NUREG–0847
Supplement No. 19

Safety Evaluation Report

related to the operation of Watts Bar Nuclear Plant, Units 1 and 2

Docket Nos. 50–390 and 50–391

Tennessee Valley Authority

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

November 1995

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ABSTRACT

This report supplements the Safety Evaluation Report (SER), NUREG-0847 (June 1982), Supplement No. 1 (September 1982), Supplement No. 2 (January 1984), Supplement No. 3 (January 1985), Supplement No. 4 (March 1985), Supplement No. 5 (November 1990), Supplement No. 6 (April 1991), Supplement No. 7 (September 1991), Supplement No. 8 (January 1992), Supplement No. 9 (June 1992), Supplement No. 10 (October 1992), Supplement No. 11 (April 1993), Supplement No. 12 (October 1993), Supplement No. 13 (April 1994), Supplement No. 14 (December 1994), Supplement No. 15 (June 1995) Supplement No. 16 (September 1995), Supplement No. 17 (October 1995), and Supplement No. 18 (October 1995) issued by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission with respect to the application filed by the Tennessee Valley Authority, as applicant and owner, for licenses to operate the Watts Bar Nuclear Plant, Units 1 and 2 (Docket Nos. 50-390 and 50-391). The facility is located in Rhea County, Tennessee, near the Watts Bar Dam on the Tennessee River. This supplement provides recent information regarding resolution of some of the outstanding and confirmatory items, and proposed license conditions identified in the SER.

CONTENTS

CONTENTS (Continued)

ABBREVIATIONS

BISI	bypassed and inoperable status indication
CAP	corrective action program
CFR	*Code of Federal Regulations*
CNPP	Corporate Nuclear Performance Plan
FR	*Federal Register*
FSAR	final safety analysis report
GDC	general design criterion
IE	Office of Inspection and Enforcement
ITP	Initial Test Program
LCO	limiting condition for operation
LOCA	loss-of-coolant accident
LWR	light-water reactor
MSIV	main steam isolation valve
NRC	Nuclear Regulatory Commission
NSSS	nuclear steam supply system
NUDOCS/AD	NRC document control system
OBE	operating basis earthquake
PORV	pilot-operated relief valve
QA	quality assurance
RTD	resistance temperature detector
SER	safety evaluation report
SP	special program
SRP	standard review plan
SSER	supplement to safety evaluation report
SSI	soil-structure interaction
STSs	Standard Technical Specifications
TAC	technical assignment control
TI	temporary instruction
TRM	Technical Requirements Manual
TSs	Technical Specifications
TVA	Tennessee Valley Authority
WBNPP	Watts Bar Nuclear Performance Plan
WISP	Workload Information and Scheduling Program

1 INTRODUCTION AND DISCUSSION

1.1 Introduction

In June 1982, the Nuclear Regulatory Commission staff (NRC staff or staff) issued a Safety Evaluation Report, NUREG-0847, regarding the application by the Tennessee Valley Authority (TVA or the applicant) for licenses to operate the Watts Bar Nuclear Plant, Units 1 and 2. The Safety Evaluation Report (SER) was followed by SER Supplement No. 1 (SSER 1, September 1982), Supplement No. 2 (SSER 2, January 1984), Supplement No. 3 (SSER 3, January 1985), Supplement No. 4 (SSER 4, March 1985), Supplement No. 5 (SSER 5, November 1990), Supplement No. 6 (SSER 6, April 1991), Supplement No. 7 (SSER 7, September 1991), Supplement No. 8 (SSER 8, January 1992), Supplement No. 9 (SSER 9, June 1992), Supplement No. 10 (SSER 10, October 1992), Supplement No. 11 (SSER 11, April 1993), Supplement No. 12 (October 1993), Supplement No. 13 (SSER 13, April 1994), Supplement No. 14 (SSER 14, December 1994), Supplement No. 15 (SSER 15, June 1995), Supplement 16 (SSER 16, September 1995), Supplement No. 17 (SSER 17, October 1995), and Supplement No. 18 (SSER 18, October 1995). The staff has completed its review of the applicant's Final Safety Analysis Report (FSAR) up to Amendment 91, the final amendment.

The SER and its supplements were written to agree with the format and scope outlined in the Standard Review Plan (SRP, NUREG-0800). Issues raised by the SRP review that were not closed out when the SER was published were classified into outstanding issues, confirmatory issues, and proposed license conditions (see Sections 1.7, 1.8, and 1.9, respectively, which follow). All issues were acceptably resolved for Unit 1.

In addition to the guidance in the SRP, the staff issues generic requirements or recommendations in the form of technical reports, bulletins, and generic letters. Each of these documents carries its own applicability, work scope, and acceptance criteria; some are applicable to Watts Bar. The review and implementation status of applicable generic issues are addressed in Appendix EE of SSER 16.

Each of the following sections and appendices of this supplement is numbered the same as the section or appendix of the SER that is being updated, and the discussions are supplementary to, and not in lieu of, the discussion in the SER, unless otherwise noted. Accordingly, Appendix A continues the chronology of the safety review. Appendix E lists principal contributors to this supplement. Appendix FF, originally published in SSER 18, is supplemented. Appendix GG, the final memorandum from Region II addressing completion of inspection activities, is added in this supplement. The other appendices are not changed by this supplement.

The staff concludes that, on the basis of its determination that Watts Bar Unit 1 has met all applicable regulations and guidance as stated in the SER and supplements, and satisfactory findings from all applicable inspections, an operating license can be granted.

The Project Manager is Peter S. Tam, who may be contacted by calling (301) 415-7000, or by writing to the following address:

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1.7 Summary of Outstanding Issues

In SER Section 1.7, the staff listed 17 outstanding issues (open items) that had not been resolved at the time the SER was issued. Additional outstanding issues were added in SER supplements that followed. In this section, the staff updates the status of those items. The completion status of each of the issues is tabulated below with the relevant document in which the issue was last addressed shown in parentheses. Detailed, up-to-date status information for still-unresolved issues is conveyed in the staff's summaries of the licensing status meetings.

Issue[1]	Status	Section
(1) Potential for liquefaction beneath ERCW pipelines and Class 1E electrical conduit	Resolved (SSER 3)	2.5.4.4
(2) Buckling loads on Class 2 and 3 supports	Resolved (SSER 4)	3.9.3.4
(3) Inservice pump and valve test program (TACs M74801, M92773)	Resolved (SSERs 14 and 18)	3.9.6
(4) Qualification of equipment		
(a) Seismic (TAC M71919)	Resolved (SSER 9)	3.10
(b) Environmental (TAC M63591)	Resolved (SSER 15)	3.11
(5) Preservice inspection program (TACs M63627, M86037, M93313)	Resolved for Unit 1 (SSER 16)	5.2.4
(6) Pressure-temperature limits for Unit 2 only	On hold (SER)	5.3.2, 5.3.3
(7) Model D-3 steam generator preheater tube degradation	Resolved (SSER 4)	5.4.2.2
(8) Branch Technical Position CSB 6-4	Resolved (SSER 3)	6.2.4
(9) H_2 analysis review	Resolved (SSER 4)	6.2.5

[1]The TAC (technical assignment control) numbers that appear in parentheses after some issue titles and elsewhere in this document, are internal NRC control numbers by which the issue is managed through the Workload Information and Scheduling Program (WISP) and by which relevant documents are filed. Documents associated with each TAC number can be located by the NRC document control system, NUDOCS/AD.

Issue	Status	Section
(10) Safety valve sizing analysis (WCAP-7769)	Resolved (SSER 2)	5.2.2
(11) Compliance of proposed design change to the offsite power system to GDCs 17 and 18 (TAC M63649)	Resolved (SSER 13)	8.2
(12) Fire-protection program (TAC M63648)	Resolved (SSER 18)	9.5.1
(13) Quality classification of diesel generator auxiliary system piping and components (TAC M63638)	Resolved (SSER 5)	9.5.4.1
(14) Diesel generator auxiliary system design deficiencies (TAC M63638)	Resolved (SSER 5)	9.5.4, 9.5.5, 9.5.7
(15) Physical Security Plan (TAC M63657)	Resolved (SSER 15)	13.6
(16) Boron-dilution event	Resolved (SSER 4)	15.2.4.4
(17) QA Program (TAC M76972)	Resolved (SSER 13)	17
(18) Seismic classification of cable trays and conduit (TACs R00508, R00516)	Resolved (SSER 8)	3.2.1, 3.10
(19) Seismic design concerns (TACs M79717, M80346)		
(a) Number of OBE events	Resolved (SSER 8)	3.7.3
(b) 1.2 multi-mode factor	Resolved (SSER 9)	3.7.3
(c) Code usage	Resolved (SSER 8)	3.7.3
(d) Conduit damping values	Resolved (SSER 8)	3.7.3
(e) Worst case, critical case, bounding calculations	Resolved (SSER 12)	3.7.3
(f) Mass eccentricities	Resolved (SSER 8)	3.7.2.1.2
(g) Comparison of set A versus set B response	Resolved (SSER 11)	3.7.2.12
(h) Category 1(L) piping qualification	Resolved (SSER 8)	3.9.3
(i) Pressure relief devices	Resolved (SSER 7)	3.9.3.3
(j) Structural issues	Resolved (SSER 9)	3.8
(k) Update FSAR per 12/18/90 letter	Resolved (SSER 8)	3.7
(20) Mechanical systems and components (TACs M79718, M80345)		
(a) Feedwater check valve slam	Resolved (SSER 13)	3.9.1
(b) New support stiffness and deflection limits	Resolved (SSER 8)	3.9.3.4
(21) Removal of RTD bypass system (TAC M63599)	Resolved (SSER 8)	4.4.3
(22) Removal of upper head injection system (TAC M77195)	Resolved (SSER 7)	6.3.1

Issue	Status	Section
(23) Containment isolation using closed systems (TAC M63597)	Resolved (SSER 12)	6.2.4
(24) Main steamline break outside containment (TAC M63632)	Resolved (SSER 14)	3.6.1
(25) Health Physics Program (TAC M63647)	Resolved (SSER 10)	12
(26) Regulatory Guide 1.97, Instruments To Follow Course of Accident (TACs M77550, M77551)	Resolved (SSER 9)	7.5.2
(27) Containment sump screen design anomalies (TAC M77845)	Resolved (SSER 9)	6.3.3
(28) Emergency procedure (TAC M77861)	Resolved (SSER 9)	13.5.2.1

1.8 Summary of Confirmatory Issues

In SER Section 1.8, the staff listed 42 confirmatory issues for which additional information and documentation were required to confirm preliminary conclusions. Issue 43 was added in SSER 6. In this section, the staff updates the status of those items for which the confirmatory information has subsequently been provided by the applicant and for which review has been completed by the staff. The completion status of each of the issues is tabulated below, with the relevant document in which the issue was last addressed shown in parentheses.

Issue	Status	Section
(1) Design-basis groundwater level for the ERCW pipeline	Resolved (SSER 3)	2.4.8
(2) Material and geometric damping effect in SSI analysis	Resolved (SSER 3)	2.5.4.2
(3) Analysis of sheetpile walls	Resolved (SSER 3)	2.5.4.2
(4) Design differential settlement of piping and electrical components between rock-supported structures	Resolved (SSER 3)	2.5.4.3
(5) Upgrading ERCW system to seismic Category I (TAC M63617)	Resolved (SSER 5)	3.2.1, 3.2.2
(6) Seismic classification of structures, systems, and components important to safety (TAC M63618)	Resolved (SSER 5)	3.2.1
(7) Tornado-missile protection of diesel generator exhaust	Resolved (SSER 2)	3.5.2, 9.5.4.1, 9.5.8

Issue	Status	Section
(8) Steel containment building buckling research program	Resolved (SSER 3)	3.8.1
(9) Pipe support baseplate flexibility and its effects on anchor bolt loads (IE Bulletin 79-02) (TAC M63625)	Resolved (SSER 8)	3.9.3.4
(10) Thermal performance analysis	Resolved (SSER 2)	4.2.2
(11) Cladding collapse	Resolved (SSER 2)	4.2.2
(12) Fuel rod bowing evaluation	Resolved (SSER 2)	4.2.3
(13) Loose-parts monitoring system	Resolved (SSER 3)	4.4.5
(14) Installation of residual heat removal flow alarm	Resolved (SSER 5)	5.4.3
(15) Natural circulation tests (TACs M63603, M79317, M79318)	Resolved (SSER 10)	5.4.3
(16) Atmospheric dump valve testing	Resolved (SSER 2)	5.4.3
(17) Protection against damage to containment from external pressure	Resolved (SSER 3)	6.2.1.1
(18) Designation of containment isolation valves for main and auxiliary feedwater lines and feedwater bypass lines (TAC M63623)	Resolved (SSER 5)	6.2.4
(19) Compliance with GDC 51	Resolved (SSER 4)	6.2.7, App. H
(20) Insulation survey (sump debris)	Resolved (SSER 2)	6.3.3
(21) Safety system setpoint methodology	Resolved (SSER 4)	7.1.3.1
(22) Steam generator water level reference leg	Resolved (SSER 2)	7.2.5.9
(23) Containment sump level measurement	Resolved (SSER 2)	7.3.2
(24) IE Bulletin 80-06	Resolved (SSER 3)	7.3.5
(25) Overpressure protection during low-temperature operation	Resolved (SSER 4)	7.6.5
(26) Availability of offsite circuits	Resolved (SSER 2)	8.2.2.1
(27) Non-safety loads powered from the Class 1E ac distribution system	Resolved (SSER 2)	8.3.1.1

Issue	Status	Section
(28) Low and/or degraded grid voltage condition (TAC M63649)	Resolved (SSER 13)	8.3.1.2
(29) Diesel generator reliability qualification testing (TAC M63649)	Resolved (SSER 7)	8.3.1.6
(30) Diesel generator battery system	Resolved (SSER 2)	8.3.2.4
(31) Thermal overload protective bypass	Resolved (SSER 2)	8.3.3.1.2
(32) Update FSAR on sharing of dc and ac distribution systems (TAC M63649)	Resolved (SSER 13)	8.3.3.2.2
(33) Sharing of raceway systems between units	Resolved (SSER 2)	8.3.3.2
(34) Testing Class 1E power systems	Resolved (SSER 2)	8.3.3.5.2
(35) Evaluation of penetration's capability to withstand failure of overcurrent protection device (TAC M63649)	Resolved (SSER 7)	8.3.3.6
(36) Missile protection for diesel generator vent line (TAC M63639)	Resolved (SSER 5)	9.5.4.2
(37) Component cooling booster pump relocation	Resolved (SSER 5)	9.2.2
(38) Electrical penetrations documentation (TAC M63648)	Resolved (SSER 18)	9.5.1.3
(39) Compliance with NUREG/CR-0660 (TAC M63639)	Resolved (SSER 5)	9.5.4.1
(40) No-load, low-load, and testing operations for diesel generator (TAC M63639)	Resolved (SSER 5)	9.5.4.1
(41) Initial test program	Resolved (SSER 3)	14
(42) Submergence of electrical equipment as result of a LOCA (TAC M63649)	Resolved (SSER 13)	8.3.3.1.1
(43) Safety parameter display system (TAC M73723)	Resolved (SSER 15)	18.2

1.9 Summary of Proposed License Conditions

In Section 1.9 of the SER and in SSERs that followed, the staff listed 43 proposed license conditions. Since these documents were issued, the applicant has submitted additional information on some of these items, thereby removing the necessity to impose a condition. The completion status of the proposed license conditions is tabulated below, with the relevant document in which the issue was last addressed shown in parentheses. Detailed, up-to-date status of still-unresolved issues is conveyed in the staff's summaries of the licensing status meetings.

Proposed Condition	Status	Section
(1) Relief and safety valve testing (II.D.1)	Resolved (SSER 3)	3.9.3.3, 5.2.2
(2) Inservice testing of pumps and valves (TAC M74801)	Resolved (SSER 12)	3.9.6
(3) Detectors for inadequate core cooling (II.F.2) (TACs M77132, M77133)	Resolved (SSER 10)	4.4.8
(4) Inservice Inspection Program (TAC M76881)	Resolved (SSER 12)	5.2.4, 6.6
(5) Installation of reactor coolant vents (II.B.1)	Resolved (SSER 5)	5.4.5
(6) Accident monitoring instrumentation (II.F.1)		
(a) Noble gas monitor (TAC M63645)	Resolved (SSER 5)	11.7.1
(b) Iodine particulate sampling (TAC M63645)	Resolved (SSER 6)	11.7.1
(c) High-range in-containment radiation monitor (TAC M63645)	Resolved (SSER 5)	12.7.2
(d) Containment pressure	Resolved (SSER 5)	6.2.1
(e) Containment water level	Resolved (SSER 5)	6.2.1
(f) Containment hydrogen	Resolved (SSER 5)	6.2.5
(7) Modification to chemical feedlines (TAC M63622)	Resolved (SSER 5)	6.2.4
(8) Containment isolation dependability (II.E.4.2) (TAC M63633)	Resolved (SSER 5)	6.2.4
(9) Hydrogen control measures (NUREG-0694, II.B.7) (TAC M77208)	Resolved (SSER 8)	6.2.5, App. C
(10) Status monitoring system/BISI (TACs M77136, M77137)	Resolved (SSER 7)	7.7.2
(11) Installation of acoustic monitoring system (II.D.3)	Resolved (SSER 5)	7.8.1
(12) Diesel generator reliability qualification testing at normal operating temperature	Resolved (SSER 2)	8.3.1.6
(13) DC monitoring and annunciation (TAC M63649)	Resolved (SSER 13)	8.3.2.2
(14) Possible sharing of dc control power to ac switchgear	Resolved (SSER 3)	8.3.3.2.4

Proposed Condition	Status	Section
(15) Testing of associated circuits	Resolved (SSER 3)	8.3.3.3
(16) Testing of non-Class 1E cables	Resolved (SSER 3)	8.3.3.3
(17) Low-temperature overpressure protection/power supplies for pressurizer relief valves and level indicators (II.G.1) (TAC M63649)	Resolved (SSER 7)	8.3.3.4
(18) Testing of reactor coolant pump breakers	Resolved (SSER 2)	8.3.3.6
(19) Postaccident sampling system (TAC M77543)	Resolved (SSER 14)	9.3.2
(20) Fire protection program (TAC M63648)	Resolved (SSER 18)	9.5.1.8
(21) Performance testing for communications systems (TAC M63637)	Resolved (SSER 5)	9.5.2
(22) Diesel generator reliability (NUREG/CR-0660) (TAC M63640)	Resolved (SSER 5)	9.5.4.1
(23) Secondary water chemistry monitoring and control program	Resolved (SSER 5)	10.3.4
(24) Primary coolant outside containment (III.D.1.1) (TACs M63646, M77553)	Resolved (SSER 10)	11.7.2
(25) Independent safety engineering group (I.B.1.2) (TAC M63592)	Resolved (SSER 8)	13.4
(26) Use of experienced personnel during startup (TAC M63592)	Resolved (SSER 8)	13.1.3
(27) Emergency preparedness (III.A.1.1, III.A.1.2, III.A.2) (TAC M63656)	Resolved (SSER 13)	13.3
(28) Review of power ascension test procedures and emergency operating procedures by NSSS vendor (I.C.7) (TAC M77861)	Resolved (SSER 10)	13.5.2
(29) Modifications to emergency operating instructions (I.C.8) (TAC M77861)	Resolved (SSER 10)	13.5.2
(30) Report on outage of emergency core cooling system (II.K.3.17)	Resolved (SSER 3)	13.5.3
(31) Initial test program (TAC M79872)	Resolved (SSER 7)	14.2

Proposed Condition	Status	Section
(32) Effect of high-pressure injection for small-break LOCA with no auxiliary feedwater (II.K.2.13)	Resolved (SSER 4)	15.5.1
(33) Voiding in the reactor coolant system (II.K.2.17)	Resolved (SSER 4)	15.5.2
(34) PORV isolation system (II.K.3.1, II.K.3.2) (TAC M63631)	Resolved (SSER 5)	15.5.3
(35) Automatic trip of the reactor coolant pumps during a small-break LOCA (II.K.3.5)	Resolved (SSER 4)	15.5.4
(36) Revised small-break LOCA analysis (II.K.3.30, II.K.3.31) (TAC M77298)	Resolved (SSER 5)	15.5.5
(37) Detailed control room design review (I.D.1) (TAC M63655)	Resolved (SSER 15)	18.1
(38) Physical security of fuel in containment (TACs M63657, M83973)	Resolved (SSER 10)	13.6.4
(39) Control of heavy loads (NUREG-0612) (TAC M77560)	Resolved (SSER 13)	9.1.4
(40) Anticipated transients without scram (Generic Letter 83-28, Item 4.3) (TAC M64347)	Resolved (SSER 5)	15.3.6
(41) Steam generator tube rupture (TAC M77569)	Resolved (SSER 14)	15.4.3
(42) Loose-parts monitoring system (TAC M77177)	Resolved (SSER 5)	4.4.5
(43) Safety parameter display system (TAC M73723)	Opened (SSER 5)	18.2
(44) Physical Security Plan (TACs M63657, M83973)	Opened (SSER 15)	13.6

1.12 Approved Technical Issues for Incorporation in the License as Exemptions

The applicant applied for exemptions from certain provisions of the regulations. These have been reviewed by the staff and approved in appropriate sections of the SER and SSERs. These technical issues are listed below and the actual exemptions will be incorporated in the operating license:

(1) Airlock seal leakage test instead of full-pressure test, schedular exemption (Section 6.2.6, SSERs 4 and 19) (TAC M63615)

(2) Criticality monitor (Section 9.1, SSER 5) (TAC M63615)

(3) Schedule to implement the vehicle bomb rule (Section 13.6.9, SSER 15) (TAC M90696)

In addition to these, the staff granted the following two exemptions to the applicant on December 15, 1994, and October 17, 1995, respectively:

(4) Issuance, storage, and retrieval of badges for personnel (TAC M90729)

(5) Participation by States within the ingestion exposure pathway emergency planning zone in the emergency preparedness exercise (TAC M92943)

In SSER 14, the staff reevaluated three technical issues previously approved for exemption from various provisions of Appendix G to 10 CFR Part 50. As a result, Section 5.3.1.1 of SSER 14 reports that these exemptions are no longer needed.

1.13 Implementation of Corrective Action Programs and Special Programs

On September 17, 1985, the NRC sent a letter to the applicant, pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f), requesting that the applicant submit information on its plans for correcting problems concerning the overall management of its nuclear program as well as on its plans for correcting plant-specific problems. In response to this letter, TVA prepared a Corporate Nuclear Performance Plan (CNPP) that identified and proposed corrections to problems concerning the overall management of its nuclear program, and a site-specific plan for Watts Bar entitled "Watts Bar Nuclear Performance Plan" (WBNPP). The staff reviewed both plans and documented results in two safety evaluation reports, NUREG-1232, Vol. 1 (July 1987), and NUREG-1232, Vol. 4 (January 1990).

In a letter of September 6, 1991, the applicant submitted Revision 1 of the WBNPP. In SSER 9, the staff concluded that Revision 1 of the WBNPP does not necessitate any revision of the staff's safety evaluation report, NUREG-1232, Vol. 4.

In NUREG-1232, Vol. 4, the staff documented its general review of the corrective action programs (CAPs) and special programs (SPs) through which the applicant would effect corrective actions at Watts Bar. When the report was published, some of the CAPs and SPs were in their initial stages of implementation. The staff stated that it would report its review of the implementation of all CAPs and SPs and closeout of open issues in future supplements to the licensing SER, NUREG-0847; accordingly, the staff prepared Temporary Instructions (TIs) 2512/016-043 for the Inspection Manual and adhered to the TIs to perform inspections of the CAPs and SPs. This new section was introduced in SSER 5 to be updated in subsequent SSERs. The current status of all CAPs and SPs follows. The status described here fully supersedes that described in previous SSERs.

1.13.1 Corrective Action Programs

(1) Cable Issues (TAC M71917; TI 2512/016)

Program review status: Complete: NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), April 25, 1991 (the safety evaluation was reproduced in SSER 7 as Appendix P); supplemental safety evaluation dated

April 24, 1992 (Appendix T of SSER 9); letter, P. S. Tam (NRC) to M. O. Medford (TVA), February 14, 1994.

Implementation status: 100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence to be published in Inspection Report 50-390, 391/95-77.

NRC inspections: Complete: Inspection Reports 50-390, 391/90-09 (June 22, 1990); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/90-22 (November 21, 1990); 50-390, 391/9024 (December 17, 1990); 50-390, 391/90-27 (December 20, 1990); 50-390, 391/90-30 (February 25, 1991); 50-390, 391/91-07 (May 31, 1991); 50-390, 391/91-09 (July 15, 1991); 50-390, 391/91-12 (July 12, 1991); 50-390, 391/91-31 (January 13, 1992); 50-390, 391/ 92-01 (March 17, 1992); audit report of June 12, 1992 (Appendix Y of SSER 9); 50-390, 391/92-05 (April 17, 1992); 50-390, 391/92-13 (July 16, 1992); 50-390, 391/92-18 (August 14, 1992); 50-390, 391/92-22 (September 18, 1992); 50-390, 391/92-26 (October 16, 1992); 50-390, 391/92-30 (November 13, 1992); 50-390, 391/92-35 (December 15, 1992); 50-390, 391/92-40 (January 15, 1993); 50-390, 391/93-10 (March 19, 1993); 50-390, 391/93-11 (March 25, 1993); 50-390, 391/93-35 (June 10, 1993); 50-390, 391/93-40 (July 15, 1993); 50-390, 391/93-48 (August 13, 1993); 50-390, 391/93-56 (September 20, 1993); 50-390, 391/93-63 (October 18, 1993); 50-390, 391/93-70 (November 12, 1993); 50-390, 391/93-74 (December 20, 1993); 50-390, 391/93-85 (January 14, 1994); 50-390, 391/93-91 (February 17, 1994); 50-390, 391/94-11 (March 16, 1994); 50-390, 391/94-18 (April 18, 1994); 50-390, 391/94-32 (May 16, 1994); 50-390, 391/94-35 (June 20, 1994); 50-390, 391/94-45 (July 15, 1994); 50-390, 391/94-51 (August 11, 1994); 50-390, 391/94-53 (September 20, 1994); 50-390, 391/94-55 (September 16, 1994); 50-390, 391/94-61 (October 12, 1994); 50-390, 391/94-66 (November 16, 1994); 50-390, 391/94-75 (December 19, 1994); 50-390, 391/94-82 (January 13, 1995); 50-390, 391/94-88 (February 15, 1995); 50-390, 391/95-17 (April 13, 1995); 50-390, 391/95-45 (August 15, 1995); 50-390, 391/95-57 (September 15, 1995); 50-390, 391/95-64 (October 11, 1995; 50-390, 391/95-77 (to be published).

(2) Cable Tray and Tray Supports (TAC R00516; TI 2512/017)

Program review status: Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 13, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.

Implementation status: 100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence to be published in Inspection Report 50-390, 391/95-69.

NRC inspections:	Complete: Inspection Reports 50-390, 391/89-14 (December 18, 1989); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/90-22 (November 21, 1990); 50-390, 391/ 92-02 (March 17, 1992); audit report of May 14, 1992 (Appendix S of SSER 9); 50-390, 391/92-13 (July 16, 1992); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/93-07 (February 19, 1993); 50-390, 391/94-64 (December 15, 1994); 50-390, 391/94-88 (February 15, 1995); 50-390, 391/95-23 (May 2, 1995); 50-390, 391/95-27 (May 31, 1995); 50-390, 391/95-35 (June 28, 1995); 50-390, 391/95-69 (to be published).

(3) Design Baseline and Verification Program (TAC M63594; TI 2512/019)

Program review status:	Complete: Inspection Report 50-390, 391/89-12 (November 20, 1989); NUREG-1232, Vol. 4; Inspection Report 50-390/95-36 (June 21, 1995).
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, September 27, 1995); staff concurrence in Inspection Report 50-390, 391/95-47 (August 16, 1995).
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-12 (November 20, 1989); 50-390, 391/90-09 (June 22, 1990); 50-390, 391/90-20; (September 25, 1990); 50-390/91-201 (March 22, 1991); 50-390, 391/91-20 (October 8, 1991); 50-390, 391/91-25 (December 13, 1991); 50-390, 391/92-06 (April 3, 1992); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/93-29 (May 14, 1993); 50-390, 391/93-66 (October 29, 1993); 50-390, 391/94-69 (November 18, 1994); 50-390/95-36 (June 21, 1995); 50-390, 391/95-47 (August 16, 1995).

(4) Electrical Conduit and Conduit Support (TAC R00508; TI 2512/018)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 1, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 30, 1995); staff concurrence to be published in Inspection Report 50-390, 391/95-69.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-05 (May 25, 1989); 50-390, 391/89-07; (July 11, 1989); 50-390, 391/89-14 (December 18, 1989); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/91-31 (January 13, 1992); 50-390, 391/92-02 (March 17, 1992); audit report of May 14, 1992 (Appendix S of SSER 9); 50-390, 391/92-05 (April 17, 1992); 50-390, 391/92-09 (June 29, 1992); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/92-26 (October 16, 1992); 50-390, 391/93-07 (February 19, 1993);

50-390, 391/93-35 (June 10, 1993); 50-390, 391/93-70 (November 12, 1993); 50-390, 391/93-74 (December 20, 1993); 50-390, 391/93-91 (February 17, 1994); 50-390, 391/94-11 (March 16, 1994); 50-390, 391/94-32 (May 16, 1994); 50-390/94-64 (December 15, 1994); 50-390, 391/94-82 (January 13, 1995); 50-390, 391/94-88 (February 15, 1995); 50-390, 391/95-23 (May 2, 1995); 50-390, 391/95-27 (May 31, 1995); 50-390, 391/95-35 (June 28, 1995); 50-390, 391/95-57 (September 15, 1995); 50-390, 391/95-69 (to be published).

(5) Electrical Issues (TAC M74502; TI 2512/020)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 11, 1989; NUREG-1232, Vol. 4.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence to be published in Inspection Report 50-590, 391/95-77.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-30 (February 25, 1991); 50-390, 391/92-22 (September 18, 1992); 50-390, 391/92-40 (January 15, 1993); 50-390, 391/93-35 (June 10, 1993); 50-390, 391/93-40 (July 15, 1993); 50-390, 391/93-63 (October 18, 1993); 50-390, 391/94-11 (March 16, 1994); 50-390, 391/94-18 (April 18, 1994); 50-390, 391/94-31 (May 11, 1994); 50-390, 391/94-45 (July 15, 1994); 50-390, 391/94-53 (September 20, 1994); 50-390, 391/94-66 (November 16, 1994); 50-390, 391/94-82 (January 13, 1995); 50-390, 391/94-88 (February 15, 1995); 50-390, 391/95-57 (September 15, 1995); 50-390, 391/95-64 (October 11, 1995); 50-390, 391/95-77 (to be published).

(6) Equipment Seismic Qualification (TAC M71919; TI 2512/021)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 11, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.10.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 30, 1995); staff concurrence in Inspection Report 50-390, 391/95-55, August 28, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-05 (May 10, 1990); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/90-28 (January 11, 1991); 50-390, 391/91-03 (April 15, 1991); audit report of May 14, 1992 (Appendix S of SSER 9); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/93-07 (February 19, 1993); 50-390, 391/93-79 (March 4, 1994); 50-390, 391/95-30 (June 22, 1995); 50-390,

391/95-55 (August 28, 1995).

(7) Fire Protection (TAC M63648; TI 2512/022)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 7, 1989; NUREG-1232, Vol. 4; SSER 18, Section 9.5.1 and Appendix FF.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence in Inspection Report 50-390, 391/95-61, October 5, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/94-45 (July 15, 1994); 50-390, 391/94-63 (November 2, 1994); 50-390, 391/94-62 (November 16, 1994); 50-390, 391/94-66 (November 16, 1994); 50-390, 391/94-78 (December 21, 1994); 50-390, 391/94-82 (January 13, 1995); 50-390, 391/95-03 (January 31, 1995); 50-390, 391/95-13 (March 1, 1995); 50-390, 391/95-16 (April 6, 1995); 50-390, 391/95-26 (May 1, 1995); 50-390, 391/95-32 (June 9, 1995); 50-390, 391/95-39 (July 18, 1995); 50-390, 391/95-40 (September 12, 1995); 50-390, 391/95-61 (October 5, 1995).

(8) Hanger and Analysis Update Program (TAC R00512; TI 2512/023)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), October 6, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 27, 1995); staff concurrence in Inspection Report 50-390, 391/95-53, September 8, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-14 (December 18, 1989); 50-390, 391/90-14 (August 3, 1990); 50-390, 391/90-18 (September 20, 1990); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/90-28 (January 11, 1991); 50-390, 391/91-03 (April 15, 1991); audit report of May 14, 1992 (Appendix S of SSER 9); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/92-26 (October 16, 1992); 50-390, 391/92-35 (December 15, 1992); 50-390, 391/93-07 (February 19, 1993); 50-390, 391/93-35 (June 10, 1993); 50-390, 391/93-45 (July 20, 1993); 50-390, 391/93-56 (September 20, 1993); 50-390, 391/93-70 (November 12, 1993); 50-390, 391/93-74 (December 20, 1993); 50-390, 391/94-11 (March 16, 1994); 50-390, 391/94-32 (May 16, 1994); 50-390, 391/94-55 (September 16, 1994); 50-390, 391/95-06 (March 16, 1995); 50-390, 391/95-23 (May 2, 1995); 50-390, 391/95-27 (May 31, 1995); 50-390, 391/95-35 (June 28, 1995); 50-390, 391/95-53

(September 8, 1995).

(9) Heat Code Traceability (TAC M71920; TI 2512/024)

Program review status:	Complete: Inspection Report 50-390, 391/89-09 (September 20, 1989); NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), March 29, 1991.
Implementation status:	100% (certified by letter, E. Wallace (TVA) to NRC, July 31, 1990); staff concurrence in SSER 7, Section 3.2.2.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-09 (September 20, 1989); 50-390, 391/90-02 (March 15, 1990).

(10) Heating, Ventilation, and Air-Conditioning Duct and Duct Supports (TAC R00510; TI 2512/025)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), October 24, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 10, 1995); staff concurrence in Inspection Report 50-390, 391/95-46, August 1, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-14 (December 18, 1989); 50-390, 391/90-05 (May 10, 1990); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/91-01 (April 4, 1991); 50-390, 391/92-02 (March 17, 1992); audit report of May 14, 1992 (Appendix S of SSER 9); 50-390, 391/92-08 (May 15, 1992); 50-390, 391/92-13 (July 16, 1992); 50-390, 391/92-201 (September 21, 1992); 50-390, 391/93-07 (February 19, 1993); 50-390, 391/93-91 (February 17, 1994); 50-390, 391/94-08 (March 11, 1994); 50-390, 391/95-23 (May 2, 1995); 50-390, 391/95-35 (June 28, 1995); 50-390, 391/95-46 (August 1, 1995).

(11) Instrument Lines (TAC M71918; TI 2512/026)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 8, 1989; NUREG-1232, Vol. 4; Appendix K of SSER 6; letter, P. S. Tam (NRC) to O. D. Kingsley (TVA), May 5, 1994.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 31, 1995); staff concurrence in Inspection Report 50-390, 391/95-61, October 5, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-14

(August 3, 1990); 50-390, 391/90-23 (November 19, 1990); 50-390, 391/90-29 (January 29, 1991); 50-- 390, 391/91-02 (March 6, 1991); 50-390, 391/91-03 (April 15, 1991); 50-390, 391/91-26 (December 6, 1991); 50-390, 391/93-74 (December 20, 1993); 50- 390, 391/94-11 (March 16, 1994); 50-390, 391/94-24 (July 1, 1994); 50-390, 391/94-32 (May 16, 1994); 50-390, 391/94-55 (September 16, 1994); 50-390, 391/95-23 (May 2, 1995); 50-390, 391/95-27 (May 31, 1995); 50-390, 391/95-35 (June 28, 1995); 50-390, 391/95-53 (September 8, 1995); 50-390, 391/95-61 (October 5, 1995).

(12) <u>Prestart Test Program (TAC M71924)</u>

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), October 17, 1989; NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), March 27, 1991.
Implementation status:	Withdrawn by letter, J. H. Garrity (TVA) to NRC, February 13, 1992. Applicant re-performed preoperational test program per Regulatory Guide 1.68, Revision 2.

(13) <u>Quality Assurance Records (TAC M71923; TI 2512/028)</u>

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), December 8, 1989; NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to M. O. Medford (TVA) June 9, 1992 (Appendix X of SSER 9); letter, P. S. Tam (NRC) to M. O. Medford (TVA), January 12, 1993; letter, F. J. Hebdon (NRC) to M. O. Medford (TVA), August 12, 1993; letter, P. S. Tam (NRC) to O. D. Kingsley (TVA), April 25, 1994.
Implementation status:	100% (certified by letter, W. J. Museler (TVA), to NRC, April 27, 1994); staff concurrence in Inspection Report 50-390, 391/94-40, June 24, 1994.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-06 (April 25, 1990); 50-390, 391/90-08 (September 13, 1990); 50-390, 391/91-08 (May 30, 1991); 50-390, 391/91-15 (September 5, 1991); 50-390, 391/91-29 (December 27, 1991); 50-390, 391/92-05 (April 17, 1992); 50-390, 391/92-10 (June 11, 1992); 50-390, 391/92-21 (September 18, 1992); 50-390, 391/93-11 (March 25, 1993); 50-390, 391/93-21 (April 9, 1993); 50-390, 391/93-29 (May 14, 1993); 50-390, 391/93-34 (July 5, 1993); 50-390, 391/93-35 (June 10, 1993); 50-390, 391/93-50 (September 3, 1993); 50-390, 391/93-59 (October 25, 1993); 50-390, 391/93-69 (November 12, 1993); 50-390, 391/93-70 (November 12, 1993); 50-390, 391/93-78 (December 16, 1993); 50-390, 391/93-86 (January 24, 1994); 50-390, 391/94-04 (February 23, 1994); 50-390,

391/94-09 (March 11, 1994); 50-390, 391/94-17 (April 1, 1994); 50-390, 391/94-28 (May 5, 1994); 50-390, 391/94-40 (June 24, 1994).

(14) Q-List (TAC M63590; TI 2512/029)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), September 11, 1989; NUREG-1232, Vol. 4; letters, P. S. Tam (NRC) to O. D. Kingsley (TVA), January 23, 1991 and March 17, 1994 (enclosure of this letter reproduced as Appendix AA in SSER 13).
Implementation status:	100% (certified by letter, W. J. Museler (TVA), to NRC, January 28, 1994); staff concurrence in Inspection Report 50-390, 391/94-27, April 21, 1994.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-08 (September 13, 1990); 50-390, 391/91-08 (May 30, 1991); 50-390, 391/91-29 (December 27, 1991); 50-390, 391/91-31 (January 13, 1992); 50-390, 391/93-20 (April 16, 1993); 50-390, 391/93-68 (November 12, 1993); 50-390, 391/94-27 (April 21, 1994).

(15) Replacement Items Program (TAC M71922; TI 2512/027)

Program review status:	Complete: Letter, S. C. Black (NRC) to O. D. Kingsley (TVA), November 22, 1989; NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to O. D. Kingsley (TVA), February 11, 1991 (Appendix N of SSER 6); letter, P. S. Tam (NRC) to M. O. Medford (TVA), July 27, 1992, April 5, 1994, and February 6, 1995.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 13, 1995); staff concurrence in Inspection Report 50-390, 391/95-50 (August 29, 1995).
NRC inspections:	Complete: Inspection Reports 50-390, 391/91-08 (May 30, 1991); 50-390, 391/91-29 (December 27, 1991); 50-390, 391/92-03 (March 16, 1992); 50-390, 391/92-11 (June 12, 1992); 50-390, 391/92-17 (July 22, 1992); 50-390, 391/92-21 (September 18, 1992); 50-390, 391/92-40 (January 15, 1993); 50-390, 391/93-22 (April 25, 1993); 50-390, 391/93-34 (July 9, 1993); 50-390, 391/93-38 (June 24, 1993); 50-390/94-201 (December 14, 1994); 50-390, 391/95-34 (June 23, 1995); 50-390, 391/95-50 (August 29, 1995).

(16) Seismic Analysis (TAC R00514; TI 2512/030)

Program review status:	Complete: Letters, S. C. Black (NRC) to O. D. Kingsley (TVA), September 7 and October 31, 1989; NUREG-1232, Vol. 4; SSER 6, Section 3.7.

Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 30, 1999); staff concurrence in SSER 9, Section 3.7.1.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-21 (May 10, 1990); 50-390, 391/90-20 (September 25, 1990); audit report by L. B. Marsh, October 10, 1990.

(16)(a) Civil Calculation Program (TAC R00514)

Program review status:	No program review. A number of civil calculation categories are required by the Design Baseline and Verification Program CAP and constitute parts of the applicant's corrective actions. This program is regarded as complementary to but not part of the Seismic Analysis CAP. Staff efforts consist mainly of audits performed at the site and in the office.
Implementation status:	100% (final calculations transmitted by letter, W. J. Museler (TVA) to NRC, July 27, 1992).
NRC audits:	Complete: Memorandum (publicly available), T. M. Cheng (NRC) to P. S. Tam, January 23, 1992; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), January 31, 1992; letters, P. S. Tam (NRC) to M. O. Medford (TVA), May 26 and December 18, 1992 and July 2, 1993; 50-390, 391/93-07 (February 19, 1993); letter, P. S. Tam (NRC) to M. O. Medford (TVA), November 26, 1993.

(17) Vendor Information Program (TAC M71921; TI 2512/031)

Program review status:	Complete: Letter, P. S. Tam (NRC) to O. D. Kingsley (TVA), September 11, 1990 (Appendix I of SSER 5); Appendix I of SSER 11.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence to be published in Inspection Report 50-390, 391/95-67.
NRC inspections:	Complete: Inspection Reports 50-390, 391/91-08 (May 30, 1991); 50-390, 391/91-29 (December 27, 1991); 50-390, 391/93-27 (May 14, 1993); 50-390, 391/95-10 (March 17, 1995); 50-390, 391/95-67.

(18) Welding (TAC M72106; TI 2512/032)

Program review status:	Complete: Inspection Reports 50-390, 391/89-04 (August 9, 1989); 50-390, 391/90-04 (May 17, 1990); NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), March 5, 1991; these inspection reports also address recurrence control: 50-390, 391/93-02 (February 2, 1993); 50-390, 391/93-84 (December 21, 1993); 50-390, 391/94-79 (January 11, 1995).

Implementation status:	100% (certified by letter, W. J. Museler (TVA) to NRC, January 9, 1993); staff concurrence in Inspection Report 50-390, 391/94-79, January 11, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-04 (August 9, 1989); 50-390, 391/90-04 (May 17, 1990); 50-390, 391/90-20 (September 25, 1990); 50-390, 391/91-05 (May 28, 1991); 50-390, 391/91-18 (October 8, 1991); 50-390, 391/91-23 (November 21, 1991); 50-390, 391/91-32 (February 10, 1992); 50-390, 391/9220 (August 12, 1992); 50-390, 391/92-28 (October 9, 1992); 50-390, 391/93-02 (February 2, 1993); 50-390, 391/93-19 (March 15, 1993); 50-390, 391/93-38 (June 24, 1993); 50-390, 391/93-84 (December 21, 1993); 50-390, 391/94-05 (February 19, 1994); 50-390, 391/94-16 (March 15, 1994); 50-390, 391/94-49 (July 21, 1994); 50-390, 391/94-79 (January 11, 1995).

1.13.2 Special Programs

(1) Concrete Quality (TAC M63596; TI 2512/033)

Program review status:	Complete: NUREG-1232, Vol. 4.
Implementation status:	100% (certified by letter, E. Wallace (TVA) to NRC, August 31, 1990); staff concurrence in SSER 7, Section 3.8.2.1.
NRC inspections:	Complete: NUREG-1232, Vol. 4; Inspection Reports 50-390, 391/89-200 (December 12, 1989); 50-390, 391/90-26 (January 8, 1991).

(2) Containment Cooling (TAC M77284; TI 2512/034)

Program review status:	Complete: NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to D. A. Nauman (TVA), May 21, 1991 (Section 6.2.2 of SSER 7).
Implementation status:	100% (certified by letters, W. J. Museler (TVA) to NRC, December 30, 1993, and R. R. Baron (TVA) to NRC, September 28, 1995); staff concurrence in Inspection Report 50-390, 391/95-38, July 11, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/93-56 (September 20, 1993); 50-390, 391/95-38 (July 11, 1995).

(3) Detailed Control Room Design Review (TAC M63655; TI 2512/035)

Program review status:	Complete: Appendix D of SER; NUREG-1232, Vol. 4; Section 18.1 and Appendix L of SSER 6; Section 18.1 of SSERs 5 and 15.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to

NRC, October 30, 1995); staff concurrence in SSER 15.

NRC inspections: Complete: Inspection Report 50-390, 391/94-22 (April 28, 1994); audit reports in SSER 5 and 15.

(4) Environmental Qualification Program (TAC M63591; TI 2512/036)

Program review status: Complete: NUREG-1232, Vol. 4; Section 3.11 of SSER 15.

Implementation status: 100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence in Inspection Report 50-390, 391/95-54, September 8, 1995.

NRC inspections: Complete: Inspection Reports 50-390, 391/93-63 (October 18, 1993; 50-390, 391/94-28 (April 18, 1994); 50-390, 391/94-74 (January 13, 1995); 50-390, 391/95-15 (April 5, 1995); 50-390, 391/95-54 (September 8, 1995).

(5) Master Fuse List (TAC M76973; TI 2512/037)

Program review status: Complete: NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to O. D. Kingsley (TVA), February 6, 1991; letter, P. S. Tam (NRC) to TVA Senior Vice President, March 30, 1992 (Appendix U of SSER 9).

Implementation status: 100% (certified by letter, R. R. Baron (TVA) to NRC, October 30, 1995); staff concurrence in Inspection Report 50-390, 391/93-31, May 6, 1993.

NRC inspections: Complete: Inspection Reports 50-390, 391/86-24 (February 12, 1987); 50-390, 391/92-05 (April 17, 1992); 50-390, 391/92-09 (June 29, 1992); 50-390, 391/92-27 (September 25, 1992); 50-390, 391/93-31 (May 6, 1993).

(6) Mechanical Equipment Qualification (TAC M76974; TI 2512/038)

Program review status: Complete: NUREG-1232, Vol. 4; Section 3.11 of SSER 15.

Implementation status: 100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence in Inspection Report 50-390, 391/95-54, September 8, 1995.

NRC inspections: Complete: Inspection Reports 50-390, 391/95-15 (April 5, 1995); 50-390, 391/95-54 (September 8, 1995).

(7) Microbiologically Induced Corrosion (TAC M63650; TI 2512/039)

Program review status: Complete: NUREG-1232, Vol. 4; Appendix Q of SSER

8; Appendix Q of SSER 10.

Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 30, 1995); staff concurrence in Inspection Report 50-390, 391/93-67, November 1, 1993.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-09 (June 22, 1990); 50-390, 391/90-13 (August 2, 1990); 50-390, 391/93-01 (February 25, 1993); 50-390, 391/93-09 (March 26, 1993); 50-390, 391/93-67 (November 1, 1993).

(8) <u>Moderate Energy Line Break Flooding (TAC M63595; TI 2512/040)</u>

Program review status:	Complete: NUREG-1232, Vol. 4; Section 3.6 of SSER 11.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, October 31, 1995); staff concurrence in Inspection Report 50-390, 391/95-61, October 5, 1995.
NRC inspections:	Complete: Inspection Reports 50-390, 391/93-85 (January 14, 1994); 50-390, 391/95-53 (September 8, 1995); 50-390, 391/95-61 (October 5, 1995).

(9) <u>Radiation Monitoring Program (TAC M76975; TI 2512/041)</u>

Program review status:	Complete: NUREG-1232, Vol. 4; this program covers areas addressed in Chapter 12 of the SER and SSERs.
Implementation status:	100% (certified by letter, R. R. Baron (TVA) to NRC, November 1, 1995); staff concurrence to be published in Inspection Report 50-390, 391/95-65.
NRC inspections:	Complete: Inspection Reports 50-390, 391/94-56 (October 6, 1994); 50-390, 391/95-65 (to be published).

(10) <u>Soil Liquefaction (TAC M77548; TI 2512/042)</u>

Program review status:	Complete: NUREG-1232, Vol. 4; letter, P. S. Tam (NRC) to TVA Senior Vice President, March 19, 1992; Section 2.5 of SSER 9.
Implementation status:	100% (certified by letter, W. J. Museler (TVA) to NRC, July 27, 1992); staff concurrence in SSER 11, Section 2.5.4.4.
NRC inspections:	Complete: Inspection Reports 50-390, 391/89-21 (May 10, 1990); 50-390, 391/89-03 (May 11, 1989); audit report, L. B. Marsh (NRC) (October 10, 1990); audit report, P. S. Tam (NRC) to D. A. Nauman (TVA), January 31, 1992; audit reports, P. S. Tam (NRC) to M. O. Medford (TVA), May 26 and December

18, 1992; Inspection Report 50-390, 391/92-45 (February 17, 1993).

(11) <u>Use-as-Is CAQs (TAC M77549; TI 2512/043)</u>

Program review status:	Complete: NUREG-1232, Vol. 4.
Implementation status:	100% (certified by letter, W. J. Museler (TVA) to NRC, July 24, 1992); staff concurrence in Inspection Report 50-390, 391/93-10, March 19, 1993.
NRC inspections:	Complete: Inspection Reports 50-390, 391/90-19 (October 15, 1990); 50-390, 391/91-08 (May 30, 1991); 50-390, 391/93-10 (March 19, 1993).

6 ENGINEERED SAFETY FEATURES

6.2 Containment Systems

6.2.6 Containment Leakage Testing

In SSER 4, the staff stated that, as a result of the applicant's request of December 3, 1984, a partial exemption from paragraph III.D.2(b)(ii) of Appendix J to 10 CFR Part 50 would be granted. This will have the effect of permitting substitution of the seal leakage test of paragraph III.D.2(b)(iii) for the full-pressure test of paragraph of III.D.2(b)(ii). Paragraph III.D.2(b)(ii) requires that if an air lock is opened during Modes 5 and 6, an overall air lock leakage test at not less than P_a be performed before plant heatup and startup (i.e., entering Mode 4). The exemption will permit that if no maintenance that could affect sealing capability has been performed on an air lock, then no full-pressure test need be performed.

Subsequently, Appendix J was revised so that it now provides two options. Option A contains requirements identical to those before the revision. Option B permits use of performance-based technical specifications. The choice of Option A or B is voluntary on the licensee's part.

By letter dated November 2, 1995, the applicant stated its intention of adopting Option B 90 days after restart from the first refueling outage. The applicant committed to request, sometime during the first fuel cycle, an amendment to the operating license and to plant Technical Specifications to support its choice of Option B. The applicant's revised request has the effect of shortening the effective period of the exemption from 40 years (the duration of an operating license) to approximately 2 years.

The staff finds this schedular exemption acceptable on the basis that the staff already found the exemption, as proposed in the applicant's December 3, 1984, letter, acceptable. The staff tracked this effort by TAC M93601.

8 ELECTRICAL POWER SYSTEMS

8.3 Onsite Electric Power System

In SSER 10, the staff evaluated the design of the fifth diesel generator. However, the current design basis of Watts Bar Unit 1 includes only the four original emergency diesel generators. The fifth is not currently part of the design basis for Unit 1, but is intended to be available to replace one of the four original diesel generators should one of those be out of service.

In Section 9.5.4.1 of SSER 9, the staff concluded that the support systems for the fifth diesel generator are essentially the same design as those for the original four. Thus, the evaluation and conclusions reached by the staff regarding diesel generator auxiliary support systems in the SER, SSER 3, and SSER 5 also apply to the fifth diesel generator.

Subsequently, by letter dated July 28, 1993, the applcant notified the staff that the fifth diesel generator is currently being maintained and modified as described in docketed correspondence to the staff. Modifications that were being implemented to upgrade the fifth diesel generator and make it equivalent to the other four would be completed; however, not all of the modifications would be completed before the Watts Bar operating license was issued. Further, the applicant stated that modifications to, and surveillances on the fifth diesel generator, including preoperational testing in accordance with Regulatory Guide 1.68, Revision 2, would be completed before declaring the fifth diesel generator operable as a replacement for one of the four.

The staff finds this commitment acceptable.

9 AUXILIARY SYSTEMS

9.4 Heating, Ventilation, and Air Conditioning Systems

9.4.5 Engineered Safety Features Ventilation System

In SSER 16, the staff stated that the diesel engine room exhaust fans will be operated at least once a month as required by the plant Technical Specifications. The staff further noted that the monthly operation of the exhaust fans was adequate to maintain hydrogen levels in the diesel generator battery room well below the explosive limits and to prevent the buildup of hydrogen gas above 2 percent by volume. As a matter of clarification, the Technical Specifications do not specifically cover operation of engine exhaust fans in the diesel room. The exhaust fans automatically start when the diesel generator starts. Therefore, diesel generator testing, as required by the Technical Specifications, results in operation of the diesel engine room exhaust fans.

This is a clarification, and does not alter the staff's conclusions reached in SSERs 9, 10, 11, and 16. The staff tracked this effort by TAC M93601.

10 STEAM AND POWER CONVERSION SYSTEM

10.3 Main Steam Supply System

10.3.1 Main Steam Supply System (Up to and Including the Main Steam Isolation Valves)

In Section 10.3.1 of the SER, the staff stated that the main steam isolation valves (MSIVs) were capable of closing in 5 seconds after receipt of a closure signal. In Amendment 91 to the FSAR, the applicant revised this closing time to 6 seconds. MSIV closure time includes the overall time for signal generation, processing and delay of the isolation signal, and physical valve closure time. To support this additional 1-second valve closure time, the applicant performed an evaluation based on a sensitivity study of all the design-basis accidents that are affected by MSIV closure time. The staff reviewed the results of the sensitivity study and concluded that a total time of 8 seconds (previously assumed to be 7 seconds in all of the applicant's analyses) for main steam line isolation, including generation, processing, and delay of the isolation signal and valve closure was acceptable for all the related design-basis accidents.

On the basis of the acceptable results of the accident analyses associated with a total time of 8 seconds for main steam isolation, the staff concludes that the revised maximum closure time of 6 seconds for the MSIVs is acceptable.

The staff tracked this effort by TAC M93601.

14 INITIAL TEST PROGRAM

In SSER 12, 14, 16 and 18, the staff found the applicant's Initial Test Program (ITP) up to FSAR Amendment 90 acceptable. Subsequently, by Amendment 91, the applicant made additional changes to the FSAR affecting the power ascension phase of its ITP. The staff tracked this effort by TAC M93601.

14.2 Preoperational Tests

Item 14

The applicant amalgamated power ascension test summaries contained in Table 14.2-2, "Plant Trip From 100% Power (Turbine Trip)" and Table 14.2-2, "Plant Trip From 100% Power (Electrical Load Rejection)" test summaries into Table 14.2-2, Sheet 36 of 38, "Plant Trip From 100% Power." Section 5, "Power-Ascension Tests," of Appendix A to Regulatory Guide (RG) 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," Revision 2 (August 1978) provides a list of the types of performance demonstrations, measurements, and test that should be included in the power-ascension test phase of an ITP.

Appendix A to RG 1.68, subparagraphs 5.1.1 and 5.n.n provide for the applicant to demonstrate that the dynamic response of the plant is in accordance with design requirements for the cases of a turbine trip and a full-load rejection, respectively. In addition, subparagraph 5.1.1 provides that the applicant may combine the performance of a turbine trip transient with a full-load rejection event as described in subparagraph 5.n.n. if the turbine trip is initiated by all remote-manual openings or automatic trips of the generator main breaker, i.e., a direct electrical signal, not a secondary effect such as a turbine overspeed event.

On the basis of its review of Table 14.2-2, Sheet 36 of 38, "Plant Trip From 100% Power" test summary as described in the ITP and as updated to Amendment 91, the staff concludes that the applicant's ITP continues to comply with the guidance in Appendix A to RG 1.68, subparagraphs 5.1.1 and 5.n.n. This is acceptable.

The staff finds the ITP description contained in Chapter 14 of the FSAR through Amendment 91 to be generally comprehensive and to encompass the major phases of the testing program requirements prescribed by the Standard Review Plan (NUREG-0800) and "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)" (Regulatory Guide 1.70).

16 TECHNICAL SPECIFICATIONS

The following evaluation supersedes what the staff published in the SER. The staff tracked this effort by TAC M76742.

16.1 Introduction

The review of the Watts Bar Unit 1 Technical Specifications (TSs) was closely coupled to the development of the improved Standard Technical Specifications (STSs) within the framework of the Technical Specifications Improvement Program in accordance with the Commission's "Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors" (Final Policy Statement) published on July 22, 1993 (58 FR 39132). The criteria specified in the Final Policy Statement are incorporated into the rule change for 10 CFR 50.36 (60 FR 36953). Since the Watts Bar design is a Westinghouse 4-loop design, most of the Unit 1 TSs were modeled after NUREG-1431, "Standard Technical Specifications - Westinghouse Plant." These improved STSs contain the benefits of the accumulated operating experience from currently operating light-water reactors.

The proposed Unit 1 TSs, submitted in a letter from William J. Museler (TVA) to the NRC, dated August 27, 1992, were developed based on the Westinghouse improved STSs. Subsequently, the staff reviewed the proposed Unit 1 TSs to confirm similarities between them and the STSs, as appropriate. Then the staff concentrated its review on those parts of the Unit 1 TSs that are unique because of Watts Bar-specific design features. Dispositions of comments resulting from the staff review were incorporated into the "proof and review" Unit 1 TSs. Those TSs were then issued to the applicant and made available to the staff for comment. All comments from the applicant and the staff on the proof and review TSs were incorporated into the final draft Unit 1 TSs. TVA certified that the final draft Unit 1 TSs were accurate.

16.2 Evaluation

The staff evaluated the Unit 1 TSs to confirm that these Technical Specifications will preserve the validity of the Final Safety Analysis Report (FSAR) by assuring that the plant will be operated within the required conditions bounded by the FSAR, and with operable equipment that is essential to prevent accidents and to mitigate the consequences of accidents postulated in the FSAR. The Commission provided guidance for the contents of TSs in 10 CFR 50.36 in which the Commission indicated that compliance with 10 CFR 50.36 satisfied § 182a of the Atomic Energy Act. The staff evaluated the proposed August 27, 1992, TSs to confirm that they met the criteria specified in 10 CFR 50.36. Any proposed technical specification which did not fall within, or satisfy, any of the criteria, were not included in the TSs. Appropriate requirements were included in applicant-controlled documents.

As part of the Unit 1 TS review, the SER and its supplements (SSERs 1 to 18) were reviewed to determine the staff-imposed TS requirements. In the SER and its supplements, the staff specified 112 items which would require limiting conditions for operation (LCOs), action statements, or surveillance requirements. The Unit 1 TS review has resolved these requirements in accordance with the TS criteria as follows:

(1) 75 of the SER requirements have been incorporated into the Unit 1 TSs.

(2) 22 of the SER requirements have not been included in the Unit 1 TSs but have been addressed in the TS Bases, Technical Requirements Manual (TRM), FSAR, or other applicant-controlled documents.

(3) 4 of the SER requirements have been incorporated into the Unit 1 TSs; associated tables, figures, and core operating limits have been placed in appropriate applicant-controlled documents.

(4) 9 of the SER requirements were reevaluated by the staff and were found to be no longer applicable or required to be included in the Unit 1 TSs. The staff addressed these items in previous SSERs.

(5) One requirement is under generic review by the staff, and the staff will propose appropriate technical specifications upon completion of the generic review.

(6) One SER requirement is not required to be implemented until Unit 2 is licensed.

The staff has concluded that the SER requirements not included in the Watts Bar Unit 1 TSs either do not meet the criteria specified in 10 CFR 50.36, are satisfied by TS requirements already in the Watts Bar Unit 1 TSs, or are controlled by regulations, and thus can be addressed by the Watts Bar Unit 1 TS Bases, TRM, Quality Assurance (QA) Plan, or other licensee-controlled documents. Changes to these documents and the requirements contained therein are controlled by 10 CFR 50.59, 10 CFR 50.54, 10 CFR Part 20, and other applicable regulations.

16.3 Conclusion

On the basis of the staff's review of the Watts Bar Unit 1 TSs, as discussed above, the staff concludes that the Unit 1 TSs are consistent with the regulatory guidance contained in the Westinghouse STSs, and contain design-specific parameters and additional TS requirements considered appropriate by the staff. Therefore, the staff concludes that the Unit 1 Technical Specifications satisfy 10 CFR 50.36 and are acceptable.

APPENDIX A

CHRONOLOGY OF RADIOLOGICAL REVIEW OF WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2, OPERATING LICENSE REVIEW

Most of the following documents are referenced in this SSER. In no way is this an exhaustive list of all correspondence exchanged between the staff and the applicant during this period. The reader may obtain an exhaustive list through the NRC document control system (NUDOCS), the Public Document Room, or the local Public Document Room.

<u>NRC Letters and Summaries</u>

October 2, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), regarding finding of no significant environmental impact for exemption involving requirements of 10 CFR Part 50, Appendix E, Section IV.F.2(a).
October 6, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), transmitting copy of meeting notice published in the *Federal Register* of Advisory Committee on Reactor Safeguards Ad Hoc Subcommittee on Watts Bar.
October 6, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), transmitting Safety Evaluation Report, Supplement 17 related to operation of plant and notice of availability sent to the *Federal Register*.
October 12, 1995	Letters, P. S. Tam to several individuals, responding to requests to be added to NRC service list for documents regarding TVA.
October 16, 1995	Letters, P. S. Tam to several individuals, responding to requests to be added to NRC service list for documents regarding TVA.
October 17, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), transmitting exemption regarding ingestion pathway portion of requirement in 10 CFR Part 50, Appendix E, IV.F.2(a).
October 19, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), transmitting technical evaluation report prepared by Idaho National Engineering Laboratory (INEL-95\0468) dated September 1995 regarding Technical Specifications audit.
October 25, 1995	Letter, F. J. Hebdon to O. D. Kingsley (TVA), authorizing alternative from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code inservice testing requirements pertaining to relief valve testing.

October 31, 1995	Letter, P. S. Tam to O. D. Kingsley (TVA), transmitting copies of Safety Evaluation Report, Supplement 18 regarding operation at Watts Bar Plant.
November 3, 1995	Summary by T. Wambach of September 5, 1995, meeting with members of the public.

TVA Letters

October 5, 1995	Letter, R. R. Baron to NRC, transmitting Revision 0 to Engineering Report 0006-00922-02, "Watts Bar Nuclear Plant Engineering Report for Penetration Seal Program."
October 6, 1995	Letter, R. R. Baron to NRC, proposing changes to Final Safety Analysis Report Chapter 8 to resolve Amendment 90 issues.
October 10, 1995	Letter, R. R. Baron to NRC, notifying that activities regarding Generic Letter 88-17, "Loss of Decay Heat Removal" are complete for Watts Bar Nuclear Plant Unit 1.
October 10, 1995	Letter, R. R. Baron to NRC, notifying that TVA completed Heating, Ventilation, and Air Conditioning Corrective Action Program.
October 11, 1995	Letter, R. R. Baron to NRC, submitting additional information to clarify basis for electrical separation requirements regarding cable trays.
October 12, 1995	Letter, R. R. Baron to NRC, submitting additional information regarding maximum pressure case for postulated accident scenario.
October 12, 1995	Letter, R. R. Baron to NRC, transmitting Revision 1 of "Watts Bar Nuclear Plant Unit 1, Cycle 1, Core Operating Limits Report."
October 12, 1995	Letter, R. R. Baron to NRC, revising certain variables from previous submittals on Regulatory Guide 1.97.
October 13, 1995	Letter, R. R. Baron to NRC, certifying complete implementation of Replacement Items Corrective Action Program.
October 16, 1995	Letter, P. P. Carier to NRC, responding to Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety Related Power-Operated Gate Valves."
October 18, 1995	Letter, J. A. Scalice to NRC, transmitting final photo-ready copy of Watts Bar Unit 1 Technical Specifications.

October 25, 1995	Letter, R. R. Baron to NRC, notifying that certain previously identified special tests will not be performed before fuel load.
October 26, 1995	Letter, P. P. Carier to NRC, transmitting pieces of correspondence previously submitted by TVA which may not have reached Document Control Desk.
October 26, 1995	Letter, R. R. Baron to NRC, submitting revised information regarding resolution of Generic Issue 70, "Power-Operated Relief Valve and Block Valve Reliability."
October 26, 1995	Letter, R. R. Baron to NRC, certifying complete implementation of Hanger and Analysis Update Corrective Action Program.
October 27, 1995	Letter, R. R. Baron to NRC, submitting revised information regarding baseline leak test results from leak reduction program for system identified in TVA's July 24, 1993, letter.
October 30, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of Master Fuse List Special Program.
October 30, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Conduit and Conduit Support Corrective Action Program.
October 30, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Equipment Seismic Qualification Corrective Action Program.
October 30, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Detailed Control Room Design Review Special Program.
October 30, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Microbiologically Induced Corrosion Special Program.
October 31, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Instrument Line Corrective Action Program.
October 31, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Moderate Energy Line Break Special Program.
November 1, 1995	Letter, P. P. Carier to NRC, providing information regarding financial protection, nuclear liability and property insurance for Watts Bar.

November 1, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Vendor Information Corrective Action Program.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Environmental Qualification and Mechanical Equipment Qualification Special Programs.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of the complete implementation of the Radiation Monitoring System Special Program.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of the complete implementation of the Fire Protection Corrective Action Program.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Cable Issues Corrective Action Program.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Electrical Issues Corrective Action Program.
November 1, 1995	Letter, R. R. Baron to NRC, notifying of complete implementation of the Cable Tray and Cable Tray Supports Corrective Action Program.
November 2, 1995	Letter, O. J. Zeringue to NRC, providing information regarding implementation of the revised Appendix J to 50.
November 2, 1995	Letter, R. R. Baron to NRC, providing replacement pages for the photo-ready version of the Unit 1 Technical Specifications.
November 3, 1995	Letter, O. D. Kingsley to NRC, informing of completed work necessary to load fuel and begin low- power operations at Unit 1.

APPENDIX E

PRINCIPAL CONTRIBUTORS

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APPENDIX FF*
SAFETY EVALUATION
WATTS BAR NUCLEAR PLANT FIRE PROTECTION PROGRAM
DOCKET NOS. 50-390/391
(TAC M63648)

3.0 GENERAL PLANT FIRE PROTECTION AND SAFE SHUTDOWN FEATURES

3.1 Fire Protection Design

3.1.1 Building and Compartment, Fire Barriers

In SSER 18, the staff indicated that all floors, walls, and ceilings enclosing the control room and the cable spreading room are fire rated at a minimum of 3 hours. However, the actual "as-built" condition is that he walls enclosing the control room and the cable spreading room are rated at a minimum of 3 hours. In addition, the main control room area contains peripheral rooms which that are located within the main control room complex. These peripheral rooms are separated from the main control room by 1-hour fire-rated barriers in lieu of 1-1/2-hour barriers as stated in SSER 18.

In SSER 18, the staff indicated that fire barriers in buildings or compartments (walls, ceilings, floors) are constructed either of reinforced concrete or of reinforced-concrete blocks. Further, the concrete fire barriers are a minimum 12 inches thick and the concrete block barriers are normally 8 inches thick. However, the reinforced-concrete fire barriers are actually 8 inches thick (minimum thickness).

The staff concludes that these "as-built" conditions do not affect the conclusions made in SSER 18 and, therefore, are acceptable.

3.1.4 Fire Barrier Penetration Seals

3.1.4.1 Electrical and Mechanical Penetration Seals

In Watts Bar Fire Protection Report (FPR) Sections II.12.6, VIII.D.1.j, and D.3.d, the applicant committed to install fire barrier mechanical and electrical penetration seals that were qualified by tests meeting the guidance and acceptance criteria of the American Society for Testing and Material (ASTM) Standard E814-1994, "Standard Test Method for Fire Tests of Through-Penetration Fire Stops" (for mechanical fire barrier penetration seals) and Institute of Electrical and Electronics Engineers (IEEE) Standard 634-1978, "IEEE Standard Cable Penetration Fire Stop Qualification Test" (for electrical fire barrier penetration seals).

At the time of the July 1995 audit, the applicant had not completed its engineering analysis and evaluation of fire barrier penetration seals. Based

*This appendix was originally published in SSER 18; the evaluation here supplements or revises that evaluation.

on a preliminary review of portions of this draft penetration seal program assessment engineering report (Report No. 0006-00922-02A, Revision 0A), the staff specifically identified concerns regarding qualification testing and extrapolation of thermal performance data for cable slots, large cable tray blockouts and large diameter mechanical sleeves. In addition, the staff determined that: (1) the tests did not meet the applicant's commitments described in the FPR; (2) the test specimens in the qualification test reports are either not representative of or bound the as-built penetration seal conditions; (3) the acceptability of the bounding conditions for the critical fire penetration seal material and design attributes (e.g., material density, location/need for damming boards, amount and type of cables penetrating the seal test specimens) were not clear; (4) the installation details and their qualification basis did not clearly establish the fire endurance rating of the seal design; (5) testing of similar test specimens did not yield consistent thermal performance results; (6) the qualification testing referenced by the draft engineering report generally deviated significantly from the testing (collection of thermal performance data) guidance provided in industry fire endurance penetration seal testing standards; and (7) the applicant had not properly evaluated the auto-ignition temperatures (refer to IEEE 634 for guidance) of the various types of cable jacket and insulation used and pass-through fire-rated penetration seals.

By letter dated October 5, 1995, the applicant submitted its fire barrier penetration seal engineering evaluations. This report (1) documents the typical fire barrier seal configurations used at the Watts Bar Nuclear Plant; (2) defines the basis of the acceptability of fire-rated penetration seal typical details; (3) establishes the bounding parameters for each fire barrier penetrations seal design; (4) provides a detailed description of the extent to which Watts Bar meets appropriate penetration seal testing standards; and (5) documents the acceptability of the typical penetration seal designs. In addition, this submittal documents the applicant's commitment to perform additional penetration seal fire testing.

In lieu of developing the design for 63 different fire barrier penetration seal details used at WBN from known tested configurations (e.g., penetration seal detail designed to be representative of a tested configuration), the applicant elected to develop the required penetration details from as-built plant conditions; therefore, the applicant has as-built penetration seals which are not representative of the tested configurations. Thus, in its engineering evaluation, the applicant has backfitted the test results of qualified configurations (which in many cases are not representative of the Watts Bar penetration seal design detail), and has extrapolated data and performance observations which it concludes justifies its typical design details.

In addition, the applicant, in its engineering evaluation, reviewed the qualification tests which it relied on to qualify its typical seal designs and compared them to the testing protocol established by either ASTM E-814-1983 (for mechanical seals) or IEEE 634-1978 (for electrical seals). Where testing protocol deviations were noted, the applicant provided technical justification for these deviations.

The applicant, in its comparison of the Watts Bar typical penetration seal design details to the tested attributes of those seals in the qualification tests, made the following assumptions:

- Penetration seal assemblies successfully tested for a specific barrier thickness and type bound similar configurations installed in a thicker barrier of a same type.

  (Note - The staff agrees with the applicant's assumption, providing that the similar configurations suggested by this assumption are truly representative of the tested configuration.)

- Penetration seal assemblies successfully tested in lined openings bound similar configurations installed in unlined openings.

  (Note - The staff agrees with this assumption.)

- Penetration seal assemblies successfully tested for a specific opening size bound similar configurations of a smaller opening size.

  (Note - The staff agrees with this assumption, providing that the penetration seal is blank and has no penetrants. Size of penetrants, their thermal mass and conductivity, arrangement or configuration within the seal are important factors with regard to seal performance. In addition, seal thickness is affected by the thermal mass and conductivity of the penetrants and the fire barrier system being penetrated.)

- Penetration seal assemblies successfully tested for a specific maximum free area bound similar configurations with a smaller free area.

  (Note - The staff agrees with this assumption, providing that the test specimen is representative of the as-built plant configuration (e.g., the free area of cable tray blockout with two 18-inch-wide trays penetrating it would bound a cable tray blockout (similar blockout dimensions) with two 24-inch trays penetrating it, providing the thermal mass and conductivity of the penetrating items is less).

- Penetration seal assemblies successfully tested for a specific cable fill bound similar configurations with a small cable fill. This condition may also be applied to an internal seal within the plane of the barrier.

  (Note - The staff agrees with this assumption, providing the cable material composition is the same and the thermal mass of copper is less than what was tested in the test specimen.)

- Penetration seal assemblies successfully tested for a specific cable type bound similar configurations with cable types in which the auto-ignition temperatures of the cable jacket is equal to or greater than the jacket on the cables used in the test. Cable types tested in configurations used to bound Watts Bar typical details were either PVC, neoprene, or hypolon (chlorosulfonated polyethylene) jacketed. These cable jacketed materials are similar to the cable jacket materials used at Watts Bar with respect to auto-ignition temperature, and, therefore, bound Watts Bar configurations.

(Note - The staff agrees with this assumption, providing that the test specimen cable jacket auto-ignition temperatures and the cable jackets used in the plant have been determined by subjecting them to the same standard test method (ANSI K65.111-1971) for determining ignition temperature.)

The staff has performed a review of this submittal. Specifically, this was an audit type review of mechanical and electrical penetration seal designs. This review was limited to the information presented in the applicant's penetration seal program engineering report (Report No. 0006-00922-02, Revision: 0) and for the specific penetration seals audited, the staff did not evaluate the applicability of the test specimens and their representation of as-built plant conditions, thermal data and fire performance of these specimens as reflected in these referenced test reports.

The staff in its review of the Watts Bar fire barrier penetration seal program used the guidance of Appendix A to APCSB 9.5-1, the applicant's commitment to ASTM E-814-1983 and IEEE 634-1978, the guidance of Information Notice (IN) 88-04, and Generic Letter (GL) 86-10. The staff in IN 88-04 provided a summary of existing staff guidance related to fire barrier penetration seals. Specifically, Appendix A to IN 88-04, Item A stated the general considerations concerning the use of test results to qualify fire barrier penetration seal designs which are: "The (fire barrier seal) test specimen shall be truly representative of the construction for which classification is desired, as to materials, workmanship, and details such as dimensions of parts, and shall be built under the conditions representative of those obtaining as practically applied in building construction and operation."

IEEE 634 states that the qualification fire endurance test program for electrical penetration seals should include tests of penetration seal designs representative of the in-plant configuration. This standard: (1) gives guidance on bounding cable fill conditions; (2) gives guidance on the size of the penetration openings; (3) requires that the test specimen have a cable fill representative of its end use and the plant-specific cable construction (e.g., if end use was a tray filled with cross-linked polyethylene instrument cables, the test specimen should be representative of this condition); (4) gives guidance on the temperature conditions on the unexposed surface of the test specimen; (5) recommends that at least three thermocouples be located on the surface of the penetration seal to measure the temperature on the material's face; and (6) states that temperatures shall be measured at the cable jacket, cable penetration fire stop interface, and the interface between the fire stop and through-metallic components.

ASTM Standard E-814 states that the test specimens for the mechanical penetration seals shall be representative of actual field installations. The standard: (1) gives guidance on determining the temperature conditions on the unexposed surface of the test specimen; (2) recommends that at least three thermocouples be located on the surface (under insulated thermocouple pads) of the penetration seal to measure the temperature on the material's face; and (3) states that temperatures shall be measured at the interface between the fire stop and through-penetrating metallic component.

In GL 86-10, the guidance related to fire barrier penetration seals is provided in Appendix R Interpretation 4, Fire Area Boundaries. This interpretation states "In order to meet the regulation, fire area boundaries need not be completely sealed floor-to-ceiling, wall-to-wall boundaries. However, all unsealed openings should be identified and considered when evaluating the effectiveness of the overall barrier. Where fire area boundaries are not wall-to-wall, floor-to-ceiling boundaries with all penetrations sealed to the fire rating required of the boundaries, licensees must perform an evaluation to assess the adequacy of fire boundaries in their plants to determine if the boundaries will withstand the hazards associated with the area."

The staff as part of its penetration seal review audited the various typical Watts Bar seal design details. This audit consisted of reviewing the design detail against the tested configuration and its test results. From the applicant's cited test results, the staff made a determination if they were representative of and bound the as-built plant conditions. The following summarizes the design details reviewed:

Mechanical Penetration Seal Design Details

a. Details I, I (F-rated), V, V (F-rated), VIII, VIII (F-rated), XXII, XXII (F-rated), XL, XL (F-rated), XLIII, XLIII (F-rated), XLV, XLV (F-rated), LVI, LVI (F-rated), LXXIX, LXXIX (F-rated), LXXX, LXXX (F-rated), LXXXIII, LXXXIII (F-rated), LXXXIV, LXXXIV (F-rated), LXXXV, LXXXV (F-rated), LXXXVI, and LXXXVI (F-rated) - (3-hour fire-rated designs with a single pipe or conduit penetrant, minimum silicone foam fill depth 12 inches)

   The staff's technical evaluation of these generic type penetration seal designs is presented below.

b. Details IX, IX (F-rated), X, X (F-rated), XI, and XI (F-rated) - (3-hour fire-rated designs with multiple pipe or conduit penetrant, minimum silicone foam fill depth 12 inches)

   The staff's technical evaluation of these generic type penetration seal designs is presented below.

c. Details III, XXXVI, C9, LC, and N3 - (3-hour fire-rated designs, minimum silicone foam seal fill depth 12 inches, maximum 14-inch-diameter penetration opening with no penetrating items)

d. Detail XXXIII - (3-hour fire-rated seal design with a single pipe or conduit penetrant, minimum moderate density silicone elastomer (MDSE) fill depth 12 inches)

The staff's technical evaluation of this generic type penetration seal design is presented below.

e. Moderate Density Silicone Elastomer Seals (Seal Depth 6 inches) - Details XLII, XLIV, XLVI, LX, and LXI - (3-hour fire-rated seal design with a single pipe or conduit penetrant, minimum MDSE fill depth 6 inches)

The staff's technical evaluation of these generic type penetration seal designs is presented below.

f. Details XXXII, XXXVII, XLI, XLVII, LVII, and LXIII - (3-hour fire-rated seal design with a single pipe or conduit penetrant, minimum high density silicone elastomer (HDSE) fill depth 12 inches)

The staff's technical evaluation of these generic type penetration seal designs is presented below.

g. Details L, LIX, and LXIV - (3-hour fire-rated design, boot type seal with a maximum 5-inch annular space between the penetrant and the penetration sleeve)

The staff's technical evaluation of these generic type penetration seal designs is presented below.

Electrical Penetration Seal Design Details

a. Details, A2-2, B2-2, C-1, C2-2, K-1, L4-1, and L4-2 - (3-hour fire-rated 6-inch-diameter condulet and internal conduit type seal designs, silicone foam depth 6 inches)

b. Detail G2 - (2-hour fire-rated design with multiple cable tray penetrants, minimum silicone foam depth 10 inches)

c. Details L1, H1, A4, and M4 - (3-hour fire-rated cable slot penetration seal designs, 5-inch x 20-inch cable slots, minimum foam depth 12 inches, 1-inch-thick ceramic fiber damming boards installed over the opening on both sides of the penetration)

<u>Silicone Foam and Elastomer Density</u>

The applicant in its engineering report made the following assumptions regarding seal density ranges:

- The density range of 15-30 lb/ft^3 allowed at Watts Bar for Dow Corning Silicone RTV Foam penetration seals is supported by successful fire tested configurations.

- The density range of 76-87.2 lb/ft^3 allowed at Watts Bar for Dow Corning Sylgard 170 or GE RTV-6428 Elastomer penetration seals is supported by successful fire tested configurations.

- The density range of 150-173.5 lb/ft^3 allowed at Watts Bar for high density silicone elastomer penetration seals is supported by successful fire tested configurations.

The staff reviewed the applicant's technical justification provided in its engineering report for the above silicone foam and elastomer density criteria. The staff audited the silicone foam penetration seal fire endurance tests referenced by the applicant's engineering report to determine if the above assumptions were adequately bounded by these tests. For example, Blockout 2 of test CTP-1001A is filled with 9-inch-thick foam seal with a density of 14.4 lb/ft^3 and a 1-inch ceramic fiber board dam on the fire exposed side. This blockout was 26 inches x 42 inches and had two penetrating cable trays. At the end of its 3-hour fire exposure, the silicone foam surface temperature was 275 °F (171 °C). Test IC01091035, penetration PSS1 is filled with 8-3/4 inches of silicone foam with a density of 23.7 lb/ft^3 and had a 1-inch ceramic fiber board on the fire exposed side. This penetration blockout was 24 inches x 24 inches and had two penetrating cable trays. At the end of the 3-hour fire exposure, the foam surface temperature was 249 °F (121 °C). From its review of the thermal data presented in the referenced tests, the staff finds that the density ranges set by the silicone foam and elastomer manufacturers, which are the same as those assumed by the applicant, have little impact on the thermal performance of a qualified penetration seal and, therefore, they are acceptable.

Extrapolation of Low Density Foam Fire Endurance Test Data and Its Application to Moderate and High Density Silicone Elastomer Seal Designs

The fire endurance performance of silicone elastomer is generally better than that of silicone foam. Tests have shown that a 20-inch-diameter pipe sleeve with a 16-inch penetrating pipe with the penetration annular space filled with 12 inches of silicone foam had a unexposed side foam surface temperature which was 254 °F (123 °C) greater than the same size test specimen sealed with 12 inches of moderate density silicone elastomer material. Generally, silicone elastomer seal material in a like penetration can be qualified by a silicone foam seal qualification test providing, the same seal depth is maintained and the seal's unsupported span and free area are qualified by similar tests using elastomer materials. For example, the Watts Bar cable slots are 5 inches x 20 inches and have been tested using silicone foam (12-inch fill depth) as the penetration sealant material. The staff would find, in this case, the use of silicone elastomer (12-inch fill depth) material in lieu of silicone foam an acceptable penetration sealant material.

Extrapolation of Penetration Seal Fire Endurance Test Data

The staff, in its review of mechanical penetration seal test data and the applicant's typical design details, has determined that the following factors can have a great effect on the thermal and structural performance of a penetration seal and the extrapolation of test data and its application to "as-built" plant conditions which are not representative of tested configurations:

- The quantity of through metallic components affects the amount of heat transferred to the unexposed side of the seal assembly and different types of penetrants transfer different amounts of heat. Additionally, larger penetrating items generally represent a more severe thermal condition for penetration sealant materials than do smaller items of the same type. Fewer of penetrating items are generally better than more.

- The smaller the annular space between the steel sleeve and the penetrating pipe, the more heat will be transferred into the silicone sealant material, thus accelerating its thermal degradation. In order to compensate for this, an increase in seal material depth or density is needed to qualify a seal design.

- The larger an unsupported span and free area a penetration seal material has across a blockout or a pipe penetration sleeve, the more likely it will fail structurally during a fire. From test experience, it appears that large span silicone foam seals perform better structurally than moderate and high density silicone elastomer seals.

The staff considered these factors in its review of the Watts Bar typical penetration seal design details.

Mechanical Penetration Seals Silicone Foam Type

Silicone Foam Seals (single penetrants) design details I, I (F-rated), V, V (F-rated), VIII, VIII (F-rated), XXII, XXII (F-rated), XL, XL (F-rated), XLIII, XLIII (F-rated), XLV, XLV (F-rated), LVI, LVI (F-rated), LXXIX, LXXIX (F-rated), LXXX, LXXX (F-rated), LXXXIII, LXXXIII (F-rated), LXXXIV, LXXXIV (F-rated), LXXXV, LXXXV (F-rated), LXXXVI, and LXXXVI (F-rated) are similar seal design details.

Silicone Foam Seals design details IX, IX (F-rated), X, X (F-rated), XI, and XI (F-rated) are similar to those design details identified above, except that their design allows multiple items to penetrate the seal.

All of these seals are pipe sleeve-type penetration and use silicone foam material (density range of 15-30 lb/ft^3) to seal annular space between the penetration sleeve and the pipe/conduit penetrant(s) and are required to have a minimum foam fill depth of 12 inches. All of these designs use the following qualification tests to establish their design basis:

a. Construction Technology Laboratories Fire Test ICC1091035, "Fire and Hose Stream Test for Penetration Seal Systems," dated October 1990.

   Fire Test ICC1091035, Penetration 3, qualified a 14-inch-diameter steel pipe sleeve penetration filled with 12 inches (depth of seal material) of silicone foam in a 12-inch-thick concrete slab with no penetrating items as an effective 3-hour fire-rated design.

b. CTP 1076, "Three Hour Fire Qualification Test, HDLE, HDSE/HDLE Comparison, Radflex/Foam Composite Seal, Adhesive Sealant Conduit Seal, Nine Inch Silicone Foam W/O Damming, Radflex/Radflex B Comparison for Electrical and Mechanical Penetration Seals," dated March 28, 1985.

Fire Test CTP 1076, Penetration 6.1.17 qualified a 12-inch-diameter steel pipe sleeve penetration filled with 12 inches (depth of seal material) of silicone foam in a 12-inch-thick concrete slab with a 2-inch-diameter penetrating pipe as an effective 3-hour fire-rated design.

c. Bisco Report No. 748-49, "Fire Test Configuration for a Three Hour Rated Seal Utilizing BISCO SF-20 Where a Steel Sleeve Condition With Pipe Penetrant Exists," dated July 9, 1981.

Fire Test 748-49, Penetration 2, qualified a 12-inch-diameter steel pipe sleeve penetration filled with 12 inches (depth of seal material) of silicone foam in a 12-inch-thick concrete slab with an 8-inch-diameter penetrating pipe as an effective 3-hour fire-rated design.

d. GSU PO No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993.

Fire Test 93-H-72449, Penetration 11, demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of silicone foam can resist the passage of flame through the penetration for a specified 3-hour fire test duration (Note - This test specimen did not meet the temperature rise and hose stream acceptance criteria established by ASTM E-814 and, therefore, is not considered a 3-hour design which meets the T-rating).

The staff reviewed the applicant's qualification tests cited above and, using this data, it independently determined the bounding design parameters established by these tests. The staff believes these qualification tests adequately demonstrate that "as-built" penetration seals which meet the following conditions will provide a level of fire safety equivalent to those which were tested: 1) 14-inch-diameter (and smaller) pipe sleeve installed in 12-inch-thick (minimum) concrete slab filled with 12 inches (minimum depth of seal material) of silicone foam; and 2) a 14-inch-diameter (or smaller) pipe sleeve installed in a 12-inch-thick (minimum) concrete slab with either a single or multiple penetrants (pipes or conduits) having a circumference ratio factor* (CrF) ranging from 0.16 to 0.66 and filled with a minimum 12 inches

* Circumference Ratio Factor (CrF) is established by dividing the circumference of the penetrant (for multiple penetrants, it would be the sum of the circumferences) by the circumference of the penetration sleeve. The CrF range is established for mechanical silicone foam or elastomer seal design by the qualification test. For example, Penetration 6.1.17 (Fire Test CTP-1076) is a 12-inch pipe sleeve filled with 12 inches of silicone foam penetrated by a 2-inch-diameter pipe and has a CrF of 0.16. Penetration 2 (Fire Test 748-49) is a 12-inch pipe sleeve filled with 12 inches of silicone foam penetrated by an 8-inch diameter pipe and has a CrF of 0.66. The CrF range established by these two tested configurations is 0.16 to 0.66. This range can then be used to evaluate "as-built" configurations where the foam/elastomer fill depths were relatively the same as those tested and the largest pipe sleeve diameter evaluated does not

of silicone foam; and 3) a 20-inch-diameter pipe sleeve installed in a 12-inch-thick concrete slab with a single pipe penetrant having a CrF of 0.79 and filled with a minimum of 12 inches of silicone foam will prevent the passage of flame through the penetration and, therefore are acceptable.

Mechanical Penetrations - Moderate Density Silicone Elastomer Type

Watts Bar Typical Detail XXXIII is a pipe sleeve type penetration and is fire-rated for 3-hours. It uses MDSE material (density range of 76-87.2 lb/ft^3); the penetration annular space between the penetration sleeve and the pipe/conduit penetrant is filled with MDSE to a depth of 12 inches. Watts Bar Typical Detail XXXVIII is similar in design to this penetration except that it does not have a penetrating item. The following qualification tests were used to establish the design basis for these detail:

a. Construction Technology Laboratories Fire Test ICC0286018, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS9)," dated April 1986.

   Fire Test ICC0286018, Penetration 1, qualified a 6-inch-diameter steel pipe sleeve penetration filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab with no penetrating items as an effective 3-hour fire-rated design.

b. Construction Technology Laboratories Fire Test ICC118520, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS11)," dated January 1986.

   Fire Test ICC0286020 qualified a 30-inch x 30-inch blockout with three penetrating items filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab as an effective 3-hour fire-rated design. This blockout tested a maximum unsupported free area of 17-inch x 30-inch (510 in^2).

c. GSU PO No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993.

   Fire Test 93-H-72449, Penetration 12, qualified a 20-inch-diameter steel pipe sleeve penetration in a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of MDSE as an effective 3-hour fire-rated design.

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exceed the largest pipe sleeve tested. Therefore, it is expected that a 2-inch diameter pipe penetrating a 6-inch-diameter pipe sleeve filled with 12 inches of silicone foam (CrF =0.33) would provide an equivalent level of fire resistance to that established by these tested configurations. However, a 10-inch pipe penetrating a 12-inch-diameter sleeve filled with 12 inches of silicone foam (CrF = 0.85) would not achieve the same level of fire resistive performance.

d. Promatec Fire Test PRO293036, "Three Hour Fire Qualification Test, Comparison Test of ICMS Product 90 with D.C. Sylgard 170 and G.E. 6428 Elastomers," dated February 1993.

   Fire Test PRO293036, Blockouts 1173.4-1 and 5-1, qualified a 12-inch x 12-inch (144 in^2) blockout filled with 6 inches of MDSE and no penetrating items as an effective 3-hour fire-rated design.

The staff reviewed the qualification tests cited above and using this data it independently determined the bounding design parameters established by these tests. The staff believes these qualification tests adequately demonstrate that "as-built" penetration seals which meet the following conditions will provide a level of fire safety equivalent to those which were tested: 1) 17-inch-diameter (and smaller) pipe sleeve installed in 12-inch-thick (minimum) concrete slabs filled with a minimum 12 inches (depth of seal material) MDSE; and 2) a 16-inch-diameter (or smaller) pipe sleeve installed in a 12-inch-thick (minimum) concrete slab with a single pipe penetrant having a circumference ratio factor (CrF) ranging from 0 - 0.79 and filled with a minimum 12 inches of MDSE.

Details XLII, XLIV, XLVI, LX, and LXI are similar in design. They are all pipe sleeve type penetrations and fire-rated for 3 hours. They use MDSE material (density range of 76-87.2 lb/ft^3), the penetration annular space between the penetration sleeve and the pipe/conduit penetrant(s) is (are) filled with MDSE to a depth of 6 inches, and they use the following qualification tests to establish the design basis for these details:

a. Construction Technology Laboratories Fire Test ICC0286018, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS9)," dated April 1986.

   Fire Test ICC0286018, Penetration 1, qualified a 6-inch-diameter steel pipe sleeve penetration filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab with no penetrating items as an effective 3-hour fire-rated design.

b. Construction Technology Laboratories Fire Test ICC118520, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS11)," dated January 1986.

   Fire Test ICC0286018 qualified a 30-inch x 30-inch blockout with three penetrating items filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab as an effective 3-hour fire-rated design. This blockout tested a maximum unsupported free area of 17-inches x 30 inches (510 in^2).

c. GSU PO No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993.

   Fire Test 93-H-72449, Penetration 12, qualified a 20-inch-diameter steel pipe sleeve penetration in a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of MDSE as an effective 3-hour fire-rated design.

d. Promatec Fire Test PR0293036, "Three Hour Fire Qualification Test, Comparison Test of ICMS Product 90 with D.C. Sylgard 170 and G.E. 6428 Elastomers," dated February 1993.

   Fire Test PR0293036, Blockouts 1173.4-1 and 5-1, qualified a 12 inches x 12 inches (144 in^2) blockout filled with 6 inches of MDSE and no penetrating items as an effective 3-hour fire-rated design.

e. CTP-1142, "Three Hour Fire Qualification Test, Six (6) Inch Depth LDSE w/ Aluminum and Steel Penetrants, XLPE/PVC Cable," dated November 23, 1987.

   CTP-1142, Penetration 11, qualified a 48-inch x 48-inch blockout in a 12-inch concrete slab with various cable, conduit, cable tray of aluminum and steel penetrating the blockout as a 3-hour fire-rated seal. The blockout was sealed with 6 inches of Promatec LDSE (Promatec LDSE density range is the same as DC-170). The maximum free area tested by this test was 27.5 inches x 22 inches (605 in^2).

The above tests were reviewed by the staff and, using this data, it independently determined the bounding design parameters established by these tests. The staff believes these qualification tests adequately demonstrate that "as-built" penetration seals which meet the following conditions will provide an equivalent level of fire safety to those which were tested: 1) 22-inch-diameter (and smaller) pipe sleeve installed in 12-inch-thick (minimum) concrete slab filled with a minimum 6 inches (depth of seal material) MDSE; and 2) a 30-inch-diameter (or smaller) pipe sleeve installed in a 12-inch-thick (minimum) concrete slab with either single or multiple penetrants (pipes or conduits) having a circumference ratio factor (CrF) ranging from 0.16 to 0.53 and filled with a minimum 6 inches of MCSE.

<u>Mechanical Penetrations - High Density Silicone Elastomer Type</u>

Details XXXII, XXXVII, XLI, XLVII, LVII, and LXIII are high density silicone elastomer (HDSE) seals and are similar in design. They are pipe sleeve type penetrations and fire-rated for 3-hours. These design details use HDSE material (density range of 150-173.5 lb/ft^3) and have the penetration annular space between the sleeve and the pipe/conduit penetrant(s) is (are) filled with 6-inch (minimum depth) HDSE. The following qualification tests were used to establish the design basis for this detail:

a. Construction Technology Laboratories Fire Test ICC0286016, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS7)," dated March 1986.

   Fire Test ICC0286016, Penetration 6, qualified a 12-inch-diameter sleeve penetration in a 12-inch-thick concrete slab with a 2-inch-diameter pipe penetrant as an effective 3-hour fire-rated seal. The annular space between the pipe sleeve and the pipe was filled with 12 inches of HDSE.

b. Construction Technology Laboratories Fire Test ICC0382004, "Fire and Hose Stream Tests For Penetration Seal Systems," dated April 1982.

Fire Test ICC0382004, Penetration 8, qualified a 12-inch-diameter sleeve penetration in a 12-inch-thick concrete slab with a 2-inch-diameter pipe penetrant as an effective 3-hour fire-rated seal. The annular space between the pipe sleeve and the pipe was filled with 12 inches of HDSE.

Blockout 4 qualified a 36-inch x 36-inch blockout in 12-inch-thick (minimum) concrete slab penetrated by two 6-inch x 24-inch cable trays and a 6-inch-diameter conduit as an effective 3-hour fire-rated seal. This penetration was filled with 12 inches (minimum depth) of HDSE and had a maximum free area of 18 inches x 15 inches (270 in^2).

c. Promatec Fire Test PR0293036, "Three Hour Fire Qualification Test, Comparison Test of ICMS Product 90 with D.C. Sylgard 170 and G.E. 6428 Elastomers," dated February 1993.

Fire Test PR0293036, Blockouts 1173.1-1 and 2-1, qualified a 12-inch x 12-inch (144 in^2) blockout filled with 12 inches of HDSE and no penetrating items as an effective 3-hour fire-rated design.

d. GSU PO No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993.

Fire Test 93-H-72449, Penetration 8 qualified a 26-inch-diameter steel pipe sleeve penetration in a 12-inch-thick concrete slab with an 18-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of HDSE as an effective 3-hour fire-rated design.

The staff reviewed these tests, and using this data, it independently determined the bounding design parameters established by these tests. The staff believes these qualification tests adequately demonstrate that "as-built" penetration seals which meet the following conditions will provide a level of fire safety equivalent to those which were tested: 1) 15-inch-diameter and smaller pipe sleeve installed in 12-inch-thick (minimum) concrete slab filled with a minimum 12 inches (depth of seal material) HDSE; and 2) a 26-inch-diameter (or smaller) pipe sleeve installed in a 12-inch-thick (minimum) concrete slab with either a single or multiple penetrants (pipes or conduits) having a circumference ratio factor (CrF) ranging from 0.16 to 0.69 and filled with a minimum 12 inches of HDSE.

Electrical Penetrations - Cable Slots (3-Hour Fire-Rated)

Watts Bar penetration seal details A4, H1, L1, and M4 are 3-hour fire-rated penetration seal designs for 5-inch x 20-inch cable slots. These designs are filled with 12 inches (minimum foam depth) of silicone foam and have permanent 1- inch-thick ceramic fiber damming boards installed over the penetration opening on both sides. These damming boards are cut and fitted to allow the penetrating cables to pass through them. The applicant cited a number of qualification test reports* and used those tested configurations to support the design of the Watts Bar penetration seals. These tested configurations were large blockouts with multiple continuous cable trays passing through the penetration and were not representative of the "as-built" plant conditions. At Watts Bar the cable trays do not pass through the penetration. The applicant in Appendix G of its Penetration Seal Engineering Report stated its position on the applicability of these cable tray blockout tests to the Watts Bar "as-built" conditions.

The staff, as part of its review of the engineering report and existing plant-specific conditions, had questions regarding the thermal performance of Watts Bar cable slots and plant specific cable used at Watts Bar. The staff based its concerns on the following principles: 1) The quantity of through metallic components (e.g., large fill of power cables) affect the amount of heat transferred to the unexposed side of the seal assembly; 2) penetrating items which represent a large thermal mass generally create a more severe thermal challenge to penetration sealant materials than do items with a smaller thermal mass (e.g., large fill of instrumentation cables; and 3) the smaller the annular space between the steel liner and penetrating power (high thermal mass) cables, the more heat will be transferred into the silicone sealant material, thus accelerating its thermal degradation at the cable seal interface.

The concerns associated with these principles are demonstrated by the results of the following tests which were judged by the staff to be the closest representation of the "as-built" plant conditions:

a. Construction Technology Laboratories Fire Test IC01091035, "Fire and Hose Stream Tests for Penetration Seal Systems," dated October 1990.

   PSS1 was a 24-inch x 24-inch blockout which was subdivided into two 12-inch x 24-inch cable tray slots. The upper slot was penetrated by a 4-inch x 18-inch solid bottom cable tray and the lower slot by a 4-inch x 18-inch ladder back cable tray. Both trays had 100-percent cable fills and were filled with 8-3/4 inches of silicone foam (Density 23.7 lb/ft^3) and 1-inch-thick ceramic fiber damming board was installed over each face of the penetration opening. The ladder back type cable tray was less restrictive to the free burning of the cables during the test and its mass and cross sectional area was less, thus reducing its ability to transfer heat by conduction from the fire through the penetration seal system and dissipate it on the unexposed side of the fire test slab. This test assembly exceeded the thermal acceptance criteria required by the test plan. When compared to the results of a solid bottom tray, the

* CTP-1001A, "Three Hour Fire Qualification Test, 10" and 6" Depth Silicone RTV Foam for Electrical and Mechanical Penetration Seals," dated July 25, 1980.

Construction Technology Laboratories Fire Test ICC0386017, "Fire and Hose Stream Test For Penetration Seal Systems (NMP2-PSS8)," dated April 1986.

Construction Technology Laboratories Fire Test IC01091035, "Fire and Hose Stream Tests for Penetration Seal Systems," dated October 1990.

power cable penetration seal interface temperatures of the ladder back tray configuration were approximately 180 °F (82 °C) greater than those in the solid bottom cable tray configuration.

PSS8 was a 8-inch x 24-inch blockout penetrated by a 4-inch x 18-inch solid bottom cable tray. This tray had a 100% cable fill and was filled with 9 inches of silicone foam (Density 21.3 lb/ft^3) and 1-inch-thick ceramic fiber damming board was installed on the exposed side of the test specimen. This test assembly exceeded the thermal acceptance criteria required by the test plan. The data from this test supports the theory that the thermal mass of the penetrant in relation to the size of the penetration opening has a pivotal impact on the thermal performance of the penetration seal.

b. Construction Technology Laboratories Fire Test IC1182009, "Fire and Hose Stream Tests for Penetration Seal Systems and Seismic Gap," dated December 1982.

PSS2 was a 8-inch x 28-inch blockout penetrated by a 6-inch x 24-inch ladder back cable tray. This tray was positioned in the blockout with its bottom and one side flush up against the sides of the blockout. The tray had a 100% cable fill and was filled with 9 inches of silicone foam (Density 17.1 lb/ft^3) and 1-inch-thick ceramic fiber damming board was installed on the exposed side of the test specimen. This test assembly experienced burnthrough. This test confirms the theory that the thermal mass of the penetrant in relation to the size of the penetration opening can have a critical impact on the fire resistive characteristics of the penetration seal.

As result of NRC concerns related to the fire endurance qualification testing of cable slot type fire barrier penetration seals at Watts Bar, the applicant committed to perform plant specific testing of these seals.

During the week of October 16, 1995, at Omega Point Laboratories (OPL), Elmendorf, Texas, the applicant constructed the cable slot penetration seal test specimens. The test assembly consists of a 8-inch x 13-foot x 12-inch-thick concrete test slab with fourteen 5-inch x 20-inch cable slots penetrating the slab. On one half of the test slab, 8 cable tray slots (specimens A1 through A6 with varying control and instrumentation cable fill; specimens A7 and A8 were spare slots with no cable fill) were arranged in two parallel columns with 4 cable slots in each column. The slots in each column were separated by a 7-inch- wide concrete mullion and a 6-inch concrete mullion exists between the cable slot ends between the columns. The two cable slot columns were constructed so that they were maintained at least 24 inches away from the edge of the test slab. The remaining 6 cable slots (B1 through B6 with varying power cable fill) were located on the second half of the slab and were arranged in two parallel columns with 3 slots in each column. The columns were separated by a 6-inch-wide concrete mullion and each cable slot within each column was separated by a 7-inch-wide concrete mullion. These two cable slot columns were constructed so that the edges of cable slot columns were maintained at least 24 inches away from the edge of the test slab.

In addition, to address the staff concerns related to the combustibility of the cables used at Watts Bar, the applicant used plant-specific cables to construct the test specimens. The following summarizes the cable fill of each cable slot test specimen:

- Penetration Seal (PS) Test Specimen A1 - single layer of 4/c-#16 (43 cables)
- PS Test Specimen A2 - 100% visual fill of 4/c-#16 (230 cables)
- PS Test Specimen A3 - 100% visual fill of 4/c-#16 (230 cables)
- PS Test Specimen A4 - 50% visual fill of 4/c-#16 (150 cables)
- PS Test Specimen A5 - 50% visual fill of 4/c-#16 (150 cables)
- PS Test Specimen A6 - single layer of 4/c-#16 (43 cables)
- PS Test Specimen A7 - spare
- PS Test Specimen A8 - spare
- PS Test Specimen B1 - contains 300MCM (14 cables), 2/0-600v (3 cables), 2/0-8Kv (9 cables), 4/0 (2 cables), #2 (2 cables), #6 (4 cables), 3/c-#10 PXMJ (8 cables), and 3/c-#10 CPJJ (3-cables)
- PS Test Specimen B2 - contains 300MCM (9 cables)
- PS Test Specimen B3 - contains 300MCM (7 cables), 2/0-8Kv (3 cables), 4/0 (4 cables), #2 (1 cables), #6 (2 cables), 3/c-#10 PXMJ (10 cables), and 3/c-#10 CPJJ (6-cables)
- PS Test Specimen B4 - contains 300MCM (20 cables), 2/0 (12 cables), 4/0 (4 cables), #2 (2 cables), #6 (4 cables), 3/c-#10 PXMJ (14 cables), and 3/c-#10 CPJJ (6-cables)
- PS Test Specimen B5 - contains 300MCM (9 cables)
- PS Test Specimen B6 - contains 300MCM (7 cables), 2/0-8Kv (3 cables), 4/0 (4 cables), #2 (1 cables), #6 (2 cables), 3/c-#10 PXMJ (10 cables), and 3/c-#10 CPJJ (6-cables)

For specimens A1 through A6, each seal was constructed by installing damming board (Carborundum Fiberfax 1-in thick low density board) on the exposed (fire) surface of the specimen and filling the blockout void with 12 inches of silicone foam and was flush with the surface of the concrete. Once the foam had been injected into the blockout void, a damming board was installed on the unexposed surface of the slab.

Specimens A7 and A8 were spare penetrations with a 4-inch sleeve extension on each side of the concrete test slab. On the exposed (fire) side of A7 the damming board was attached to the end of the sleeve and 11-inch foam fill was injected into the cable slot blockout, thus creating a 9-inch air gap between the damming board and the foam on the unexposed side of the seal. Specimen A8 was constructed in the same manner, except that the 9-inch air gap was on the exposed (fire) side of the seal.

On the exposed (fire) side of PS test specimens B1 through B6, a damming board was installed and 11 inches (thickness) of silicone foam was injected into the blockout to fill the void. On the unexposed side, 1-inch thickness of ceramic fiber (Carborundum Durablanket) was installed between the foam seal and the outer damming board on the unexposed surface.

On October 22, 1995, the concrete test slab, containing the 14 cable slot penetration seal test specimens, was subjected to a 3-hour fire endurance test which followed the ASTM E-119 standard time-temperature curve and a fog hose stream test. The acceptance criteria of IEEE 634-1978, "Standard Cable Penetration Fire Stop Qualification Test," were used to evaluate the thermal/fire resistive performance of the test specimens. These criteria require the test specimen to withstand the fire endurance test without the passage of flame or gases hot hot enough to ignite cables on its unexposed side. They also require that heat transmission through the penetration seal not raise the temperature on its unexposed surface above 700 °F (371 °C) and not allow water to be projected through the penetration seal during the hose stream test.

All test specimens met the IEEE 634 acceptance criteria. The maximum unexposed cable/seal interface temperatures ranged from 323 °F (162 °C) for instrument and control cables to 601 °F (316 °C) for power cables.

The staff, based on the results of the applicant's supplemental cable slot fire endurance tests, finds those "as-built" penetrations which have been installed in accordance with Watts Bar cable slot penetration seal design details A4, H1, L1, and M4 and that are bounded by the tested cable fill (thermal mass of copper conductors) conditions will provide an equivalent level of fire safety to those which were tested. Therefore, they are acceptable.

Extrapolation of Test Data to 2-Hour Fire-rated Cable Slots

Penetrations A8158, A8159, A8160, A8162, A8163, A8164, and A13809 (Watts Bar Typical Detail H1) are 2-hour fire-rated seals for 5-inch x 20-inch cable slots. These penetrations are filled with 8 inches (minimum foam depth) of silicone foam and have permanent 1-inch-thick ceramic fiber damming boards installed over the penetration opening on both sides. These damming boards are cut and fitted to allow the penetrating cables to pass through them.

The staff compared the design of these seals to the tested configurations referenced by the applicant's engineering report.

Fire Test IC01091035, PSS8 was an 8-inch x 24-inch blockout penetrated by a 4-inch x 18-inch solid bottom cable tray. This tray had a 100% cable fill and was filled with 9 inches of silicone foam (Density 21.3 lb/ft^3) and 1-inch-thick ceramic fiber damming board was installed on the exposed side of the test specimen and was exposed to a standard time temperature test fire for 3 hours. Even though this test assembly exceeded the thermal acceptance criteria required by the test plan, it demonstrated that a 9-inch fill depth of foam, under similar conditions, was capable of preventing the passage of flame through the seal. Based on the results of this test, the minimum 8-inch fill depth, and the required 2-hour fire rating for these penetrations, the staff has reasonable assurance that these seals will adequately perform their intended design function and prevent the spread of fire from one plant area to another. Therefore, these seals are acceptable.

Evaluation of Watts Bar Penetration Seals not Bounded by Tested Configurations

There are approximately 5230 mechanical penetration seals installed at Watts Bar and approximately 96 percent of these seals have been designed and installed in accordance with the typical design details in Engineering Report

0006-00922-02, Revision 0 and are supported by adequate qualification testing. The remaining 4 percent (221 penetrations) were designed and installed using Watts Bar typical design details; however, because one or more of the bounding parameters defined by the design detail was exceeded, the applicant was required to perform additional engineering evaluations* which either addressed the adequacy of the seal as designed or its adequacy to perform its intended function based on the fire hazards and the fire protection features in the area.

The following is a summary of the 221 mechanical penetration seals for which the applicant performed additional engineering evaluations: 1) 125 penetrations that contained pipes larger than the size allowed by the typical detail; 2) 77 penetrations that contained pipes 2 inches greater in diameter sealed using a 2-layer boot assembly on each side of the penetration; 3) 7 penetration seals where spare sleeves exceed the maximum diameter allowed by the typical detail; and 4) 12 penetrations which had an annulus that exceeded the typical details. The following is the staff's audit of the applicant's engineering evaluations by design detail and Watts Bar penetration seal identification mark numbers:

Category A - Two-Layer Boot Seals With Penetrants Larger Than 2-Inch Diameter

Typical Details L, LXIV, and XLVIII

Watts Bar penetration seal Typical Details L, LXVI, and XLVIII are dual layer boot assemblies and are installed on both sides of the penetration and when tested (refer to Fire Test ICC0186015) survived the 3-hour ASTM E-119 standard fire test and hose stream exposure without the passage of flame, hot gases, or a water projection through the seal. The inner boot layer is Carborundum 36-400U Fibersil Cloth and the outer layer is Silicone Boot Arlon (KFC) grade 56493F031. The tested configuration had a maximum 5-inch annular space between the sleeve and penetrating item. Therefore, it is expected that those seals designed to Watts Bar Typical Details L, LXIV, XLVIII and that do not exceed the annular limitations will have an equivalent fire resistive performance to that of the tested configuration.

Penetrations R1S063, R1S064, R1S065, R1S066, R1S067, R1S068, and R1S070 are boot type seals (Watts Bar Typical Detail LXIV) that exceed the 5-inch annular limitations established by the tested configuration. Penetrations R1S063, R1S064, R1S065, and R1S066 are 66-inch-diameter pipe sleeves each with a 52-inch pipe penetrant and penetrations R1S067, R1S068, and R1S070 are 40-inch pipe sleeves each with a 30-inch pipe penetrant. These penetrations are installed in 3-hour fire barriers. Penetrations R1S063, R1S066, R1S067 and R1S070 are installed in the fire barrier separating the south main steam valve room (Room A501) from the Annulus (Room R150) and penetrations R1S064, R1S065,

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* Refer to Generic Letter 86-10, Appendix R Interpretation 4, Fire Area Boundaries. This interpretation states: "Where fire area boundaries are not wall-to-wall, floor-to-ceiling boundaries with all penetrations sealed to the fire rating required of the boundaries, licensees must perform an evaluation to assess the adequacy of fire boundaries in their plants to determine if the boundaries will withstand the hazards associated with the area."

and R1S068 are installed in the fire barrier separating the north main steam valve room (Room A502) from the Annulus (Room R150). The plant fire protection associated with Rooms A501 and A502 consists of automatic thermal fire detection and manual fire fighting equipment (portable fire extinguishers and hose stations in adjacent area). Plant fire protection in the annulus consists of automatic fire suppression and detection provided for cable interactions and exposed cable concentrations.

The annular space for these penetrations exceeds the tested limitation by 3/8 of an inch to 2-3/4 inches. Since these are boot seals and they are mechanically attached to both the pipe and the sleeve assembly on both sides of the penetration, it is not expected that this minimal increase in the annular space dimension will have an impact on the fire rating of these seals. The staff, based on the "as-built" design of these seals and the plant fire protection features provided in the area of these seals, has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, are acceptable.

Category B - Foam Seals With Fluid Filled Large Bore Pipe

Typical Detail I, V, VIII, and XL

The penetration seal assemblies identified in table 3.1.4.1 (a) use Watts Bar Typical Details I, V, VIII, and XL as their design basis. All of these seals are pipe sleeve type penetration and use silicone foam material (density range of 15-30 lb/ft^3) to seal annular space between the penetration sleeve and the pipe/conduit penetrant(s) and are required to have a minimum foam fill depth of 12 inches however, they exceed the sleeve size limitations qualified by test.

The staff reviewed the "as-built" design parameters of the penetration seal assemblies identified in table 3.1.4.1 (a) and compared them to Fire Test 93-H-72449, Penetration 11. This test demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of silicone foam can resist the passage of flame through the penetration for specified 3-hour fire test duration. The depth of the silicone foam in the table 3.1.4.1 (a) seals exceed the seal depth of the tested configurations from 1 to 42 inches. In addition, the required fire-rating of these seals is 2 hours which is less than the 3-hour rating of the tested configuration and the CrF (0.7 to 0.85) of these seals did not deviate significantly from the CrF (0.79) of the tested configuration.

Based on the "as-built" design parameters of these seals and their required fire resistive rating (2-hours), the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, are acceptable.

Category C - Elastomer Seals With Fluid Filled Large Bore Pipe

Typical Detail LX, LXI, XLII, XLIV, and XLVI

The penetration seal assemblies identified in table 3.1.4.1 (b) use Watts Bar Typical Details LX, LXI, XLII, XLIV and XLVI as their design basis. All of these penetrations are pipe sleeve type and they use MDSE material (density range of 76-87.2 lb/ft^3). The penetration annular space between the penetration sleeve and the pipe/conduit penetrant is filled with MDSE to a minimum depth of 6 inches. However, they exceed the sleeve size limitations qualified by test.

The staff reviewed the "as-built" design parameters of the penetration seal assemblies identified in table 3.1.4.1 (b) and compared them to Fire Test 93-H-72449, Penetration 7. This test demonstrated that a 12-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with an 8-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 6 inches (depth of seal material) of MDSE and dammed with 1-inch ceramic fiber board can resist the passage of flame through the penetration for specified 3-hour fire test duration. The depth of the MDSE in the table 3.1.4.1 (b) seals exceed the seal depth of the tested configurations from 1/2 to 18 inches. In addition, the required fire-rating of these seals is 2-hours (except for penetrations DG0001, DG0002, DG0003, and DG0004 are 3-hour rated) which is less than the 3-hour rating of the tested configuration.

Based on the "as-built" design parameters of these seals and their required fire resistive rating (2-hour and 3-hour penetrations DG0001, DG0002, DG0003, and DG0004), the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail XLVII

Penetration A2186AM is a 42-inch-diameter sleeve is a HDSE seals with a 36-inch pipe penetrant installed in a 3-hour fire barrier. This seal is filled with 15 inches of HDSE material (density range of 150-173.5 lb/ft^3). The "as-built" 36-inch pipe penetrant is filled with water. Fire Tests CTP 1124, penetration 1.c., tested a 36-inch-diameter pipe sleeve penetrated by a 10-inch-diameter water-filled pipe. This penetration was sealed with Promatec PROMAFLEX and 1-inch-thick Alumina Silica damming board. This test demonstrated that pipes filled with a liquid that the seal surface pipe interface was approximately 486 °F (252 °C) cooler than a seal not filled by a liquid.
Fire Test 93-H-72449, Penetration 8, qualified a 26-inch-diameter steel pipe sleeve penetration in a 12-inch-thick concrete slab with an 18-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of HDSE as an effective 3-hour fire-rated design.

Based on these test results, the staff has reasonable assurance that the "as-built" design parameters will adequately prevent the spread of fire from one plant area to another and, therefore, are acceptable.

<u>Category D - Single-Sided Boot Seals</u>

Typical Detail LXI

Penetration R1S062 is a single side boot type penetration seal. This penetration ia 16-inch-diameter sleeve with a 12-inch pipe penetrant in a 3-hour fire barrier. The inner boot layer is 1-layer of silicone boot Arlon (KCF) grade 56493F031 and Carborundum 36-400U Fibersil Cloth, then 3-layers of Carborundum Durablanket, and an outer boot of 1-layer of Carborundum 36-400U Fibersil Cloth and 1-layer of silicone boot Arlon (KCF) grade 56493F031. ICMS Test ICC1088024, Penetration 2 tested the same basic configuration. The test specimen met the 3-hour acceptance criteria and did not allow the passage of flame or projection water through to the unexposed side of the seal. Based on these test, the staff has reasonable assurance that this penetration seal will prevent the spread of fire from one plant area to another and, therefore, is acceptable.

Category E - Installation specific seal evaluations

Typical Details C9 and N3

Penetration R1S008 (Typical Detail C9) is a 16-inch-diameter spare sleeve (no penetrating items) through a 3-hour fire barrier. This penetration is filled with 12 inches of silicone foam and it has a steel plate bolted to and covering one side of the penetration opening.

Penetration R1S007 (Typical Detail N3) is a 16-inch-diameter spare sleeve (no penetrating items) through a 3-hour fire barrier. This penetrations is filled with 12 inches of silicone foam and it has a 1/2-inch steel plate welded on both sides to cover the penetration openings.

Penetration R1S020 (Typical Detail N3) is a 24-inch-diameter spare sleeve (no penetrating items) through a 3-hour fire barrier. This penetration is filled with 12 inches of silicone foam and it has a 1/2-inch steel plate welded on both sides to cover the penetration openings.

Penetrations R1S007 and R1S008 are located in the 3-hour fire barrier separating the Reverse Osmosis Room (Room A810) and the Containment Annulus (Room R150) and automatic detection and sprinkler protection is provided on both sides of this wall. These penetrations are filled with 12 inches of silicone foam which when tested provided the required 3-hour fire resistance in a 14-inch-diameter spare sleeve. In addition, these penetrations have a steel plate covering one or both sides of their through-wall openings.

Penetration R1S020 is located in the 3-hour fire barrier separating the Ventilation Purge Air Room (Room A705) and Containment Annulus (Room R150) and automatic detection and sprinkler protection is provided on both sides of this wall. This penetration is filled with 12 inches of silicone foam which, when tested provided the required 3-hour fire resistance in a 14-inch-diameter spare sleeve. In addition, this penetration has a steel plate covering both sides of its through-wall openings.

Based on the design of these seals and the fire protection features provided for the plant areas on either side of the affected fire barrier, the staff has reasonable assurance that these penetration seals will provided an adequate level of fire safety, thus preventing the spread of fire from one plant area to another. Therefore, they are acceptable.

Typical Detail I

Penetration A0776AM, an 18-inch-diameter sleeve with a 1-inch-diameter pipe penetrant filled with 12 inches of silicone foam, is located in the 3-hour fire barrier separating the Heating and Ventilation Room (Room A712) and Corridor (Room A701). Automatic detection is provided on both sides of the wall and sprinkler protection is provided in corridor A701. This same basic type of penetration when tested provided the required 3-hour fire resistance in a 14-inch-diameter spare sleeve. In addition, the applicant in its engineering report technically justified Detail I type penetrations with a 14-inch-diameter (or smaller) pipe sleeve installed in a 12-inch-thick (minimum) concrete slab with either a single or multiple penetrants (pipes or conduits) filled with a minimum 12 inches of silicone foam and having a CrF ranging from 0.16 to 0.66 and a 20-inch-diameter pipe sleeve with a single pipe penetrant and filled with a minimum of 12 inches of silicone foam having a CrF of 0.79. Penetration A0776AM has a CrF of 0.05, which is less than the CrF range supported by the Detail I tested configurations; therefore, it can be expected that this seal would provide the same level of fire safety as that of the tested configuration. Based on plant fire protection features provided in the area of this seal and the adequacy of the seal design, the staff has reasonable assurance that this penetration seal will prevent the spread of fire from one plant area to another and, therefore, it is acceptable.

Penetrations A0970AM, A0970BM, A0971AM and A0971BM are foam seals in 2-hour fire barriers. These penetrations are a 22-inch-diameter sleeve with a 20-inch pipe penetrant. Penetrations A0970AM and A0971AM are filled with 18 inches of foam and penetrations A0970BM and A0971BM are filled with 17 inches of foam.

Fire Test 93-H-72449, Penetration 11, demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12 inch thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of silicone foam can resist the passage of flame through the penetration for specified 3-hour fire test duration.

The "as-built" sleeve diameter is 2 inches greater in diameter than the tested configuration with a penetrant which is 4 inches greater, thus resulting in a condition which is more severe than the tested configuration. However, this is conservatively compensated for by the 5 inches (minimum) greater in foam depth and reduction in required fire-rating (2 hours). Based on "as-built" design parameters of these seals and the 2-hour fire-rating requirement, the staff has reasonable assurance that these seals will adequately prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail VIII

Penetration A1469AM is an 18-inch pipe sleeve type penetration with a 16-inch pipe penetrant. This penetration is installed in a 3-hour fire barrier which separates pipe gallery (Room A307 and Unit 1 pipe gallery (Room A406) and is filled with 11-5/8 inches of silicone foam within the barrier and 3-7/8 of additional silicone foam in the sleeve extension on the top side of the barrier. The plant fire protection features in the area of this penetration seal consists of automatic detection and sprinkler protection.

The staff reviewed the "as-built" design parameters of this penetration seal and compared it to Fire Test 93-H-72449, Penetration 11. This test demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of silicone foam can resist the passage of flame through the penetration for specified 3-hour fire test duration. The depth of the silicone foam in penetration A1469AM exceeds the seal depth of the tested configurations by 3-1/2 inches.

Based on the "as-built" design parameters of penetration A1469AM and the plant fire protection features in the area of this seal, the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail XXXII

Penetration A0008AM is a 26-inch-diameter sleeve with a 11-1/4-inch intermediate sleeve with a 10-inch pipe penetrant in a 2-hour fire barrier separating containment spray pump 1B-B room (Room A208) and pipe gallery (Room A216). The 26-inch-diameter sleeve is filled with 46 inches of HDSE and the 10-inch pipe penetrating the 11-1/4-inch intermediate sleeve is sealed with a 2-layer boot assembly on both sides of the wall. The fire protection features in the area of the seal are automatic fire detection and manual fire fighting equipment (i.e., portable fire extinguishers and hose stations).

Fire Test 93-H-72449, Penetration 8 qualified a 26-inch-diameter steel pipe sleeve penetration in a 12-inch-thick concrete slab with an 18-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of HDSE as an effective 3-hour fire-rated design. Penetration A0008AM has a CrF of 0.40 which is less than the CrF (0.79) of the tested assembly. Based on the "as-built" design of this seal (penetration filled with a 46-inch depth of HDSE) and the required fire resistive rating (2-hours), the staff has reasonable assurance that this penetration seal will prevent the spread of fire from one plant area to another and, therefore, it is acceptable.

Typical Detail XXXVIII, XLVI, and XLII

Penetration A0766AM (Watts Bar Typical Detail XLVI) and Penetration A0766BM and A0766CM (typical detail XLII) are 40-inch-diameter pipe sleeves each with a 24-inch pipe penetrant. These penetrations are installed in the 12-thick concrete 2-hour fire barrier separating corridor (Room A701) from auxiliary building corridor (A401) and each penetration is filled with 10 inches of MDSE. Both sides of the barrier are protected by automatic sprinklers and an ionization smoke detection system.

Penetration A0457BM (Watts Bar Typical Detail XLVI) is a 20-inch-diameter pipe sleeve with three 2-inch-diameter pipe penetrants. This penetration is installed in a 12-inch-thick concrete 2-hour fire barrier separating Unit 1 pipe gallery (Room A406) and pipe gallery (Room A307) and is filled with 7 inches of MDSE. Both sides of this barrier are protected by automatic sprinklers and an ionization smoke detection system.

Penetrations C0001A, A0777AM, and A0463BM (Watts Bar Typical Detail XXXVIII) are 18-inch-diameter pipe sleeves with no penetrating items. Penetration C0001A and A0777AM are filled with 7 inches of MDSE and Penetration A0463BM is filled with 11 inches of MDSE. Penetration C0001A is installed in a 3-hour fire barrier separating the Turbine Building (Room T201) and Auxiliary Building Corridor (Room A401). Penetrations A0777AM and A0463BM are installed in 2-hour fire barriers. The fire barrier in which Penetration A0777AM is installed, separates Heating Ventilation Room (Room A712) from Auxiliary Building Corridor (Room A401). Penetration A0463AM is installed in the fire barrier separating Heat Exchanger 1-B Room (Room A411) and Heat Exchanger 1-A Room (Room A412).

Fire Test ICC0286018, qualified a 30-inch x 30-inch blockout with three penetrating items filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab as an effective 3-hour fire-rated design. This blockout tested a maximum unsupported free area of 17 inches x 30 inches (510 in^2). The tested configuration consisted of a 6-inch depth of silicone elastomer with no damming. The installed configurations each have a minimum of 6 inches of silicone elastomer in the barrier with an additional 4 inches of elastomer in the sleeve extension on the top side of the penetration. Since the 3-hour rated configuration with 6 inches foam was structurally stable, Penetration A0463BM with 11 inches, Penetrations A0766AM, A0766BM and A0766CM with 10 inches, and Penetrations C0001A, A0463BM, and A0457BM with 7 inches of elastomer are expected to maintain their structural integrity and maintain the fire resistance required by their respective fire barriers. Based on the "as-built" design of these seals, their required fire resistive rating (2 hours), and the plant fire protection features provided in the area of these seals, the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail XLVI - Deviations from 3-Hour Designs

The penetration seal assemblies identified in the table below use Watts Bar Typical Details XLVI as their design basis. All of these penetrations are pipe sleeve type and they use MDSE material (density range of 76-87.2 lb/ft^3) and are installed in 3-hour fire barriers. The penetration annular space between the penetration sleeve and the pipe/conduit penetrant is filled with MDSE to a minimum depth of 6 inches. However, they exceed the sleeve size limitations qualified by test.

PENETRATION ID	SLEEVE DIA.	PENETRANT DIA.	ELASTOMER DEPTH
A0956CM	18"	12"	13"
A0956DM	18"	12"	13"
A1109AM	12"	8"	14"
A1110AM	12"	8"	14"
A0968AM	12"	8"	12"
A1035CM	14"	8"	11"
A1806AM	16"	12"	12"
A1807AM	12"	8"	12"
C0012A	12"	8"	13"
A1893AM	18"	16"	12"
A1901AM	18"	16"	12"

The staff reviewed the "as-built" design parameters of the penetration seal assemblies identified in table and compared them to Fire Test 93-H-72449, Penetration 12. This test demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of MDSE can resist the passage of flame through the penetration for specified 3-hour fire test duration. The CrF of this tested configuration is 0.79 and the "as-built" conditions identified in the table above have a CrF ranging from 0.57 to 0.88. The staff's review of Fire Test 93-H-72449 revealed that the test specimen passed the fire endurance test with margin. Therefore, it can be expected that Penetrations A1893AM and A1901AM (which exceed the tested configuration CrF) will adequately perform their fire resistive function.

Based on the "as-built" design parameters of these seals, the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail XLVI - Deviations from 2-Hour Designs

The penetration seal assemblies identified in the table below use Watts Bar Typical Details XLVI as their design basis. All of these penetrations are pipe sleeve type and they use MDSE material (density range of 76-87.2 lb/ft^3) and are installed in 2-hour fire barriers. The penetration annular space between the penetration sleeve and the pipe/conduit penetrant is filled with

MDSE to a minimum depth of 6 inches. However, they exceed the sleeve size limitations qualified by test.

PENETRATION ID	SLEEVE DIA.	PENETRANT DIA.	ELASTOMER DEPTH
A0920BM	24"	22"	11"
A0920DM	24"	22"	27"
C0067A	12"	8"	7"
C0068A	12"	8"	8"
A1109BM	12"	8"	7"
A0929AM	12"	8"	9"
A0929BM	12"	8"	9"
A0967AM	12"	8"	11"
A0967BM	12"	8"	11"
A1035BM	14"	8"	10"

The staff reviewed the "as-built" design parameters of the penetration seal assemblies identified in table and compared them to Fire Test 93-H-72449, Penetration 12. This test demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 4-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of MDSE can resist the passage of flame through the penetration for specified 3-hour fire test duration.

In addition, the staff compared these "as-built" penetration seal designs to Construction Technology Laboratories Fire Test ICC0186015, "Fire and hose Stream Test for Penetration Seal Systems," dated March 1986. Specifically, the test of Penetration 3 which demonstrated that a 12-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 2-inch-diameter pipe penetrating the sleeve and the-5 inch annular space between the pipe and the sleeve filled with 6 inches (depth of seal material) of MDSE can resist the passage of flame through the penetration for specified 3-hour fire test duration.

Using the thermal data from these tests, a general extrapolation can be made which would support a minimum 8-1/2-inch MDSE fill depth is needed in the annular space between the 12-inch pipe sleeve and the 8-inch penetrating item for a 3-hour fire rating.

Therefore, based on the "as-built" design parameters of these seals and their required fire resistive rating (2 hours), the staff has reasonable assurance that these penetration seals will prevent the spread of fire from one plant area to another and, therefore, they are acceptable.

Typical Detail LXXXIII

Penetration A1880AM is a foam seal in a 3-hour fire barrier. This penetration is an 18-inch-diameter sleeve with a 16-inch pipe penetrant and is filled with 17-1/2 inches of foam. The fire barrier separates the Upper Head Injection Equipment Room (Room E101) and nitrogen Storage Area (Room A506). These plant areas are provided with manual fire fighting equipment and automatic fire detection capability.

Fire Test 93-H-72449, Penetration 11 demonstrated that a 20-inch-diameter steel pipe sleeve penetrating a 12-inch-thick concrete slab with a 16-inch-diameter pipe penetrating the sleeve and the 2-inch annular space between the pipe and the sleeve filled with 12 inches (depth of seal material) of silicone foam can resist the passage of flame through the penetration for specified 3-hour fire test duration.

The "as-built" sleeve diameter is 2 inches smaller in diameter than the tested configuration with a penetrant which is equal to that which was tested, resulting in a condition which is more severe than the tested configuration. However, this is conservatively compensated for by the 5-1/2 inches of additional foam depth. Based on "as-built" design parameters and the plant fire protection features in the area of this seal, the staff has reasonable assurance that it will adequately prevent the spread of fire from one plant area to another. Therefore, it is acceptable.

Category F - Large Annulus Spare Sleeves

Typical Detail III, XXXVIII

Penetration A0463AM (Watts Bar Typical Detail III) is an 18-inch-diameter spare pipe sleeve (with no penetrants) filled with a minimum of 12 inches of silicone foam in a 2-hour fire barrier. Fire Test ICC1091035, Penetration 3 qualified a 14-inch-diameter steel pipe sleeve penetration filled with 12 inches (depth of seal material) of silicone foam in a 12-inch-thick concrete slab with no penetrating items as an effective 3-hour fire-rated design. This penetration exceeds the free area limitations of this test. However, based on the similarity in design to the tested 3-hour fire-rated configuration and its required 2-hour fire rating, the staff has reasonable assurance that it will adequately perform its intended design function and prevent the spread of fire from one plant area to another. Therefore, the staff finds this penetration acceptable.

Penetrations A0463BM, A0777AM, and C001A (Watts Bar Typical Detail XXXVIII) are 18- inch-diameter spare pipe sleeves with no penetrants filled with a minimum of 6 inches of MDSE. However, Fire Test ICC1185020 qualified a 30-inch x 30-inch blockout with three penetrating items filled with 6 inches (depth of seal material) of MDSE in a 12-inch-thick concrete slab as an effective 3-hour fire-rated design. This blockout tested a maximum unsupported free area of 17 inches x 30 inches (510 in^2). The free area of the tested configuration exceeds the free area of the 18-inch sleeve by 256 in^2. Therefore, it is expected that a fire would not structurally degrade the integrity of the silicone foam seal in the 18-inch sleeve. Based on this, the staff has reasonable assurance that Penetrations A0463BM, A0777AM, and C001A will adequately perform their intended design function and prevent the spread of fire from one plant area to another and, therefore, these penetrations are acceptable.

The staff concludes from its audit of the applicant's penetration seal program that this program adequately demonstrates the fire resistive rating of these typical penetration seal designs and, therefore, they conform to the guidelines of Positions D.1.j and D.3.d of Appendix A to BTP (APCSB) 9.5-1 and are acceptable.

3.2 Safe Shutdown Capability

3.2.1 Separation of Safe Shutdown Functions

In SSER 18, the staff indicated that for safe shutdown components located inside the containment building, the applicant would use one of the means specified above, or one of the following means to achieve separation between trains:

(1) Automatic fire detection and suppression installed in the area
(2) Separation of equipment, components, and associated circuits of redundant systems by a radiant energy shield (refer to SER Section 6.0, Deviations, Combustibility of Radiant Energy Heat Shields).

In addition to the separation method specified above, the applicant has provided 20 feet or more of horizontal spatial separation, which is void of intervening combustibles or fire hazard, between redundant safe shutdown functions inside containment.

The staff concludes that these methods satisfy the technical requirements of Appendix R, Section III.G, "Fire Protection of Safe Shutdown Capability," and, therefore, are acceptable.

3.8 Smoke Control and Ventilation

In SSER 18, the staff indicated that where smoke is ducted to other rooms, the normal ventilation rates or the natural vent openings in these rooms are sufficient to prevent smoke from stratifying or excessively concentrating in the rooms. The smoke will be removed from these rooms directly to the outside. When fixed ventilation equipment is used for the removal of smoke, all necessary equipment and cabling from the fire area are separated by 1 1/2-hour fire-rated barriers. However, the actual "as-built" conditions assure that all necessary equipment and cabling are separated from the area affected by the fire by minimum 1-hour fire barrier.

The staff concludes that these "as-built" conditions do not affect the applicant's smoke removal concept and are, therefore, acceptable.

4.0 FIRE PROTECTION SYSTEMS

4.2 Active Fire Control and Suppression Features

4.2.1 Automatic Fire Suppression Systems

4.2.1.1 Sprinklers and Fixed Spray Systems With Closed Heads

Fixed water spray systems and sprinkler systems are designed in accordance with the applicable requirements of National Fire Protection Association Standard No. 13-1975 (NFPA 13), "Standard for Installation of Sprinkler Systems," and NFPA 15-1973, "Standard for Water Spray Fixed System." In SSER 18, the staff evaluated the applicant's code compliance review. As a result of final plant walkdowns, the applicant in its November 1, 1995, submittal (Revision 5 of the Watts Bar Fire Protection Report) identified additional code deviations to NFPA 13, Sections 4-4.11 and 4-4.13. In this code deviation, the applicant identified the following plant locations that do not have sprinklers installed under gratings/platforms:

- Room 692.0-A7 - grating located above High Pressure Fire Pump FCVs in the Unit 1 penetration room.
- Room 757.0-A10 - grating located south of column line A4/W.
- Room 737.0-A9 - grating located northwest of column A11/W.
- Room 737.0-A12 - grating located between the exterior wall and the first bank of filters.
- Room 737.0-A3 - grating located between the exterior wall and the first bank of filters.
- Room 757.0-A2 - under the stairs
- Room 757.0-A3 - under the stairs
- Room 772.0-A9 - platform over the HEPA filters.

In addition, the applicant in its code deviation identified the following plant areas that do not have sprinklers installed under equipment spray shields:

- Room 692.0-C10 - equipment spray shield over the chillers.
- Room 737.0-A1 - equipment spray shields over the chillers 0-CHR-31-36/2, 0-CHR-31-96, and 0-CHR-31-80, radiation monitors 1-RE-90-112 and 1-RE-90-106, and the Unit 2 AFW pump steam generator level control valves (Sprinklers will need to be provided for the Unit 2 AFW pump steam generator level control valves prior to fuel load for this Unit)

During the week of October 30, 1995, the staff performed an on-site walkdown of these deviations and found that the lack of sprinkler protection under the above gratings/platforms and spray shields (installed to prevent damage to water-sensitive equipment in the event of an inadvertent actuation of the area sprinkler) acceptable deviations from NFPA 13 and that they will not affect the overall fire suppression system performance and the level of fire safety provided by these systems. Therefore, they are acceptable.

5.0 FIRE PROTECTION FOR SPECIFIC PLANT AREAS AND HAZARDS

5.2 <u>Control Room Complex</u>

5.2.1 Control Room

In SSER 18, the staff indicated that below the main control room consoles, a 3 ft X 4 ft access walkway extends approximately 4 ft down into the cable spreading room and that this walkway was separated from the cable spreading room by a 3-hour fire-related barrier. In addition, the staff stated that all the cabling enters the metal gutters from the spreading room cable tray system at the bottom of the enclosed raceway, passing through 3-hour fire-rated penetration seals. In actuality, this walkway is not separated from the cable spreading room by a 3-hour fire barrier and the 3-hour fire-rated penetration seals are not provided for the cabling entering the metal gutters. The staff finds that this "as-built" condition does not affect the overall fire safety provided for the control room complex and is, therefore, acceptable.

5.3 Cable Spreading Room

In SSER 18, the staff indicated that the walls, floors, and ceiling or the cable spreading room are designed to have a fire rating of 3 hours. However, in actuality, the walls are rated for 3 hours, the floor is rated for 2-hours and portions of the ceiling are rated for 1-hour.

Based on the level of fire protection provided for the cable spreading room (refer to SSER 18), the staff concludes that these "as-built" fire barrier conditions do not affect the overall fire safety or impact the ability to achieve and maintain post-fire safe shutdown conditions and, therefore, are acceptable.

6.0 DEVIATIONS FROM STAFF FIRE PROTECTION GUIDANCE

6.7 Deviation - Emergency Lighting

Section III.J of Appendix R requires emergency lighting units with at least 8-hours battery power supply be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto.

The applicant in its November 1, 1995 submittal, revised its position with regard to emergency lighting for the containment annulus. The applicant has provided the required lighting in the containment annulus. However, inside the lower containment, the applicant has requested deviation from providing emergency lighting inside the lower containment. Manual actions requiring entry into the primary containment would only result from fire damage to the RHR isolation valves or the cables near these valves which are located in the lower containment. The re-alignment of these valves may be necessary as result of fire damage and can be performed anytime within four hours after the reactor is tripped. A fire affecting the RHR isolation valves could damage the lighting circuits in the immediate vicinity, but it would not disable all the lower containment lighting. In addition to normal plant lighting in this area there is diesel backed (standby) lighting located on three different elevations both inside and outside the crane wall. The staff reviewed the lighting circuits and their cable routings in the area of the lower containment and determined that the normal lighting and the standby lighting for the access and egress paths to the lower containment would not be affected by the fire.

The applicant claims that batteries for the 8-hour emergency lighting units can not be qualified for high temperature and humidity environment such as that experienced inside the primary containment. Due to ALARA concerns access into the primary containment during plant operations is very limited, which means that inspection and testing of the battery units could only be done during an outage. The applicant has provided dedicated hand-held portable lighting units for use in supporting manual fire fighting and safe shutdown actions for fires in the lower containment.

Based on its review of the normal lighting and standby lighting in the lower containment, the staff concluded that adequate lighting exists for access and egress to the manual action sites and that dedicated hand-held portable lighting units for use in supporting manual fire fighting and safe shutdown actions are an acceptable deviation from the lighting criteria required by Section III.J, of Appendix R and, therefore, are acceptable.

6.9 Deviations - BTP 9.5-1, Appendix A

6.9.7 Fire Barrier Between Refueling Floor and Unit 2 Reactor Building

The applicant in its November 1, 1995 submittal, requested a deviation from Section D.1.j of Appendix A to APCSB BTP 9.5-1 for the fire barrier between the refueling floor and the Unit 2 Reactor Building. This section of Appendix A states, "Penetration in these fire barriers, including conduits and piping should be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself. The fire hazard in each area should be evaluated to determine the barrier requirements."

The fire barrier separating the Refueling floor from the Unit 2 Reactor Building is a 3-hour fire-rated barrier and it contains a non fire-rated equipment hatch door assembly. The equipment hatch door is closed by the blast doors and the overhead rolling door. The area between these doors is provided with an automatic detection and suppression system. For a fire inside the Unit 2 reactor building to propagate to the refueling floor, it would have to breach the steel blast doors, not be controlled by the automatic suppression system and breach the rolling steel door. The staff considers this type of fire scenario improbable and considers the level of existing fire protection to provide a level of fire safety equivalent to that specified by Section D.1.j of Appendix A to APCSB BTP 9.5-1 and, therefore, is acceptable.

TABLE 3.1.4.1 (a) CATEGORY B - FOAM SEALS WITH FLUID FILLED LARGE BORE PIPE				
PENETRATION ID	SLEEVE DIA. (INCHES)	PENETRANT DIA. (INCHES)	SEAL DEPTH (INCHES)	FIRE RATING (HOURS)
A002BM	20	14	13	2
A002CM	20	14	13	2
A002DM	20	14	15	2
A0010BM	28	20	13	2
A0094AM	30	18	54	2
A0094BM	30	18	17	2
A0142BM	30	24	36	2
A0205AM	20	16	30	2
A0205BM	20	16	27	2
A0208BM	24	20	12	2
A0395BM	24	18	27	2
A0473CM	24	18	28	2
A0473DM	24	18	30	2
A0474BM	24	18	15	2
A0474DM	24	18	14	2
A0480BM	28	20	36	2
A0483AM	24	18	12	2
A0483BM	24	18	12	2
A0484BM	24	18	12	2
A0485AM	20	16	23	2
A0623AM	28	20	48	2
A0753AM	30	24	27	2
A0753BM	30	24	39	2
A0753CM	30	24	13	2
A0753DM	30	24	12	2
A0758CM	24	18	12	2
A0758DM	24	18	27	2

TABLE 3.1.4.1 (a) - CONTINUED CATEGORY B - FOAM SEALS WITH FLUID FILLED LARGE BORE PIPE				
PENETRATION ID	SLEEVE DIA. (INCHES)	PENETRANT DIA. (INCHES)	SEAL DEPTH (INCHES)	FIRE-RATING (HOURS)
A0765AM	24	18	12	2
A0765BM	24	18	17	2
A0807BM	24	18	36	2
A0808AM	24	18	36	2
A0808BM	24	18	21	2
A0816BM	24	18	30	2
A0817BM	24	18	30	2
A02140AM	42	36	27	2

TABLE 3.1.4.1 (b) CATEGORY C - ELASTOMER SEALS WITH FLUID FILLED LARGE BORE PIPE				
PENETRATION ID	SLEEVE DIA. (INCHES)	PENETRANT DIA. (INCHES)	ELASTOMER DEPTH (INCHES)	FIRE RATING (HOURS)
A0002AM	20	14	6.5	2
A0263DM	16	12	12	2
A0472AM	20	16	24	2
A0486AM	24	18	12	2
A0486BM	24	18	12	2
A0486CM	24	18	12	2
A0486DM	24	18	18	2
A0486EM	24	18	10.5	2
A0486GM	24	18	12	2
A0484IM	24	18	12	2
A0657EM	10	8	9	2
A0657FM	10	8	11	2
A0657GM	10	8	12	2
A0657HM	10	8	10	2
A0752DM	30	24	12	2
A0758AM	24	18	12	2
A0760CM	20	16	12	2
A0760DM	20	16	6	2

TABLE 3.1.4.1 (b) - CONTINUED Category C - SEALS WITH FLUID FILLED LARGE BORE PIPE				
PENETRATION ID	SLEEVE DIA. (INCHES)	PENETRANT DIA. (INCHES)	SEAL DEPTH (INCHES)	FIRE-RATING (HOURS)
A0766AM	40	24	6	2
A0766BM	40	24	6	2
A0766CM	40	24	6	2
A0801AM	30	24	6	2
A0801BM	30	24	6	2
A0993AM	14	10	27	2
DG0001	14	10	7	3
DG0002	14	10	7	3
DG0003	14	10	7	3
DG0004	14	10	7	3

APPENDIX GG

FINAL MEMORANDUM ON FACILITY COMPLETION IN ACCORDANCE WITH INSPECTION MANUAL CHAPTER 94300

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

November 9, 1995

MEMORANDUM TO: William T. Russell, Director
Office of Nuclear Reactor Regulation

FROM: Stewart D. Ebneter
Regional Administrator

SUBJECT: TENNESSEE VALLEY AUTHORITY (TVA) - WATTS BAR UNIT 1
DOCKET NO. 50-390, STATUS OF FACILITY COMPLETION,
FIFTH REPORT

This memorandum summarizes the status of key inspection activities for Watts Bar Unit 1 and provides the Region's recommendation for issuance of the low-power operating license.

1.0 CONSTRUCTION INSPECTION

1.1 Corrective Action Programs (CAPs) and Special Programs (SPs)

There are twenty-eight CAPs and SPs. All have been inspected and found to be successfully implemented. The CAPs and SPs are completed and closed.

1.2 Construction Inspection Program

The construction inspection program has been completed. A reconstitution or examination to validate completeness was completed and is documented in NUREG-1528, which was published October 6, 1995. Additionally, the Office of Nuclear Reactor Regulation did an independent audit of the reconstitution process. The results of this audit confirmed the adequacy of the construction inspection program as implemented.

1.3 Construction Open Items

The are no NRC construction items open.

1.4 Construction Summary

Watts Bar Unit 1 construction is complete, and implementation of the construction inspection program confirms that the facility has been built in accordance with the Final Safety Analysis Report, TVA commitments, and the regulations.

2.0 PREOPERATIONAL TESTING

2.1 Preoperational Testing Inspection Program

TVA has completed their preoperational test program. Our inspection of this program is also complete. All mandatory test procedures were reviewed prior to test performance; all mandatory tests were witnessed as they were performed, and the results of mandatory tests were inspected to assure that test deficiency notices were adequately dispositioned and that the test results were acceptable.

For the other tests, twenty-five procedures were reviewed prior to test performance; nineteen tests were observed as they were performed; and forty-two test result packages were reviewed.

2.2 Preoperational Test Open Items

There are no NRC preoperational test open items.

2.3 Preoperational Testing Summary

Preoperational testing by the applicant is complete. Our inspections of preoperational testing have led us to conclude that the plant has been tested in accordance with TVA commitments and the regulations. The completed test program demonstrated that the safety systems were capable of performing their design functions.

3.0 PROGRAMMATIC OPERATIONAL READINESS

3.1 Programmatic Operational Readiness Inspection Program

The programmatic operational readiness inspections have been completed. All areas inspected are considered ready for operation. Site staffing is adequate. All licensed operators have been fully examined and are appropriately qualified. Other staff positions are also filled with trained and qualified personnel. All Watts Bar training programs have been reaccredited. TVA has procedures in place by which to operate the plant under normal conditions and to cope with emergency conditions.

During the turnover of the radiation monitoring system, which was the last important-to-safety system turned over, it was noted that TVA control room operators appeared unfamiliar with some aspects of the operation of the radiation monitoring equipment. TVA will conduct remedial training, which will be completed before initial criticality and confirmed by NRC inspection.

TVA's last full participation emergency exercise was conducted in the fall of 1993. A full participation emergency exercise is scheduled for November 15, 1995. The Region will inspect this drill and plans to participate with a full site team. This emergency exercise will have to be successfully completed before full power licensing.

3.2 Programmatic Operational Readiness Open Items

NRC programmatic open items required to be completed for issuance of a low-power operating license are closed.

3.3 Programmatic Operational Readiness Summary

TVA has in place adequate operational programs by which to load fuel, startup, and operate Watts Bar Unit 1.

4.0 POWER ASCENSION PROGRAM

TVA has in place the procedures to load fuel and to startup and test Watts Bar Unit 1.

5.0 ALLEGATIONS

There are 46 allegations open for Watts Bar Unit 1. Of the open allegations, all have been either inspected or evaluated in order to determine that, if substantiated, they would not affect the licensing decision. None of the allegations affect licensing the facility.

A summary of the allegation inspection status is provided in the attached Table.

6.0 SAFETY ISSUES

There were 65 safety issues identified in an NRR audit (Status of Safety Issues at Watts Bar Unit 1 Nuclear Power Plant) as requiring verification by inspection. All of them have been inspected. Two could not be closed before issuance of the low power operating license.

The first of the two is the TMI item on the Safety Parameter Display System (SPDS) being fully operational (TMI Item I.D.2.3). The system is fully functional, but the item cannot be closed until full power is achieved.

The second is Generic Safety Issue 51 (Proposed Requirements for Improving the Reliability of Open Cycle Service Water Systems). Implementation of this issue was embodied in Generic Letter 89-13. TVA was granted an extension in meeting their commitments to Generic Letter 89-13 until the end of the first refueling outage. The service water system has been inspected and is considered fully functional.

7.0 CONCLUSION AND RECOMMENDATION

TVA has constructed Watts Bar Unit 1 in accordance with their commitments, the FSAR, and the regulations. TVA has appropriately tested the plant in accordance with their commitments and regulatory requirements. TVA has also demonstrated their readiness to load fuel and to operate the plant. Issuance of a low power operating license is recommended.

Attachment:
Allegation Table

ALLEGATION TABLE

Total Number of Allegations Open:	46
• Total number of allegations open for Department of Labor action but for which there were either no technical issues or for which the technical issues have been closed:	27
• Total number of allegations for which technical issues have had inspections completed and are in the documentation and closure process:	16
• Total number of allegations reviewed and found not to impact the licensing decision but for which inspection activity is not complete:	2
• Total number of allegations awaiting action by NRR as lead office:	1[1]

[1] This allegation has been evaluated and found not to affect the licensing decision since it concerns an area outside of regulatory jurisdiction.

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

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Same as 8. above.

10. SUPPLEMENTARY NOTES

Docket Nos. 50-390 and 50-391

11. ABSTRACT (200 words or less)

Supplement No. 19 to the Safety Evaluation Report for the application filed by the Tennessee Valley Authority for license to operate Watts Bar Nuclear Plant, Units 1 and 2, Docket Nos. 50-390 and 50-391, located in Rhea County Tennessee, has been prepared by the Office of Nuclear Reactor Regulation of the Nuclear Regulatory Commission. The purpose of this supplement is to update the Safety Evaluation with (1) additional information submitted by the applicant since Supplement No.18 was issued, and (2) matters that the staff had under review when Supplement No.18 was issued.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

Safety Evaluation Report (SER)
Watts Bar Nuclear Plant
Docket Nos. 50-390/50-391

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