50-327/328

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

November 8, 1996

LICENSEE: Tennessee Valley Authority

FACILITY: Sequoyah Nuclear Plant, Units 1 and 2

SUBJECT: SUMMARY - NOVEMBER 4, 1996, MEETING WITH TVA TO BRIEF THE STAFF ON THE STATUS OF THERMO-LAG FIRE BARRIER UPGRADES AT SEQUOYAH

On November 4, 1996, representatives of the Tennessee Valley Authority (TVA) met with members of the NRC staff in Rockville, Maryland. The staff requested this meeting to discuss with TVA the status of the Thermo-Lag fire barrier corrective action program at the Sequoyah Nuclear Plant (SQN) and the three-year slippage in the schedule for completion of the program. A list of attendees is given in Enclosure 1. Copies of the handouts provided by TVA are given in Enclosure 2.

TVA representatives discussed the Thermo-Lag testing program they conducted in order to gain the necessary confidence that use of additional Thermo-Lag material in the upgrades would be prudent. This testing included fire endurance testing, material property and composition testing, ampacity (current carrying capacity) derate testing, and seismic testing.

There are approximately 4,400 linear feet of single conduit configurations and 1,650 square feet of special configurations that utilize Thermo-Lag at SQN. On the basis of its test results, TVA believes that approximately 2,100 feet of the linear configuration Thermo-Lag can be qualified as is. The remainder of the fire barriers will need to be upgraded by addition of material. Standard designs have been developed and detailed walkdowns will be required to verify the qualification of the 2,100 feet of linear barrier and to apply the standard designs to the remaining configurations. TVA stated that most of these walkdowns (as well as during the installation of the additional material) would require erection of temporary scaffolding and much of this work would be in proximity to sensitive equipment. The sensitive equipment is mostly electrical and instrumentation. During the meeting, the TVA representatives could not characterize how many of the barriers were in close proximity to sensitive equipment.

TVA plans to train and use a number of relatively small installation teams to ensure quality work and to minimize risk of plant upsets while the plants are operating, which will be throughout most of the walkdowns and installation of the upgrades. There is also concern regarding this work jeopardizing required system/component availability during outage periods. TVA noted the differences between performing Thermo-Lag upgrades at Watts Bar (single unit) prior to the plant receiving its operating license and performing the upgrades at SQN with at least one unit operating (most of the time with both units operating).

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The installation effort is expected to require approximately 110,000 person-hours of direct support and approximately 11,000 person-hours of engineering support. The walkdowns are scheduled to start within the next several months and finish in late 1999. Total cost over the next three fiscal years is estimated at about $9 million. The staff had requested, in advance of the meeting, that TVA be prepared to discuss other planned/budgeted capital and O&M projects with which the Thermo-Lag upgrade is competing. This information can be found in Enclosure 2.

The staff requested specific information from TVA regarding documentation of the integrated program plan/schedule that could be reviewed by NRC inspectors at the plant site to determine whether or not TVA had complied with 10 CFR 50, Appendix B, Criterion XVI, *Corrective Action*, requiring **prompt** corrective action of conditions adverse to quality. TVA agreed to make this information available to the staff. The staff informed TVA that it is still concerned about the length of the Sequoyah Thermo-Lag corrective action program and the significant delay in TVA's previously proposed completion schedule (i.e., October 1999 vs. October 1996).

The staff questioned TVA's decision to resolve the Thermo-Lag issues at it's Watts Bar Nuclear Plant, at that time a Near-Term Operating License plant, prior to resolving them at Sequoyah, an operating plant. There was speculation by some staff members that more preliminary work could have been performed at Sequoyah during the past few years in parallel with the testing program. The staff requested an historical breakdown of resources expended by TVA on Thermo-Lag resolutions by site (Browns Ferry, Watts Bar, and Sequoyah) and year since the identification of the technical concerns by the staff in 1992 and a breakdown of the projected resources to be expended until all Thermo-Lag issues are resolved. The staff requested the breakdown by site because TVA made its presentation in the context of the TVA-wide program.

Finally, the staff requested a comprehensive accounting of the amounts of installed Thermo-Lag in relation to the sensitive equipment that TVA is concerned about disrupting during this project.

Original signed by

Ronald W. Hernan, Senior Project Manager
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-327 and 50-328

Enclosures: 1. Attendance List
2. TVA Handout
cc w/enclosures: See next page
DOCUMENT NAME: G:\SQN\MEETSUM.114

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F. Miraglia (FJM)
R. Zimmerman (RPZ)
A. Thadani (ACT)
S. Varga (SAV)
B. Sheron (BWS)
G. Holahan (GMH)
J. Zwolinski (JAZ)
E. Jordan (JKR)
T. Marsh (LBM)
S. West (KSW)
F. Hebdon (FJH)
R. Jenkins (RVJ)
L. Tran (LNT)
L. Whitney (LEW1)
P. Madden (PMM)
G. Tracy (GMT)
E. Merschoff (EWM)
R. Hernan (RWH)
B. Clayton

150075

Mr. Oliver D. Kingsley, Jr.
Tennessee Valley Authority

cc:
Mr. O. J. Zeringue, Sr. Vice President
Nuclear Operations
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Mark O. Medford, Vice President
Engineering & Technical Services
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

Mr. R. J. Adney, Site Vice President
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

General Counsel
Tennessee Valley Authority
ET 10H
400 West Summit Hill Drive
Knoxville, TN 37902

Mr. Raul R. Baron, General Manager
Nuclear Assurance and Licensing
Tennessee Valley Authority
4J Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Pedro Salas, Manager
Licensing and Industry Affairs
Tennessee Valley Authority
4J Blue Ridge
1101 Market Street
Chattanooga, TN 37402-2801

Mr. Ralph H. Shell, Manager
Licensing and Industry Affairs
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

SEQUOYAH NUCLEAR PLANT

Mr. J. T. Herron, Plant Manager
Sequoyah Nuclear Plant
Tennessee Valley Authority
P.O. Box 2000
Soddy Daisy, TN 37379

Regional Administrator
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW., Suite 2900
Atlanta, GA 30323

Mr. Mel C. Shannon
Senior Resident Inspector
Sequoyah Nuclear Plant
U.S. Nuclear Regulatory Commission
2600 Igou Ferry Road
Soddy Daisy, TN 37379

Mr. Michael H. Mobley, Director
Division of Radiological Health
3rd Floor, L and C Annex
401 Church Street
Nashville, TN 37243-1532

County Executive
Hamilton County Courthouse
Chattanooga, TN 37402-2801

ATTENDEES

NRC/TVA MEETING ON NOVEMBER 4, 1996 REGARDING THERMO-LAG

Name	Affiliation
Ron Hernan	NRC/NRR/DRPE/PD II-3
Kent W. Brown	TVA - Sr. Elect. Engr., Corp
Mark Henry Salley	TVA - Sr. Engr., Corp
Craig Butcher	TVA - Elect. Engr. Mgr., SQN
James K. Rochelle	TVA - Civil Engr., Corp
John K. Gates	TVA - Project Manager
Michael J. Lorek	TVA - Mech. Engr. Mgr., SQN
Mark J. Burzynsky	TVA - Engr. & Matls Mgr. - SQN
Jon R. Rupert	TVA - Engr. & Tech. Supp., SQN
Raul R. Baron	TVA - Gen. Mgr. NA&L, TVAN
Ralph H. Shell	TVA - Mgr., Lic & Ind Affairs
Ronaldo V. Jenkins	NRC/NRR/EELB - Elect. Engr.
Linh N. Tran	NRC/NRR/DRP, Lead Proj. Mgr.
Fred Hebdon	NRC/NRR/DRP, PD 2-3
Jim Smith	TVA - SQN Licensing Supervisor
Patrick Madden	NRC/NRR/DSSA, Fire Prot. Engr.
K. Steven West	NRC/NRR/DSSA, Fire Prot. SL
L. B. Marsh	NRC/NRR/DSSA, Chief, SPLB
Brian Sheron	NRC/NRR, Acting Assoc. Dir.
Theresa Sutter	Bechtel, Licensing Engr.
Mike Schoppman	Florida Power & Light, Beth.
E. A. Thompson	Florida Power & Light, PE

ENCLOSURE 1

Tennessee Valley Authority
Sequoyah Nuclear Plant
TVA/NRC Thermo-Lag Meeting
November 4, 1996

Sequoyah Nuclear Plant
TVA/NRC Thermo-Lag Management Meeting
November 4, 1996
Agenda

Introduction	M. J. Burzynski
TVA Thermo-Lag Testing Plan	
- Fire Protection	M. H. Salley
- Ampacity	K. W. Brown
- Seismic	J. K. Rochelle
Thermo-Lag Application to SQN	M. J. Lorek/C. R. Butcher
Thermo-Lag Schedule	J. K. Gates
Summary	J. R. Rupert

Sequoyah Nuclear Plant

Introduction

Sequoyah Nuclear Plant
Introduction

- TVA Strategy
  - Research to bound testing
  - Testing
  - Internal standards
  - Design
  - Implementation
- TVA Perspective
  - Browns Ferry
  - Watts Bar
  - Sequoyah
- Schedule
  - Why we changed
  - Where we will be in '97

Sequoyah Nuclear Plant

Thermo-Lag Testing

Sequoyah Nuclear Plant
TVA Thermo-Lag Testing Plan

- TVA Integrated Thermo-Lag Program
  - WBN Unit 1 TVA Nuclear (TVAN) lead plant
  - BFN Units 2 and 3
    - Cable rerouting
    - Thermo-Lag - intake pumping station
  - SQN Units 1 and 2 final TVAN plant
    - Prototype for TVA Nuclear testing
    - Qualification and upgrade
- Multi-disciplined approach to resolve related issues
  - Fire protection rating
  - Ampacity derating
  - Seismic adequacy

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- TVA Nuclear Testing Position
  - NRC/NRR meeting, October 7, 1992
  - NRC GL 86-10, Supplement 1, March 25, 1994
  - Regulatory Information Conference, May 4, 1993
  - ACRS Subcommittee meeting, November 9, 1993
  - ACRS Full Committee, December 9, 1993
  - ASME International Joint Power Generation Conference, October 1995
  - TVA continues to share testing with industry (NEI)

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- Fire Endurance Testing Phase I
  - Developed testing methodology and acceptance criteria
  - Started construction, October 1992
  - Conducted testing, December 1992 through April 1993
    - Fundamental one-hour configurations
      - Six full-scale fire tests
      - Basic conduits
      - Basic air drops
      - Basic junction boxes

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- Fire Endurance Testing Phase II
  - Started construction, June 1993
  - Conducted testing, September 1993 through October 1993
    - Cable trays and advanced one-hour configurations
      - Seven full-scale fire tests
      - Three cable tray tests
      - Four SQN configurations
        - Boxed and ganged conduits
        - Improved junction box design

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- Fire Endurance Testing Phase III
  - Started construction, October 1994
  - Conducted testing, December 1994 through January 1995
    - Conduit, cable tray, junction box (basic three-hour configurations)
      - Two full-scale tests
      - Four-hour, ten-minute rating

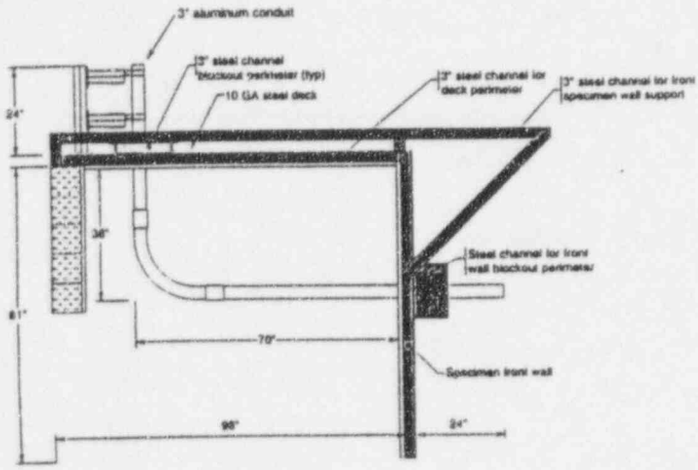
Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- Fire Endurance Testing Phase IV
  - Started construction, November 1995
  - Conducted test, January 1996
    - SQN material properties
      - Thermogravimetric Analysis (TGA)
      - Infrared (IR) Spectroscopy
      - SQN/WBN June 15, 1995 update to GL 92-08 RAI
      - Effects of cable fill in conduit
      - Effects of banding

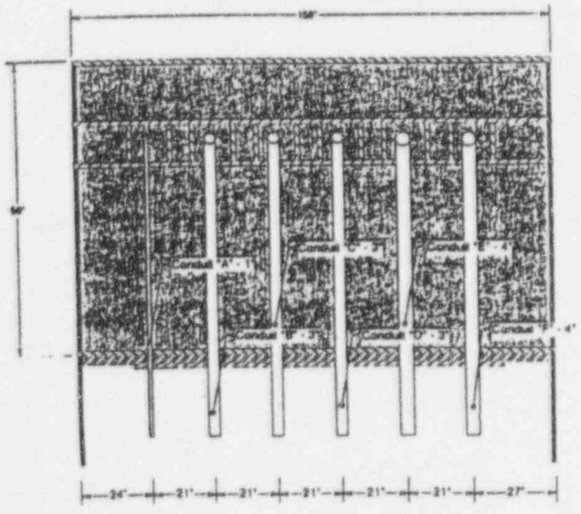
Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- January 1996 Test Results
  - OMEGA Point Laboratories Report issued March 20, 1996
  - Qualified SQN vintage material
  - Qualified 3-inch conduit protected with a single layer of nominal 5/8-inch Thermo-Lag 330-1
    - Qualified existing bands on 3-inch and larger conduct
    - Developed relationship for conduit cable fill and thermal performance

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection



Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection



Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- January 1996 Fire Test Results (cont.)

Conduit	Size	Thermo-Lag 330-1 ERFBS	Cable Fill (lbs./ft.)	Conduit Surface Delta Tave (deg F)	Conduit Surface Delta Tmax (deg.F)
A	1"	Min. 1/2" TGA = ? Nom. 3/8" TGA = √	0.0	157	161
B	3"	Nom. 5/8" TGA = ?	0.0	248	300
C	3"	Min. 1/2" TGA = ?	0.85	221	275
D	3"	Min. 1/2" TGA = ?	2.70	199	238
E	4"	Min. 1/2" TGA = ?	0.0	178	210
F	4"	Min. 1/2" TGA = √	0.0	189	230

Sequoyah Nuclear Plant
Thermo-Lag Testing
Fire Protection

- Summary
  - Existing Thermo-Lag performance
    - SQN original installation is high quality
      - Limiting conduit (1-inch) approximately 40-minute rating
      - Unique configurations upgrading
  - TVA received approval for Thermo-Lag ERFBS, October 1995
    - NRC NUREG-0847, Supplement 18
  - Testing has been thorough and systematic

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- TVA Test Program Overview
- Results and Issues

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Thermo-Lag Test Program
  - No original manufacturer deratings used
  - TU derating applied to single open-top trays
  - TVA test programs address
    - Single conduits (single layer and upgrade)
    - Boxed multiple conduits
    - Covered trays
    - Stacked trays

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Thermo-Lag Test Program
  - Testing based on IEEE P-848, "Procedure for the Determination of the Ampacity Derating of Fire Protected Cables"
  - TVA program led the industry on numerous issues
    - Conduit
      - Effect of conduit emissivity
      - Effect of number of conductors
      - Non-standard configurations
      - Three-hour systems
    - Tray
      - Non-standard configurations
      - Three-hour systems

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Thermo-Lag Test Program
  - Final ampacity derating factors
    - Single conduits (includes 5% margin to address emissivity)
      - 5/8-inch, 1-hour - 7%
      - 3/8-inch + 3/8-inch, 1-hour - 7%
      - 5/8-inch + 3/8-inch, 1-hour - 8%
      - 330-1/770-1, 2 inch and larger, 3-hour - 18%
    - Boxed conduits
      - Unistrut frame, 1-hour - 12%
      - Direct mounted, 1-hour - 26%

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Thermo-Lag Test Program
  - Final ampacity derating factors
    - Tray
      - Open top, 1-hour (TU test) - 32%
      - Sheet steel-covered, 1-hour - 40%
      - Stacked trays common enclosure, 1-hour - 41%
      - 330-1/770-1, 3-hour - 48%

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Four questions from August 29, 1996 WBN request for additional information (RAI)
  - Confirm absence of tray cover on specimen 7.1 baseline
  - Cure time of wrapped specimen 7.3
  - Simultaneous testing of two specimens
  - Margin

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

Issue Number One

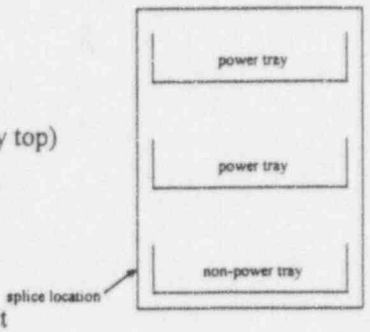
Confirm absence of tray cover on specimen 7.1 baseline

- Testing of an open tray confirmed in four sections of the report
  - Test plan
    - Sequence and Procedure
    - List of test configurations
  - Description of test articles
  - Photographs

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

Issue Number Two

Cure time of wrapped specimen 7.3



- Original spacing 8 inches (tray bottom-to-tray top)
- Altered spacing 6-1/2 inches (bottom tray-to-middle tray)
- Spacing restored and enclosure spliced
- Shortened splice cure has insignificant impact
  - Low percentage of the barrier affected by the splice (4%)
  - Location of the splice next to non-power tray
  - Elevated temperature exposure beginning October 4

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

Issue Number Two

Cure time of wrapped specimen 7.3

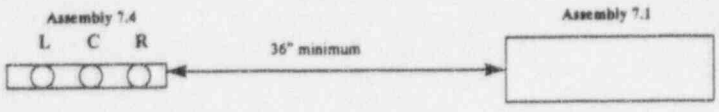
- Assembly chronology
  - August 30, 1994 - Begin application of ERFBS with altered spacing between lower trays
  - September 7, 1994 - Initial completion
  - September 8, 1994 - Altered spacing deemed unacceptable, spacing restored with "splice"
  - September 9, 1994 - Splice completed
  - October 4, 1994 - Assembly placed in test enclosure and energized
  - October 6, 1994 - Ampacity evaluation completed

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

Issue Number Three

Simultaneous testing of two specimens

- Simultaneous testing had no effect
  - Hottest conduit in specimen 7.4 was away from assembly 7.1
  - Left- and right-side external temperatures within 0.2°C



Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

Issue Number Four

Margin

- Cables not reanalyzed with new multipliers
- Minimal impact expected
  - No wrapped power cable trays
  - Little change in conduit derating factors
- TVA Design Standard includes new multipliers

Sequoyah Nuclear Plant
Thermo-Lag Testing
Ampacity

- Summary
  - Development of test standard
  - Numerous configurations evaluated
  - Internal standards will ensure acceptable installation

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- Objective
  - Describe TVA static, dynamic, and acceptance tests and application of test results for seismic/structural qualification of Thermo-Lag 330-1 ERFBS
- Requirements
  - Seismic II/I protection for safety-related equipment, components, and electrical cables
  - Account for Thermo-Lag mass and stiffness effects in qualification of enclosed electrical raceway systems
- Testing
  - Static (mechanical property)
  - Dynamic (shake table)
  - Lot acceptance (receipt inspection)

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- TVA Milestones
  - Nov 94 Submitted static (mechanical property) and dynamic (shake table) test reports to NRC
  - Mar 95 Responded to Dec 94 RAIs describing plans for:
    - New WBN enclosures and replacement of BFN enclosures
    - Evaluation and upgrade of SQN enclosures
    - Thermo-Lag enclosure design standards based on TVA tests
    - Acceptance testing for density and shear strength
    - Installation per TVA General Specification (G-Spec) and plant-specific design output
  - Apr 95 NRC WBN site audit of Thermo-Lag Seismic Adequacy

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- TVA Milestones
  - Oct 95 Completed WBN Thermo-Lag installation (DCN closed)
  - Oct 95 NRC IN 95-49 - Thermo-Lag seismic adequacy and TVA test results
  - Dec 95 Completed BFN Thermo-Lag replacement (DCN closed)
  - Sep 96 Submitted revised response to Dec 94 RAI for SQN

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- Static (Mechanical Property) Tests at Singleton Laboratory (SL), September 1994
  - Specimens fabricated by TVA; joints cured 30 days
  - Procedures per ASTM standards to extent possible; special fixtures developed
  - Tested worst case conditions (125°F and minimum curing time)
  - Submitted SL Report, November 11, 1994
  - Strength/stiffness properties needed for analysis
  - Comparison to TSI data (IN 95-49)

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- Dynamic (Shake Table) Tests (Wyle Laboratory, September 1994)
  - Cable tray, conduit, air drop fixtures and enclosures fabricated by TVA; cured 30 days
  - Required Response Spectra (RRS) enveloped WBN requirements
  - Simulated two OBEs followed by one SSE - triaxial input
  - Resonance search tests before and after proof tests (to assess changes)
  - Tested at 125°F and minimum (30-day) cure time
  - Submitted Wyle Report, November 11, 1994
  - Video reviewed during WBN audit
  - Test Response Spectra enveloped RRS in axes and frequency ranges
  - Specimens performed very well (no significant damage)

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- Material Lot Acceptance Tests (Singleton laboratory, March - August 1995)
  - Tests for each lot of material used at WBN and BFN
  - Board specimens tested for density and in-plane shear strength
  - Pre-formed (curved) panel specimens tested for density
  - Shear strength tests at 125°F
  - First tests provided basis for acceptance criteria in G-Spec (included material from lots used in TVA-sponsored fire, ampacity, and seismic tests)
  - SL Report, September 26, 1995 (Over 200 lots tested) (One 1-1/4 inch thick board lot rejected for low density)
  - Additional lot acceptance tests planned for SQN upgrade material

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- TVA Civil Design Standard
  - Scope: Thermo-Lag 330-1 enclosures installed or upgraded per TVA G-Spec
  - Qualification by attribute comparison to dynamic test specimens and spectra
  - Allowable stresses based on static test minimum strength values
  - Modulus of elasticity and shear modulus values based on average test values
  - Density for boards (72 pcf) and pre-formed curved panels (84 pcf) based on mean plus one standard deviation of phase I acceptance test data
  - Stress checks for enclosure qualification by analysis and analytical methods (correlated)

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- TVA Civil Design Standard
  - Methods for qualifying enclosed raceways for added mass and stiffness
  - Reviewed during WBN Seismic Adequacy Audit, April 1995
  - Used to qualify WBN and BFN enclosures
  - Resulted in minor structural enhancements and span limits for Thermo-Lag enclosures qualified by TVA fire tests
  - To be applied for SQN Thermo-Lag designs

Sequoyah Nuclear Plant
Thermo-Lag Testing
Seismic

- Summary
  - TVA static, dynamic, and acceptance tests provided basis for seismic/structural qualification of Thermo-Lag enclosures and enclosed raceways at WBN and BFN
  - Mechanical property/density values from TVA tests more specific than TSI data
  - Mechanical properties from TVA tests lower than TSI properties (IN 95-49)
  - WBN and BFN enclosures installed per TVA G-Spec and plant-specific design output
  - Conservative tests: at maximum operating temperature (125°F) and minimum curing time (30 days)
  - Application of TVA Civil DS resulted in minor structural enhancements and span limits for Thermo-Lag enclosures qualified by TVA fire tests (minor impact on enclosure design) (no significant impact on fire or ampacity qualification)
  - TVA Civil DS and G-Spec to be applied for SQN designs

Sequoyah Nuclear Plant

Thermo-Lag Application to Sequoyah

Sequ ah Nuclear Plant
Thermo-Lag Testing
Application

- Current wrapped configurations
  - 4374 linear feet of single conduit (1 inch, 1-1/2 inch, 2 inch, 2-1/2 inch, 3 inch, and 4 inch)
  - 1646 square feet of special configurations
    - Four boxed conduit configurations (three 4 inch, one 2 inch)
    - Twenty junction boxes
    - Three cable trays
- Reduction allowed by test results
  - 2132 linear feet of 3 inch and 4 inch conduit will be qualified as is
  - 2242 linear feet of 1 inch, 1-1/2 inch, 2 inch, and 2-1/2 inch conduit will require upgrade
  - 1646 square feet of special configurations will require upgrade

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Upgrade implementation plan
  - Walkdowns of installed Thermo-Lag will be required to verify acceptability
    - Verification of design attributes (32 required by RAI)
    - Installation constructibility
    - Civil support considerations
  - A significant percentage of installed Thermo-Lag is on conduit runs near the ceiling of each elevation of the auxiliary building which will require a significant amount of scaffolding to access

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Scaffolding will have to be constructed around sensitive equipment
  - RCP undervoltage and underfrequency relays
  - S/G pressure transmitters
  - 120V AC vital instrument power boards
  - 125V DC vital battery boards
  - 6.9kV shutdown boards
  - Component cooling water pumps
  - 480V MOV boards
  - 6900V/480V shutdown transformers

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Engineering effort required to resolve Thermo-Lag
  - Estimated 13,000 man-hours for Fiscal Year '97
  - Scoping walkdowns account for 10% of this estimate
  - Approximately 90 cables require ampacity review
  - Civil Engineering required to evaluate ERFBS supports
- Efforts best accomplished by dedicated teams of reasonable size to ensure consistency and high quality

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Walkdown attributes
  - Thermo-Lag installations will be walked down
    - Dedicated, specially-trained team consisting of fire protection engineers, electrical engineers, civil engineers, modifications engineers, and operations
  - Special scaffolding required, some in close proximity to sensitive equipment
  - Team will perform detailed documented inspections of existing installation for attributes such as:
    - Correct thickness
    - Correct surface texture
    - Cracks or shrinkage in material
    - Visible gaps or separation from adjacent materials
    - Compliance with requirements to cover intervening items

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Walkdown attributes (continued)
  - Presence of mechanical fasteners and compliance with space rules
  - Presence of surface voids (unacceptable)
  - Presence of surface delaminations (unacceptable)
  - Adequacy of civil support systems
  - Protection of mechanical fasteners and civil supports
  - Water damage and the need to use a protective coating
  - Need for weep holes (junction boxes)
  - Document the acceptability of single conduits $\geq$ 3 inches
  - Initiate minor maintenance documents to correct minor deficiencies
  - Document required upgrades to be made
  - Verify constructability of upgrade configurations

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Engineering analysis to support upgrade configurations
  - Existing configurations will be evaluated and those found compliant to requirements will be returned to service
    - Currently estimated that approximately 2100 feet of conduit will be acceptable as-is and returned to service following documentation from walkdowns
  - Ampacity evaluations of approximately 90 power cables
  - Civil evaluations of structural support systems
  - Fire protection evaluations of fire barriers to conform to requirements (GL 86-10 evaluations)
  - Creation of entire new drawing series to document installation details
  - Potential cable rerouting
- Two design change notices per unit planned
  - One for removal of material no longer required
  - One for upgrade of fire barriers

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Thermo-Lag reduction
  - Installations identified by evaluations as not required can be removed
  - Material will be retained to evaluate acceptability of past installations
    - Verify presence of stress skin material
    - Verify assembly was pre-buttered at time of initial installation

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Training of team members
  - Improved training based on lessons learned from WBN
  - Extensive training of engineering and modifications individuals
    - Requirements for inspections
    - Requirements for installations
    - Clear understanding of requirements
    - Consistent direction from engineering staff
    - Promotes a strong and effective team
- Highest quality can be achieved through smaller installation teams
- Consistency of installations and retention of lessons learned

Sequoyah Nuclear Plant
Thermo-Lag Testing
Application

- Implementation of fire barrier upgrades
  - Additional 11,000 man-hours estimated for engineering support
  - Modification estimates near 111,000 man-hours for implementation
  - Scaffolding will be required in the same sensitive areas previously described
  - Installation is very labor intensive
  - To ensure quality construction, a crew of 10-12 insulators with previous Thermo-Lag installation experience will be utilized with close supervision
  - Most locations will be difficult to work in
  - Final document closure following installation and verification
  - Integration of resources with other site projects
  - Balance Thermo-Lag upgrades with other reliability issues
  - Multi-year business plans

Sequoyah Nuclear Plant

Thermo-Lag Schedule

Sequoyah Nuclear Plant
Thermo-Lag Schedule

- Majority of implementation nonoutage
- Spring and Fall outages in '97 dictate Engineering resources
- Application is specialized work
- Management concerns
  - Capital Projects Three-Year Plan
  - O&M Projects Three-Year Plan
  - Implementation i.. auxiliary building

Sequoyah Nuclear Plant

Summary

Sequoyah Nuclear Plant
Summary

- Overall TVA systematic approach
- Thermo-Lag installation details
- Implementation considerations for quality of work
- Schedule reflects a balanced approach to address reliability and regulatory issues

SEQUOYAH O&M PROJECTS LIST

FISCAL YEARS 1997-1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
Tech Spec Upgrade (Includes Procedure Upgrade)			$696	$1,407	$1,441
Work Management System Data Bases			$802	$518	$416
ISI Support	U1C8	Jun-97	$165		
Erosion/Corrosion	U1C8	Jun-97	$187		
Coatings		Sep-97	$214		
Raw Water Inspection		Sep-97	$140		
Erosion/Corrosion	U2C8		$144		
ISI Support	U2C8		$85		
Drawing Backlogs			$735	$1,110	
Thermolag Enhancements			$748	$3,076	$2,996
II SQ960654PER Resolution (Partial Mods)		Sep-97	$449		
DCN Closeout	U1C8		$426	$200	
Relief Valve Issue	U2C8		$193	$303	
U1 & Common Relief Valve Issue	U1C9			$250	$500
Loss of Voltage Relay, Annunciator Main Bus	U1C8	Apr-97	$3		
U1 Replace Flow Switches			$12	TBD	TBD
Control Air for ABGTS		Jul-97	$180		
Thermal Barrier Isolation Vlvs	U1C8	Apr-97	$41		
Ecolochem			$516		

SEQUOYAH O&M PROJECTS LIST

FISCAL YEARS 1997-1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
PROJECTS TO IMPROVE RELIABILITY					
MCR Annunciator		Jul-97	$81		
Power Circuit Breakers	U2C8		$11	$20	
Replace Doors C49 and C50				$104	
SCWS Pump Discharge Iso Valves	U1C8	Apr-97	$13		
SCWS Pump Discharge Iso Valves	U2C8		$11	$10	
Con Demin Waste		Sep-97	$85		
NASH Relief Valve Drain Pipe	U2C8		$51	$26	
No. 7 HDT Optimization			$24	$133	
U1 Upgrade Rad Monitor Software		Jul-97	$55		
U2 Upgrade Rad Monitor Software		Sep-97	$55		
Sight Glass Replacement	U2C8		$45	$39	
No. 7 Heater Drain Tank Flow in MCR	U1C8	Apr-97	$23		
No. 7 Heater Drain Tank Flow in MCR	U2C8		$23	$5	
U1 No. 3 HDTP Seal Injection Low Delta P Alarm		Jul-97	$15		
ERCW Traveling Screens			$19	TBD	
Various Reach Rod Operated Valves			$11	TBD	TBD
Press Control Vlvs 77-430,431	U1C9		$20	TBD	TBD
Press Control Vlvs 77-430,431	U2C8		$20	TBD	
Positioner for 2-PCV-47-189	U2C8		$12	$8	
Interlock Gen Output Breaker to MOD	U2C8		$14	$12	
Add T-Drains to 35 MOVs	U2C8		$30	TBD	TBD

SEQUOYAH O&M PROJECTS LIST

FISCAL YEARS 1997-1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
U2 AMSAC Test Switch		Jun-97	$22		
Change Elev Benchmark Liquid Level Gauge	U1C8	Apr-97	$16		
U1 AMSAC Test Switch		Jun-97	$22		
Feedwater Heater Isolation Logic	U2C8		$42	$6	
System Descriptions		Sep-97	$30		
Future Modifications				$500	$700
Miscellaneous O&M		TBD	$14		
TOTAL			**$6,500**	**$7,727**	**$6,053**

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
OPERATOR WORK AROUNDS					
REPL MOTOR OPERATORS 1-FCV-47-180 & 181	U1C9			TBD	TBD
REPL MOTOR OPERATORS 2-FCV-47-180 & 181	U2C8		60	TBD	
FLOW MODIFIER 1-FM-142A TERRY TURBINE CNTRL	U1C8	Apr-97	68		
FLOW MODIFIER 2-FM-142A TERRY TURBINE CNTRL	U2C8		53	TBD	
REPLACE ICE CONDENSER GLYCOL CHILLERS				3,297	485
POST U1C7 ARROW-HART ISSUES		Nov-96	36		
HEAT TRACE RECORDERS FOR FREEZE PROTECTION		Jan-97	28		
U1C8 ARROW-HART ISSUES	U1C8	Apr-97	2,224		
U2C8 ARROW-HART ISSUES	U2C8		211		
CVCS VENTING	U1C9			615	248
CVCS VENTING	U2C9			125	738
GLYCOL CHILLERS INSTRUMENTATION				249	
INSTALL NEW MFP MINIFLOW VALVE NEW ORFICE AND NEW CONTROLLERS	U1C9			350	300
INSTALL NEW MFP MINIFLOW VALVE NEW ORFICE AND NEW CONTROLLERS	U2C8		200	400	50
RHR SYSTEM DISCHARGE PIPING WATER HAMMER (GAS ENTRAINMENT)	U1C8	Apr-97	350		
RHR SYSTEM DISCHARGE PIPING WATER HAMMER (GAS ENTRAINMENT)	U2C8		191	159	
POST U2C7 ARROW-HART ISSUES		Nov-96	355		
REPL ARROWHART CONTACTORS (FY97 MONEY IN PCN'S 2048, 2158, 2159, & 3031)			ABOVE	1,150	1,400
SUBTOTAL OPERATOR WORK AROUNDS			**3,776**	**6,345**	**3,221**
REPLACEMENT OF OBSOLETE EQUIPMENT					
MAIN TURBINE SUPERVISORY INSTR U1	U1C9			TBD	TBD
MAIN TURBINE SUPERVISORY INSTR U2	U2C9			TBD	TBD
OBSOLETE RECORDERS	U2C8		165	TBD	
REPLACE AUX AIR COMPRESSORS				TBD	
POWER SUPPLY 1-PX-3-142	U1C8	Apr-97	14		
REPLACE CRD COOLER CONTROLLERS U1		Jun-97	98		
REPLACE CRD COOLER CONTROLLERS U1		Jul-97	94		

SEQUOYAH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
REPLACE DUNHAM BUSH TIMER TMR-103		Jun-97	63		
REPLACE S&K FLOW INDICATING XMITTERS U1	U1C8	Apr-97	245		
REPLACE S&K FLOW INDICATING XMITTERS U2	U2C8		200	TBD	
OBSOLETE EQUIPMENT			DETAIL	1,000	1,000
AUXILIARY POILER RECORDER AND CONTROLS UPGRADE				300	
OBSOLETE RECORDERS	U1C8	May-97	405		
REPLACE MICRO R 100 RECORDERS				200	
REPLACE MICRO R 100 RECORDERS				200	
SUBTOTAL REPLACEMENT OF OBSOLETE EQUIPMENT			**1,284**	**1,700**	**1,900**
CHEMISTRY & RAD PROTECTION UPGRADES					
RESOLVE PAS SYS PROBLEMS		Jul-97	307		
RESOLVE PAS SYS PROBLEMS		Jul-97	294		
INSTALL CABLE AND CONDUIT TO POWER PLASMA SPECTROMETER				200	
SECONDARY SAMPLING AND INSTRUMENT		Feb-97	1,019		
SECONDARY SAMPLING AND INSTRUMENT			2,542	50	
INSTALL DATA ACQUISITION SYSTEM			703		
REPLACE ERCW CHLORINATION SYS			1,063	50	
REPLACE RCW CHLORINATION SYSTEM				981	
LOWER COMPARTMENT COOLER COILS				325	
SUBTOTAL CHEMISTRY & RAD PROTECTION UPGRADES			**5,928**	**1,606**	**0**
FIRE PROTECTION ISSUES					
CSST A OIL RETAINING CURB		Jan-97	176		
UPGRADE FIRE PROTECTION SYS			2,562	200	
FIRE DETECTION IN PASF		Jul-97	332		
SUBTOTAL FIRE PROTECTION ISSUES			**3,070**	**200**	**0**
VARIOUS BUILDING UPGRADES					
REACTOR BLDG ROOF UPGRADE			140	140	

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
SOLAR BLDG ELEVATOR INSTALLATION		Jul-97	75		
ALPINE VILLAGE UPGRADE		Jul-97	100		
SOLAR BUILDING UPGRADE		Jul-97	100		
PLANT OFFICE BUILDING UPGRADE		Jul-97	350		
SUBTOTAL VARIOUS BUILDING UPGRADES			**765**	**140**	**0**
ELECTRICAL PENETRATION CHANGEOUTS					
ELECTRICAL PENETRATIONS	U1C8	May-97	2,005		
ELECTRICAL PENETRATIONS U2C8	U2C8		640		
REPLACE ELECTRICAL PENETRATIONS (FY97 MONEY IN PCN'S 2174 & 3080)			ABOVE	2,440	300
SUBTOTAL ELECTRICAL PENETRATION CHANGEOUTS			**2,645**	**2,440**	**300**
STEAM GENERATOR PRESERVATION					
RETUBE GLAND STEAM CONDENSER	U1C8	Apr-97	122		
CONDENSER RETUBE PROJECT	U1C8	Jun-97	23,596		
CONDENSER RETUBE PROJECT	U2C7	Dec-96	200		
INSTALL S/G N16 MONITOR	U1C9			175	75
INSTALL S/G N16 MONITOR	U2C9			50	200
SUBTOTAL STEAM GENERATOR PRESERVATION			**23,918**	**225**	**275**
UPGRADE/REBUILD OF PLANT EQUIPMENT					
REBUILD J-A ERCW PUMP & MOTOR		Feb-97	487		
REPLACE SCSA COMPRESSORS		Jul-97	600		
REPLACE WASTE GAS ANALYZER		Jul-97	325		
SUBTOTAL UPGRADE/REBUILD OF PLANT EQUIPMENT			**1,412**	**0**	**0**
OUTAGE IMPROVEMENT					
LOWER CONTAINMENT COOLING	U1C9			26	85
LOWER CONTAINMENT COOLING	U2C9				32
CRDM DUCT REPLACEMENT AT RPV HEAD	U1C8	May-97	91		

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
PRESSURIZER SAFETY VALVES	U1C9		1,399	TBD	TBD
PRESSURIZER SAFETY VALVES	U2C8		701	699	
SUBTOTAL OUTAGE IMPROVEMENT			**2,191**	**725**	**117**
ICE COND FLOOR MODIFICATIONS					
ICE COND FLOOR MODIFICATION	U1C8		666	600	650
ICE COND FLOOR MODIFICATION	U2C9			1,450	1,350
SUBTOTAL ICE COND FLOOR MODIFICATIONS			**666**	**2,050**	**2,000**
PROJECTS TO IMPROVE RELIABILITY					
GENERATOR DIAGNOSTIC SYSTEM				200	
GENERATOR DIAGNOSTIC SYSTEM				200	
REDUNDANT CUNO FILTER	U1C8	Apr-97	142		
CHANGE MFP CONTROLS FROM MHC TO EHC					560
MOTOR DRIVEN AUX FEEDWATER WATER LEVEL CONTROL VALVES	U2C9			250	355
INSTALL BEARING LUBE WATER UPGRADE SYSTEM (CCW)			502		
CHANGE MFP CONTROLS FROM MHC TO EHC	U2C10				100
MOTOR DRIVEN AUX FEEDWATER WATER LEVEL CONTROL VALVES	U1C9			545	60
STATION BATTERY BANK REPLACEMENT		Dec-96	42		
STM. GEN. FEEDWATER INTERFACE PIPING	U1C9			1,000	506
STM. GEN. FEEDWATER INTERFACE PIPING	U2C9				1,737
PMP FLOODING ISSUE		Jul-97	150		
CABLE DRIVE FOR TRANSFER SYSTEM	U2C9		300	620	
UPGRADE AIRBORNE RAD MONITORS-(CAMs)				561	
NO. 2 FEEDWATER HEATER - AUTO BYPASS TO CONDENSER	U1C9			200	92
NO. 2 FEEDWATER HEATER - AUTO BYPASS TO CONDENSER	U2C9			75	255
REPLACE RAD MONITOR 0-RE-090-122		Aug-97	298		
480V BOARD ROOM SUPPLEMENTAL COOLING				285	185
480V BOARD ROOM SUPPLEMENTAL COOLING				250	185
ROD POSITION INDICATING SYSTEM	U1C9			125	550

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
ROD POSITION INDICATING SYSTEM	U2C9			150	600
YARWAY ARC VALVE REPLACEMENT	U1C9			650	85
YARWAY ARC VALVE REPLACEMENT	U2C9			200	550
REPLACEMENT OF THE 125V DC DIESEL GENERATOR BATTERIES				620	
MAIN GENERATOR VOLTAGE REGULATOR REPLACEMENT	U1C9			600	400
MAIN GENERATOR VOLTAGE REGULATOR REPLACEMENT	U2C9			100	900
SUPER SHORT CYCLE MODIFICATION	U1C8	Apr-97	450		
FEEDWATER HEATER SHROUD UPGRADE	U1C9			190	50
FEEDWATER HEATER SHROUD UPGRADE	U2C9				260
DIGITAL MFW CONTROL SYSTEM	U1C10			735	1,300
DIGITAL MFW CONTROL SYSTEM	U2C10				550
MANHOLE SUMP PUMPS				340	100
SUBTOTAL PROJECTS TO IMPROVE RELIABILITY			**1,884**	**7,896**	**9,380**
CIVIL/SEISMIC ISSUES					
CIVIL ISSUE - LARGE BORE PIPING REVIEW		Jan-97	406		
CIVIL ISSUE - UNQUALIFIED PIPING IN AUX BLDG U1			90		
CIVIL ISSUE - CCS THERMAL OP MODE U1	U1C9		1,499		
CIVIL ISSUE- U2 CCS OP MODES	U2C8		400		
CIVIL ISSUES (FY97 MONEY IN PCN'S 167, 2088, 2084, & 2099)			ABOVE	2,475	1,485
SUBTOTAL CIVIL/SEISMIC ISSUES			**2,395**	**2,475**	**1,485**
MINOR CAPITAL PROJECTS					
REPLACE CAT. 2 LIGHTS WITH CAT. 1 SYSTEM 3					TBD
REPLACE TEMPERATURE SWITCHES		Feb-97	43		
CONTROL BLDG LOW LEAKAGE DAMPERS				TBD	
REDUNDANT VAPOR EXTRACTOR - MAIN TURBINE OIL TANK	U1C10				TBD
HIGH PRESSURE ALARM FOR SAFETY INJECTION	U1C10				TBD
REPLACE FT'S ON EGTS & CONTAINMENT AIR RETURN FANS	U1C10				TBD
SPENT FUEL BRIDGE CRANE HOIST					TBD

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
EQUALIZATION VALVES ON HIGH PRESSURE FILTERS PDS-47-12, 17-41	U1C9			TBD	TBD
EQUALIZATION VALVES ON HIGH PRESSURE FILTERS PDS-47-12, 17-41	U2C9			TBD	TBD
AFWPT 1A-S OIL DRAIN SAMPLE VALVE	U1C8	Apr-97	15		
ADD LOOP L-77-1 (RCDT LEVEL) TO PLANT COMPUTER					TBD
HEAT TRACE & INSULATE 1-RE-90-106/112 LINES		Feb-97	84		
HEAT TRACE & INSULATE 2-RE-90-106/112 LINES		Dec-96	84		
FIRE DETECTION @ AUX BLDG HVAC ROOMS		Jan-97	127		
REPLACE LUNDELL ANNUNCIATOR U1		Jul-97	150		
REPLACE LUNDELL ANNUNCIATOR U2		Jan-97	77		
REPLACE SECURITY BACK-UP DIESEL FUEL TANK				TBD	TBD
FIFTH DIESEL SECURITY PROTECTION		Nov-96	44		
EMERGENT PCN 0282		TBD	52		
MINOR CAPITAL WORK			DETAIL	1,000	1,000
SUBTOTAL MINOR CAPITAL PROJECTS			**676**	**1,000**	**1,000**
PURCHASE OF TAGGED EQUIPMENT					
TAGGED EQUIPMENT			DETAIL	350	350
MANSEL LEVEL MONITOR SYSTEM			58		
TORBO-TGC TURBINE OIL CONDITIONER			77		
D/G DATA ACQUISITION SYSTEM			25		
RCS VACUUM PUMP			50		
X-RAY ANALYZER			130		
PIPING VIBRATION MEASUREMENT TRANSDUCER			10		
SUBTOTAL PURCHASE OF TAGGED EQUIPMENT			**350**	**350**	**350**
PLANT COMPUTER CHANGEOUT					
INTEGRATED COMPUTER SYSTEM (ICS)	U1C8	Apr-97	4,689		
INTEGRATED COMPUTER SYSTEM (ICS)	U2C7	Nov-96	282		
SUBTOTAL PLANT COMPUTER CHANGEOUT			**4,971**	**0**	**0**

SEQUOYQH CAPITAL PROJECTS LIST

FISCAL YEARS 1997 - 1999

PROJECT TITLE	OUTAGE	SCHED FINISH	FY 1997	FY 1998	FY 1999
ENVIRONMENTAL COMPLIANCE					
PCB RISK REDUCTION				2,149	
SUBTOTAL ENVIRONMENTAL COMPLIANCE			**0**	**2,149**	**0**
MAINTENANCE IMPROVEMENT					
CVCS VALVE RELOCATION IN ACCUMULATOR ROOM	U1C9			300	TBD
CVCS VALVE RELOCATION IN ACCUMULATOR ROOM	U2C9			300	TBD
FOUR ADDITIONAL RCCA'S	U1C9			275	150
FOUR ADDITIONAL RCCA'S	U2C9			250	175
SUBTOTAL MAINTENANCE IMPROVEMENT			**0**	**1,125**	**325**
PERSONNEL SAFETY					
ADDITION OF PLANT ACCESS PLATFORMS FOR MSVV'S	U1C9			500	100
ADDITION OF PLANT ACCESS PLATFORMS FOR MSVV'S				120	580
SUBTOTAL PERSONNEL SAFETY			**0**	**620**	**680**
MANAGEMENT & MISCELLANEOUS					
EMERGENT WORK			1,000	1,500	1,500
CAPITAL SUPPORT			4,400	4,000	4,000
CAPITALIZED WORK REQUESTS			500	500	500
SUBTOTAL MANAGEMENT & MISCELLANEOUS			**5,900**	**6,000**	**6,000**
TOTAL			61,831	37,046	26,133