

TENNESSEE VALLEY AUTHORITY

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FEB 06 1989

U.S. Nuclear Regulatory Commission
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Gentlemen:

In the Matter of
Tennessee Valley Authority

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Docket Nos. 50-327, 50-328
50-390, 50-391
50-259, 50-260
50-296, 50-438
50-439

EMPLOYEE CONCERNS TASK GROUP

Enclosure 1 provides a complete listing of the 107 updated Employee Concerns Special Program (ECSP) subcategory reports, all of which are included in this submittal. Enclosure 2 transmits these reports, which have been revised to reflect corrective actions implemented and verified complete as of September 30, 1988. As indicated by the report cover sheets, the reports have undergone final reviews by the Senior Review Panel and the Employee Concerns Task Group management.

If you have any questions, please telephone R. F. Campbell at (615) 751-4892.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

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Enclosures
cc: See page 2

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Enclosure 1

EMPLOYEE CONCERNS SPECIAL PROGRAM SUBCATEGORY REPORTS

CONSTRUCTION CATEGORY

<u>REPORT NUMBER</u>	<u>TITLE</u>
10100	Soils
10200	Concrete
10300	Coating and Paint
10400	Embeds
10500	Deterioration of Permanent Facilities
10600	Bolting (Construction)
10700	Instrument Tubing
10800	Structural
10900	Cable
11100	Hangers/Support
11200	Workplan/Work Control
11300	Anchorage
15100	Damage/Construction Control
15200	Housekeeping
15300	Construction Equipment
17100	Mechanical
17300	Instrument Line Installation As Related to Construction
19100	Electrical Equipment
19200	Conduit and Cable Tray

ENGINEERING CATEGORY

20400	Engineering Organization and Operating Procedures
20600	As-Built Reconciliation
20800	Human Factors
20900	Q-List
21000	Environmental Qualification
21200	Pipe Support Program
21300	Electrical Testing and Planning
21800	Pipe Stress Calculations
22000	Support Design General
22100	Pipe Support Design
22300	Instrument Supports Design
22400	Raceway Support Design
22500	Battery Support Design
22600	Seismic Interaction Design
22800	Unistrut Support Design
22900	Instrumentation and Control Design
23000	HVAC Design
23100	Fire Protection Design
23300	Essential Raw Cooling Water Piping
24200	Electrical Separation
24500	Incorporation of Requirements, Commitments, and Experience in Design
24600	Design Calculations
25000	Civil/Structural Design and Pipe Whip Restraint Design

REPORT NUMBER**TITLE**

25500	Support Weld Design
26000	Flushing and Piping Valve Design
26500	Electric Safety and Systems Design
26600	Raceway and Cable System Design

OPERATIONS CATEGORY

30100	Mechanical Equipment Reliability/Design
30200	Electrical and Communications
30300	Instrumentation and Radiation Monitoring
30400	Cables and Conduit
30500	Accessibility
30600	Fire Protection
30700	Nuclear Power Site Programs/Procedures
30800	Maintenance
30900	Engineering
31000	Operations/Operational
31100	Health Physics
31200	Security
31300	Miscellaneous

MATERIAL CONTROL CATEGORY

40200	Purchasing and Requisitioning
40300	Material Control - Installation
40400	Storage and Handling
40500	Material Identification
40600	Quality of Material
40700	Procedural Control
40800	Training

WELDING CATEGORY

50100	Browns Ferry Nuclear Plant
50200	Bellefonte Nuclear Plant
50300	Sequoyah Nuclear Plant
50400	Watts Bar Nuclear Plant

MANAGEMENT AND PERSONNEL CATEGORY

70100	Subjourneymen
70200	Work Rules
70300	Work Schedules
70400	Overtime
70500	Equal Employment Opportunity
70600	Management Technique
70700	Organization
70800	Morale
70900	Public Safety Service
71000	Productivity
71100	Materials
71200	Miscellaneous

REPORT NUMBER**TITLE**

71300	Medical
71400	Drugs
71500	Employee Programs
71600	Labor Relations
71700	Personnel Qualifications
71800	Employment
71900	Pay
72000	Personnel Records
72100	Veterans' Preference

QUALITY ASSURANCE CATEGORY

80100	QA Management and Policy
80200	Inspection
80300	Quality Assurance Personnel
80400	Nonconformance Control and Corrective Action
80500	Document Control and Records
80600	General Management and Policy

INDUSTRIAL SAFETY CATEGORY

90100	Management of Safety
90400	Protective Equipment
90500	Life Safety
90600	Electrical
90700	Design
90800	Emergency Equipment and Plant Response to Emergencies
90900	Walking and Working Surfaces
91000	Unsafe Conditions
91100	Defective/Inadequate Equipment
91200	Industrial Hygiene Practice

ENCLOSURE 2

TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM

REPORT NUMBER: 10100

REPORT TYPE: - SUBCATEGORY - Construction
(Final Report)

REVISION NUMBER: 2

TITLE: Soils

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REASON FOR REVISION:

Incorporate I&S and SRP comments; Executive Summary; Line
Management Response on Corrective Action; and Finalize Report

Revision 1

Incorporate I&S and SRP comments and refinalize report

Revision 2

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ECSP MANAGER DATE

NA
MANAGER OF NUCLEAR POWER DATE
CONCURRENCE (FINAL REPORT ONLY)

Preface, Glossary, and List of Acronyms
for ECTG Subcategory Reports

HISTORY OF REVISION

REV NUMBER	PAGES REVISED	REASON FOR CURRENT REVISION
3	i	To clarify that one or more attachments will help the reader find where a particular concern is evaluated

Preface

This subcategory report is one of a series of reports prepared for the Employee Concerns Special Program (ECSP) of the Tennessee Valley Authority (TVA). The ECSP and the organization which carried out the program, the Employee Concerns Task Group (ECTG), were established by TVA's Manager of Nuclear Power to evaluate and report on those Office of Nuclear Power (ONP) employee concerns filed before February 1, 1986. Concerns filed after that date are handled by the ongoing ONP Employee Concerns Program (ECP).

The ECSP addressed over 5800 employee concerns. Each of the concerns was a formal, written description of a circumstance or circumstances that an employee thought was unsafe, unjust, inefficient, or inappropriate. The mission of the Employee Concerns Special Program was to thoroughly investigate all issues presented in the concerns and to report the results of those investigations in a form accessible to ONP employees, the NRC, and the general public. The results of these investigations are communicated by four levels of ECSP reports: element, subcategory, category, and final.

Element reports, the lowest reporting level, will be published only for those concerns directly affecting the restart of Sequoyah Nuclear Plant's reactor unit 2. An element consists of one or more closely related issues. An issue is a potential problem identified by ECTG during the evaluation process as having been raised in one or more concerns. For efficient handling, what appeared to be similar concerns were grouped into elements early in the program, but issue definitions emerged from the evaluation process itself. Consequently, some elements did include only one issue, but often the ECTG evaluation found more than one issue per element.

Subcategory reports summarize the evaluation of a number of elements. However, the subcategory report does more than collect element level evaluations. The subcategory level overview of element findings leads to an integration of information that cannot take place at the element level. This integration of information reveals the extent to which problems overlap more than one element and will therefore require corrective action for underlying causes not fully apparent at the element level.

To make the subcategory reports easier to understand, three items have been placed at the front of each report: a preface, a glossary of the terminology unique to ECSP reports, and a list of acronyms.

Additionally, at the end of each subcategory report will be a Subcategory Summary Table that includes the concern numbers; identifies other subcategories that share a concern; designates nuclear safety-related, safety significant, or non-safety related concerns; designates generic applicability; and briefly states each concern.

Either the Subcategory Summary Table or another attachment or a combination of the two will enable the reader to find the report section or sections in which the issue raised by the concern is evaluated.

**TVA EMPLOYEE CONCERNS
SPECIAL PROGRAM**

REPORT NUMBER: 10100

FRONT MATTER REV: 2

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The subcategories are themselves summarized in a series of eight category reports. Each category report reviews the major findings and collective significance of the subcategory reports in one of the following areas:

- management and personnel relations
- industrial safety
- construction
- material control
- operations
- quality assurance/quality control
- welding
- engineering

A separate report on employee concerns dealing with specific contentions of intimidation, harassment, and wrongdoing will be released by the TVA Office of the Inspector General.

Just as the subcategory reports integrate the information collected at the element level, the category reports integrate the information assembled in all the subcategory reports within the category, addressing particularly the underlying causes of those problems that run across more than one subcategory.

A final report will integrate and assess the information collected by all of the lower level reports prepared for the ECSP, including the Inspector General's report.

For more detail on the methods by which ECTG employee concerns were evaluated and reported, consult the Tennessee Valley Authority Employee Concerns Task Group Program Manual. The Manual spells out the program's objectives, scope, organization, and responsibilities. It also specifies the procedures that were followed in the investigation, reporting, and closeout of the issues raised by employee concerns.

ECSP GLOSSARY OF REPORT TERMS*

classification of evaluated issues the evaluation of an issue leads to one of the following determinations:

- Class A: Issue cannot be verified as factual
- Class B: Issue is factually accurate, but what is described is not a problem (i.e., not a condition requiring corrective action)
- Class C: Issue is factual and identifies a problem, but corrective action for the problem was initiated before the evaluation of the issue was undertaken
- Class D: Issue is factual and presents a problem for which corrective action has been, or is being, taken as a result of an evaluation
- Class E: A problem, requiring corrective action, which was not identified by an employee concern, but was revealed during the ECTG evaluation of an issue raised by an employee concern.

collective significance an analysis which determines the importance and consequences of the findings in a particular ECSP report by putting those findings in the proper perspective.

concern (see "employee concern")

corrective action steps taken to fix specific deficiencies or discrepancies revealed by a negative finding and, when necessary, to correct causes in order to prevent recurrence.

criterion (plural: criteria) a basis for defining a performance, behavior, or quality which ONP imposes on itself (see also "requirement").

element or element report an optional level of ECSP report, below the subcategory level, that deals with one or more issues.

employee concern a formal, written description of a circumstance or circumstances that an employee thinks unsafe, unjust, inefficient or inappropriate; usually documented on a K-form or a form equivalent to the K-form.

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evaluator(s) the individual(s) assigned the responsibility to assess a specific grouping of employee concerns.

findings includes both statements of fact and the judgments made about those facts during the evaluation process; negative findings require corrective action.

issue a potential problem, as interpreted by the ECTG during the evaluation process, raised in one or more concerns.

K-form (see "employee concern")

requirement a standard of performance, behavior, or quality on which an evaluation judgment or decision may be based.

root cause the underlying reason for a problem.

*Terms essential to the program but which require detailed definition have been defined in the ECTG Procedure Manual (e.g., generic, specific, nuclear safety-related, unreviewed safety-significant question).

Acronyms

AI	Administrative Instruction
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BFN	Browns Ferry Nuclear Plant
BLN	Bellefonte Nuclear Plant
CAQ	Condition Adverse to Quality
CAR	Corrective Action Report
CATD	Corrective Action Tracking Document
CCTS	Corporate Commitment Tracking System
CEG-H	Category Evaluation Group Head
CFR	Code of Federal Regulations
CI	Concerned Individual
CNTR	Certified Material Test Report
COC	Certificate of Conformance/Compliance
DCR	Design Change Request
DNC	Division of Nuclear Construction (see also NU CON)

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DNE	Division of Nuclear Engineering
DNQA	Division of Nuclear Quality Assurance
DNT	Division of Nuclear Training
DOE	Department of Energy
DPO	Division Personnel Officer
DR	Discrepancy Report or Deviation Report
ECN	Engineering Charge Notice
ECP	Employee Concerns Program
ECP-SR	Employee Concerns Program-Site Representative
ECSP	Employee Concerns Special Program
ECTG	Employee Concerns Task Group
EEOC	Equal Employment Opportunity Commission
EQ	Environmental Qualification
EHRT	Emergency Medical Response Team
EN DES	Engineering Design
ERT	Employee Response Team or Emergency Response Team
FCR	Field Change Request
FSAR	Final Safety Analysis Report
FY	Fiscal Year
GET	General Employee Training
HCI	Hazard Control Instruction
HVAC	Heating, Ventilating, Air Conditioning
II	Installation Instruction
INPO	Institute of Nuclear Power Operations
IRN	Inspection Rejection Notice

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L/R	Labor Relations Staff
M&AI	Modifications and Additions Instruction
MI	Maintenance Instruction
HSPB	Aerit Systems Protection Board
MT	Magnetic Particle Testing
NCR	Nonconforming Condition Report
NDE	Nondestructive Examination
NPP	Nuclear Performance Plan
NPS	Non-plant Specific or Nuclear Procedures System
NQA.I	Nuclear Quality Assurance Manual
NRC	Nuclear Regulatory Commission
NSB	Nuclear Services Branch
NSRS	Nuclear Safety Review Staff
NU COM	Division of Nuclear Construction (obsolete abbreviation, see DNC)
NUMARC	Nuclear Utility Management and Resources Committee
OSHA	Occupational Safety and Health Administration (or Act)
ONP	Office of Nuclear Power
OWCP	Office of Workers Compensation Program
PHR	Personal History Record
PT	Liquid Penetrant Testing
QA	Quality Assurance
QAP	Quality Assurance Procedures
QC	Quality Control
QCI	Quality Control Instruction

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QCP	Quality Control Procedure
QTC	Quality Technology Company
RIF	Reduction in Force
RT	Radiographic Testing
SQN	Sequoyah Nuclear Plant
SI	Surveillance Instruction
SOP	Standard Operating Procedure
SRP	Senior Review Panel
SWEC	Stone and Webster Engineering Corporation
TAS	Technical Assistance Staff
T&L	Trades and Labor
TVA	Tennessee Valley Authority
TVTLC	Tennessee Valley Trades and Labor Council
UT	Ultrasonic Testing
VT	Visual Testing
WBECS	Watts Bar Employee Concern Special Program
WBN	Watts Bar Nuclear Plant
WR	Work Request or Work Rules
WP	Workplans

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EXECUTIVE SUMMARY

SOILS

SUBCATEGORY 10100

SUMMARY OF ISSUES

This report presents the findings of the eight issues that were derived from twenty employee concerns. The issues involve two major questions: (1) Had improper backfill material and/or backfill placement methods resulted in the structural integrity of the structures being compromised? (2) Had backfill for some plant features been placed on foundations that were questionable and had not been properly justified?

Seven of the issues were site-specific to Watts Bar Nuclear Plant (WBN) and one issue was site-specific to Sequoyah Nuclear Plant (SQN). The four issues deemed "safety-related" were at WBN and consisted of (1) barrier trenches, (2) ERCW pipeline backfill, (3) north valve room backfill, and (4) general. The issues deemed "non-safety-related" were made up of three WBN issues, (1) sink hole, (2) blowdown lines backfill, and (3) low volume waste holding pond dike-and one SQN issue, Dry Active Waste Building.

MAJOR FINDINGS

The evaluations concluded that there was no evidence of significant programmatic problems. The backfill materials were correctly used, placed, inspected, and documented in accordance with drawings, specifications, and procedures in both "safety-related" and "non-safety-related" areas, except in two specific non-QA areas that have been analyzed as being acceptable. The Dry Active Waste Building (non-QA) required an evaluation of the soil structure of the foundation area prior to the start of construction activities on the building. The foundation was excavated, backfilled and compacted as a result of the evaluation.

COLLECTIVE SIGNIFICANCE OF FINDINGS

The soils issues produced no programmatic problems, and only two site specific non-QA problems. The materials were correctly used, placed, inspected, and documented in accordance with drawings, specifications, and procedures to satisfy the structures designed function in all cases, both QA and non-QA. The plant's ability to perform their designed function safely has not been compromised by any of the soils issues. Engineering and Construction practices pertaining to soils were satisfactory.

Note: See Executive Summary Table Number 1 for Review

SOILS

Executive Summary Table #1

ISSUES	SR	INS	FINDINGS	CAUSE	CORR. ACTION	SIGNIFICANCE
1. Barrier Trenches	X		The trenches were installed and inspected using proper materials and methods specified on drawings and by specifications. A consultant confirmed the acceptability of the trenches.	None	None	None
2. Sink Hole		X	Sink hole existed and was properly corrected and backfilled prior to the concern.	Leaking construction air line	Already completed	None
3. Blowdown Lines Backfill		X	Leaked such that erosion occurred. Quality control inspectors would not take verbal instructions such that a CCN was written to clarify backfill requirements. The leak was not caused by improper backfill operations, rather a poor design and poor installation of the blowdown pipe.	Inadequate design and inadequate installation	Already Completed	Inadequate DNE guidance Inadequate DNC installation practices
4. ERCW Pipe Line Backfill	X		Backfill was installed, inspected, and documented in accordance with drawings, specifications, and procedures.	None	None	None
5. North Valve Room Backfill	X		The specified material was placed in accordance with drawings and specifications.	None	None	None

SOILS

Executive Summary Table #1

ISSUES	SR	NS	FINDINGS	CAUSE	CORR. ACTION	SIGNIFICANCE
6. Low Volume Waste Holding Pond Dike		X	Craft personnel followed site engineering instructions, site engineering did not coordinate and communicate with quality control inspectors for required inspections and interpretations of drawings/specifications. DNE analyzed and accepted dike as installed.	Site engineering was inconsistent in control of backfilling operations in regard to establish procedures.	No major corrective action required. A note is to be added to drawing 10W228-1 that any other use of the dike will require approval by DNE.	Site implementation of procedures.
7. General	X		Bad backfill practices and instructions to intentionally bypass backfill inspection holdpoints could not be substantiated.	None	None	None
8. Dry Active Waste (DAW) Building		X	DNE (Impell) did not specify foundation requirements because DAW building was Non-QA such that building was to be built on unsuitable backfill. Existing material was removed for building foundation and replaced with properly compacted 1032 material before construction of building started.	DNE drawings/specifications did not initially define the foundation requirements.	Already completed after identification by concern.	Inadequate DNE guidance.
WBN FSAR Clarification (side issue found during investigation of barrier trenches)	X		WBN FSAR did not include the "as-built" configuration of the barrier trenches and the class "A" backfill around the category I intake pumping station and associated sheet pile wall.	Lack of coordination between DNE and Licensing group	"As-built" information to be incorporated in WBN FSAR (CATD 10100-WBN-02)	

1.0 CHARACTERIZATION OF ISSUES

1.1 Introduction

Subcategory Report 10100 - Soils of the Construction Category of the Watts Bar Nuclear Plant (WBN) Employee Concerns Task Group (ECTG) details the evaluation of the backfill operations during construction and the foundation integrity of various features of the Watts Bar and Sequoyah Nuclear Plants. The 20 concerns were broken down and evaluated in eight major issues.

Three of the concerns were general comments about WBN with no specific information and were evaluated from the results of the other sixteen concerns investigated at WBN. One concern (JAN-86-002) involved the integrity of the Dry Active Waste Building (DAW) foundation at the Sequoyah Nuclear Plant (SQN). This concern at SQN was evaluated as a separate issue. All concerns are site specific. An independent engineering review of the barrier trench issue was performed, after the ECTG evaluation, by Robert L. Cloud Associates (RLCA), Inc. and reviewed by Professor H. Bolton Seed at the University of California at Berkeley (report RLCA/P154/01-86-001). The RLCA, Inc. report addresses the concerns of the barrier trenches at the WBN plant. The results of the RLCA, Inc. report have been incorporated into this evaluation report.

Watts Bar Nuclear Plant

<u>Employee Concern No.</u>	<u>Issue</u>
IN-85-066-001	Barrier Trenches
IN-85-442-X13	Barrier Trenches
IN-85-472-007	Barrier Trenches
IN-85-496-001	Barrier Trenches
IN-85-529-003	Barrier Trenches
IN-85-978-002	Barrier Trenches
IN-85-978-003	Barrier Trenches
IN-85-978-011	Barrier Trenches
WI-85-040-004	Barrier Trenches
WI-85-040-005	Barrier Trenches
IN-85-442-X11	Sink Hole
IN-85-196-001	Blowdown Lines Backfill
IN-85-472-003	Blowdown Lines Backfill
IN-85-529-004	Blowdown Lines Backfill

IN-86-205-001	ERCW Pipelines Backfill
IN-85-978-003	North Valve Room Backfill
IN-85-978-011	North Valve Room Backfill
IN-85-088-002	Low Volume Waste Holding Pond Dike
IN-95-302-001	General
IN-85-978-013	General
IN-85-472-006	General

Sequoyah Nuclear Plant

JAN-86-002 Backfill DAW Building

These perceived concerns may be the result of lack of communication; organizational cooperation; inadequate design information; lack of management/supervision control; and inadequate procedures, standards, site requirements, or work practices.

1.2 Description of Issues

1.2.1 Barrier Trenches

The barrier trenches had ten concerns that questioned the reason for the barrier trenches and/or whether the designed function had possibly been compromised by the type material used, the methods used in placing and testing fill material, the existing surface conditions of the trench area before backfill placement, a water source that had opened a hole in the slope face, and the stability of the slopes from erosion. Another area that needed resolution was whether Division of Nuclear Construction (DNC) or Division of Nuclear Engineering (DNE) had any breakdowns in specifications or procedures used in the design and/or construction of the trenches.

1.2.2 Sink Hole

The issue was that a large sink hole had been formed in the earthfill on the east side of the Turbine Building (TB), that the necessary corrective action had not identified the cause, and adequate corrective action had not been performed by the construction forces.

1.2.3 Blowdown Lines Backfill

The issue was that the cooling tower blowdown piping was leaking so badly, due to improper installation (improper backfill), that erosion below the piping would cause collapse of the pipe and the seismic barrier could be eroded. The concern stated that the pipeline was reworked because of improper backfill and a construction change notice (CCN) had to be issued because Quality Control (QC) inspectors would not take verbal directions from site engineering on the type of backfill material to be used.

1.2.4 Essential Raw Cooling Water (ERCW) Pipeline Backfill

The issue was that improper backfill methods (uncontrolled dumping) were used during original installation of the ERCW piping, resulting in the 30-inch diameter pipe having excessive stress placed on them.

1.2.5 North Valve Room Backfill

The issue was that personnel used improper and uncertified material, and placed the material in two or three foot lifts, resulting in material not meeting compaction levels.

1.2.6 Low Volume Waste Holding Pond (LVWHP) Dike

The issue was that the construction craft personnel ignored QC inspectors instructions for backfilling operations and worked with site engineers to obtain approval to deviate from drawings and specifications. They were concerned that this would jeopardize the structural integrity of the dike and also establish bad policy.

1.2.7 General Concerns:

Three concerns were very general which stated that there were procedure violations and intentional bypassing of Quality Assurance (QA) hold points.

1.2.8 Dry Active Waste (DAW) Building - (SQN)

The issue was that soil condition under the DAW Building was inadequate, potentially causing uneven settlement of the building.

2.0 SUMMARY

2.1 Summary of Issues

There were two major areas of concerns:

Improper backfill material and/or backfill placement methods had resulted in the structural integrity of the barrier trenches, pipelines, or dikes being compromised.

Backfill for some plant features had been placed on foundations that were questionable and had not been properly justified.

2.2 Summary of Evaluation Process

The evaluation of these concerns consisted of a review of applicable documents; interviews of cognizant personnel; physical walkdowns of site areas involved to observe actual conditions; a review of pertinent inspection records and drawings; and a review of investigation reports generated by the Nuclear Safety Review Staff (NSRS), Employee Response Team (ERT), DNE, and/or DNC organizations as a result of their evaluation of similar concerns. RLCA, Inc. was retained after ECTG had performed it's evaluation to provide an independent engineering report on existing soil conditions of the barrier trenches to ensure that safety had not been compromised (RLCA/P154/01-86/001). The RLCA, Inc. report was incorporated into this report as additional basis for the conclusions.

The evaluation approached the concerns with regard to three questions:

- Were the concerns factual?
- If the concerns were factual, did the situation compromise the structural integrity of the plant and/or had the problem been corrected?
- If a problem existed, was it programmatic or an isolated incident?

2.3 Summary of Findings

The Issue Findings for the soil subcategory were evaluated, and there was no evidence of significant programmatic problems. These concerns were addressed only within the construction category.

The concerns varied with respect to their accuracy of site conditions and/or actions of DNC and DNE personnel. However, any problems concerning the backfill material, backfill methods used, and foundations of the identified structures had been documented and analyzed, and have not compromised the structural integrity of the WBN.

2.4 Summary of Collective Significance

The soils issues introduced no programmatic problems. There were only two site specific non-QA problems. The materials were correctly used, placed, inspected, and documented in accordance with drawings, specifications, and procedures to satisfy the structures designed function in all cases. The plants' ability to perform their design function safely have not been compromised by any of the soils issues. Engineering and Construction practices were satisfactory in these soils applications.

2.5 Summary of Causes

The 20 concerns resulted in no generalized cause. The problem areas were isolated drawing and specification interpretations in the non-QA area.

2.6 Summary of Corrective Action

No significant corrective actions were necessary with regard to general soil conditions at WBN and SQN. However, three areas will require minor corrective actions.

Barrier Trench:

1. DNE-CEB to issue ECN to excavate the seepage point area and cosmetically repair slope damage on southwest side of intake pumping station, after a monitoring program.
2. WBN FSAR Section 2.5: Incorporation of underground barrier "as-built" information was incorporated into the WBN FSAR.

Low Volume Waste Holding Pond Dike

1. WBN DNE Civil Engineers to initiate an ECN to put note on drawing 10W228-1 clarifying use of dike.

3.0 EVALUATION PROCESS

3.1 General Methods of Evaluation

Barrier Trenches

Reviewed the design drawings, specifications and procedures related to the underground barrier trench to become familiar with the designed aspects and requirements for constructing the trenches.

Reviewed Engineering Change Notice (ECN) 3960 and WBN Final Safety Analysis Report (FSAR) Section 2.5.4.2.1.2, 2.5.4.2.1.3, 2.5.4.8, 2.5.5.1.2 to determine the basis and function for the Barrier Trenches.

Reviewed NSRS Investigation Report IN-85-442-X13 and DNE/DNC's response for previous investigative work and conclusions drawn to determine if further investigation was required.

Interviewed responsible DNE design engineers to establish the designed function, checked for documentation and backup to changes from original design to the actual condition, and any documentation on field inspections that were made to approve site conditions by verbal approval.

Interviewed the responsible DNC WBN engineers to determine the construction methods used, and discussed the as-built conditions of the Barrier Trenches as construction progressed.

Interviewed Civil-Quality Control (CQC) inspectors to determine their views and inspection methods of the Barrier Trench areas.

Reviewed Nonconformance Reports (NCR) 5257, 5131, 6323, 6338, and 564 for determining if areas of specification and/or procedural failure had been documented.

Reviewed Nuclear Regulatory Commission (NRC) Inspection Reports 50-390/83-41, 50-390/84-16, and 50-390/84-64 for determining NRC inspection findings on the trenches A and B backfill placement and inspection practices.

Reviewed backfill daily reports for 1983 and 1984 for barrier trenches to verify material and required inspection test records.

Reviewed WBN-Quality Control Procedure (QCP) 2.06, WBN-QCP 2.01, and General Construction Specifications G-9 and T-1 to determine the material placement, inspection, and documentation criteria for the backfilling operations.

Reviewed as-built cross-sections of Trenches A and B to determine the type backfill material used, location and inspection test results.

Compared as-built cross-section information to documentation that was supplied to the NRC with regard to engineering analysis and NCRs.

Interviewed cognizant Engineering Assurance engineers to determine documentation breakdowns in using "verbal instructions" to direct phases of work.

Inspected trench area to observe slope conditions attributed to artesian well and yard drainage concerns.

Reviewed WBN FSAR, amendment 55, dated April 15, 1985 for areas questioned by NSRS Investigation Report IN-85-442-X13 to determine if changes had been made or were actually required.

Reviewed RLCA Inc., independent engineering report (RLCA/P154/01-86/001) August 4, 1986, and September 15, 1986.

Sink Hole

Interviewed cognizant WBN civil engineers to determine what, in their view, was done to evaluate and correct the sink hole problem on the east side of the TB.

Inspected the east side of the TB area to determine the existing site conditions and get familiar with actual site area.

Interviewed cognizant WBN QC inspectors to determine type of material used to backfill the area, the condition of the hole before backfilling, and the inspection criteria used.

Reviewed Backfill Daily Reports from April 29, 1985 to May 9, 1985, to verify material and required inspection test records.

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Reviewed drawing (10N210, Revision 28) to verify the as-built site conditions in that area.

Reviewed DNC response to Employee Concern IN-85-442-X11.

Reviewed WBN-QCP 2.06 and General Construction Specifications T-1 to determine if all backfill was installed according to specifications and procedures.

Blowdown Lines Backfill

Interviewed cognizant WBN civil engineers to determine the reason for the pipeline leakage, the corrective action taken, and the backfill methods used.

Interviewed cognizant WBN QC inspectors to determine inspection methods and whether problems existed with verbal instructions being used.

Reviewed DNC responses to Employee Concerns IN-85-529-004, IN-85-196-001, and IN-85-472-003 for information and concurrence.

Inspected the Cooling Tower Blowdown Pipeline location for any physical evidence of continued water leakage.

Reviewed random samples of Backfill Daily Reports for original backfill operation between February 16, 1976 and October 11, 1978, for determining the adequacy of inspection records and type material used.

Reviewed drawings, CCM-C47, Revision 0 through Revision 3 and memorandums to confirm construction requirements.

ERCW Pipelines Backfill

Reviewed the design drawings 17A302-1 through -7, 17W302-2 through -7 and specifications relating to the backfill operations around the ERCW pipelines to become familiar with the design aspects and requirements for burying pipes.

Reviewed compaction test records of in-place material test to verify that potential "soft" areas in trench subgrade were inspected and verified acceptable.

Interviewed cognizant WBN mechanical engineers to determine the condition of ERCW pipes when they were cut during concrete lining installation.

Interviewed cognizant WBN CQC inspectors, that were involved with concrete lining inspection, to determine the condition of pipe as they were cut during concrete lining installation.

Reviewed WBN Tracking and Reporting of Open Items (TROI) list for any NCRs generated against backfill of ERCW piping.

Reviewed WBN FSAR sections 2.5.4.8 and 3.7.3.12 to determine the analysis that have been performed on existing soil conditions.

Reviewed NSRS Investigation Report No. I-85-598-WBN for information and concurrence.

Interviewed cognizant WBN civil engineers to determine their involvement and construction history of the pipeline placement.

Interviewed cognizant WBN CQC inspectors to determine inspection methods and whether problems existed with original backfill.

Reviewed Random Backfill Daily Reports and fill compaction test data for type A earthfill and limestone sand material to verify adequacy of inspection records, type material used, and that all material placed was within specifications.

North Valve Room Backfill

Interviewed cognizant WBN civil engineer to determine the construction history of the north valve room foundation.

Reviewed drawing (41N397-1, R1) to determine the design requirements of backfill material.

Interviewed cognizant CQC inspectors involved with backfill operations and inspections at the time of placement to determine if they knew of any discrepancies at the time.

Reviewed backfill daily reports to verify exactly what material was placed in area.

Low Volume Waste Holding Pond Dike

Reviewed drawings 10N225, Revision 10 and 10N228-1, Revision 1 to become familiar with design requirements.

Reviewed NSRS investigation report IN-85-088-002 and the series of DNC and DNE responses for information and concurrence.

Interviewed cognizant WBN civil engineers to determine the construction history and their views on the decisions made as dike construction progressed.

Interviewed cognizant DNE engineer to determine the design requirements and his directions as dike construction progressed.

Interviewed cognizant CQC inspectors and supervisors to determine inspection methods and any problems with the dike construction.

Reviewed various memorandums documenting the actions taken by DNC personnel since dike construction was finished to clarify the construction practices on non-QA areas.

Reviewed General Construction Specification G-9 to determine construction specification requirements.

General Concerns - WBN

The concerns (3) were general comments and were evaluated from the results of the other sixteen concerns investigated at WBN.

Dry Active Waste (DAW) Building - SQW

Reviewed Employee Concerns files and other files, including QTC expurgated files, for additional information and reports related to this concern.

Interviewed Cognizant engineers of the SQW Modifications Unit to determine the construction details of the DAW Building foundation, inspection methods used, and documentation available of backfill operation.

Reviewed TVA memorandum to Impell about DAW Building contract, dated February 21, 1986.

Reviewed DAW General Arrangement Drawing Impell Number H-01, January 15, 1981.

Reviewed Impell Design of DAW Building for SQN proposal, dated October, 1985.

Reviewed memorandum - Project Manager, Sequoyah Engineering Project to Design Services Manager, Sequoyah Nuclear Plant, dated February 3, 1986, Subject: SQN-Dry Active Waste (DAW) Building - Inspection of Foundation Excavation (B25 860203 020) to determine problems and outlined course of action by site.

Reviewed drawing INPELL CORP. C-01 to determine foundation requirements.

Reviewed SQN onsite employee concern impact evaluation report, JAN-86-020, dated February 5, 1986.

3.2 Requirements Or Criteria Established For Individual Issues

3.2.1 Barrier Trenches

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments
NSRS Invest. No. IN-85-442-X13		The elements and attributes covered by the source documents are: Barrier Trenches - All Attributes
WBNP PSAR, AMEND. 54	2.5.4	Barrier Trenches - Backfill Material
	2.5.5	Barrier Trenches - Slope Deterioration
	Fig. 2.5-225	Barrier Trenches - Backfill Material
	Fig. 2.5-226	Barrier Trenches - Backfill Material
	Fig. 2.5-226a	Barrier Trenches - Backfill Material
	Fig. 2.5-580	Barrier Trenches - Designed Function
	Fig. 2.5-581	Barrier Trenches - Designed Function
	Fig. 2.5-582	Barrier Trenches - Designed Function
	Fig. 2.5-583	Barrier Trenches - Designed Function
Gen. Construction. Specs G-9, R5		Barrier Trenches - Backfill Material
		Barrier Trenches - Fill Placement
Gen. Construction. Specs T-1, R1: Sect. 1032 Sect. 1075		Barrier Trenches - Backfill Material

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/OTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments The elements and attributes covered by the source documents are:
Drawing 10N210, R28		Barrier Trenches
Drawing 10N213-1, R1		Barrier Trenches
Drawing 10N213-2, R6		Barrier Trenches
Drawing 10N215, R10		Barrier Trenches
Drawing 10N225, R10		Barrier Trenches - Yard Drainage
Drawing 10N234, R14		Barrier Trenches - Yard Drainage
Drawing 10W235, R10		Barrier Trenches - Yard Drainage Barrier Trenches - Slope Deterioration
Drawing 10W245-1, R1	Sheet 8	Barrier Trenches - Slope Deterioration
Drawing 31N224-1, R10		Barrier Trenches - Incorr. Construction
Drawing 41N200-1, R4		Barrier Trenches - Incorr. Construction
ECN No. 3960, dated 6/9/83		Barrier Trenches - Backfill Material
ECN No. 4557, dated 1/24/84		Barrier Trenches - Backfill Material
FCR No. F-3247 dated 4/30/84		Barrier Trenches - Fill Placement
WBNP-OCP-2.01, R6 dated 6/20/84		Barrier Trenches - Backfill Material Barrier Trenches - Fill Placement

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments
WBNP-QCP-2.06, R4 dated 7/9/82		Barrier Trenches - Backfill Material
		Barrier Trenches - Fill Placement
WBNP-QCP-1.02, R15 dated 11/1/85		Barrier Trenches - Fill Placement
NCR 5257, dated 12/1/83		Barrier Trenches - Fill Placement
NCR 5131, dated 10/14/83		Barrier Trenches - Fill Placement
NCR 5804, dated 8/28/84		Barrier Trenches - Backfill Material
		Barrier Trenches - Fill Placement
NCR 6338, dated September 24, 1985		Barrier Trenches - Fill Placement
Backfill Deiley Reports for 1983, & 1984		Barrier Trenches - Fill Placement
Granular Compaction Test- Sand Cone Method Reports for 1983 and 1984		Barrier Trenches - Backfill Material
		Barrier Trenches - Fill Placement
		Barrier Trenches - Backfill Material
Memorandum, SOMP & WBNP Design Projects Manager to: WBNP Project Manager, dated June 22, 1976, "WBNP: -Yard Conduits and Piping-: Backfilling during Construction"		Barrier Trenches - Backfill Material
		Barrier Trenches - Backfill Material

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	<u>Comments</u> The elements and attributes covered by the source documents are:
Memorandum, Manager of Construction to Construction dated January: 30, 1980, "Earthfill Operations and Quality Control"		Barrier Trenches - Backfill Material Barrier Trenches - Fill Placement
Memorandum, OE/CEB to CEB Files, Dated August 1, 1983, "WBNP-Liquifaction Potential Underground Barrier Remedial Treatment: --Status and Observations Based on Field Inspection"		Barrier Trenches
Letter, TVA to US NRC, dated: January 16, 1985, "In for- mation Concerning the As- Built Configuration of the Under-Ground Barrier at WBNP"		Barrier Trenches
"As-Built" Cross-Sections for Barrier Trenches		Barrier Trenches - Backfill Material Barrier Trenches - Fill Placement
NRC Inspection Reports No. 50-390/83-41 (A02- 831021 019) No. 50-390/84- 16 (A02-84316 001) No. 50- 390/84-64 (A02-840917 029)		Barrier Trenches
Memorandum, OE/OC WBNP Project Managers to W. R. Brown, Project Manager, WBNP Date March 18, 1986, "NSRS Investigation Report: IN-85-442-X13 -Seismic Trenches:		Barrier Trenches "B" OC Response to NSRS Investigation Report

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments The elements and attributes covered by the source documents are:
Memorandum, Chief Civil Engineer (R. O. Barnett to: Chief Nuclear Engineer (J. A. Raulston), Dated March 27, 1986, "WBNP-FSAR: Section 2.5 -Incorporation: of Underground Barrier "As: -Built" Information (B41 860327 018)		Barrier Trench - FSAR Corrections
Letter, TVA to NRC, Dated December 6, 1983, "WPNP- NRC OIE Region XI Inspec- tion Report 50-390/83-41, 50-391/83-30 - Response to: Violation" (A27 831206018):		Barrier Trenches Inspections
Memorandum, Director of Nuclear Engineering To Those Listed, Dated April 4, 1986 "Policy Memorandum: Formal Approval Required for Field Change Requests": (B05 860404 003)		Barrier Trenches - "Verbal Instruction"
Memorandum-J.C. Standifer, Project Engineer, WBN Engineer Project to R. D. Tooley, Acting Site Design: Services Manager, WBN, Dated April 25, 1986, "WBN: -FSAR Revision Package Number 463"		Barrier Trenches FSAR Revision in Response to NSRS Investigation
Nuclear Dispatch, Dated May 5, 1986 - "TVA Evaluation Substantiates Integrity of Underground Barrier."		Barrier Trenches Admiral White-Response to NSRS
Robert L. Cloud Associates Report RLCA/PISA/01-86/001 August 4, 1986 Final: September 15, 1986		Barrier Trenches Independent Evaluation and follow-up inspection

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3.2.2 Sink Hole

Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)			<u>Comments</u>
WBNP-QCP 2.06, R4	:	:	Grandular - Fill
Dated July 9, 1982	:	:	
Material	:	:	
General Construction Specs	:	Section 1032	Grandular - Fill
T-1	:	:	
OC Response Employee Concern:	:	:	Sink Hole
IN-85-442-X11	:	:	Corrective Action
Backfill Daily Reports	:	:	Sink Hole
April 29, 1985 through	:	:	Fill Inspection
May 9, 1985	:	:	
Drawing 10N210, R28	:	:	Sink Hole Location

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3.2.3 Blowdown Line Backfill

Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	<u>Comments</u>
OC Response to Employee Concern IN-85-529-004		Blowdown Lines Backfill
OC Response to Employee Concern IN-85-196-001		Blowdown Lines Backfill
OC Response to Employee Concern IN-85-196-001		Blowdown Lines Backfill
CCN Number C-47 R0, R1, R2,		Blowdown Lines - Backfill
Memorandum to Files from C. Freeman, CEU, WBNP, dated: September 4, 1985, "WBNP- Soil Compaction Requirements:		Blowdown Lines - Backfill
Memorandum to Files from S. T. Wrigt, CEU, "WBNP OC, Dated February 27, 1985, "WBNP-Backfill Operation of: Cooling Towers Blowdown Pipe: Replacement"		Blowdown Lines - Backfill
Drawings 17W303-1, -2, -3, -4		Blowdown Lines - Backfill
Drawing 10N213-1, R1		Blowdown Lines - Backfill
Drawing 10N213-2, R6		Blowdown Lines - Backfill
WBNP-OCP-2.01, R4 Dated June 20, 2984		Blowdown Lines - Backfill
WBNP-OCP-2.06, R4 Dated July 9, 1982		Blowdown Lines - Backfill
Drawing 17W02-2, R6		Blowdown Lines - Backfill

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3.2.4 ERCW Pipeline Backfill

Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments
Drawings 17A302-1 Through -7: RO		ERCW Pipeline Backfill Requirements
WBNP-FSAR, Amendment 54, Dated April 15, 1985	3.7.3.12 Fig. 2.5-273	ERCW Pipeline Backfill Analysis Criteria
NSRS Report Number I-85-598- WBN		ERCW Pipeline Investigation
Random Backfill Daily Reports on ERCW fill From May 10, 1982 to October 26, 1982		ERCW Pipeline Backfill Records
Drawings 17W302 - 1 and 7		ERCW Pipeline Backfill Design
WBNP-FSAR, Amendment 54	2.5.4 Figure 2.5.549: Through - 553	ERCW Pipeline Backfill Analysis of FDM
Inplace Material Compaction Test Records from March 25, 1977 to November 3, 1977		ERCW Pipeline Subgrade Test

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3.2.5 North Valve Room Backfill

Information Source	:	:	<u>Comments</u>
(Applicable Procedures,	:	:	
OE Documents, Previous	:	Applicable	
Reports, NSRS/QTC/ERT	:	Section	
Investigation Reports	:	:	
Including revision or date)	:	:	
WBNP - QCP 2.06, R4	:	:	1032 - Crushed Stone
Dated July 9, 1982	:	:	Fill Material
General Construction	:	:	1032 - Crushed Stone
Specifications T-1, R1	:	:	Fill Material
Drawing 41N397-1, R1	:	:	North Valve Room Outline
	:	:	And Backfill Requirements

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3.2.6 Low Volume Waste Holding Pond Dike

Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)		Comments
NSRS Investigation Report Number In-85-088-002	Applicable Section	LVWHP Dike Construction
Response to NSRS Investment Number In-85-088-002 Dated July 23, 1985		LVWHP Dike Construction
Memorandum - NSRS to General Manager, "Response to Board: Comment-WBNP- Request for Investment/Evaluation - QTC Concern Number In-85-088-00 (Q01 85-0806 050)		LVWHP Dike Construction
Memorandum R. J. Hunt to P. D. Herald, Dated September 12, 1985, "WBNP- LVWHP Dike - Stability		LVWHP Dike - As - Constructed Analysis Findings
Memorandum - Acting Site Director to Project Manager: Dated November 19, 1985, WBNP - Employee Concerns Number IN-85-088-002		LVWHP Dike Investment Response Request
Memorandum - WBNP Project Manager to all H-Scheduled Employees WBNP OC, Dated December 13, 1985, "WBNP- DRG Integrity on BOP Features" (C24 851213 012)		LVWHP Dike Investment
Memorandum - WBNP Site Director To Director of NSRS, Dated December 18, 1985, "WBNP-Response to Employee Concern Investment Report I-85-088002"		LVWHP Dike - Construction

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	<u>Comments</u>
Memorandum CEU WBNP to WBNP Files, Dated January 18, 1985, "WBNP-Non-QA Permanent Backfill/Earthfill Operations"		LVWHP Dike - Construction
Memorandum - WB Engineering Project, Project Manager to to WBNP Project Manager, OC, Date December 19, 1985, "WBNP: LVWHP Dike Stability"		LVWHP Dike - Construction
Memorandum - Director of NSRS to Acting Site Director: Dated January 10, 1986, "Corrective Action Response Evaluation"		LVWHP Dike - Evaluation
Memorandum - Site Director WBNP ONP to Project Manager WBNP OC, Dated February 11, 1986, "WBNP-Employee Concerns IN-85-088-002"		LVWHP Dike - Investigation Response
Memorandum - Project Manager: Watts Bar Engineering Project to Project Manager, WBNP Project, WB OC, Dated February 25, 1986, "WBNP - LVWHP Dike-Employee Concerns"		LVWHP Dike - Analysis
Memorandum - G. Wadewitz, Project Manager, WBN-OC, to W. I. Cottle, Site Director, WBN-ONP, Dated February 27, 1986, "WBN-Request for Investment/Evaluation"		LVWHP Dike - Response to Investigation NSRS
Drawing 10N255, R10		LVWHP Dike Construction
Drawing 10W228-1, R1 10W228-2, R0		LVWHP Dike Construction

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Information Source (Applicable Procedures, OE Documents, Previous Reports, NSRS/QTC/ERT Investigation Reports Including revision or date)	Applicable Section	Comments
Construction Work Package C-199022		LVWHP Dike Construction
General Construction Specifications G-9, K5		LVWHP Dike Construction
Memorandum - (Informal) CQC, WBNP to CEU, WBNP, Dated June 20, 1985, "WBNP-Civil Quality Control Inspection Non-QA Areas"		Inspection in General Problems in Non-QA
Memorandum - (Informal) CEU, WBNP to CQC, WBNP, Dated July 24, 1985, "WBNP - Civil Quality Control Inspection Non-QA Areas"		Response to CQC Questions
Memorandum - (Informal) CEU, WBNP to CQC, WBNP, Dated October 8, 1985, "WBNP - Civil Quality Control Inspection-Non-QA Areas"		Revised Response to CQC Questions
Drawing 15W810-11, R10 15W810-37, 15W810-45		Conduit to Met. Station Through LVWHP Dike
CCN - C53, R2		Note to DWG. 10W228-1 and 10W228-2 CW LVWHP Dike

4.0 Findings

4.1 Barrier Trenches

4.1.1 Site Specific

Discussion

Design Function

The designed purpose of the Underground Barriers is to prevent the lateral flow of soils should an earthquake occur that could liquefy some of the soils below the ERCW piping and 1E conduits. The Underground Barriers do not keep the soil from liquefying, but are intended to contain the liquefiable soil. The Underground Barriers are located between the safety-related piping and conduits, and the area towards which the soil would attempt to flow should the soils liquefy. The Underground Barrier resulted from an extensive and conservative analysis of soil liquefaction that is presented in the WBN FSAR, Section 2.5.4.8. The Barrier Trench was then incorporated on ECN 3960 and constructed according to drawings 10N213-1 and 10N213-2, "Underground Barriers for Potential Soil Liquefaction."

Concern: Backfill Material

Backfill Material: The areas of concern were that (1) 1075-crushed stone granular material was used instead of compactible clay because of schedule and weather conditions, and the material was unacceptable for structural fill; (2) unauthorized or uncertified material was used; and (3) material was used before necessary tests and approvals obtained.

Response:

DNE/DNC response to NSRS to Investigation Report IN-85-442-X13, dated March 13, 1986, addressed the issue of 1075-crushed stone granular material use. The results of this ECTG evaluation concurs with the DNE/DNC response, and statements from that report are repeated here to give a consolidated finding.

1075-crushed stone fill material was used extensively in Barrier Trench B. Its use was based on the three valid reasons listed below, and arranged in order of priority as to the importance of reasons:

The Trench B was excavated to a greater depth at the south end, than the exploratory borings had indicated prior to start of work. Stability analysis performed at the time the excavation was open, by DNE engineers, indicated a need for a higher shear strength for the backfill material or to make the trench wider. The option of using 1075-crushed stone with higher shear strength properties in lieu of Al-earthfill was selected. The use of the 1075-crushed stone met the higher shear strength requirements and provided the additional stability needed for actual field conditions.

The site engineers were concerned with the available quantity of Al/earthfill, since the trenches were so large. Locating a new borrow area would have required more testing and delays.

The Barrier Trench B had to be completed prior to fuel load. This required the placing of backfill through the winter season. The use of 1075- and 1032-crushed stone definitely solved that problem. However, if the material had not met the requirements some other option would have been explored.

The use of 1075-crushed stone (equivalent to ASTM D448, size 56) was an option available to construction as prescribed in the design documents and construction drawings. Its use was analyzed and documented in the TVA design report on the "as-built configuration of the underground barrier at WBN" submitted to the NRC dated January 16, 1985. The analysis documented that 1075-crushed stone was used extensively and that all potential failure planes were evaluated on all cross-sections. The cross-sections submitted in the TVA design report were those sections that had the lowest factor-of-safety, as a result of the analysis of potential failure planes, and also, representative of the backfill materials used in both trenches.

The drawing (10N213-2) defined the materials and placement requirements that applied to the use of 1075-crushed stone. Earthfill Note-1 specified the placement and acceptance criteria for the 1075-crushed stone. Earthfill Note-4C specified that 1075-crushed stone could be used.

Unauthorized or uncertified material was never used in the Barrier Trenches. Inspectors were present at all times during backfill placement. The earthfill used came from designated borrow areas as specified in Note-2 and -6B on Drawing 10N213-2. Granular material, both 1032- and 1075-crushed stone, came from a qualified offsite source. Records are on file documenting that all materials used were certified, and backfill placement materials were constantly monitored according to WBN QCP 2.01, WBN QCP 2.06, and General Construction Specification G-9 and I-1.

Material was never used before necessary tests and approvals were obtained. The reasons cited above is documented proof that backfill was controlled properly. The Trench A and B excavation was started prior to completion of the laboratory soil strength test of the backfill soils. However, these tests were completed prior to fill placement having started in Trench A. Memorandum, Office of Engineering (OE)/Civil Engineering Branch (CEB) to CEB files, dated August 1, 1983, "WBN-Liquefaction Potential-Underground Barrier remedial treatment--status and observations based on field inspection" (CEB 830801 020) discusses these strength test as being complete and the fill placement just getting started. The "as-built cross-sections" show all fill in Trench A passed all required test, except those documented on NCR 5131.

The Robert L. Cloud Associates, Inc. Technical Evaluation and Response addressed this issue by answering TVA's first and second question presented to them as independent engineers.

The first question presented by TVA was as follows: "Was the use of 1075-crushed stone for earthfill technically acceptable?"