the ECSP, the Vertical Slice Review, and NRC open items. These specific items (CATDs, VSR DRs, CAQa, NRC open items) were identified for each CAP in a July 13, 1989 letter to NRC. The CAPs were intended to address the root cause by collectively evaluating the individual items to ensure the corrective actions for the CAP bounded and resolved the broad scope, programmatic, and generic issues. The CAPs are listed below:

Cable Issues

Cable Tray and Tray Supports
Design Baseline and Verification Program
Electrical Conduit and Conduit Support
Electrical Issues
Equipment Seismic Qualification
Fire Protection
Hanger and Analysis Update Program
Heat Code Traceability
Heating, Ventilation, and Air Conditioning Duct and Duct Supports
Instrument Lines
Prestart Test Program
QA Records
Q-List
Replacement Items Program
Seismic Analysis
Vendor Information Program
Welding

TVA rescinded the Prestart Test Program CAP in 1991 after committing to perform the entire pre-operational test program again.

Many significant issues, which were not as broad in scope as CAPs, or where substantial progress had already been made toward their resolution with several reports submitted to NRC, were bounded in a number of Special Programs. These programs were not submitted to NRC for prior endorsement of approach because they were not as broad in scope, or because significant progress had already been made in their implementation. A brief description of each Special Program was contained in the Watts Bar Nuclear Performance Plan. The Special Programs are listed below:

Concrete Quality Program
Containment Cooling
Detailed Control Room Design Review
Master Fuse List
Mechanical Equipment Qualification
Microbiologically Induced Corrosion (MIC)
Moderate Energy Line Break Flooding
Radiation Monitoring System
Soil Liquefaction
Use-as-Is CAQs

4.2.1 NRC Acceptance of CAPs and SPs

In NUREG-1232 NRC evaluated the CAPs and SPs as a part of its review of TVA's WBNPP. NRC endorsed the general approaches and methods proposed by TVA, and stated

that NRC endorsement was limited to the approach and general methods which, if properly developed and thoroughly implemented, should address the identified deficiencies.

4.2.2 NRC Inspections of CAPs and SPs

TVA formulated the Corrective Action Program plans and Special Programs as part of the Systematic Evaluation by the WBN Program Team. The CAPs and SPs do not encompass all work necessary to license WBN. However, they consolidate issues and identify areas where collective corrective actions can be more effective by use of an integrated plan. 18 CAPs and 11 SPs were developed by TVA and accepted by NRC. NRC believed that there was a specific need to identify inspection effort for the CAPs and SPs. As a result Temporary Inspection Instructions (TIs) were written to direct inspection activities for the CAPs and SPs. The TIs perceived that both interim inspections and a final inspection would be necessary to effectively monitor the implementation of CAPs and SPs. TVA and NRC agreed that the criterion for determining when TVA was ready for the 75% inspections was that TVA's engineering was 100% complete and field work was 50% complete. This would allow NRC inspections to review the engineering approach that would be taken to resolve the identified problems and to observe how that approach was being implemented in the remaining field work. Several CAPs have had several interim (75 %) inspections while most have had just one 75% inspection. The 100% inspection then concentrated on confirming that the implementation actually accomplished the objectives.

As the CAPs and SPs represent those activities at greatest risk at Watts Bar, NRC decided to inspect or audit the completion of each. The total number of CAPs/SPs decreased from 29 to 28 when TVA decided to repeat essentially the entire pre-operational test program and withdrew Prestart Test CAP. Early review and closure of these programs was conducted by the Office of Special Programs (OSP), with the Heat Code Traceability, and Seismic Analysis CAPs and the Concrete Quality SP being completed by TVA and closed by NRC in 1990. In 1992, an inspection of the Master Fuse List (MFL) SP revealed weaknesses in TVA's CAPs/SPs completion and readiness review process. Also in 1992, due to the numerous issues that interface with the CAPs/SPs such as employee concerns, and open items, NRC requested TVA to provide specific completion information for each CAP and SP. This process eventually evolved into TVA developing binders or "books" for each CAP and SP. These books were intended to be living documents that are updated periodically with status information and which could be used by both TVA and NRC to conduct reviews. Before the books were developed, a basic inspection process was established, whereby NRC could conduct inspections against the CAPs/SPs whenever needed, but that TVA would, as a minimum, inform NRC before conducting its inspection. The status books supplemented this effort for each CAP and SP at the 75% and 100% completion points. Several of the CAPs and SPs were not inspected at 75%, either because a book was not developed (Welding CAP, Use-As-Is CAQs SP, Soil Liquefaction SP, DCDR SP) or the programs were either unique (QA Records CAP) or inspected as part of the ongoing inspection process (Fire Protection CAP and EQ CAP and Mechanical Equipment SP). These have been inspected periodically or at set times in the licensing process. Most of the remaining CAPs/SPs were coordinated

for multi-inspector reviews around the 75% completion schedule. Also, as part of the on-site resident inspector efforts, all CAPs/SPs that required field modifications were routinely inspected as the work progressed.

For the most part, after the MFL inspection, subsequent status books and resulting inspections improved, with some notable exceptions. Although inspected much later than the master fuse list (MFL) SP, the 75% inspection of the Vendor Information CAP (1993), the Electrical Issues CAP (1994) and the Radiation Monitor SP (1994) were unsatisfactory in several respects. A recurring theme was incomplete or unsatisfactory work, followed by either a QA document review or a cursory hardware review prior to NRC inspection. Performance in the other CAPs/SPs was spread between strong and comprehensive in several of the mechanical-related Programs (MELB SP, HVAC Duct and Duct Supports, Elect. Conduit/Supports CAP, Cable Tray/Supports CAP, and the Containment Cooling SP) and the Q-List CAP to mediocre in the RIP, HAAUP, DBVP, Equipment Seismic, Instrument Lines and Cable Issues CAPs, and the MIC SP.

As the construction completion schedule continued to slip in the early 1990s, the CAPs and SPs, most tied directly to system turnovers, began to slip also. Closure or 100% inspections was more difficult to attain. Scheduling inspections became increasingly difficult. Even with this scheduling problem, several CAPs and SPs have been closed independent of the plant completion schedule. These are Use-As-Is CAQs SP, Soil Liquefaction SP, Q-List CAP, QA Records CAP, MIC SP and MFL SP. The original intent of the 100% inspections was to close the CAPs/SPs when all of the work within the program was accomplished. As the programs began to slip, most 100% completion schedule dates moved to within a few weeks of estimated fuel load. After several years of CAPs/SPs inspections, NRC decided that inspection of the majority of the remaining CAPs/SPs just prior to fuel load would not be feasible. The closure process was revised in 1994, whereby TVA would provide periodic completion status to the NRC and NRC staff would decide when to inspect for closure or perform interim inspections. NRC agreed to close out the CAPs and SPs with a limited amount of work remaining and would then review that effort with routine inspection follow-up, prior to licensing. This process enables the bulk of the CAPs/SPs closure inspections to be spread out over a longer period of time. As of April 1, 1995, Welding CAP was successfully closed in late-1994, using this process. The NRC staff continues to monitor CAPs/SPs status, conduct interim inspection and review completion status to schedule closure before licensing WBN, Unit 1.

4.3 Conclusions

5. SIGNIFICANT REGULATORY ISSUES

5.1 Welding

During the mid-1980's, concerns were raised by the NSRS and by various employees through the employee concerns program regarding probable weld deficiencies that could affect the construction quality and the operation of WBN-1. In October 1985, TVA contracted through the Department of Energy, Idaho Operations Office (DOE/ID) with EG&G Idaho, Inc. to perform a review of the TVA welding program and assess the significance of the welding concerns at WBN-1 in a program known as the Weld Evaluation Program (WEP).

The specific objectives of the WEP were to (1) assess compliance of TVA's documented weld program to the requirements in the WBN FSAR, (2) assess the applicable TVA employee concerns and quality documents to determine if they identified quality problems with the TVA-fabricated, safety-related welds, (3) evaluate TVA's as-constructed plant weld status by conducting an examination of the welds in the plant, and (4) assess the compliance of the plant welds with applicable welding construction codes.

In 1986 and 1987, the NRC staff performed a comprehensive review of the implementation of the WEP and of TVA's weld reinspection activities. The staff held several public meetings with TVA (January 7, 1986, June 25, 1986, and January 21, 1987) and conducted team inspections at the Watts Bar site (NRC Inspection Reports 50-390/86-17, 50-390/86-26, 50-390/87-09, and 50-390/87-19). In addition, numerous inspections regarding welding and associated activities have been conducted by the on-site NRC regional and resident inspectors. The NRC staff specifically reviewed the findings regarding structural, piping and HVAC welds. In addition, the staff reviewed issues arising from the employee concerns and quality indicators[1]. The results of the inspection efforts discussed above generally confirmed that the WEP was adequate for identifying welding problems at WBN-1 as well as for determining the overall quality of welding within the WEP scope at WBN-1. However, the results of the WEP revealed that there was a significant breakdown in some of the original WBN-1 welding activities, particularly in the areas of structural (AWS Code) welding, piping (ASME Boiler & Pressure Vessel Code) welding and HVAC ductwork welding as further discussed below.

The WEP reported that of approximately 15,000 AWS welds reinspected, 20 percent failed to meet the acceptance standards for which they were certified. The majority of the welds that failed to meet the WEP acceptance criteria were rejected for weld size, weld profile, and weld length and location. The staff concluded that the identification of such a large number of significant deviant conditions by the weld reinspection was a clear indicator that the original TVA weld inspection program was inadequate and, therefore, a clear breakdown of the quality assurance program had occurred.

The WEP reported that of 401 ASME piping welds examined by visual reinspection, 19

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[1] The term "quality indicator" was created by the DOE/WEP after a review of quality-related documents that were written during the construction of the WBN-1. Those quality-related documents included: Nonconforming Condition Reports; 10 CFR 50.55(e) reports; Quality Assurance Audit Reports; NRC enforcement items; Discrepancy Reports; Corrective Action Reports; Condition Adverse to Quality Reports; Special Inspection Service Reports; allegations reported to the NRC; NSRS Review Reports; OE Audit Reports; Stop Work Orders; and individual reports.

percent failed to meet the original acceptance criteria. As a result, NRC concluded that TVA had an ineffective original construction QA/QC program which allowed acceptance of large numbers of unacceptable welds.
For the HVAC ductwork system weldments, the WEP reported that one general and one specific group of safety-related welds on HVAC ductwork systems at WBN-1 were reinspected. TVA subsequently removed the HVAC welding reinspection work from the WEP work scope and incorporated this area into a separate corrective action program (HVAC Duct and Supports CAP). The staff found that TVA had failed to have an effective QA/QC program for safety-related HVAC weldments prior to 1980.

Overall, NRC found that the WEP was an effective sampling effort. Thus, the results of the reinspection was considered an acceptable method to be used to assess the welding at WBN-1. NRC also concluded, on the basis of its inspection activities, that the WEP was adequately implemented. On the basis of its analysis of the WEP report in regards to corrective actions and sample expansion, NRC found that the WEP adequately identified weld deficiencies that required analysis and repairs and/or areas that required TVA to expand the sample inspections to 100 percent. Consequently, NRC concluded that a significant breakdown in overall compliance with 10 CFR Part 50, Appendix B, relative to the QA/QC inspection aspect of the structural welding program had occurred.

In January 1989, TVA submitted the Welding CAP to NRC to address the Unit 1 safety related welding issues at Watts Bar. NRC accepted the CAP in NUREG 1232 Volume IV. The welding CAP was designed to address the welding issues identified through the various methods discussed above and included the methods used to expand the sample program to 100%, where warranted, and correct the hardware and associated documentation. An example of identified problems that required an expanded sample was the structural welds at elevation 741 of the control building. The resolution of these welds required a 100% re-inspection by the licensee and re-work of 1091 of the 1098 welds located at this elevation.

Evaluation of the welding program by TVA was addressed in three separate phases. Phase 1 was a comprehensive assessment of safety related welding and was performed by the Welding Project (WP) with personnel independent of Watts Bar management and a Department of Energy (DOE) contractor (EG&G). The Phase 1 program was submitted to NRC on February 21, 1989. The Phase 1 program and associated commitments were reviewed by NRC and found to be acceptable.

Phase 2 investigated the as-found condition of the safety related welds and associated records. The evaluation consisted of: physical reinspection of selected welded structures and components, evaluation of welding related employee concerns identified through the Employee Concerns Special Program and review and analysis of weld-related quality indicators. The evaluation was performed by the WP, the Department Of Energy Welding Evaluation Project and the ECSP. The Phase 2 report was submitted to NRC on April 10, 1989. The report was reviewed by NRC and found acceptable.

The Phase 3 program included evaluation and upgrading of welding related programs and procedures to ensure that future welding activities are conducted in accordance with licensing requirements. The WP final report was submitted to NRC on August 25, 1989. The review

of the final report was inspected by NRC in conjunction with the final review of the TVA Welding CAP. The final Welding CAP was submitted to NRC on January 9, 1993. On January 11, 1995, NRC inspection of the Welding CAP and associated programs concluded that, with the exception of a weld accountability issue and final ASME N-5 Supplement completion, the Welding CAP had been adequately implemented. These issues are being followed to completion by NRC separately from the Welding CAP.

To assure welding problems and welding programs were corrected, NRC has conducted 59 welding inspections since 1985. Some of these inspections were major team inspections with NRR, Resident Inspectors, Region II Specialist and contractor welding specialists involved. In addition to the team inspections and normal routine welding inspections conducted by the resident inspector staff and Region II technical welding personnel, NRC with the use of contractors, reviewed the radiographs for all TVA fabricated pipe welds (approximately 2,700 welds) made on site between commencement of welding through November 11, 1991. As of November 11, 1991, NRC determined that TVA had adequate corrective actions in place regarding welding and radiographic examinations and NRCs 100 percent radiographic reviews were discontinued. To assure continued compliance since November 1991, NRC has periodically performed sample reviews of welding activities and the radiographic inspection program. Additionally, since 1986 NRC has reviewed and closed nine 10 CFR 50.55(e) reports that identified welding problems.

NRC Inspection Report 50-390/94-79, issued January 11, 1995, concluded that the Welding CAP had been adequately implemented. Two open issues discussed above are being followed to completion prior to fuel load. On-going welding activities are being inspected as they occur. Pending successful implementation of the completion of on-going welding activities and closure of the open issues, NRC believes TVA has adequately addressed all welding problems at Watts Bar.

Conclusion:

5.2 Electrical Cable Damage

Beginning in 1985, concerns were raised by the NSRS (NSRS report I-85-06-WBN) and by various employees through the employee concerns program regarding the acceptability of Class 1E cables. These concerns focused on cable installation practices which were believed to have resulted in damage to the cables. The NSRS report had concluded that there was the potential that the environmental qualification of the cables could have been potentially invalidated due to the cable pulling practices. TVA initially took the same approach to resolution of this issue at Watts Bar that they had previously taken at Sequoyah and Browns Ferry. That approach was to determine the fifteen worst case conduits for pull-by damage and then test them by applying a high potential signal. That method was developed based on selection of conduits/cables from theoretical pull-by damage criteria for gross damage, since no damaged cables had been found.

In June 1989, Unit 2 Class 1E cables were being removed from a conduit to evaluate an existing employee concern which had identified the potential for cable damage due to heat from welding near the respective conduit (arc strike). During the inspection of the removed

cables, no heat damage was observed. However, cable insulation damage was found by NRC on several of the cables removed from the conduit. The identified damage consisted of nicks, cuts, punctures, damaged insulation, a sawcut through the cable jacket, and pieces of broken cable. TVA performed laboratory analysis of the identified cable damage and concluded that the damage occurred as a result of cable pullbys. Cable pullbys occur when new cables are pulled into conduits which have existing cables. Pulling new cables into conduits with existing cables results in increased sidewall bearing pressures as the cables are being installed. In addition, the pull rope being used to install the new cables can cut into the jacket/insulation of the existing cables if the pull tension is too high.

Other Class 1E cables were removed from conduits for inspection to determine the extent of condition. This resulted in the discovery of more cable damage similar to the damage on the original cables. A complete new plan was prepared to determine the extent of condition and correct the cable damage problems found. Up until the discovery of the damage TVA had resisted pulling cable out of conduits to perform cable damage inspections, having chosen to perform the in-situ high potential testing instead. The cutting of the cable jacket/insulation by the nylon pull ropes had not been factored into the gross damage criteria used to select the cables that would have been high potential tested.

The new resolution plan for the cable pullby damage issue involved cable replacements of approximately 660,000 linear feet of cable, inspections, hi-pot testing, and use-as-is dispositions. Conduits were categorized into high and low risk categories based on the potential for pullby damage using the known cable damage analysis information. The high risk category was defined as the family of conduits in which sidewall bearing pressures and damage could be expected to be found with considerable frequency. Cables in the high risk category conduits were replaced.

Cables in the low risk category were accepted as-is based on high potential testing of a worst case sample from the population. Because of the lower calculated pull tensions in the low risk category, similar cable damage was not expected making the high potential testing an acceptable method. NRC inspections have reviewed the implementation of the corrective actions for the cable pullby issue with acceptable results. TVA also estimated that approximately 246,000 linear feet of electrical cable would be replaced due to ampacity concerns. Other cable replacement occurred due to other electrical modifications.

Independent of the cable damage issue, TVA determined that cable splices, installed during the construction period, could not be shown as qualified. To correct this problem, TVA committed to replace all 10 CFR 50.49 cable splices and selected non-10 CFR 50.49 splices (approximately 26,000 cable splices). Additionally, TVA installed numerous splices as part of the cable replacement issues discussed above. The additional splices resulted because the cable pull-by damage and cable replacement was generally limited to those routed in conduits. For example, where cable running through conduits had to be replaced and the cable continued into a cable tray, TVA determined that cable removal in trays was impractical due to the vimasco fire retardant coating applied over cables in the trays. This resulted in removing the cable from the conduits and cutting the cable where it enters the tray, then re-using the cable in the tray by splicing the new cable from the conduit to the old cable in the tray. This resulted in additional splices at the tray to conduit juncture point.

During the above discussed hi-pot testing of low risk cables, several cables were observed to fail hi-pot testing. The test failures were evaluated and partly attributed to cable shorting to ground at junction boxes during the testing. The cables shorted to ground near splices. The cause of the failure was due to ring cuts to the cable conductors at the point where the cables broke out of the cable jacket. Ring cuts were introduced by electricians stripping back the cable jacket by use of a sharp object (e.g, a knife) which penetrated the conductor insulation. TVA developed corrective actions in October 1990 to address the splice deficiencies. The corrective actions included re-inspection of all cable splices made between May 1989, and October 1990 (approximately 15,000 splices). The 1989 date represented the start of work to replace all 10 CFR 50.49 cable splices and selected non-10 CFR 50.49 splices. NRC inspections of the implementation of corrective actions have been performed since the Watts Bar 1991 construction restart.

In the fall of 1994 multiple examples of electrical cable splicing, crimping, and connector problems were found on Emergency Diesel Generator cables (IR 94-72). These problems resulted from work control and field personnel not following procedures and design requirements. Through engineering evaluation and testing, TVA was able to accept most of the deficient cable splices and crimp connectors. The remaining ones were reworked.

In January 1995, the Watts Bar QA organization was performing a closure review assessment of the adequacy of the implemented corrective actions to resolve the cable splice damage issue. During this assessment, numerous examples of cable damage were identified which included ring cuts, flattened cables, nicks, scratches, cuts, pinholes, and bend radius violations. Based on the identified deficiencies, QA and Engineering concluded that the corrective actions to resolve the previously identified deficiencies were inadequately implemented. The causes of the identified deficiencies included:

- Inadequate inspection of cables and splices for damage in 1990.
- Failure to identify remaining splices required to be re-inspected for damage.
- Re-inspection of splices deferred to other work documents which were replacing the cable splice. However, the new work document did not identify that the cable and/or splice was suspected of having damage. Therefore, the new work only required making of the new splice and did not require re-inspection of the cable as well.
- Damage was not identified during new work activities by construction and plant personnel.
- Personnel training inadequate in the recognition of cable damage.
- Quality control inspectors failed to identify damaged cables.

TVA has developed additional corrective actions to re-inspect all 10 CFR 50.49 cable splices for possible cable damage. This re-inspection started on March 6, 1995. NRC is closely following TVA work on cable splices to assure compliance is achieved.

Conclusion:

5.3 Quality Assurance Records

The QA Records CAP was developed by TVA after NRC questioned the auditability and retrievability of safety-related QA records (390/86-24). Follow-up actions by TVA found indications that records at Watts Bar (1) were not retrievable in a timely manner, (2) were maintained in improper storage, and (3) had quality problems (e.g., were technically or administratively deficient). Initially the CAP was directed at corrective actions for known records problems which were identified as CAQs. In NRC inspection 390/90-08 NRC expressed concern that the implemented QA Records CAP may not allow Watts Bar to demonstrate to NRC that TVA had all records required for licensing. In response the CAP was revised to provide for a systematic evaluation of all Watts Bar records in accordance with ANSI N45.2.9. The systematic evaluation was called the Additional Systematic Records Review (ASRR). The ASRR included several different types of records reviews: the records quality review assessed the retrievability and quality of all of the ANSI types of records, the records hardware review compared the records to the installed hardware, and the records technical content review compared the design output to the hardware and records.

In 1985/1986 TVA began a recovery process to ensure that Watts Bar was adequately constructed (i.e., plant hardware was acceptable). This recovery process has been and continues to be accomplished by various CAPs and SPs including one on the Q-List, as well as corrective actions to non-conformance reports, resolution of employee concerns, corrective actions for CDRs, etc. During each of these corrective actions, records have been developed which document the completion of corrective actions. These records were used by TVA to supplement the original construction records, or, in some cases, serve as a substitute for the original construction records. These corrective actions were termed by TVA as "alternate technical basis" and the records developed by these efforts were termed "alternate records".

As a result of the findings by the ASRR and in an effort to document properly the construction records licensing basis for Watts Bar, TVA developed a series of QA record plans, which described in detail the records which were applicable to each type of system, structure, or component. These record plans made use of the extensive CAPs and served as a "road map" to define which records provided the licensing basis, i.e. original construction records in combination with alternate records. TVA developed thirty nine (39) of these record plans. NRC completed a review these record plans and the associated plant records to verify technical adequacy of Watts Bar records for licensing. Some of these record plans were reviewed as a part of the associated CAP, however, the largest portion of these plans were reviewed as a part of the closeout of the QA Records CAP.

NRC inspection of the QA Records CAP was performed by a series of team inspections conducted over approximately a nine month period utilizing an inspection team leader and three contract inspectors. This series of inspections included review of virtually all types of plant hardware. The hardware areas reviewed included cables, instrument lines, large bore piping, small bore piping, instruments, valves, mechanical equipment, masonry walls,

coatings, cable tray supports, HVAC supports, concrete structures, foundations, electrical equipment, instrument line supports, cable raceway, HVAC equipment, structural steel, large bore pipe supports, small bore pipe supports, and conduit supports. Each of these inspections included the verification of the record plan for the area reviewed for technical adequacy; the records for a sample of approximately fifteen hardware items to verify that the records were retrievable, and properly documented installation in accordance with the record plan; and the records for a sample of approximately six hardware items were compared to the design output and the hardware in the plant (including a field walk-down), to verify that the items were properly installed in accordance with the design and the records accurately reflected this installation. In addition, the results of reviews obtained by TVA's ASRR in each area were compared to the inspection teams results, and deficiencies noted by the ASRR were reviewed for adequate corrective action. These inspections resulted in the identification of only a few minor problem areas which were dispositioned in accordance with normal NRC enforcement practices.

In addition, a QA Records CAP final closure team inspection was performed. This inspection involved the input of approximately eight inspectors and an inspection team leader over the period of one month. The inspection was conducted in order to review all areas of the CAP, which had not been previously reviewed during the series of inspections discussed above. The inspection included a review of: the CAP Final Closure Report, the CAP Actions to Prevent Recurrence of Records Deficiencies, CAP Closure Documentation including corrective actions for items which formed the basis for the CAP, the ASRR Sampling Methodology, the Records Retrievability Guide, the ASRR Integrated Assessment of records deficiencies, and ASRR actions concerning "Unique Record Types". All of these areas were found to be satisfactory.

Conclusion:

6. ADDITIONAL NRC ACTIVITIES

6.1 NRC Corrective Actions to Improve Its Regulatory Oversight

During 1984, NRC noted deterioration in the TVA's nuclear program performance. TVA employees' complaints of harassment and intimidation, delays in TVA's implementation of generic requirements, a large number of inspection deficiencies at Browns Ferry, significant corporate quality assurance problems, and TVA employees' poor performance in operator licensing and re-qualification examinations, all should have indicated serious problems at TVA's nuclear program and triggered NRC's agency-level response. But no such response occurred. While NRC took actions to get TVA's attention to address these problems through meetings with TVA's mid-level management, escalated enforcement actions, and poor SALP ratings, the actions were not taken at NRC's senior management and TVA's Board level to prevent subsequent breakdown of effective TVA management of nuclear program.

By mid 1985, TVA employees voiced significant safety concerns, and reported there

concerns to NRC and to U.S.Congress. TVA, realizing that it had lost the confidence of its employees in its management's ability to manage its nuclear program, shut down it's Browns Ferry and Sequoyah units. In April 1986, TVA withdrew its certification that Watts Bar, Unit 1 was ready to load fuel. TVA's actions had a common root cause; a realization by TVA that it had a serious management breakdown throughout the TVA nuclear organization.

In SECY-86-334, NRC found that the TVA's management breakdown had its roots in its fundamental organizational structure and attitudes of its managers at the time. From its earliest days TVA was divided into two separate groups; one to construct facilities, and other to operate them. With this structure TVA built one of the largest utilities in the world and had won praise for its innovative engineering, construction, and operation of a highly reliable and inexpensive power system based on hydroelectric and fossil power stations. However, its structure and success created management attitudes which were precursors of subsequent failures of its nuclear program.

In the nuclear area, TVA's management was fragmented. No one below the Board of Directors and General Manager could exercise authority over its employees. The construction of nuclear plants was the responsibility of its construction group, which functioned independent of the operating group. The operating group staff, which planned outages, maintenance, and modification installations functioned independent of the operating plant managers. rendering the plant managers ineffective. The quality assurance organizations were fragmented into up to seven independent organizations. Beyond the structural fragmentation, cooperation between construction group and operating group was very poor because each had its own, often conflicting goals, priorities, and procedures.

A position taken by NRC as a result of lessons learned from Three Mile Island accident reviews was to take a hands off approach to self initiated independent safety reviews that were not conducted under specific NRC requirements. The position was taken to encourage licensees to independently initiate safety evaluations whose findings would not be used by NRC against the licensees. The position allowed licensees to have broad independent reviews accomplished whose findings could alert the licensees of programmatic problems within their organizations including assessments of the effectiveness of the independent QA function, without fear of NRC's enforcement actions. The position was intended to encourage licensee management to assess the effectiveness of their own organizations without relying solely on NRC as an evaluator of their QA function.

The independent safety reviews accomplished by INPO and NSRS had discovered weaknesses in the TVA construction program. INPO had conducted construction reviews at the Bellefonte site in 1984 and at Watts Bar in 1985. The findings from both reviews were applicable to Watts Bar. It is not clear that NRC ever reviewed or used this information in relation to whether or not Watts Bar was ready to receive an operating license. In relation to NSRS, Region II had taken the position that since NSRS reported directly to the TVA Board of Directors, they were not part of the line QA function required by 10 CFR 50 Appendix B. Region II took the position that NSRS was similar in nature to INPO and therefore applied the same hands off approach to the NSRS findings. NSRS was assigned additional responsibilities in 1985 in relation to the Employee Response Team. These responsibilities

included investigation of the many employee concerns being received by the independent contractor that was interviewing the Watts Bar employees. From the many construction reviews conducted by NSRS from 1981 until 1985 and the employee concern investigations conducted in 1985-86, NSRS was able to assimilate a broad based perception of the lack of WBN, Unit 1 readiness operate. These reviews and perceptions were not used by NRC in making its assessment of the readiness of Watts Bar for an operating license in 1985. As NRC learned later in 1985, these perceptions were contrary to NRC perception in very early 1985 that Watts Bar was progressing successfully toward an operating license.

NRC had not staffed the Watts Bar site with a strong construction resident staff after the senior construction resident left in 1983 and the other construction resident inspector died in August 1984. NRC did not assign another construction resident inspector to the site until mid 1986, after licensing was delayed due to allegations of inadequate construction. Instead, NRC decided to staff the site with operations residents beginning in 1983. By 1984 there were three operations residents at the site. The construction inspection program was completed by the NRC's inspection staff. However, after anonymous allegations were received by Congressional staff in early 1985, NRC management realized that significant construction problems existed at Watts Bar.

NRC paid little attention to employee concern programs prior to 1985. NRC only investigated and followed employee concern resolution if the employee concerns were brought directly to NRC. Although TVA had an employee concerns program, it was not effective, but NRC was not aware of that fact until allegations were received in 1985.

NRC's inspection staff appears to have recognized the TVA's fundamental problems. But, while inspection staff was able to persuade TVA's mid- management to institute major corrective programs, it was unable to persuade TVA that its problems were rooted in its fundamental and long-established fragmented management structure.

NRC's senior management did not begin to elevate the TVA's problems for agency-wide action until the middle of 1985. It is possible that earlier concerted action by TVA's Board and/or agency-wide NRC action could have brought about the fundamental structural changes and prevented the nuclear program breakdown.

As discussed above, under its Corporate Nuclear Performance Plan, TVA reorganized to correct its management structural problems by placing all nuclear power functions under one manager reporting directly to the TVA Board and, as discussed in Chapters 3 and 4, put in place a variety of corrective actions addressing human performance problems and WBN hardware problems.

Also, as a result of serious Congressional concerns about the construction deficiencies found at several nuclear projects (other than WBN) U.S.Congress directed NRC (Ford Amendment to NRC Authorization Act of 1982) to perform a study to assess what went wrong that caused serious problems at some construction plants, and what should be done to detect and correct nuclear power program problems in a timely manner.

A discussion of NRC studies and actions in response to the Ford Amendment study and the

study of lessons learned from TVA's breakdown of its nuclear programs and WBN construction problems follows.

6.1.1 Quality Assurance Report to Congress

As a result of Congressional concerns about major problems in the quality of design and/or construction at several nuclear power plant construction projects in the 1970s and early 1980s, NRC was directed by Congress in NRC Authorization Act for fiscal years 1982 and 1983 (Public Law 97-415) to conduct a study of existing and alternative programs for improving quality assurance and quality control in the construction of commercial nuclear power plants. Projects having received widespread attention in this regard included Marble Hill, Midland, Zimmer, South Texas, and Diablo Canyon. Because of the those quality-related problems and others in the U.S. nuclear industry, many in the public and in Congress questioned (1) the nuclear industry's ability to design, construct, and operate reactors in a manner consistent with maintaining public health and safety, and (2) NRC's ability to provide effective regulatory oversight of those activities.

The results of the NRC's study were documented in NUREG-1055, "Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants, ~ herein called the QA report, published in May 1984. A primary focus of the study was to determine the underlying causes of major quality-related problems in the construction of some nuclear power plants and the untimely detection and correction of these problems. The study conclusion that actions were needed to avoid recurrence had broad implications for the NRC's licensing and inspection approaches as well as for the agency's oversight of licensee QA organization performance.

The QA report recommended a number of improvements in industry and NRC programs. For industry, the QA report recommended self-imposed rising standards of excellence, treatment of quality assurance as a management tool rather than as a substitute for management, improved trend analysis and identification of root causes of quality problems, and a program of comprehensive third party audits of present and future construction projects. For NRC, the QA report recommended a heavier emphasis on team inspections and resident inspectors, an enhanced review of new applicant's capabilities to construct commercial nuclear power plants, more attention to management issues, improved diagnostic and trending capabilities, improved quality and quality assurance for operating reactors, and development of guidance to facilitate the prioritization of quality assurance measures commensurate with the importance of plant structures, systems, and components to the achievement of safetY.

One problem identified in the QA report was that although early indications of quality problems were present from a variety of sources, neither licensees nor NRC effectively integrated or synthesized those indications into an overall picture of licensee performance. The 1987 reorganization merging the principal functions of the Office of Inspection and Enforcement with the Office of Nuclear Reactor Regulation improved the coordination and integration of information on plant performance. A QA-specific performance indicator program was subsumed by NRC's plant-wide Performance Indicator Program, a tool by which the agency maintains a perspective on selected, significant aspects of each nuclear power plant's performance. The SALP process, which aims at synthesizing individual

inspection findings into an overall evaluation of licensee performance, has been improved. The Performance Evaluation Branch was established to independently integrate and assess the ongoing aspects of the performance of each operating plant, and the Events Assessment Branch was organized to review and assess plant events. These groups provide performance information to senior NRC managers on a case-by-case and periodic basis. Additionally, a process wherein senior NRC management periodically meet to assess licensee performance, identify problem plants, and settle on needed follow-up actions has improved the agency's ability to draw conclusions and take action based on inspection findings.

The QA report concluded that, in part, quality problems reached a critical stage because licensee and NRC auditing and inspection techniques were not effective in detecting problems early, and because NRC inspections were programmatic in nature~ Recommendations implemented in the area of inspections and diagnostic ability follow. The resident inspector program was expanded, putting at least two inspectors at construction sites, and the inspection program resources are now allocated as needed according to operating plant performance. In contrast to previous inspections which were mainly concerned with procedural and paper aspects of licensee programs, inspections such as the construction appraisal team inspections and integrated design inspections examined in greater detail the quality of actual products to identify whether the quality program had been effectively implemented.

The increased use of inspection teams was emphasized. The team inspections such as safety system functional inspections and safety system outage/modifications inspections, now look at products and performance. In depth inspections are accomplished by performance appraisal teams and the large, multi-disciplinary Diagnostic Evaluation Teams directed to a site as a result of a decision of the senior managers at their twice-yearly meeting. Very importantly, a significant feature of these and other inspection teams is that the multi-disciplinary team approach provides a strong mechanism for integrating findings in individual areas into a comprehensive picture of a licensee's programs to achieve and assure safety and quality.

Lack of top utility management understanding and involvement in their programs and in dealing with problems was identified in the QA report as a significant contributor to quality breakdowns. To some extent, this resulted from NRC's ineffectiveness in communicating to utility management the significance and seriousness of problems being identified. Enforcement actions are an important part of communicating NRC concerns to utilities. Orders, confirmatory orders, and other enforcement options, including civil penalties, are examples of enforcement tools which are being used more aggressively to send strong messages to licensees when significant and/or repetitive problems are identified.

Another significant problem contributing to quality breakdowns was the NRC's approach to quality assurance. In the past, quality assurance plans were often approved without adequate consideration given to implementation experience. Inspections of quality assurance programs tended to place emphasis on the review of records. Thus the industry was pointed toward a paper heavy program rather than generating good quality in the product - with suitable documentation. This has sometimes been characterized as an overemphasis on the programmatic aspects of quality assurance at the expense of the measuring the actual performance of quality-related functions. In the mid-1980s, NRC started to changed their

inspection focus to a "performance-based" posture. Training was developed to support this, and the Standard Review Plan was revised by adding Chapter 17.3, "Quality Assurance Program Description."

The Readiness Review concept was identified in NUREG-1055 as a means of helping to correct the problem. A licensee-initiated pilot Readiness Review program was successfully completed for Vogtle Unit 1, and Georgia Power Company used a similar program for licensing Vogtle Unit 2. NRC has supported and encouraged the Institute of Nuclear Power Operations, the Nuclear Utility Management and Resources Council, now Nuclear Energy Institute, and owners' groups initiatives to implement a recommendation of the QA report aimed at recognizing and endorsing, as appropriate, proven industry programs for improving quality through better utility management. Such initiatives include those in areas such as training, maintenance, and fitness-for-duty. Recognition and endorsement of industry initiatives has been and continues to be a specifically defined agency-wide policy and objective. A few examples of industry programs which NRC endorsed include limited recognition of the American Society of Mechanical Engineers Accreditation Program for N Stamp Holders, Georgia Power Company and Washington Public Power Supply System initiatives to conduct readiness review pilot programs, and Ed;son Electric Institute Nuclear Supplier Quality Assurance Committee's utility cooperative supplier audit program.

Efforts to develop guidance to facilitate the prioritization of quality assurance measures commensurate with the importance of plant structures, systems, and components to the achievement of safety are continuing. Initial efforts in this area focused on the use of probabilistic risk assessments (PRAs). Because few plants had completed a plant-specific PRA, the efforts to implement graded QA were postponed. With the completion of the plant specific risk assessment studies, the staff is now working on the regulatory requirements for graded QA. The plant system risk ranking efforts that licensees have implemented to fulfill the Maintenance Rule have provided a starting point for risk ranking in the QA environment. Based on PRA insights, as further evaluated by an expert panel, decisions can be made as to the relative importance of plant equipment. QA controls can then be tailored based on the importance of the equipment and the safety function that it performs. The staff initiated discussions with Nuclear Energy Institute (NEI) on its initiative to develop industry guidance for grading quality controls. While the staff and NEI have not reached full agreement on the implementation details, the staff is now working with three licensees that are continuing to refine the process whereby the QA!controls can be applied in a manner commensurate with equipment safety significance.

6.1.2 NRC Report on Lessons Learned from TVA's Nuclear Program Problems

As a result of serious problems at TVA's nuclear projects, the NRC staff examined the interactions between TVA and NRC before recognition of the TVA's nuclear programs problems to identify means by which NRC could have: (1) recognized the overall severity of the TVA's deficiencies at an earlier and less serious stage; and (2) taken more effective actions to ensure that TVA corrected these deficiencies. The results of that study were reported to the Commission in SECY-86-334 of November 12, 1986. In that Commission Paper the NRC staff developed recommendations for improving NRC's regulatory oversight. Lessons learned from that study were, as much as possible, coordinated with other ongoing

or planned activities for improving NRC's regulatory oversight. The other activities included those reported in the above discussed Quality Assurance Report to Congress, the 1984 and later revisions to the inspection manual, NRC Executive Director for Operations memorandum of September 29, 1986 to the Commission on new inspection methods, The NRC Commission Paper (SECY-86-317) on Performance indicators, and other initiatives to improve regulatory oversight including lessons learned from Davis-Besse and Fermi plants.

In SECY-86-334, the NRC staff identified the following 7 preliminary lessons learned:

1. NRC needs to further develop and implement a systematic process for identification of poor performing licensees and for focusing agency-wide attention on poor performing licensees. As part of this attention, at early stages of degraded licensee performance, the Regional Administrator should meet with senior licensee management to identify problems using whatever means required to be sure that the message is clearly understood;

2. NRC needs to develop a program and the skills for assessing overall licensee management performance and identifying indicators of management and organizational deficiencies;

3. NRC inspection documents need to include a clear assessment of the programmatic and cumulative significance of the specific deficiencies and violations identified;

4. Since NRC is heavily dependent on effective licensee design, construction, and self inspection programs for providing a basis for concluding that a plant is designed and constructed to operate safely, NRC needs to do more to assure the validity of those programs and their implementation;

5. NRC needs to ensure that sufficient resources are provided not only to carry out programmatic efforts as well as increased efforts at poor performing licensees but are devoted to those areas of greatest identified concern;

6. Efforts, such as those made in the QA programs at TVA, to correct major problems should not have been considered complete until specific deliberate inspections, evaluation of results over an extended period indicated that similar problems were not still occurring and that previous problems had been corrected; and

7. Perfunctory responses to long-term, resource-intensive regulatory requirements, like fire protection, and equipment qualification and a poor record of surveillance and maintenance were indicative of a lack of TVA management's effective overall commitment to safety. NRC needs to exert diligence in requiring licensees to promptly complete actions in response to regulatory requirements and commitments.

From the above seven preliminary lessons learned the staff developed 27 recommendation for NRC action and briefed the Commission on its study and recommendations on November 16, 1986. After the briefing, the Commission directed the staff to seek comments on the report of its study from senior TVA executives involved in TVA's nuclear programs during the

period of deteriorating TVA performance, and from former senior NRC managers who were involved in TVA's nuclear programs' oversight. The staff was directed to modify its recommendations reflecting the comments received, and develop a program for implementing the final recommendations.

The NRC Executive Director for Operations forwarded the preliminary report to a number of former senior TVA and NRC managers, who were personally involved with TVA's nuclear program or its regulation from 1980 to 1985, for their comments. The comments received generally supported the thrust and focus of the preliminary paper, and provided valuable perspectives and insights. The NRC staff modified 27 recommendations of the preliminary report to reflect the comments. As a result 19 final recommendations were outlined in SECY-87-211 as requiring some action, ranging from emphasizing the existing policy and procedures to studying some issues further.

NRC has implemented several of the lessons learned. In 1987 NRC reorganized to integrate its inspection functions into its nuclear reactor regulation functions, thereby promoting the coordination and integration of information on licensees' performance. Agency's Performance Indicator program was expanded to include QA-specific indicators. NRC's SALP process was improved to enhance synthesizing inspection findings and improve overall oversight of licensees' programs. Performance Evaluation Branch and Event Assessment Branch were established to independently integrate and assess operating plant licensees' performance. NRC's senior management meets periodically to assess licensee performance, identify problems, and set the course of follow-up actions. Although Senior Management Meetings primarily focus on poor performing operating plants, major construction projects such as WBN are also considered for agency-wide actions. These meetings have been effective in forcing NRC attention on licensees' performance to assure that problems are detected and corrected early, and negative trends in licensees' performance are subject to new NRC enforcement policy and are promptly directed to senior licensee management. NRC has adopted increased use of special team inspections. Team inspections, such as safety systems functional inspections and safety system outage/modification now look at products and performance. In-depth inspections are accomplished by performance appraisal teams; and the large, multi-disciplinary diagnostic evaluation teams are directed to a site as a result of decisions taken at NRC senior management meetings. These initiatives have significantly improved NRC's oversight of TVA's nuclear programs in general; and employee concerns, implementation of corrective actions, and quality assurance of WBN, Unit 1 in particular.

6.2 Special Inspections

NRC conducted several special inspections at WBN site as a response to lessons-learned studies findings that NRC should put increased reliance on special team inspections that are capable of integrating the results of the inspections and assess the programmatic significance of their inspection findings. At WBN site NRC conducted several IDIs and a broad-based CAT inspections discussed below.

6.2.1 Broad-Based Construction Assessment Team Inspections

NRC performed a Broad-Based Construction Appraisal Team (CAT) inspection to assess the quality of WBN construction. The findings of the inspection are documented in NRC inspection report 50-390/89-200 of December 12, 1989.

The inspection team's general concerns were (1) the poor general condition of plant equipment, (2) a number of problems not previously identified by TVA, (3) the site management's lack of understanding of the amount and scope of remaining work, and (4) the lack of control over interrelationships among site programs.

Inspectors found a large number of hardware deficiencies, and the potential for further damage because of the poor control of on-going work activities which made the team doubt TVA's ability to protect completed equipment and hardware installations during the remaining construction. Inspectors found a lack of control of interfaces between on-site programs. The team found that integration and coordination of the various licensee corrective action programs, special programs, and related activities were not adequate to ensure that all required work activities and corrective actions would be correctly performed. The team also found weakness in the integration of activities between site organizations that provide requirements and site organizations that implement those requirements.

6.2.2 Integrated Design Inspections

NRC conducted an Integrated Design Inspection (IDI) covering mechanical, electrical, and instrumentation & control during January 7 through 18 and February 4 through 8, 1991 (Inspection Report No. 50-390/91-201 dated March 22, 1991). The inspection examined the design, design basis, calculations, engineering procedures, and records, primarily for the auxiliary feed-water system.

The team determined that TVA was making progress in establishing a complete and comprehensive set of design basis documents for Watts Bar. The electrical systems calculations regenerated as a part of the design basis verification program (DBVP) were of consistently high quality. However, TVA's review of mechanical system calculations performed as a part of the DBVP had not been effective in ensuring their technical adequacy or consistency with current plant design. TVA had not implemented adequate corrective actions in response to the relevant DBVP design findings.

Based on TVA's response to the inspection report and NRC's follow-up inspection, the open items were closed(Inspection Report No.50-390/93-201 dated June 29,1993).

NRC conducted an IDI covering civil and structural disciplines during July 13 through August 7, 1992 (Inspection Report No(50-390/92-201 dated September 21, 1992). The primary focus of the inspection was to assess the adequacy of the design control process for selected structures, piping, and supports. The team identified significant concerns that may have generic implications such as the use of U-bolts rather than clamps to support and restrain piping with pin connected supports, and missing and loose hardware in pipe and conduit supports. Other concerns were related to a missing conduit support, inadequate consideration of as-built support weld sizes and anchor bolt pullout capacity, specifying incorrect design criteria, failure to follow TVA's design criteria or licensing commitments,

and use of potentially nonconservative design approaches in detail designs.

Based on TVA's responses to the inspection report and NRC's follow-up inspection, most open items were closed (Inspection Report No. 50-390/93-201 dated June 29, 1993. Two items requiring additional NRC staff review were use of U-bolts as pipe clamps and potentially non-conservative seismic loads in HVAC duct support evaluations. In addition inspector follow-up was required concerning installation deficiencies in pipe supports and conduit supports and missing supports in the field.

In response to the findings from the 1991 IDI and TVA's self-assessments, TVA initiated a mechanical nuclear calculation program and assembled a team of corporate specialists and industry senior technical managers to review the program. This program revised existing calculations, generated new calculations in support of the design bases, revised test scoping documents, and closed open items. NRC performed a follow-up inspection (Inspection Report No. 50-390/93-202 dated June 2, 1993) to evaluate the impact of TVA's program for improving design calculations on the adequacy of mechanical systems design and the design process. The inspection focused on the mechanical system design for the essential raw cooling water and the component cooling systems. The team noted that the system descriptions and calculations were thorough and consistent and adequately supported the design. These documents had improved in terms of content, consistency, accuracy, and completeness compared to those reviewed during the 1991 IDI. The team identified a significant concern regarding the lack of freeze protection for the essential raw cooling water system piping and instrument tubing in the intake pumping station. This issue was the subject of a Notice of Violation.

6.3 Conclusions

7. CONSTRUCTION STOP WORK 1990-1991

On December 21, 1990 TVA issued a stop work order on construction activities. The stop work was issued as the result of NRC inspection findings. On December 14, 1990, an exit for IR 390/90-31 on the corrective action program indicated that there were multiple examples in various work disciplines of failures to establish and implement the corrective action program properly. These included untimeliness in determining the scope and significance of identified problems, failure to establish adequate criteria for entry into the corrective action program, failures to identify and address recurrent and programmatic deficiencies, failures to address the root causes of deficiencies, and deficient closures of corrective action documents. The apparent violation identified a programmatic breakdown in the corrective action program. On December 21, 1990, at the exit for IR 390/90-30, inspectors identified a multiple example, repeat violation in the work control area. The multiple examples included many facets of work control, indicating a programmatic breakdown in the work control area. These two reports identified the problems that had plagued TVA since before 1985. They were documented in the Employee Concern Special Program on Corrective Action Tracking Documents and were believed by TVA to have been corrected. The inspection results indicated that TVA was no further along in 1990 in the control of construction activities than they had been prior to 1985. As a result Watts Bar site management issued the stop work order.

A meeting was held on January 15, 1991, to discuss TVA's construction stop work at Watts Bar. During that meeting NRC requested and received a commitment that the NRC staff would be involved in the decision to restart any construction activity at Watts Bar. The summary of that meeting was sent by NRC to TVA on January 18, 1991. An enforcement conference to discuss the work control and corrective action program breakdowns was conducted on April 12, 1991. TVA acknowledged in the enforcement conference that their past efforts to correct programmatic deficiencies at Watts Bar addressed primarily the symptoms of the problems rather than their root causes. TVA also outlined in general terms the steps that TVA was taking to correct the situation as well as some of the methodology that would be used to judge the success of the corrective actions. These steps included a Quality Improvement Plan (QIP) that included 14 areas of improvement with the major thrust being to use quality measurement feedback to achieve improvement. Some examples of the QIP included Quality Report Cards, Procedure/Process Improvements, craft certification, training and assessment of management personnel.

TVA began self assessments shortly after the construction stop work in December 1990 to determine the root causes behind the programmatic problems identified by NRC in the work control and corrective action areas. These self assessments showed TVA that these problems were long standing problems that had been identified during the Employee Concerns Special Program reviews and extended back to at least the early 1980s. Although these problems had been identified several times over the previous ten years, the corrective actions did not focus on the root causes or timeliness of solutions. TVA realized that these problems were widespread over many organizations and disciplines. The key areas of analysis were the construction, quality assurance, and engineering functions. Other areas were assessed as the interfaces related to these areas, i.e. material controls and integrated scheduling.

TVA's corrective actions were focused mainly on the key areas. The construction craft work force was laid off and a contractor was hired to provide the craft labor. The contractor also provided the craft supervision to perform the work. However, people from the old, TVA construction force were often hired by the construction contractor. TVA provided an interface organization that worked with the contractor to finish the plant modifications. The interface organization consisted of a project management and work planning function and was similar to the Modifications organization at TVA's operating plants. The work planning function implemented new work control processes that had been proven successful at Browns Ferry and in the industry. Management was downsized with known good performers placed in key positions. Work plans issued were closed and remaining work was identified on the Remaining Work List (RWL). New, simplified work plans were then written to perform remaining work. Work plan quality was considered an important element that should be attained before construction was to restart. Inherent in changing the work control process was setting up a review of the in-process work plans. TVA put a program in place (safety-net) to verify the work completed on the in-process work plans and to close them; then write new work plans under the new process for the remaining work.

The Quality Assurance organization was considered weak in the communication of problems to senior management and in establishing quality performance standards. Quality Assurance personnel changes were made including down sizing and management changes. In addition, a contractor was brought in to supplement the organization in the construction inspection

area. Performance standards were developed that included the trending of selected attributes. Work plan quality and engineering design output were key performance indicators during the construction stop work period.

Engineering design interfaces between functions were marginal. In addition, TVA had implemented a new, revised engineering design process prior to the construction stop work and had not completely converted all active old process design documents to the new method which resulted in higher than normal backlogs. This resulted in poor engineering performance, including a large number of field changes. Engineering was downsized to provide better control and cross discipline coordination. Additional contractors were used to perform the engineering evaluations. Backlog reduction became one of the key focus areas during the stop work period. This was to ensure that engineering stayed ahead of the modifications work. Quality monitoring and performance measurement became an important factor for the engineering function in providing feedback to engineering management.

TVA also found that the root causes extended beyond the processes for each organization. The root causes had general performance components, attitudinal components, environmental components, and individual performance components. These four components indicated to TVA that they had embedded, learned cultural barriers to successful behavior and change below the senior management level. TVA realized that the root causes indicated an overall problem with the attitude about corrective action. Consequently the Senior Management Review Team initially acted as the Corrective Action Program Management Review Committee. This was to instill in lower level management the expectation that corrective action must fix the root causes, not just the symptoms, and that corrective action must be timely.

The above changes included rewriting many procedures and directly implementing corporate standards into site standard practices. This approach had proved effective at Browns Ferry.

Inherent in such broad based changes are a complete retraining of existing workers and initial training of contractor personnel. Management's hopes were that the personnel changes, bringing in contractors and placing known TVA good performers in key positions, would be able to break through the learned cultural barriers. In addition, a new focus on accountability and ownership of work quality was emphasized.

In an August 26, 1991 letter to TVA, NRC stated that although a significant civil penalty would normally be proposed for the work control and corrective action program breakdowns, its decision was to exercise enforcement discretion. The justification provided was that although many past attempts at fixing root causes by TVA had failed, only positive results from the programs outlined at the enforcement conference would cause NRC staff to agree that the restart of construction activities at Watts Bar was appropriate. The letter emphasized that corrective actions must be effectively implemented such that, upon completion of construction, all regulatory requirements and TVA commitments specified in the FSAR and other documents are met. The letter also stated that the quality of design and construction at Watts Bar must be fully verified and documented, and that the level of future performance required substantial improvement.

NRC inspection of TVA's self assessments and corrective actions were performed during the stop work period. The inspections focussed on the adequacy of the self assessments and TVA's progress in implementing their corrective actions. These changes took approximately 11 months to implement. NRC conducted a construction restart readiness inspection (IR 91-29) from October 28 - November 15, 1991. The inspection reviewed the changes that TVA had made since the stop work in December 1990 to site procedures, work plans, material controls, organizational interfaces, quality records and document control programs, and the corrective action program. The inspection concluded that the root causes of the stop work had been addressed and NRC's concerns associated with the stop work were programmatically resolved.

In a letter to NRC dated November 18, 1991 TVA stated they were ready to restart construction at Watts Bar. That position was discussed during a meeting with NRC on November 19, 1991. NRC's letter to TVA dated November 26, 1991 documents NRC's concurrence of November 22, 1991 to the restart of construction at Watts Bar. The letter confirmed several conditions of the concurrence upon which previous agreement had been reached. These included resumption on a slow start basis with a gradual, deliberate staffing-up of construction forces; informing the resident inspector staff, before the fact, of those work packages selected for implementation; and the processes, procedures, organizations, and controls in place upon concurrence (November 22, 1991) constituted the baseline for WBN work and there would be no unilateral changes to those. Any changes that could significantly change the way work was done, the criteria for work, or reduce the effectiveness of work controls would be coordinated with NRC prior to implementation.

Initially the process began on balance of plant equipment, and later it was applied to safety equipment. The slow, monitored restart gave TVA management a chance to observe the implementation of their changes and to control the implementation on a small scale. When successes were achieved, as indicated by performance indicators, manpower was increased. NRC conducted inspections during the slow, staffing-up period to assess implementation of the construction programs. Early in the restart effort the inspections indicated that TVA needed to increase efforts in the areas of management overview and attention to detail (IR 92-01). Subsequent NRC inspections found the in-process work activities to be of good quality (IR 92-05 and 92-08). NRC gave unconditional release for the construction restart on June 11, 1992 and restarted the SALP process for Watts Bar.

7.1 Corrective Action Problems after Construction Restart (1994)

From construction restart in December 1991 until mid-1994, NRC had documented at least 50 findings related to inadequacies or weaknesses in the corrective action program. The findings were characterized as 27 violations, two non-cited violations, 15 unresolved items, three IFIs, one IDI deficiency, one "concern" (with additional examples in a subsequent report), and an "observation." In addition, based on a trend of corrective action problems from 1993 into 1994, and to address examples being found by NRC, TVA QA conducted an assessment of corrective action program implementation that resulted in a Significant Corrective Action Report (SCAR) being issued by TVA in spring 1994.

The findings of the SCAR and the previous and current examples of inadequate corrective

action prompted NRC to conduct a team inspection in the summer of 1994 to assess the corrective action program implementation (IR 94-37). The inspection found 35 additional examples of violations that were similar to those found in the SCAR. Also, an 8 example violation was issued for cases not similar to those found in the SCAR. Both the inspection and TVA QA review had similar findings, that the corrective action program was not being properly implemented; however no direct hardware deficiencies were identified. The report noted that: the root causes of problems were not always properly identified; corrective actions did not always address the identified problem; the full extent of problems was not always fully identified, resulting in repetitive problems of similar nature; and numerous deficiencies were identified in corrective action documents.

In the late summer and early fall of 1994, NRC inspections of NRC open items did identify examples of inadequate corrective action in which there were hardware related problems that could have impaired the ability of the equipment to perform its function. These included RCP motor unqualified coatings issues (94-59); electrical cable manhole preventive maintenance problems (94-72); electrical cable splicing, crimping, and connector problems on Emergency Diesel Generator cables (94-72); and cable damage to electrical penetration Kapton leads (94-61).

As a result of these findings TVA pursued a reverification program to review everything closed for the previous year, including corrective action documents, CATDs, VSR DRs, and NRC open items. The review determined that a small number of packages had closure verification concerns, with about 8 being identified as rejections. The rejections were the result of inadequate field verification. In addition, a large number of packages (88) packages needed to be supplemented for minor problems such as unclear wording, inclusion of additional justification, typographical errors, etc. TVA's conclusions after reverification of corrective action documents and NRC open item packages were that they did not have a major breakdown in the closure verification process, but improvement was needed. Additionally, in late summer of 1994, QA implemented a 100% closure review of all corrective action documents.

7.2 Strengthening of QA Organization

TVA recognized during the stop work period that the QA organization was not setting quality performance standards for the site. Although management changes were made and contract QC support was added, NRC inspections after 1991 still indicated that QA was not always identifying and resolving items that were problems. NRC inspection presence on the site was significant and tended to establish the quality standard when QA did not. In the 1993 SALP report (390/93-46) the marginal accomplishment of the QA functions was noted as a weakness. TVA initiated a third party, independent QA assessment to provide an evaluation of the QA Program implementation. TVA made additional management changes that strengthened QA. The changes resulted in improvement in the QA functions. The 1994 SALP report (390/94-41) noted improvement in the independent verification of CAPs and SPs. However, it was not until fall 1994 that QA established overall leadership for quality. Trending reports on corrective action documents with QA management support are bringing problems to the attentions of senior line management. Quality monitoring and audit functions

have improved in the identification of programmatic problems.

Conclusion:

8. INTEGRATED ASSURANCE OF ACCEPTABLE CONSTRUCTION QUALITY

8.1 Pre-operational Testing

TVA's CAPS included a corrective action plan for modification of its pre-operational test instructions (PTI) to comply with its Pre-operational Test Program in Chapter 14 of the FSAR. By a letter of February 13, 1992, TVA informed NRC that it will abandon its CAP and will essentially re-perform the entire pre-operational test program, based on new pre-operational testing instructions that it was planning to prepare.

To write its new PTIs, TVA hired contractors with previous pre-operational testing experience at various power plants. The contractors began writing PTIs in late 1992. Testing according to new PTIs began in early 1993, although there was much construction and repair work still in progress. In the early stages of the program, NRC inspectors encountered deficiencies in the quality of the pre-operational test procedures. Deficiencies in the test program were found when the program was compared to the test scope and methods described in chapter 14 of the FSAR.

Starting in late 1992 and through early 1993, TVA established another series of documents called the Test Scoping Documents (TSD). These TSDs were TVA controlled documents that described the pre-operational test methods and acceptance criteria for each system. During inspections, NRC found numerous contradictions among the FSAR, TSDs, DBDs, and the newly finished PTIs submitted to NRC for review. The causes of these quality problems were all related to a lack of thoroughness and attention to detail in preparing and reviewing the PTIs.

By fall 1993, NRC had compiled a significant history of violations, deviations, and problems with PTIs. As a result of the NRC's inspection findings, TVA decided to halt the pre-operational test program, and hired a new contractor, as start-up manager, with extensive (and successful) testing experience in the industry.

The new start-up manager completely overhauled the administrative procedures manual for writing, approving, conducting, and documenting results of pre-operational tests, called the Start-up Manual Procedures (SMPs) TVA contractor hired, indoctrinated, and trained Additional staff. TVA decided to retire the intermediate documents called TSDs, following NRC's expressed concerns that design information would be lost by merely discarding the TSDs, TVA agreed to include the design information from the TSDs into the DBD.

According to NRC's reviews, the new PTIs produced in early 1994 were of substantially better quality. However, TVA continued to experience some problems in achieving consistency among the FSAR, the DBD, the PTIs, and the as built plant. In late spring of 1994, TVA replaced the start-up manager again. The new startup manager was a TVA employee from Browns Ferry, who brought several experienced testing staff from Browns Ferry to Watts Bar. NRC continued to review at least a sample of each PTI produced, and issued violations where appropriate. Consequently, NRC was able to conclude that the inspection of the preparation of procedures, the conduct of testing, and the documentation of results were accomplished well above the minimum program goals.

TVA essentially completed pre-operational test program by early 1995, except for a full dress rehearsal;retesting planned for a second Hot Functional Test (HFT 2).

8.2 Program for Assurance of Completion and Assurance of Quality (PAC/AQ)

TVA established Program for Assurance of Completion and Assurance of Quality (PAC/AQ) to confirm that WBN was constructed in accordance with licensing commitments and that the facility is operationally ready. Specifically, PAC/AQ involved the detailed identification of commitments made from the date the construction permit was issued until November 18, 1991. PAC/AQ also established the functional correlation of these commitments with implementing documents and confirmed the technical adequacy of the process controls.

To accomplish these objectives, PAC/AQ was structured into the following five distinct phases:

Phase I **Identification of Commitments** - Commitments were researched and tabulated in both database and hard-copy format. Source documents included: the Final Safety Analysis Report (FSAR) up to and including Amendment 68, safety evaluation reports (SERs), including all supplements through SSER 8, inspection findings, generic communications, and miscellaneous TVA correspondence through November 18, 1991. This effort is complete, with over 13,000 commitments identified.

Phase II **Matching commitments with Implementing Documents** - A site procedure, drawing, specification, and/or calculation that implemented each commitment was identified. This effort is complete.

Phase III **Confirmation of Technical Adequacy of Implementing Documents** This activity focused on corrective action programs (CAPs), special programs (SPs), and selected processes to gain objective evidence that the commitments were properly implemented. This effort is complete.

Phase IV **Vertical Slice Reviews** - TVA performed vertical slice reviews on the

essential raw cooling water system, 6.9-kV unit power system, the component cooling system, and the control air system to ensure that implementing documents were correctly developed and adequately reflected the plant hardware configurations. This effort is complete.

Phase V **Oversight of Operations Readiness** - TVA will use PAC/AQ-identified commitments and implementing documents to address overall operational readiness of WBN prior to fuel load. This effort is scheduled ~or completion in 1995.

NRC documented its evaluation of PAC/AQ activities associated with Phase I through III in Inspection Report 50-390/93-203 dated October 19, 1993. The results of this inspection effort indicated that, in general, Phase I, II, and III activities of PAC/AQ were effective in assuring the identification of regulatory commitments and the translation of those commitments into the corresponding implementation documents. It was also determined that TVA's process for capturing commitments under PAC/AC was comprehensive and well implemented and that the process for the identification of implementing documents and the confirmation of their technical adequacy was acceptable.

Phase IV PAC/AQ activities which involved TVA's vertical slice reviews of the essential raw cooling water system, 6.9-kV unit power system, component cooling system, and control air system were evaluated and the results

documented in Inspection Report 50-390/93-204 dated June 21, 1994. The Phase IV vertical slice reviews were performed to ensure that the implementing documents have been properly reflected in plant hardware configurations. Based on the results of the evaluation of the PAC/AQ process NRC has ascertained that Phase IV activities were effective in the identification and substantiation of system design and installation requirements. PAC/AQ Phase IV fulfilled TVA's established requirement and NRC identified the PAC/AQ as a program strength.

The remaining PAC/AQ activities involving Phase V (Oversight of Operational Readiness) will be evaluated during NRC's operational readiness assessment process prior to 'fuel load.

8.3 TVA's Reasonable Assurance Assessment TBD

8.4 TVA's IDI TBD

In Volume 4 of the NPP, TVA committed to perform an indepth technical udit similar to an NRC Integrated Design Inspection (IDI). By letter dated March 20, 1995, TVA informed the staff that it still intends to complete this audit on a system that is essentially complete and at or near acceptance by the operaing staff. An audit plan will be developed after the system is selected, and will be available onsite for NRC review.

8.5 FSAR Licensing Review TBD

8.6 Reconstitution of MC 2512 Inspection Program TBD

The objective of NRC Inspection Manual Chapter (MC) 2512 Reconstitution Program is to ensure adequate completion of the construction inspection program for Watts Bar Unit 1 and to determine TVA's readiness to operate WBN, Unit 1. The MC 2512, Construction Phase Inspection Program was initially completed for WBN, Unit 1 in 1985. NRC continued to perform inspections of construction activities associated with licensee corrective action programs for the resolution of the problems identified in the 1985 and by subsequent allegations. The reconstitution program addresses the potential impact of the problems identified in the 1985 time frame on the adequate completion of the construction inspection program. Since 1985 construction-related activities have been documented primarily against construction inspection temporary instructions. As such, post-1985 inspections have not been correlated to MC 2512 inspection procedures. Therefore, the current MC 2512 Inspection Program is being re-evaluated with the objective of assuring that the requirements of program procedures established to ensure the quality of construction have been satisfied. To the greatest extent possible, program reconstitution will be accomplished using results of post-1985 inspection activities. Where the program review procedures or field verification procedures of commodities can not be verified complete based on post-1985 inspections, records inspections and/or pre-1986 inspection effort will be used as appropriate.

The inspection program;requirements to be verified as complete by the WBN, Unit 1 reconstitution program are contained in NRC MC 2512 dated December 17, 1986. Applicable inspection procedures are identified in MC 2512 Appendix I, dated August 25, 1994. The reconstitution program process consists of four phases.

Phase I, Post-1985 Document Reviews, compares completion of inspection procedure requirements for construction to the scope and results of inspections performed at WBN after 1985. This phase also contains a review of post-1985 allegations to determine if they impact on the use of post-1985 inspection results for completing inspection procedure requirements. If inspection requirements are met and there is no residual impact resulting from allegations, the results are reviewed and accepted by management. If all requirement are completed by Phase I, the reconstitution is then considered as complete for the procedure.

For procedure requirements not completed during the Phase I review and where physical inspection is feasible, a Phase II (reconstitution) Inspection is performed to complete the remaining inspection requirements. A similar management review to Phase I is also completed at the end of this phase

If direct inspection is not feasible, or all inspection requirements were not satisfied by Phase II, Phase III is performed, during which pre-1986 inspection information is evaluated for use. Specifically, the objective of this phase is to determine if issues impacting on the use of pre-1986 inspection result's have been adequately resolved and what additional inspection of records may be needed to satisfy the remaining inspection requirements. First, a review is performed of the status of resolution of allegations and employee concern issues (CATDs) and of the extent of their residual impact, if any, on the use of pre-1986 inspection results. A Phase III, Pre-1986 Document Review and Record Inspection, is then performed. The results of the Phase III effort determines if the specific pre-1986 NRC effort serves to complete inspection requirements in impacted areas of the inspection program. If achieved, the reconstitution of the procedure is considered completed.

For inspection procedure requirements not completed by use of Phase I-III alternatives, a Phase IV, Case-by-Case action and review by management is used to address and document their disposition.

Qualified NRC inspectors have been assigned to complete the reconstitution of inspection procedure requirements for each program area. The performance of reconstitution assignments is managed and tracked consistent with the process described above. To accommodate the numerous document searches needed to verify completion of inspection program requirements, all prior and current Watts Bar inspection related documentation has been assembled, converted into electronic format, and incorporated into a ZYINDEX computer data base. Staff at Region II, NRR, and the Watts Bar site have access to the computer data base. In addition, allegation related information has been included in the Region II data base.

Oversight of the Region's implementation of the reconstitution program is performed by the NRR program office. The reconstitution program will be completed prior to the Watts Bar Unit 1 fuel load date.

8.7 Conclusions

9. TVA's RECENT PERFORMANCE TBD

10. OPERATIONAL READINESS TBD

10.1 TVA's Activities to Demonstrate Operational Readiness TBD

10.2 Quality of Start-up and Power Ascension Procedures TBD

10.3 Operating Organization's Qualifications to Operate WBN, Unit 1 TBD

10.4 Lessons Learned from Recent NTOL Operational Readiness Reviews TBD

10.5 HFT 2 "Dress Rehearsal" TBD

10.6 Summary of TVA's Operational Readiness TBD

10.7 Conclusions TBD

11. NRC's OVERALL ASSESSMENT TBD

TVA stated that it has performed a review of NRC's draft report, "Overall Assessment of Watts Bar Quality and Quality Assurance" (Enclosure 3). TVA found the draft report to be comprehensive and factually correct, except for minor items related to the circumstances surrounding its construction "stop work" order of 1990. NRC staff indicated that it will reexamine the draft report and reconcile TVA's comments in the final report.

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Docket No. 50-390

Enclosures: 1. Attendees List
2. TVA view-graphs
3. Overall Assessment

cc w/enclosures: See next page

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