U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

NUREG-0847
Supplement 29

Safety Evaluation Report

Related to the Operation of Watts Bar Nuclear Plant, Unit 2

Docket Number 50-391

Tennessee Valley Authority

Office of Nuclear Reactor Regulation

AVAILABILITY OF REFERENCE MATERIALS IN NRC PUBLICATIONS

NRC Reference Material

As of November 1999, you may electronically access NUREG-series publications and other NRC records at NRC's Library at www.nrc.gov/reading-rm.html. Publicly released records include, to name a few, NUREG-series publications; *Federal Register* notices; applicant, licensee, and vendor documents and correspondence; NRC correspondence and internal memoranda; bulletins and information notices; inspection and investigative reports; licensee event reports; and Commission papers and their attachments.

NRC publications in the NUREG series, NRC regulations, and Title 10, "Energy," in the *Code of Federal Regulations* may also be purchased from one of these two sources.

1. **The Superintendent of Documents**
   U.S. Government Publishing Office
   Mail Stop IDCC
   Washington, DC 20402-0001
   Internet: bookstore.gpo.gov
   Telephone: (202) 512-1800
   Fax: (202) 512-2104

2. **The National Technical Information Service**
   5301 Shawnee Rd., Alexandria, VA 22312-0002
   www.ntis.gov
   1-800-553-6847 or, locally, (703) 605-6000

A single copy of each NRC draft report for comment is available free, to the extent of supply, upon written request as follows:

Address: **U.S. Nuclear Regulatory Commission**
Office of Administration
Publications Branch
Washington, DC 20555-0001
E-mail: distribution.resource@nrc.gov
Facsimile: (301) 415-2289

Some publications in the NUREG series that are posted at NRC's Web site address www.nrc.gov/reading-rm/doc-collections/nuregs are updated periodically and may differ from the last printed version. Although references to material found on a Web site bear the date the material was accessed, the material available on the date cited may subsequently be removed from the site.

Non-NRC Reference Material

Documents available from public and special technical libraries include all open literature items, such as books, journal articles, transactions, *Federal Register* notices, Federal and State legislation, and congressional reports. Such documents as theses, dissertations, foreign reports and translations, and non-NRC conference proceedings may be purchased from their sponsoring organization.

Copies of industry codes and standards used in a substantive manner in the NRC regulatory process are maintained at—

The NRC Technical Library
Two White Flint North
11545 Rockville Pike
Rockville, MD 20852-2738

These standards are available in the library for reference use by the public. Codes and standards are usually copyrighted and may be purchased from the originating organization or, if they are American National Standards, from—

American National Standards Institute
11 West 42nd Street
New York, NY 10036-8002
www.ansi.org
(212) 642-4900

The NUREG series comprises (1) technical and administrative reports and books prepared by the staff (NUREG–XXXX) or agency contractors (NUREG/CR–XXXX), (2) proceedings of conferences (NUREG/CP–XXXX), (3) reports resulting from international agreements (NUREG/IA–XXXX), (4) brochures (NUREG/BR–XXXX), and (5) compilations of legal decisions and orders of the Commission and Atomic and Safety Licensing Boards and of Directors' decisions under Section 2.206 of NRC's regulations (NUREG–0750).

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

NUREG-0847
Supplement 29

Safety Evaluation Report

Related to the Operation of Watts Bar Nuclear Plant, Unit 2

Docket Number 50-391

Tennessee Valley Authority

Manuscript Completed: October 2015
Date Published: October 2015

Office of Nuclear Reactor Regulation

ABSTRACT

This report supplements the Staff's evaluation of the application filed by the Tennessee Valley Authority (TVA), as applicant and owner, for a license to operate Watts Bar Nuclear Plant (WBN), Unit 2 (Docket No. 50-391). This supplemental evaluation documents the Staff's findings with respect to the applicable elements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.57, which lists the findings the Nuclear Regulatory Commission (NRC) must make to issue an operating license.

The application for a construction permit for WBN, Units 1 and 2 was submitted on May 14, 1971, and constructions permits CPPR-91 and CPPR-92 were issued January 23, 1973. Subsequently, on October 4, 1976, an application for operating licenses for WBN, Units 1 and 2 was submitted by TVA. In its safety evaluation report (SER) published June 1982 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML072060491) and Supplemental SERs (SSERs) 1 through 20, issued by the Office of Nuclear Reactor Regulation (NRR) of the NRC, the NRC staff documented its safety evaluation (SE) and determination that WBN, Unit 1, met all applicable regulations and regulatory guidance. Based on satisfactory findings from all applicable inspections, on February 7, 1996, the NRC issued a full-power operating license (OL) to WBN, Unit 1, authorizing operation up to 100-percent power.

In SSER 21 published February 2009 (ADAMS Accession No. ML090570741), the NRC staff addressed TVA's application for a license to operate WBN, Unit 2, and gave information on the status of the items remaining to be resolved that were outstanding at the time that TVA deferred construction of WBN, Unit 2, and were not evaluated and resolved as part of the licensing of WBN, Unit 1. SSERs 22 to 28 documented the NRC staff's ongoing evaluation and closure of open items in support of TVA's application for a license to operate WBN, Unit 2.

This SSER documents the NRC staff's completion of its review of open items in related to TVA's application for an OL for WBN, Unit 2. In addition to closure of remaining open items, this SSER discusses a revision to the motor operated valve testing program, the fire protection program, the technical specifications, and final SER modifications made by the applicant.

TABLE OF CONTENTS

Page

ABBREVIATIONS

3M	Minnesota Mining and Manufacturing
ABGTS	auxiliary building gas treatment system
AC	alternating current
ACR	auxiliary control room
ACRS	Advisory Committee for Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
AFW	auxiliary feedwater
ALARA	as low as is reasonably achievable
ANSI	American National Standards Institute
ANS	American Nuclear Society
AOR	analysis of record
APCSB	Auxiliary Power Conversion Systems Branch (of NRR)
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AV	analysis volume
BEACON	Westinghouse Best Estimate Analyzer for Core Operations—Nuclear
BL	bulletin
BOP	balance of plant
BTP	Branch Technical Position
BTU	British thermal unit
CAP	corrective action program
CCP	centrifugal charging pump
CCS	component cooling system
CECC	Central Emergency Control Center
CFR	*Code of Federal Regulations*
CI	confirmatory issue
CO_2	carbon dioxide
CP	construction permit
CPU	central processing unit
CRDR	control room design review
CSP	cyber security plan
CSST	common station service transformer
CST	condensate storage tank
DBA	design-basis accident
DCN	design change notice
DCS	distributed control system
DG	diesel generator
DVR	degraded voltage relay
EA	Environmental Assessment
EAL	emergency action level
ECCS	emergency core cooling system
EDG	emergency diesel generator
EMC	electromagnetic compatibility
EMI	electromagnetic interference
EOF	emergency operations facility
EOP	emergency operating procedure
EP	emergency preparedness

EPA	electrical penetration assemblies
EPIP	emergency preparedness implementation procedure
EPRI	Electric Power Research Institute
EPZ	emergency planning zone
EQ	environmental qualification
ERCW	essential raw cooling water
ERDS	emergency response data system
ERFBS	electric raceway fire barrier system
ERO	Emergency Response Organization
ESF	engineered safety feature
ETE	evacuation time estimate
FCV	flow control valve
FEMA	Federal Emergency Management Agency
FHA	fuel-handling accident
FPR	fire protection report
FSAR	final safety analysis report
FSSD	fire safe shutdown
GDC	general design criterion/criteria
GL	generic letter
gpm	gallon per minute
HAB	hostile action based
HFT	hot functional testing
HPFP	high-pressure fire protection
HRCAR	high range containment air radiation
HVAC	heating, ventilation, and air conditioning
ICM	interim compensatory measures
IE	Office of Inspection and Enforcement
IEB	Office of Inspection and Enforcement Bulletin
IEEE	Institute of Electrical and Electronics Engineers
IFR	Interim Finding Report
IITA	in-core instrumentation thimble assembly
IPEEE	individual plant examination of external events
IPS	intake pumping station
ISG	interim staff guidance
JLD	Japan Lessons-learned Directorate
kV	kilovolt
kVA	kilovolt ampere
LAR	license amendment request
LOCA	loss-of-coolant accident
LOOP	loss-of-offsite power
LTOP	low-temperature overpressure protection
LVR	low voltage relay
M&E	mass and energy
MBtu	million British units
MCC	motor control center
MCR	main control room
MOV	motor-operated valve
MSIV	main steam isolation valve
MSO	multiple spurious operation
NEI	Nuclear Energy Institute
NFPA	National Fire Protection Association

NPG	Nuclear Power Group
NPP	nuclear performance plan
NPSH	net positive suction head
NPSHA	net positive suction head available
NRC	U.S. Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NSAL	nuclear safety advisory letter
NTTF	Near-Term Task Force
NUREG	report prepared by NRC staff
OBE	operating-basis earthquake
ODCM	Offsite Dose Calculation Manual
ODS	Operations Duty Specialist
OL	operating license
OMA	operator manual action
OSA	on-shift staffing analysis
PAD	performance analysis and design
PAMS	post-accident monitoring system
PASS	post-accident sampling system
PDR	public document room
PORV	power-operated relief valve
PPM	performance prediction methodology
psi	pressure per square inch
psig	pressure per square inch gauge
PRT	pressurizer relief tank
PTLR	Pressure and Temperature Limits Report
PWR	pressurized-water reactor
QA	quality assurance
RAI	request for additional information
RCP	reactor coolant pump
RCS	reactor coolant system
RCW	raw cooling water
REP	Radiological Emergency Plan
RES	radiant energy shield
RFI	radio frequency interference
RG	Regulatory Guide
RHR	residual heat removal
RPV	reactor pressure vessel
RWST	refueling water storage tank
SE	safety evaluation
SER	safety evaluation report, NUREG-0847, dated June 1982
SFP	spent fuel pool
SG	steam generator
SIAS	Safety Injection Actuation Signal
SPND	self-powered neutron detector
SRM	Staff Requirements Memorandum
SPS	signal processing system
SRP	Standard Review Plan, NUREG-0800
SRS	software requirements specification
SSC	structure, system, and component
SSE	safe shutdown earthquake
SSEP	safety, security, and emergency preparedness

SSER	Supplemental SER
Std.	Standard
TCD	thermal conductivity degradation
TI	Technical Instruction
TMI	Three Mile Island
TPS	Transmission and Power Supply
TS	technical specification
TSO	transmission system operator
TSTF	Technical Specification Task Force
TVA	Tennessee Valley Authority
UFSAR	Updated Final Safety Analysis Report
UL	Underwriter’s Laboratories, Inc.
V	volt
VAC	volt alternating current
VCT	volume control tank
VDC	volt direct current
VPA	ventilation and purge air
V&V	verification and validation
WBA	Web-based ADAMS
WBN	Watts Bar Nuclear Plant
χ/Q	atmospheric dispersion estimate

1 INTRODUCTION AND DISCUSSION

1.1 Introduction

The Watts Bar Nuclear Plant (WBN or Watts Bar) is owned by the Tennessee Valley Authority (TVA) and is located in southeastern Tennessee, approximately 50 miles (80 kilometers) northeast of Chattanooga. The facility consists of two Westinghouse-designed four-loop pressurized-water reactors (PWRs) within ice condenser containments.

In June 1982, the U.S. Nuclear Regulatory Commission (NRC) staff issued safety evaluation report (SER), NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant Units 1 and 2," (Agencywide Documents Access and Management System (ADAMS) Accession No ML072060490) on TVA's application for licenses to operate WBN, Units 1 and 2. In SER Supplements (SSERs) 1 through 20, the NRC staff concluded that WBN, Unit 1, met all applicable regulations and regulatory guidance, and on February 7, 1996, the NRC issued an operating license (OL) to WBN, Unit 1. TVA did not complete WBN, Unit 2. Accordingly, the NRC did not make a final approval or denial of the request for an operating license for WBN, Unit 2.

On March 4, 2009 (ADAMS Accession No. ML090700378), TVA submitted an updated application in support of its request for an OL for WBN, Unit 2, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities."

In SSER 21 which was published in February 2009 (ADAMS Accession No. ML090570741), the NRC staff reported on the WBN, Unit 2, items remaining to be resolved, which were outstanding at the time that TVA deferred construction of Unit 2, and which were not evaluated and resolved as part of the licensing of WBN, Unit 1. In SSERs 22 through 28, the NRC staff documented its evaluation and closure of open items in support of TVA's application for a license to operate WBN, Unit 2.

This SSER documents the NRC staff's completion of its evaluation and closure of open items in response to TVA's application.

The format of this document is consistent with the format and scope outlined in the "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition (NUREG-0800)," dated July 1981 (SRP, NUREG-0800). The NRC staff added additional chapters to address the overall assessment of the facility, nuclear performance plan (NPP) issues, and other generic regulatory topics.

Each of the sections and appendices of this supplement is numbered the same as the SER section that is being updated, and the discussions are supplementary to, and not in lieu of, the discussion in the SER, unless otherwise noted. For example, Appendix E continues to list the principal contributors to the SSER. However, the chronology of the safety review correspondence previously given in Appendix A has been discontinued, and a reference is supplied instead to the NRC's Agencywide Documents Access and Management System (ADAMS) or the Public Document Room (PDR). Public correspondence exchanged between the NRC and TVA is available through ADAMS or the PDR. References listed as "not publicly available” in the SSER contain proprietary information and have been withheld from public disclosure in accordance with 10 CFR 2.390, “Public inspections, exemptions, requests for withholding.”

Appendix HH includes an action items table. This lists all the closed items, confirmatory issues, and proposed license conditions that have been resolved in support of an NRC finding of reasonable assurance on the OL application for WBN, Unit 2.

The NRC’s ADAMS is the agency’s official recordkeeping system. ADAMS has the full text of regulatory and technical documents and reports written by the NRC, NRC contractors, or NRC licensees. Documents include NRC regulatory guides, NUREG-series reports, correspondence, inspection reports, and other materials. These documents are assigned accession numbers and are searchable and accessible in ADAMS. Documents are released periodically during the day in the ADAMS PUBLIC/Legacy Interface Combined (ADAMS PUBLIC) and Web-based ADAMS (WBA) interfaces; they are released once a day in Web-based Publicly Available Records System (PARS). These documents in full text can be searched using ADAMS accession numbers or specific fields and parameters such as docket number and document dates.

More information on ADAMS and help for accessing documents may be obtained on the NRC Public Website at http://www.nrc.gov/reading-rm/adams/faq.html#1.

All WBN documents may be accessed using WBN Docket Nos. 05000390 and 05000391 for Units 1 and 2, respectively.

The WBN, Unit 2, Project Manager is Justin C. Poole, who may be contacted by calling (301) 415-2048, by email to Justin.Poole@nrc.gov, or by writing to the following address:

Mr. Justin Poole
Mail Stop O-8G9A
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

1.7 Summary of Outstanding Issues

NUREG-0847 is the SER for the application filed by TVA, 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 NRC staff documented its previous review and conclusions on the OL application for WBN, Unit 1, in the SER (NUREG-0847, dated June 1982) and its Supplements 1 through 20. Based on these reviews, the NRC staff issued an OL for WBN, Unit 1, in 1996. In the SER and SSERs 1 through 20, the NRC staff also reviewed and approved certain topics for WBN, Unit 2, though no final conclusions were made about an OL for WBN, Unit 2. To establish the remaining scope and the regulatory framework for the NRC staff’s review of an OL for WBN, Unit 2, the NRC staff reviewed the SER and SSERs 1 through 20. Based on this review, the NRC staff identified “resolved” topics (i.e., out of scope for review) and “open” topics (i.e., in scope for NRC staff review) for WBN, Unit 2. Where it was not clear whether the SER topic applied to Unit 2, or not, the NRC staff conservatively identified it as “open” pending further evaluation. It should be noted that these were not technical evaluations of each topic; rather, it was a status review to determine whether the topic was “open” or “resolved.” The NRC staff documented this evaluation in SSER 21 as the baseline for resumption of the review of the OL application for

Unit 2. Thus, SSER 21 reflects the status of the NRC staff's review of WBN, Unit 2, up to 1995. The NRC staff notes that a subsequent, more detailed assessment found some topics conservatively identified in the initial assessment as "open" should be redefined as "closed." Conversely, the NRC staff notes that there have been circumstances that resulted in the need to reopen some previously closed topic areas that may have been adequately documented and that are considered closed in SSER 21. Such cases are identified by a footnote in the relevant SSER to document that previous "open" topics have been recategorized as "closed" without requiring further review, or vice versa.

The SER and SSERs 1 through 20 evaluated the changes to the final safety analysis report (FSAR) until Amendment No. 91. FSAR Amendment No. 91 was the initial licensing basis for WBN, Unit 1. At this time, the FSAR was applicable to both Units 1 and 2. As part of its updated OL application for WBN, Unit 2, TVA split FSAR Amendment No. 91 into two separate FSARs – one for WBN, Unit 1, and one for WBN, Unit 2. TVA has submitted WBN, Unit 2, FSAR Amendment Nos. 92 through 114 to address the "open" topics in support of its OL application for WBN, Unit 2. These FSAR amendments reflect changes that have occurred since 1995. Reviews of FSAR changes that have been completed by the NRC staff are documented in SSERs 22 through 29.

Additional general topics (e.g., financial qualifications that were not included in SSER 21, but that should be resolved before issuance of an OL) are also identified in SSER 22 and subsequent supplements.

SSER 21 initially contained the table below documenting the status of each SER topic. The relevant document in which the topic was last addressed is shown in parentheses. This table was maintained in supplements subsequent to SSER 21 to reflect the status of review for each topic.

ISSUE STATUS TABLE

	Issue	Status		Section	Note
(1)	Site Envelope			2	
(2)	Geography and Demography	Resolved	(SSER 22)	2.1	
(3)	Site Location and Description	Resolved	(SER) (SSER 22)	2.1.1	3
(4)	Exclusion Area Authority and Control	Resolved	(SER) (SSER 22)	2.1.2	3
(5)	Population Distribution	Resolved	(SER) (SSER 22)	2.1.3	
(6)	Conclusions	Resolved	(SER) (SSER 22)	2.1.4	
(7)	Nearby Industrial, Transportation, and Military Facilities	Resolved	(SSER 22)	2.2	
(8)	Transportation Routes	Resolved	(SER) (SSER 22)	2.2.1	
(9)	Nearby Facilities	Resolved	(SER) (SSER 22)	2.2.2	
(10)	Conclusions	Resolved	(SER) (SSER 22)	2.2.3	

	Issue	Status		Section	Note
(11)	Meteorology	Resolved	(SER) (SSER 22)	2.3	
(12)	Regional Climatology	Resolved	(SER) (SSER 22)	2.3.1	
(13)	Local Meteorology	Resolved	(SER) (SSER 22)	2.3.2	
(14)	Onsite Meteorological Measurements Program	Resolved	(SER) (SSER 22) (SSER 25)	2.3.3	
(15)	Short-Term (Accident) Atmospheric Diffusion Estimates	Resolved	(SER) (SSER 14) (SSER 22)	2.3.4	
(16)	Long-Term (Routine) Diffusion Estimates	Resolved	(SER) (SSER 14) (SSER 22)	2.3.5	
(17)	Hydrologic Engineering	Resolved	(SSER 27) (SSER 28)	2.4	
(18)	Introduction	Resolved	(SER)	2.4.1	
(19)	Hydrologic Description	Resolved	(SER)	2.4.2	
(20)	Flood Potential	Resolved	(SER)	2.4.3	
(21)	Local Intense Precipitation in Plant Area	Resolved	(SER)	2.4.4	1
(22)	Roof Drainage	Resolved	(SER)	2.4.5	1
(23)	Ultimate Heat Sink	Resolved	(SER)	2.4.6	
(24)	Groundwater	Resolved	(SER)	2.4.7	1
(25)	Design Basis for Subsurface Hydrostatic Loading	Resolved	(SER) (SSER 3)	2.4.8	
(26)	Transport of Liquid Releases	Resolved	(SER) (SSER 22)	2.4.9	2
(27)	Flooding Protection Requirements	Resolved	(SER) (SSER 24) (SSER 27) (SSER 28)	2.4.10	
(28)	Geological, Seismological, and Geotechnical Engineering	Resolved	(SER) (SSER 24)	2.5	
(29)	Geology	Resolved	(SER)	2.5.1	
(30)	Seismology	Resolved	(SER)	2.5.2	
(31)	Surface Faulting	Resolved	(SER)	2.5.3	
(32)	Stability of Subsurface Materials and Foundations	Resolved	(SER) (SSER 3) (SSER 9) (SSER 11)	2.5.4	
(33)	Stability of Slopes	Resolved	(SER)	2.5.5	
(34)	Embankments and Dams	Resolved	(SER) (SSER 22)	2.5.6	
(35)	References		(SER) (SSER 22)	2.6	

	Issue	Status		Section	Note
(36)	Design Criteria - Structures, Components, Equipment, and Systems			3	
(37)	Introduction			3.1	
(38)	Conformance With General Design Criteria	Resolved	(SER)	3.1.1	
(39)	Conformance With Industry Codes and Standards	Resolved	(SER)	3.1.2	
(40)	Classification of Structures, Systems and Components	Resolved	(SSER 14) (SSER 22)	3.2	
(41)	Seismic Classifications	Resolved	(SER) (SSER 3) (SSER 5) (SSER 6) (SSER 8)	3.2.1	
(42)	System Quality Group Classification	Resolved	(SER) (SSER 3) (SSER 6) (SSER 7) (SSER 9) (SSER 22)	3.2.2	
(43)	Wind and Tornado Loadings			3.3	
(44)	Wind Loading	Resolved	(SER)	3.3.1	
(45)	Tornado Loading	Resolved	(SER)	3.3.2	
(46)	Flood Level (Flood) Design			3.4	
(47)	Flood Protection	Resolved	(SER)	3.4.1	
(48)	Missile Protection			3.5	
(49)	Missile Selection and Description	Resolved	(SER) (SSER 9) (SSER 14) (SSER 22)	3.5.1	
(50)	Structures, Systems, and Components to be Protected from Externally Generated Missiles	Resolved	(SER) (SSER 2) (SSER 22)	3.5.2	
(51)	Barrier Design Procedures	Resolved	(SER)	3.5.3	
(52)	Protection Against the Dynamic Effects Associated with the Postulated Rupture of Piping	Resolved	(SER) (SSER 6) (SSER 11)	3.6	
(53)	Plant Design for Protection Against Postulated Piping Failures in Fluid System Outside Containment	Resolved	(SER) (SSER 14) (SSER 22)	3.6.1	
(54)	Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping	Resolved	(SER) (SSER 14) (SSER 22)	3.6.2	3

	Issue	Status		Section	Note
(55)	Leak-Before-Break Evaluation Procedures	Resolved	(SSER 5) (SSER 12) (SSER 22) (SSER 24)	3.6.3	
(56)	Seismic Design	Resolved	(SER) (SSER 6)	3.7	2
(57)	Seismic Input	Resolved	(SER) (SSER 6) (SSER 9) (SSER 16)	3.7.1	2
(58)	Seismic Analysis	Resolved	(SER) (SSER 6) (SSER 8) (SSER 11) (SSER 16)	3.7.2	2
(59)	Seismic Subsystem Analysis	Resolved	(SER) (SSER 6) (SSER 7) (SSER 8) (SSER 9) (SSER 12) (SSER 22)	3.7.3	
(60)	Seismic Instrumentation	Resolved	(SER)	3.7.4	1
(61)	Design of Seismic Category I Structures	Resolved	(SER) (SSER 9)	3.8	2
(62)	Steel Containment	Resolved	(SER) (SSER 3)	3.8.1	
(63)	Concrete and Structural Steel Internal Structures	Resolved	(SER) (SSER 7)	3.8.2	
(64)	Other Seismic Category I Structures	Resolved	(SER) (SSER 14) (SSER 16) (SSER 29)	3.8.3	
(65)	Foundations	Resolved	(SER)	3.8.4	
(66)	Mechanical Systems and Components	Resolved	(SER)	3.9	
(67)	Special Topics for Mechanical Components	Resolved	(SER) (SSER 6) (SSER 13) (SSER 22)	3.9.1	
(68)	Dynamic Testing and Analysis of Systems, Components, and Equipment	Resolved	(SER) (SSER 14) (SSER 22)	3.9.2	

	Issue	Status		Section	Note
(69)	ASME Code Class 1, 2, and 3 Components, Component Structures, and Core Support Structures	Resolved	(SER) (SSER 3) (SSER 4) (SSER 6) (SSER 7) (SSER 8) (SSER 15) (SSER 22) (SSER 29)	3.9.3	
(70)	Control Rod Drive Systems	Resolved	(SER)	3.9.4	
(71)	Reactor Pressure Vessel Internals	Resolved	(SER) (SSER 23) (SSER 26)	3.9.5	
(72)	Inservice Testing of Pumps and Valves	Resolved	(SER) (SSER 5) (SSER 12) (SSER 14) (SSER 18) (SSER 20) (SSER 22) (SSER 27)	3.9.6	
(73)	Seismic and Dynamic Qualification of Seismic Category I Mechanical and Electrical Equipment	Resolved	(SER) (SSER 1) (SSER 3) (SSER 4) (SSER 5) (SSER 6) (SSER 8) (SSER 9) (SSER 23)	3.10	
(74)	Environmental Qualification of Mechanical and Electrical Equipment	Resolved	(SSER 15) (SSER 22) (SSER 27)	3.11	
(75)	Threaded Fasteners — ASME Code Class 1, 2, and 3	Resolved	(SSER 22)	3.13	
(76)	Reactor			4	
(77)	Introduction		(SER) (SSER 23)	4.1	
(78)	Fuel System Design	Resolved	(SSER 23) (SSER 27)	4.2	
(79)	Description	Resolved	(SER) (SSER 13) (SSER 23)	4.2.1	
(80)	Thermal Performance	Resolved	(SER) (SSER 2) (SSER 23) (SSER 27)	4.2.2	

	Issue	Status		Section	Note
(81)	Mechanical Performance	Resolved	(SER) (SSER 2) (SSER 10) (SSER 13) (SSER 23)	4.2.3	
(82)	Surveillance	Resolved	(SER) (SSER 2) (SSER 23)	4.2.4	
(83)	Fuel Design Considerations	Resolved	(SER) (SSER 23)	4.2.5	
(84)	Nuclear Design	Resolved	(SSER 23)	4.3	
(85)	Design Basis	Resolved	(SER) (SSER 13) (SSER 23)	4.3.1	
(86)	Design Description	Resolved	(SER) (SSER 13) (SSER 15) (SSER 23)	4.3.2	
(87)	Analytical Methods	Resolved	(SER) (SSER 23)	4.3.3	
(88)	Summary of Evaluation Findings	Resolved	(SER) (SSER 23)	4.3.4	
(89)	Thermal-Hydraulic Design	Resolved	(SSER 23)	4.4	
(90)	Performance in Safety Criteria	Resolved	(SER) (SSER 23)	4.4.1	
(91)	Design Bases	Resolved	(SER) (SSER 12) (SSER 23)	4.4.2	
(92)	Thermal-Hydraulic Design Methodology	Resolved	(SER) (SSER 6) (SSER 8) (SSER 12) (SSER 13) (SSER 16) SE dated 6/13/89 (SSER 23)	4.4.3	
(93)	Operating Abnormalities	Resolved	(SER) (SSER 13) (SSER 23)	4.4.4	
(94)	Loose Parts Monitoring System	Resolved	(SER) (SSER 3) (SSER 5) (SSER 16) (SSER 23)	4.4.5	
(95)	Thermal-Hydraulic Comparison	Resolved	(SER) (SSER 23)	4.4.6	

	Issue	Status		Section	Note
(96)	N-1 Loop Operation	Resolved	(SER) (SSER 23)	4.4.7	
(97)	Instrumentation for Inadequate Core Cooling Detection (Three Mile Island ((TMI) Action Item II.F.2)	Resolved	(SER) (SSER 10) (SSER 23) (SSER 27)	4.4.8	
(98)	Summary and Conclusion	Resolved	(SER) (SSER 23) (SSER 25)	4.4.9	
(99)	Reactor Materials			4.5	
(100)	Control Rod Drive Structural Materials	Resolved	(SER)	4.5.1	1
(101)	Reactor Internals and Core Support Materials	Resolved	(SER)	4.5.2	
(102)	Functional Design of Reactivity Control Systems	Resolved	(SER) (SSER 23)	4.6	
(103)	Reactor Coolant System and Connected Systems			5	
(104)	Summary Description	Resolved	(SER) (SSER 5) (SSER 6)	5.1	2
(105)	Integrity of Reactor Coolant Pressure Boundary			5.2	
(106)	Compliance with Codes and Code Cases	Resolved	(SER) (SSER 22)	5.2.1	
(107)	Overpressurization Protection	Resolved	(SER) (SSER 2) (SSER 15) (SSER 24)	5.2.2	
(108)	Reactor Coolant Pressure Boundary Materials	Resolved	(SER) (SSER 22)	5.2.3	
(109)	Reactor Coolant System Pressure Boundary Inservice Inspection and Testing	Resolved	(SER) (SSER 10) (SSER 12) (SSER 15) (SSER 16) (SSER 23)	5.2.4	
(110)	Reactor Coolant Pressure Boundary Leakage Detection	Resolved	(SER) (SSER 9) (SSER 11) (SSER 12) (SSER 22)	5.2.5	
(111)	Reactor Vessel			5.3	
(112)	Reactor Vessel Materials	Resolved	(SER) (SSER 11) (SSER 14) (SSER 22) (SSER 25)	5.3.1	

	Issue	Status		Section	Note
(113)	Pressure-Temperature Limits	Resolved	(SER) (SSER 16) (SSER 22) (SSER 25)	5.3.2	
(114)	Reactor Vessel Integrity	Resolved	(SER) (SSER 22)	5.3.3	
(115)	Component and Subsystem Design			5.4	
(116)	Reactor Coolant Pumps	Resolved	(SER) (SSER 22)	5.4.1	2
(117)	Steam Generators	Resolved	(SER) (SSER 1) (SSER 4) (SSER 22)	5.4.2	
(118)	Residual Heat Removal System	Resolved	(SER) (SSER 2) (SSER 5) (SSER 10) (SSER 11) (SSER 23)	5.4.3	
(119)	Pressurizer Relief Tank	Resolved	(SER) (SSER 22)	5.4.4	
(120)	Reactor Coolant System Vents (TMI Action Item II.B.1)	Resolved	(SER) (SSER 2) (SSER 5) (SSER 12) (SSER 23)	5.4.5	
(121)	Engineered Safety Features			6	
(122)	Engineered Safety Feature Materials			6.1	
(123)	Metallic Materials	Resolved	(SER) (SSER 23) (SSER 27)	6.1.1	
(124)	Organic Materials	Resolved	(SER) (SSER 22)	6.1.2	
(125)	Postaccident Emergency Cooling Water Chemistry	Resolved	(SER) (SSER 22) (SSER 29)	6.1.3	
(126)	Containment Systems			6.2	
(127)	Containment Functional Design	Resolved	(SER) (SSER 3) (SSER 5) (SSER 7) (SSER 12) (SSER 14) (SSER 15) (SSER 22) (SSER 29)	6.2.1	

	Issue	Status		Section	Note
(128)	Containment Heat Removal Systems	Resolved	(SER) (SSER 7) (SSER 22) (SSER 29)	6.2.2	
(129)	Secondary Containment Functional Design	Resolved	(SER) (SSER 18) (SSER 22) (SSER 29)	6.2.3	
(130)	Containment Isolation Systems	Resolved	(SER) (SSER 3) (SSER 5) (SSER 7) (SSER 12) (SSER 22) (SSER 29)	6.2.4	
(131)	Combustible Gas Control Systems	Resolved	(SER) (SSER 4) (SSER 5) (SSER 8) (SSER 22) (SSER 29)	6.2.5	
(132)	Containment Leakage Testing	Resolved	(SER) (SSER 4) (SSER 5) (SSER 19) (SSER 22) (SSER 26) (SSER 29)	6.2.6	
(133)	Fracture Prevention of Containment Pressure Boundary	Resolved	(SER) (SSER 4) (SSER 23)	6.2.7	1
(134)	Emergency Core Cooling System	Resolved	(SER)	6.3	1
(135)	System Design	Resolved	(SER) (SSER 6) (SSER 7) (SSER 11) (SSER 29)	6.3.1	
(136)	Evaluation	Resolved	(SER) (SSER 5)	6.3.2	1
(137)	Testing	Resolved	(SER) (SSER 2) (SSER 9) (SSER 29)	6.3.3	
(138)	Performance Evaluation	Resolved	(SER)	6.3.4	
(139)	Conclusions	Resolved	(SER)	6.3.5	

	Issue	Status		Section	Note
(140)	Control Room Habitability	Resolved	(SER) (SSER 5) (SSER 11) (SSER 16) (SSER 18 (SSER 22) (SSER 29)	6.4	
(141)	Engineered Safety Feature (ESF) Filter Systems			6.5	
(142)	ESF Atmosphere Cleanup System	Resolved	(SER) (SSER 5) (SSER 22) (SSER 29)	6.5.1	
(143)	Fission Product Cleanup System	Resolved	(SER)	6.5.2	1
(144)	Fission Product Control System	Resolved	(SER) (SSER 22) (SSER 26)	6.5.3	
(145)	Ice Condenser as a Fission Product Cleanup System	Resolved	(SER)	6.5.4	1
(146)	Inservice Inspection of Class 2 and 3 Components	Resolved	(SER) (SSER 10) (SSER 12) (SSER 15) (SSER 23)	6.6	
(147)	Instrumentation and Controls			7	
(148)	Introduction			7.1	
(149)	General	Resolved	(SER) (SSER 13) (SSER 16) (SSER 23)	7.1.1	
(150)	Comparison with Other Plants	Resolved	(SER) (SSER 23)	7.1.2	1
(151)	Design Criteria	Resolved	(SER) (SSER 4) (SSER 15) (SSER 23)	7.1.3	
(152)	Reactor Trip System	Resolved	(SER)	7.2	
(153)	System Description	Resolved	(SER) (SSER 13) (SSER 15) (SSER 23) (SSER 27)	7.2.1	
(154)	Manual Trip Switches	Resolved	(SER) (SSER 23)	7.2.2	1
(155)	Testing of Reactor Trip Breaker Shunt Coils	Resolved	(SER) (SSER 23)	7.2.3	1
(156)	Anticipatory Trips	Resolved	(SER) (SSER 23)	7.2.4	

	Issue	Status		Section	Note
(157)	Steam Generator Water Level Trip	Resolved	(SER) (SSER 2) (SSER 14) (SSER 23)	7.2.5	
(158)	Conclusions	Resolved	(SER) (SSER 13) (SSER 23)	7.2.6	
(159)	Engineered Safety Features System	Resolved	(SER) (SSER 13)	7.3	
(160)	System Description	Resolved	(SER) (SSER 13) (SSER 14) (SSER 23)	7.3.1	
(161)	Containment Sump Level Measurement	Resolved	(SER) (SSER 2) (SSER 23)	7.3.2	
(162)	Auxiliary Feedwater Initiation and Control	Resolved	(SER) (SSER 23)	7.3.3	1
(163)	Failure Modes and Effects Analysis	Resolved	(SER) (SSER 23)	7.3.4	
(164)	Office of Inspection and Enforcement (IE) Bulletin 80-06	Resolved	(SER) (SSER 3) (SSER 23)	7.3.5	
(165)	Conclusions	Resolved	(SER) (SSER 13) (SSER 23)	7.3.6	
(166)	Systems Required for Safe Shutdown			7.4	
(167)	System Description	Resolved	(SER) (SSER 23)	7.4.1	
(168)	Safe Shutdown from Auxiliary Control Room	Resolved	(SER) (SSER 7) (SSER 23)	7.4.2	
(169)	Conclusions	Resolved	(SER) (SSER 23)	7.4.3	
(170)	Safety-Related Display Instrumentation			7.5	
(171)	Display Systems	Resolved	(SER) (SSER 23)	7.5.1	
(172)	Postaccident Monitoring System	Resolved	(SER) (SSER 7) (SSER 9) (SSER 14) (SSER 15) (SSER 23) (SSER 25) (SSER 27) (SSER 29)	7.5.2	

	Issue	Status		Section	Note
(173)	IE Bulletin 79-27	Resolved	(SER) (SSER 23) (SSER 27)	7.5.3	
(174)	Conclusions	Resolved	(SER)	7.5.4	
(175)	All Other Systems Required for Safety			7.6	
(176)	Loose Part Monitoring System	Resolved	(SER) (SSER 23) (SSER 24)	7.6.1	
(177)	Residual Heat Removal System Bypass Valves	Resolved	(SER) (SSER 23)	7.6.2	
(178)	Upper Head Injection Manual Control	Resolved	(SER) (SSER 23)	7.6.3	
(179)	Protection Against Spurious Actuation of Motor-Operated Valves	Resolved	(SER) (SSER 23)	7.6.4	
(180)	Overpressure Protection during Low Temperature Operation	Resolved	(SER) (SSER 4) (SSER 23)	7.6.5	
(181)	Valve Power Lockout	Resolved	(SER) (SSER 23)	7.6.6	
(182)	Cold Leg Accumulator Valve Interlocks and Position Indication	Resolved	(SER) (SSER 23)	7.6.7	
(183)	Automatic Switchover From Injection to Recirculation Mode	Resolved	(SER) (SSER 23)	7.6.8	
(184)	Conclusions	Resolved	(SER) (SSER 4)	7.6.9	
(185)	Control Systems Not Required for Safety			7.7	
(186)	System Description	Resolved	(SER) (SSER 23) (SSER 24) (SSER 25) (SSER 27) (SSER 29)	7.7.1	
(187)	Safety System Status Monitoring System	Resolved	(SER) (SSER 7) (SSER 13) (SSER 23)	7.7.2	
(188)	Volume Control Tank Level Control System	Resolved	(SER) (SSER 23)	7.7.3	
(189)	Pressurizer and Steam Generator Overfill	Resolved	(SER) (SSER 23)	7.7.4	
(190)	IE Information Notice 79-22	Resolved	(SER) (SSER 23)	7.7.5	
(191)	Multiple Control System Failures	Resolved	(SER) (SSER 23)	7.7.6	
(192)	Conclusions	Resolved	(SER)	7.7.7	

	Issue	Status		Section	Note
(193)	Anticipated Transient Without Scram Mitigation System Actuation Circuitry (AMSAC)	Resolved	(SSER 9) (SSER 14) (SSER 23)	7.7.8	
(194)	NUREG-0737 Items	Resolved	(SER) (SSER 23)	7.8	
(195)	Relief and Safety Valve Position Indication (TMI Action Item II.D.3)	Resolved	(SER) (SSER 5) (SSER 14) (SSER 23)	7.8.1	
(196)	Auxiliary Feedwater System Initiation and Flow Indication (TMI Action Item II.E.1.2)	Resolved	(SER) (SSER 23) (SSER 29)	7.8.2	
(197)	Proportional Integral Derivative Control Modification (TMI Action Item II.K.3.9)	Resolved	(SER) (SSER 23)	7.8.3	
(198)	Proposed Anticipatory Trip Modification (TMI Action Item II.K.3.10)	Resolved	(SER) (SSER 4) (SSER 23)	7.8.4	
(199)	Confirm Existence of Anticipatory Reactor Trip Upon Turbine Trip (TMI Action Item II.K.3.12)	Resolved	(SER) (SSER 23)	7.8.5	
(200)	Data Communication Systems		(SSER 23)	7.9	
(201)	Electric Power Systems			8	
(202)	General	Resolved	(SER) (SSER 22) (SSER 24) (SSER 27)	8.1	
(203)	Offsite Power System	Resolved	(SER) (SSER 22)	8.2	
(204)	Compliance with GDC 5	Resolved	(SER) (SSER 13) (SSER 22)	8.2.1	
(205)	Compliance with GDC 17	Resolved	(SER) (SSER 2) (SSER 3) (SSER 13) (SSER 14) (SSER 15 (SSER 22) (SSER 27)	8.2.2	
(206)	Compliance with GDC 18	Resolved	(SER) (SSER 22)	8.2.3	
(207)	Evaluation Findings	Resolved	(SER) (SSER 22)	8.2.4	
(208)	Onsite Power Systems	Resolved	(SER) (SSER 10) (SSER 19) (SSER 22)	8.3	

	Issue	Status		Section	Note
(209)	Onsite AC Power System Compliance with GDC 17	Resolved	(SER) (SSER 2) (SSER 7) (SSER 9) (SSER 10) (SSER 13) (SSER 14) (SSER 18) (SSER 20) (SSER 22) (SSER 27) (SSER 28) (SSER 29)	8.3.1	
(210)	Onsite Direct Current System Compliance with GDC 17	Resolved	(SER) (SSER 2) (SSER 3) (SSER 13) (SSER 14) (SSER 22)	8.3.2	
(211)	Common Electrical Features and Requirements	Resolved	(SER) (SSER 2) (SSER 3) (SSER 7) (SSER 13) (SSER 14) (SSER 15) (SSER 16) (SSER 22)	8.3.3	
(212)	Evaluation Findings	Resolved	(SER) (SSER 2) (SSER 3) (SSER 7) (SSER 13) (SSER 14) (SSER 15) (SSER 16) (SSER 22)	8.3.4	
(213)	Station Blackout	Resolved	(SSER 22)	8.4	
(214)	Auxiliary Systems	Resolved	(SER) (SSER 10)	9	
(215)	Fuel Storage Facility			9.1	
(216)	New-Fuel Storage	Resolved	(SER)	9.1.1	1
(217)	Spent-Fuel Storage	Resolved	(SER) (SSER 5) (SSER 15) (SSER 16) (SSER 22)	9.1.2	

	Issue	Status		Section	Note
(218)	Spent Fuel Pool Cooling and Cleanup System	Resolved	(SER) (SSER 11) (SSER 15) (SSER 23) (SSER 26)	9.1.3	
(219)	Fuel-Handling System	Resolved	(SER) (SSER 3) (SSER 13) (SSER 22) (SSER 24)	9.1.4	
(220)	Water Systems			9.2	
(221)	Essential Raw Cooling Water and Raw Cooling Water System	Resolved	(SER) (SSER 9) (SSER 10) (SSER 18) (SSER 23) (SSER 27) (SSER 29)	9.2.1	
(222)	Component Cooling System (Reactor Auxiliaries Cooling Water System)	Resolved	(SER) (SSER 5) (SSER 23) (SSER 27) (SSER 29)	9.2.2	
(223)	Demineralized Water Makeup System	Resolved	(SER) (SSER 22)	9.2.3	
(224)	Potable and Sanitary Water Systems	Resolved	(SER) (SSER 9) (SSER 22)	9.2.4	
(225)	Ultimate Heat Sink	Resolved	(SER) (SSER 23) (SSER 27)	9.2.5	
(226)	Condensate Storage Facilities	Resolved	(SER) (SSER 12) (SSER 22) (SSER 29)	9.2.6	
(227)	Process Auxiliaries			9.3	
(228)	Compressed Air System	Resolved	(SER) (SSER 22)	9.3.1	1
(229)	Process Sampling System	Resolved	(SER) (SSER 3) (SSER 5) (SSER 14) (SSER 16) (SSER 24)	9.3.2	
(230)	Equipment and Floor Drainage System	Resolved	(SER) (SSER 22)	9.3.3	3
(231)	Chemical and Volume Control System	Resolved	(SER) (SSER 22)	9.3.4	3

	Issue	Status		Section	Note
(232)	Heat Tracing	Resolved	(SSER 22)	9.3.8	
(233)	Heating, Ventilation, and Air Conditioning Systems			9.4	
(234)	Control Room Area Ventilation System	Resolved	(SER) (SSER 9) (SSER 22)	9.4.1	
(235)	Fuel-Handling Area Ventilation System	Resolved	(SER) (SSER 22)	9.4.2	
(236)	Auxiliary Building and Radwaste Area Ventilation System	Resolved	(SER) (SSER 22)	9.4.3	
(237)	Turbine Building Area Ventilation System	Resolved	(SER) (SSER 22)	9.4.4	
(238)	Engineered Safety Features Ventilation System	Resolved	(SER) (SSER 9) (SSER 10) (SSER 11) (SSER 14) (SSER 16) (SSER 19) (SSER 22)	9.4.5	
(239)	Reactor Building Purge Ventilation System	Resolved	(SSER 22)	9.4.6	
(240)	Containment Air Cooling System	Resolved	(SSER 22)	9.4.7	
(241)	Condensate Demineralizer Waste Evaporator Building Environmental Control System	Resolved	(SSER 22)	9.4.8	
(242)	Other Auxiliary Systems			9.5	
(243)	Fire Protection	Resolved	(SER) (SSER 10) (SSER 18) (SSER 19) (SSER 26) (SSER 29)	9.5.1	3
(244)	Communications System	Resolved	(SER) (SSER 5)	9.5.2	1
(245)	Lighting System	Resolved	(SER) (SSER 22)	9.5.3	
(246)	Emergency Diesel Engine Fuel Oil Storage and Transfer System	Resolved	(SER) (SSER 5) (SSER 9) (SSER 10) (SSER 11) (SSER 12) (SSER 22)	9.5.4	2
(247)	Emergency Diesel Engine Cooling Water System	Resolved	(SER) (SSER 5) (SSER 11)	9.5.5	1

	Issue	Status		Section	Note
(248)	Emergency Diesel Engine Starting Systems	Resolved	(SER) (SSER 5) (SSER 10) (SSER 22)	9.5.6	2
(249)	Emergency Diesel Engine Lubricating Oil System	Resolved	(SER) (SSER 3) (SSER 5) (SSER 10) (SSER 22)	9.5.7	2
(250)	Emergency Diesel Engine Combustion Air Intake and Exhaust System	Resolved	(SER) (SSER 5) (SSER 10) (SSER 22)	9.5.8	2
(251)	Steam and Power Conversion System			10	
(252)	Summary Description	Resolved	(SER)	10.1	
(253)	Turbine Generator	Resolved	(SER) (SSER 5)	10.2	
(254)	Turbine Generator Design	Resolved	(SER) (SSER 12) (SSER 22)	10.2.1	
(255)	Turbine Disc Integrity	Resolved	(SER) (SSER 23)	10.2.2	
(256)	Main Steam Supply System	Resolved	(SER)	10.3	
(257)	Main Steam Supply System (Up to and Including the Main Steam Isolation Valves)	Resolved	(SER) (SSER 19) (SSER 22)	10.3.1	
(258)	Main Steam Supply System	Resolved	(SER) (SSER 22)	10.3.2	2
(259)	Steam and Feedwater System Materials	Resolved	(SER) (SSER 22)	10.3.3	
(260)	Secondary Water Chemistry	Resolved	(SER) (SSER 5) (SSER 22)	10.3.4	
(261)	Other Features			10.4	
(262)	Main Condenser	Resolved	(SER) (SSER 9) (SSER 22)	10.4.1	
(263)	Main Condenser Evacuation System	Resolved	(SER) (SSER 22)	10.4.2	
(264)	Turbine Gland Sealing System	Resolved	(SER) (SSER 22)	10.4.3	
(265)	Turbine Bypass System	Resolved	(SER) (SSER 5) (SSER 22)	10.4.4	
(266)	Condenser Circulating Water System	Resolved	(SER) (SSER 22)	10.4.5	

	Issue	Status		Section	Note
(267)	Condensate Cleanup System	Resolved	(SER) (SSER 22) (SSER 27)	10.4.6	
(268)	Condensate and Feedwater Systems	Resolved	(SER) (SSER 14) (SSER 22)	10.4.7	
(269)	Steam Generator Blowdown System	Resolved	(SER) (SSER 22) (SSER 24)	10.4.8	
(270)	Auxiliary Feedwater System	Resolved	(SER) (SSER 14) (SSER 23) (SSER 24) (SSER 29)	10.4.9	
(271)	Heater Drains and Vents	Resolved	(SSER 22)	10.4.10	
(272)	Steam Generator Wet Layup System	Resolved	(SSER 22)	10.4.11	
(273)	Radioactive Waste Management			11	
(274)	Summary Description	Resolved	(SER) (SSER 16) (SSER 24)	11.1	2
(275)	Liquid Waste Management	Resolved	(SER) (SSER 4) (SSER 16) (SSER 24)	11.2	
(276)	Gaseous Waste Management	Resolved	(SER) (SSER 8) (SSER 16) (SSER 24) (SSER 25) (SSER 27)	11.3	
(277)	Solid Waste Management System	Resolved	(SER) (SSER 16) (SSER 24)	11.4	
(278)	Process and Effluent Radiological Monitoring and Sampling Systems	Resolved	(SER) (SSER 16) (SSER 20) (SSER 24)	11.5	
(279)	Evaluation Findings	Resolved	(SER) (SSER 8) (SSER 16)	11.6	
(280)	NUREG-0737 Items	Resolved	(SER)	11.7	
(281)	Wide-Range Noble Gas, Iodine, and Particulate Effluent Monitors (TMI Action Item II.F.1.1, II.F.1.2.a, and II.F.1.2.b)	Resolved	(SER) (SSER 5) (SSER 6) (SSER 29)	11.7.1	

	Issue	Status		Section	Note
(282)	Primary Coolant Outside Containment (TMI Action Item III.D.1.1)	Resolved	(SER) (SSER 5) (SSER 6) (SSER 10) (SSER 16) (SSER 29)	11.7.2	
(283)	Radiation Protection			12	
(284)	General	Resolved	(SER) (SSER 10) (SSER 14) (SSER 24)	12.1	
(285)	Ensuring that Occupational Radiation Doses Are As Low As Reasonably Achievable (ALARA)	Resolved	(SER) (SSER 14) (SSER 24)	12.2	2
(286)	Radiation Sources	Resolved	(SER) (SSER 14) (SSER 24)	12.3	
(287)	Radiation Protection Design Features	Resolved	(SER) (SSER 10) (SSER 14) (SSER 18) (SSER 24) (SSER 26)	12.4	
(288)	Dose Assessment	Resolved	(SER) (SSER 14) (SSER 24) (SSER 27)	12.5	
(289)	Health Physics Program	Resolved	(SER) (SSER 10) (SSER 14) (SSER 24) (SSER 26)	12.6	
(290)	NUREG-0737 Items			12.7	
(291)	Plant Shielding (TMI Action Item II.B.2)	Resolved	(SER) (SSER 14) (SSER 16) (SSER 24) (SSER 27) (SSER 29)	12.7.1	
(292)	High Range In-Containment Monitor (TMI Action Item II.F.1.2.c)	Resolved	(SER) (SSER 5) (SSER 29)	12.7.2	
(293)	In-Plant Radioiodine Monitor (TMI Action Item III.D.3.3)	Resolved	(SER) (SSER 16) (SSER 29)	12.7.3	
(294)	Conduct of Operations			13	

	Issue	Status		Section	Note
(295)	Organization Structure of the Applicant	Resolved	(SER) (SSER 16) (SSER 22)	13.1	
(296)	Management and Technical Organization	Resolved	(SER)	13.1.1	
(297)	Corporate Organization and Technical Support	Resolved	(SER)	13.1.2	
(298)	Plant Staff Organization	Resolved	(SER) (SSER 8) (SSER 22) (SSER 25) (SSER 27)	13.1.3	
(299)	Training			13.2	
(300)	Licensed Operator Training Program	Resolved	(SER) (SSER 9) (SSER 10) (SSER 22)	13.2.1	
(301)	Training for Non-licensed Personnel	Resolved	(SER)	13.2.2	
(302)	Emergency Preparedness Evaluation			13.3	
(303)	Introduction	Resolved	(SER) (SSER 13) (SSER 20) (SSER 28)	13.3.1	
(304)	Evaluation of the Emergency Plan	Resolved	(SER) (SSER 13) (SSER 20) (SSER 22) (SSER 28)	13.3.2	
(305)	Conclusions	Resolved	(SER) (SSER 13) (SSER 20) (SSER 22) (SSER 28)	13.3.3	
(306)	Review and Audit	Resolved	(SER) (SSER 8) (SSER 22)	13.4	
(307)	Plant Procedures	Resolved	(SER) (SSER 22)	13.5	
(308)	Administrative Procedures	Resolved	(SER) (SSER 22)	13.5.1	
(309)	Operating and Maintenance Procedures	Resolved	(SER) (SSER 9) (SSER 10) (SSER 22)	13.5.2	

	Issue	Status		Section	Note
(310)	NUREG-0737 Items	Resolved	(SER) (SSER 3) (SSER 16) (SSER 22)	13.5.3	
(311)	Physical Security Plan	Resolved	(SER) (SSER 1) (SSER 10) (SSER 15) (SSER 20) (SSER 22)	13.6	
(312)	Introduction	Resolved	(SSER 22)	13.6.1	
(313)	Summary of Application	Resolved	(SSER 22)	13.6.2	
(314)	Regulatory Basis	Resolved	(SSER 22)	13.6.3	
(315)	Technical Evaluation	Resolved	(SSER 22)	13.6.4	
(316)	Conclusions	Resolved	(SSER 22)	13.6.5	
(317)	Cyber security Plan	Resolved	(SSER 24) (SSER 28)	13.6.6	
(318)	Initial Test Program	Resolved	(SER) (SSER 3) (SSER 5) (SSER 7) (SSER 9) (SSER 10) (SSER 12) (SSER 14) (SSER 16) (SSER 18) (SSER 19) (SSER 23)	14	
(319)	Accident Analyses			15	
(320)	General Discussion	Resolved	(SER)	15.1	
(321)	Normal Operation and Anticipated Transients	Resolved	(SER)	15.2	
(322)	Loss-of-Cooling Transients	Resolved	(SER) (SSER 13) (SSER 14) (SSER 24)	15.2.1	
(323)	Increased Cooling Inventory Transients	Resolved	(SER) (SSER 24)	15.2.2	
(324)	Change in Inventory Transients	Resolved	(SER) (SSER 18) (SSER 24)	15.2.3	

	Issue	Status		Section	Note
(325)	Reactivity and Power Distribution Anomalies	Resolved	(SER) (SSER 4) (SSER 7) (SSER 13) (SSER 14) (SSER 24) (SSER 26)	15.2.4	
(326)	Conclusions	Resolved	(SER) (SSER 4)	15.2.5	
(327)	Limiting Accidents	Resolved	(SER)	15.3	
(328)	Loss-of-Coolant Accident (LOCA)	Resolved	(SER) (SSER 12) (SSER 15) (SSER 24) (SSER 29)	15.3.1	
(329)	Steamline Break	Resolved	(SER) (SSER 3) (SSER 14) (SSER 24)	15.3.2	
(330)	Feedwater System Pipe Break	Resolved	(SER) (SSER 14) (SSER 24)	15.3.3	
(331)	Reactor Coolant Pump Rotor Seizure	Resolved	(SER) (SSER 14) (SSER 24)	15.3.4	
(332)	Reactor Coolant Pump Shaft Break	Resolved	(SER) (SSER 14) (SSER 24)	15.3.5	
(333)	Anticipated Transients Without Scram	Resolved	(SER) (SSER 3) (SSER 5) (SSER 6) (SSER 10) (SSER 11) (SSER 12) (SSER 24)	15.3.6	
(334)	Conclusions	Resolved	(SER)	15.3.7	
(335)	Radiological Consequences of Accidents	Resolved	(SER) (SSER 15) (SSER 25)	15.4	
(336)	Loss-of-Coolant Accident	Resolved	(SER) (SSER 5) (SSER 9) (SSER 18) (SSER 25)	15.4.1	
(337)	Main Steamline Break Outside of Containment	Resolved	(SER) (SSER 15) (SSER 25)	15.4.2	

	Issue	Status		Section	Note
(338)	Steam Generator Tube Rupture	Resolved	(SER) (SSER 2) (SSER 5) (SSER 12) (SSER 14) (SSER 15) (SSER 25)	15.4.3	
(339)	Control Rod Ejection Accident	Resolved	(SER) (SSER 15) (SSER 25)	15.4.4	
(340)	Fuel-Handling Accident	Resolved	(SER) (SSER 4) (SSER 15) (SSER 25)	15.4.5	
(341)	Failure of Small Line Carrying Coolant Outside Containment	Resolved	(SER) (SSER 25)	15.4.6	
(342)	Postulated Radioactive Releases as a Result of Liquid Tank Failures	Resolved	(SER) (SSER 25)	15.4.7	
(342a)	Postulated Waste Gas Decay Tank Rupture	Resolved	(SSER 25)	15.4.8	
(343)	NUREG-0737 Items			15.5	
(344)	Thermal Mechanical Report (TMI Action Item II.K.2.13)	Resolved	(SER) (SSER 4) (SSER 24)	15.5.1	
(345)	Voiding in the Reactor Coolant System during Transients (TMI Action Item II.K.2.17)	Resolved	(SER) (SSER 4) (SSER 24)	15.5.2	
(346)	Installation and Testing of Automatic Power-Operated Relief Valve Isolation System (TMI Action Item II.K.3.1) Report on Overall Safety Effect of Power-Operated Relief Valve Isolation System (TMI Action Item II.K.3.2)	Resolved	(SER) (SSER 5)	15.5.3	
(347)	Automatic Trip of Reactor Coolant Pumps (TMI Action Item II.K.3.5)	Resolved	(SER) (SSER 4) (SSER 16) (SSER 24)	15.5.4	
(348)	Small-Break LOCA Methods (II.K.3.30) and Plant-Specific Calculations (II.K.3.31)	Resolved	(SER) (SSER 4) (SSER 5) (SSER 16) (SSER 29)	15.5.5	
(349)	Relative Risk of Low-Power Operation	Resolved	(SER)	15.6	
(350)	Technical Specification	Resolved	(SER) (SSER 19) (SSER 29)	16	

	Issue	Status		Section	Note
(351)	Quality Assurance			17	
(352)	General	Resolved	(SER)	17.1	
(353)	Organization	Resolved	(SER)	17.2	
(354)	Quality Assurance Program	Resolved	(SER) (SSER 2) (SSER 5) (SSER 10) (SSER 13) (SSER 15) (SSER 22)	17.3	
(355)	Conclusions	Resolved	(SER)	17.4	
(356)	Maintenance Rule	Resolved	(SSER 29)	17.6	
(357)	Control Room Design Review			18	
(358)	General	Resolved	(SER) (SSER 5) (SSER 6) (SSER 15) (SSER 16) (SSER 22)	18.1	
(359)	Conclusions	Resolved	(SER) (SSER 16) (SSER 22)	18.2	
(360)	Report of the Advisory Committee on Reactor Safeguards	Resolved	(SER) (SSER 1) (SSER 4) (SSER 14) (SSER 20) (SSER 28)	19	
(361)	Common Defense and Security	Resolved	(SER)	20	
(362)	Financial Qualifications	Resolved	(SER)	21	
(363)	TVA Financial Qualifications for WBN, Unit 2	Resolved	(SSER 22) (SSER 23)	21.1	
(364)	Foreign Ownership, Control, or Domination	Resolved	(SSER 22)	21.2	
(365)	Financial Protection and Indemnity Requirements			22	
(366)	General	Resolved	(SER)	22.1	
(367)	Preoperational Storage of Nuclear Fuel	Resolved	(SER)	22.2	
(368)	Operating Licenses	Resolved	(SSER 22) (SSER 29)	22.3	
(369)	Quality of Construction, Operational Readiness, and Quality Assurance Effectiveness			25	

	Issue	Status		Section	Note
(370)	Program for Maintenance and Preservation of the Licensing Basis for Units 1 and 2	Resolved	(SSER 22) (SSER 27)	25.9	

Notes:

1. In the process of further validating the information in the WBN, Unit 2, FSAR, TVA identified minor administrative/typographical changes to sections previously considered resolved. TVA addressed these changes to the applicable sections in its submittals and clearly indicated them to the NRC staff. The NRC staff has reviewed and confirmed that the changes made are administrative/typographical and do not impact the NRC staff's conclusions as stated in previous SSERs. Based on this review, no additional review is necessary and this section remains resolved.

2. During the assessment of the regulatory framework for completion of the project, the NRC staff characterized certain topics as "Open" pending TVA's validation of the information contained in the section. TVA has determined that the information presented in the FSAR remained valid and only identified minor administrative or typographical changes to the section. TVA addressed the changes in its submittals and clearly indicated the changes. The NRC staff reviewed and confirmed that the changes made to the section are administrative/typographical and do not impact its conclusions as stated in previous SSERs. Therefore, no additional review is necessary and the NRC staff considers this section resolved.

3. In SSER 21, this issue was identified as "Resolved." However, TVA made changes to the Unit 2 FSAR affecting the previous NRC staff conclusions. The NRC staff evaluated the changes and the results are documented in SSERs subsequent to SSER 21.

1.9 License Conditions

The paragraphs in 10 CFR 50.54 (with the exception of paragraphs (r) and (gg)), and the applicable requirements of 10 CFR 50.55a, are conditions in every nuclear power reactor operating license issued under 10 CFR Part 50. Per 10 CFR 50.57(b), each operating license will include appropriate provisions with respect to any uncompleted items of construction and such limitations or conditions as are required to assure that operation during the period of the completion of such items will not endanger public health and safety.

During the pendency of its review of TVA's application, the Staff has considered the following additional license conditions.

1.9.1 Flooding License Condition

The NRC staff had proposed two license conditions in Section 2.4 of SSER 24. TVA has supplemented Section 2.4 since publication of SSER 24. The NRC staff's review of this information can be found in Section 2.4 of SSER 28. The NRC staff has determined that the previously proposed license conditions were no longer appropriate. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Flooding Protection Proposed License Condition:

> TVA shall implement permanent modifications to prevent overtopping of the embankments of the Fort Loudoun Dam due to the Probable Maximum Flood by February 1, 2017.

1.9.2 Cyber Security License Condition

The NRC staff had proposed two license conditions discussed in Section 13.6.6.3.22 of SSER 24. The NRC has received an updated implementation schedule from TVA. The previous license conditions were deleted. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Cyber Security Proposed License Condition:

> The licensee shall fully implement and maintain in effect all provisions of the Commission approved cyber security plan (CSP), including changes made pursuant to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The licensee CSP was approved by NUREG-0847, Supplement 28.

1.9.3 Core Operating Limits License Condition

The NRC staff proposed a license condition discussed in Section 4.2.2 of SSER 27. The proposed license condition in Section 4.2.2 of SSER 27 was "PAD4TCD may be used to establish core operating limits prior to the initial cycle, and prior to any remaining portion of the initial cycle. PAD4TCD may not be used to establish core operating limits prior to any reload cycle, and prior to any remaining portion of any reload cycle." Upon further consideration the NRC staff has decided to modify the proposed license condition. The license condition is modified to provide clarity and does not change the intent of the condition that was initially proposed in Section 4.2.2 of SSER 27. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Performance Analysis and Design (PAD) Thermal Conductivity Degradation (TCD) Proposed License Condition:

> PAD4TCD may be used to establish core operating limits for Cycle 1 only. PAD4TCD may not be used to establish core operating limits for subsequent reload cycles.

1.9.4 Electrical Design License Condition

The NRC staff proposed a license condition discussed in Section 8.2.2 of SSER 27. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Bulletin 2012-01, "Design Vulnerability in Electrical Power System," Proposed License Condition:

> By December 31, 2017, TVA will report to the NRC that the actions to resolve the issues identified in Bulletin 2012-01, "Design Vulnerability in Electrical Power System," have been implemented.

1.9.5 Fire Protection License Condition

The NRC staff proposed a license condition discussed in Appendix FF, Section 4.3, of SSER 29. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Fire Detection Monitoring Panel Proposed License Condition:

> By May 31, 2018, TVA shall ensure that a listing organization acceptable to the NRC (as the Authority Having Jurisdiction) determines that the fire detection monitoring panel in the main control room either meets the appropriate designated standards or has been tested and found suitable for the specified purpose.

1.9.6 Core Reload License Condition

The NRC staff proposed a license condition discussed in Section 15.3.1, of SSER 29. The operating license for WBN, Unit 2 will include a license condition similar to the following.

Core Reload License Condition:

> TVA will verify for each core reload that the actions taken if $F_Q^W(Z)$ is not within limits will assure that the limits on core power peaking $F_Q(Z)$ remain below the initial total peaking factor assumed in the accident analyses.

1.13 <u>Implementation of Corrective Action Programs and Special Programs</u>

In 1985, TVA developed a corporate NPP that identified and proposed corrections to problems concerning the overall management of its nuclear program and a site-specific plan for WBN entitled, "Watts Bar Nuclear Performance Plan." TVA established 18 corrective action programs (CAPs) and 11 special programs (SPs) to address these concerns.

SSER 21, Table 1.13.1 documented the status of NRC staff review of the CAPs and SPs. As indicated all items are resolved.

1.13.1 Corrective Action Programs

No.	Title	Program Review Status
(1)	Cable Issues a. Silicon Rubber Insulated Cable b. Cable Jamming c. Cable Support in Vertical Conduit d. Cable Support in Vertical Trays e. Cable Proximity to Hot Pipes f. Cable Pull-Bys g. Cable Bend Radius h. Cable Splices i. Cable Sidewall Bearing Pressure j. Pulling Cables Through 90° Condulet and Flexible Conduit k. Computer Cable Routing System Software and Database Verification and Validation	Resolved
(2)	Cable Tray and Tray Supports	Resolved
(3)	Design Baseline and Verification Program	Resolved
(4)	Electrical Conduit and Conduit Support	Resolved
(5)	Electrical Issues a. Flexible Conduit Installations b. Physical Cable Separation and Electrical Isolation c. Contact and Coil Rating of Electrical Devices d. Torque Switch and Overload Relay Bypass Capability for Active Safety-Related Valves e. Adhesive-Backed Cable Support Mount	 Resolved
(6)	Equipment Seismic Qualification	Resolved
(7)	Fire protection	Resolved
(8)	Hanger and Analysis Update Program	Resolved
(9)	Heat Code Traceability	Resolved
(10)	Heating, Ventilation, and Air-Conditioning Duct and Duct Supports	Resolved
(11)	Instrument Lines	Resolved
(12)	Prestart Test Program Plan	Resolved
(13)	Quality Assurance Records	Resolved

No.	Title	Program Review Status
(14)	Quality-List (Q-List)	Resolved
(15)	Replacement Items Program (Piece Parts)	Resolved
(16)	Seismic Analysis	Resolved
(17)	Vendor Information Program	Resolved
(18)	Welding	Resolved

1.13.2 Special Programs

No.	Title	Program Review Status
(1)	Concrete Quality Program	Resolved
(2)	Containment Cooling	Resolved
(3)	Detailed Control Room Design Review	Resolved
(4)	Environmental Qualifications Program	Resolved
(5)	Master Fuse List	Resolved
(6)	Mechanical Equipment Qualification	Resolved
(7)	Microbiologically Induced Corrosion	Resolved
(8)	Moderate Energy Line Break Flooding	Resolved
(9)	Radiation Monitoring System	Resolved
(11)	Use-As-Is Condition Adverse to Quality	Resolved

1.14 Implementation of Applicable Bulletin and Generic Letter Requirements

From time to time, the NRC staff issues generic requirements or recommendations in the form of orders, bulletins (BLs), generic letters (GLs), regulatory issue summaries, and other documents to address certain safety and regulatory issues. These are generally termed "generic communications."

The table below outlines the status of the resolution of the generic communications.

	Correspondence No.	Title
(1)	GL 1980-14	Light-Water Reactor Primary Coolant System Pressure Isolation Valves.
	TVA Action:	Submit Technical Specifications (TSs) for NRC Review.
	NRC Action:	Closed based on validation of TS 3.4.14. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(2)	GL 1980-77	Refueling Water Level - Technical Specifications Changes.
	TVA Action:	Submit Technical Specifications for NRC Review.
	NRC Action:	Closed based on validation of TS 3.9 –TS 3.9.5. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(3)	GL 1982-28	Inadequate Core Cooling Instrumentation System.
	TVA Action:	Closed.
	NRC Action:	Closed. Subsumed as part of NRC staff review of Instrumentation and Controls submitted April 8, 2010.
(4)	GL 1983-28	Required Actions Based on Generic Implications of Salem Anticipated Transient without Scram Events (Screened into the Items 4 through 7).
(4.a)	GL 1983-28 (item 3.1)	Post-Maintenance Testing (reactor trip system components).
	TVA Action:	Submit Technical Specifications for NRC Review.
	NRC Action:	Closed based on validation of TS Bases 3.0.1. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.

	Correspondence No.	Title
(4.b)	GL 1983-28 (3.2)	Post-Maintenance Testing (All Surveillance Requirement Components).
	TVA Action	Submit Technical Specifications and NRC Review.
	NRC Action	Closed based on validation of TS Bases 3.0.1. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(4.c)	GL 1983-28 (4.2)	Reactor Trip System Reliability (Preventive Maintenance and Surveillance Program for Reactor Trip Breakers).
	TVA Action	Submit Technical Specifications and NRC Review.
	NRC Action	Closed based on validation of Item 17 of TS Table 3.3.1-1. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(4.d)	GL 1983-28 (4.5)	Reactor Trip System Reliability (Automatic Actuation of Shunt Trip Attachment).
	TVA Action	Submit Technical Specifications and NRC Review.
	NRC Action	Closed based on validation of Item 18 of TS Table 3.3.1-1. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(8)	GL 1986-09	Technical Resolution of Generic Issue B-59 (N-1) Loop Operation in BWRs and PWRs.
	TVA Action	Submit Technical Specifications for NRC Review.
	NRC Action	Closed based on validation of TS 3.4.4 - TS 3.4.8. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(9)	GL 1988-20	Individual Plant Examination for Severe Accident Vulnerability.
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated August 12, 2011 (ADAMS Accession No. ML111960228).

	Correspondence No.	Title
(10)	GL 1988-20s1	Initiation of the Individual Plant Examination for Severe Accident Vulnerabilities — 10 CFR 50.54.
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated August 12, 2011 (ADAMS Accession No. ML111960228).
(11)	GL 1988-20s2	Individual Plant Examination for Severe Accident Vulnerability. Accident Management Strategies for Consideration in the Individual Plant Examination Process.
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated August 12, 2011 (ADAMS Accession No. ML111960228).
(12)	GL 1988-20s3	Individual Plant Examination for Severe Accident Vulnerability. Completion of Containment Performance Improvement Program and Forwarding of Insights for Use in the IPE for Severe Accident Vulnerabilities.
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated August 12, 2011 (ADAMS Accession No. ML111960228).
(13)	GL 1988-20s4	Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities.
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated September 20, 2011 (ADAMS Accession No. ML111960300).
(14)	GL 1988-20s5	Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - 10 CFR 50.54(f).
	TVA Action	Closed.
	NRC Action	Closed. NRC letter dated September 20, 2011 (ADAMS Accession No. ML111960300).

	Correspondence No.	Title
(15)	GL 1989-04	Guidelines on Developing Acceptable Inservice Testing Programs.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated October 21, 2014 (ADAMS Accession No. ML14289A222).
(16)	GL 1989-21	Request for Information Concerning Status of Implementation of Unresolved Safety Issue Requirements.
	TVA Action	TVA provided an updated status of unresolved safety issues on September 26, 2008, as supplemented on December 2, 2010, and January 25, 2011.
	NRC Action	Closed. See Appendix C of SSER 23.
(17)	GL 1990-06	Resolution of Generic Issues 70, "PORV [power-operated relief valve] and Block Valve Reliability," and 94, "Additional LTOP [low-temperature overpressure] Protection for PWRs."
	TVA Action	Submit Technical Specifications for NRC Review.
	NRC Action	Closed based on validation of TS 3.4.11 - TS 3.4.12. SSER 29, Section 16 documents the NRC staff's review of the WBN, Unit 2 proposed TSs.
(18)	GL 1992-08	Thermo-Lag 330-1 Fire Barriers.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. Inspection Report 2014612 (ADAMS Accession No. ML15034A211).
(19)	GL 1995-03	Circumferential cracking of Steam Generator (SG) Tubes.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).

	Correspondence No.	Title
(20)	GL 1995-05	Voltage –Based Repair Criteria for Westinghouse Steam Generator Tubes affected by Outside Diameter Stress Corrosion Cracking.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).
(21)	GL 1996-06	Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML100130227).
(22)	GL 1995-07	Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves (Not identified in SSER 21 as “Open”).
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated August 12, 2010 (ADAMS Accession No. ML100190443).
(23)	GL 1997-01	Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated June 30, 2010 (ADAMS Accession No. ML100539515).

	Correspondence No.	Title
(24)	GL 1997-04	Assurance of Sufficient Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal Pumps Integrity During Design-Basis Accident Conditions.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated February 18, 2010 (ADAMS Accession No. ML100200375).
(25)	GL 1997-05	SG Tube Inspection Techniques.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).
(26)	GL 1997-06	Degradation of SG Internals.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).
(27)	GL 1998-02	Loss of Reactor Coolant Inventory and Associated Potential for Loss of Emergency Mitigation Functions While in a Shutdown Condition.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated May 11, 2010 (ADAMS Accession No. ML101200155).

	Correspondence No.	Title
(28)	GL 1998-04	Potential for Degradation of the ECCS [Emergency Core Cooling System] and the Containment Spray System after a LOCA because of Construction and Protective Coating Deficiencies and Foreign Material in Containment.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated February 1, 2010 (ADAMS Accession No. ML100260594).
(29)	GL 2003-01	Control Room Habitability.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed. NRC Letter dated February 1, 2010 (ADAMS Accession No. ML100270076).
(30)	GL 2004-01	Requirements for SG Tube Inspection.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).
(31)	GL 2004-02	Potential Impact of Debris Blockage on Emergency Recirculation during Design-Basis Accidents at PWRs.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated September 18, 2014 (ADAMS Accession No. ML14163A658).

	Correspondence No.	Title
(32)	GL 2006-01	SG Tube Integrity and Associated Technical Specifications.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061) (See Appendix HH).
(33)	GL 2006-02	Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061) (See Appendix HH Open Item 6). Staff has reviewed Revision I to the proposed technical specifications and found that Technical Specification Task Force (TSTF) 449 has been incorporated.
(34)	GL 2006-03	Potentially Nonconforming Hemyc and MT Fire Barrier Configurations.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter February 25, 2010 (ADAMS Accession No. ML100470398).
(35)	GL 2007-01	Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 26, 2010 (ADAMS Accession No. ML100120052).

	Correspondence No.	Title
(36)	GL 2008-01	Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems.
	TVA Action	TVA submitted the information requested by the GL.
	NRC Action	Closed. NRC letter dated August 23, 2011 (ADAMS Accession No. ML112232205).
(37)	BL 1992-01 and Supplement 1	Failure of Thermo-Lag 330 Fire Barrier System to Perform its Specified Fire Endurance Function.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. Inspection Report 2014612 (ADAMS Accession No. ML15034A211).
(38)	BL 1996-01	Control Rod Insertion Problems (PWR)
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated May 3, 2010 (ADAMS Accession No. ML101200035) required Confirmatory Action (See Appendix HH Open Items 5 and 8). By letter dated July 30, 2012, TVA provided the information in the Confirmatory Action and the NRC staff verified the information and has closed Appendix HH Open Items 5 and 8.
(39)	BL 1996-02	Movement of Heavy Loads Over Spent Fuel, Over Fuel In the Reactor Core, or Over Safety-Related Equipment.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated March 4, 2010 (ADAMS Accession No. ML100480062).

	Correspondence No.	Title
(40)	BL 2001-01	Circumferential Cracking of Reactor Pressure Vessel (RPV) Head Penetration Nozzles.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated June 30, 2010 (ADAMS Accession No. ML100539515).
(41)	BL 2002-01	RPV Head Degradation and Reactor Coolant Pressure Boundary Integrity.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated June 30, 2010 (ADAMS Accession No. ML100539515).
(42)	BL 2002-02	RPV Head and Vessel Head Penetration Nozzle Inspection Program.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated June 30, 2010 (ADAMS Accession No. ML100539515).
(43)	BL 2003-02	Leakage from RPV Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC Letter dated January 21, 2010 (ADAMS Accession No. ML093631061).

	Correspondence No.	Title
(44)	BL 2004-01	Inspection of Alloy 82/182/600 Materials Used in the Fabrication of Pressurizer Penetrations and Steam Space Piping Connections at PWRs.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach was submitted for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated August 4, 2010 (ADAMS Accession No. ML102080017).
(45)	BL 2007-01	Security Officer Attentiveness.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated March 25, 2010 (ADAMS Accession No. ML100770549).
(46)	BL 2011-01	Mitigating Strategies
	TVA Action	The proposed approach has been approved for WBN, Unit 1; an updated approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. NRC letter dated October 14, 2015 (ADAMS Accession No. ML 15280A085)
(47)	BL 2012-01	Design Vulnerability In Electric Power System
	TVA Action	TVA submitted a letter on September 3, 2014 (ADAMS Accession No. ML14247A231) providing wording for the FSAR and proposed a license condition.
	NRC Action	Resolved, see license condition described in SER Section 1.9.4.

NUREG-0737, TMI Action Items (TVA letter dated September 14, 1981, applies to all of the following NUREG-0737 issues):

	Correspondence No.	Title
(48)	NUREG-0737 Item I.B.1.2	Independent Safety Engineering Group.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed. TVA letter dated August 26, 1999 (ADAMS Accession No. ML082350970) and SSER 22, Section 17.
(49)	NUREG-0737 Item I.D.1	Control Room Design Review (CRDR).
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed in SSER 22, Section 18.2.
(50)	NUREG-0737 Item II.B.3	Post-accident Sampling.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed in SSER 24, Section 9.3.2.
(51)	NUREG-0737 Item II.E.4.2	Containment Isolation Dependability.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed. Inspection Report 05000391/2011605 (ADAMS Accession No. ML112201418) and SSER 29, Section 16

	Correspondence No.	Title
(52)	NUREG-0737 Item II.F.2	Instrumentation for Detection of Inadequate Core-Cooling.
	TVA Action	Closed.
	NRC Action	Closed. See SSER 25 and SSER 26, Section 7.5.2.2. Open Items 72, 95, 96, 97, 99, 100, 102, 103, 104, 106, 107, and 109 were closed in SSER 25, Section 7.5.2.2. Open items 94, 98, 101, 105, 108, 110, and 111 were closed in SSER 26, Section 7.5.2.2.
(53)	NUREG-0737 Item II.K.3.3	Reporting Safety Valve/Reactor Vessel Failures/Challenges.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed in SSER 22, Section 13.5.3.
(54)	NUREG-0737 Item II.K.3.10	Anticipatory Trip at High Power.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed in SSER 23, Section 7.8.4.
(55)	NUREG-0737 Item III.D.1.1	Primary Coolant Outside Containment.
	TVA Action	No action or documentation is provided to show the NRC staff has reviewed the item for WBN, Unit 2, and the resolution is through submittal of a technical specification.
	NRC Action	Closed in SSER 29, Section 16.
(56)	NUREG-0737 Item III.D.3.4	Control-Room Habitability.
	TVA Action	The proposed approach has been approved for WBN, Unit 1; the same approach will be proposed for use on WBN, Unit 2, without change.
	NRC Action	Closed in SSER 22, Section 6.4.

	Correspondence No.	Title
(57)	Office of Inspection and Enforcement Bulletin (IEB) 75-08	PWR Pressure Instrumentation.
	TVA Action	The item has been approved either for both units at WBN or explicitly for WBN, Unit 2; however, a change to the original approval requires submittal of the technical specifications and NRC staff review.
	NRC Action	Closed. The ability to continuously monitor pressure and temperature is noted in the UFSAR and is consistent with the licensing basis for WBN, Unit 1. Inspection activities verified that WBN has instrumentation in place to monitor pressure and temperature to close this Bulletin (Inspection Report 50-391/85-08, ADAMS Accession No. ML082190701).
(58)	IEB 77-04	Calculation Error Affecting Performance of a System for Controlling pH of Containment Sump Water Following a LOCA.
	TVA Action	The item has been approved either for both units at WBN or explicitly for WBN, Unit 2; however, a change to the original approval requires submittal of the technical specifications and NRC staff review.
	NRC Action	Closed. Item was closed in Inspection Report 10-391/78-09 (ADAMS Accession No. ML071790565). WBN, Unit 2 has an ice condenser containment and utilizes sodium tetraborate in the ice for containment sump pH control. TVA's response (ADAMS Accession No. ML073020061) to this Bulletin reported that limiting concentrations are included in the plant TSs. Surveillance Requirement 3.6.11.5 requires verification that the boron concentration is within a specified range and is consistent with the licensing basis for WBN, Unit 1.

Fukushima-Related Orders (NRC letters dated March 12, 2012):

(59)	EA-12-049	Mitigating Strategies for Beyond-Design-Basis External Events (ADAMS Accession No. ML12054A735)
	TVA Action	Provide final compliance letter by December 17, 2014.
	NRC Action	Closed in SSER 28, Appendix JJ.

	Correspondence No.	Title
(60)	EA-12-051	Reliable Spent Fuel Pool Instrumentation (ADAMS Accession No. ML12054A679)
	TVA Action	Compliance letter sent October 29, 2014.
	NRC Action	Closed in SSER 28, Appendix JJ.

1.17 Financial Assurance for Decommissioning

The NRC's regulations at 10 CFR, 50.75, "Reporting and Recordkeeping for Decommissioning Planning, and 50.33(k), require, in part, an applicant for, or holder of, an operating license under Part 50 to provide a report certifying financial assurance for decommissioning in an amount that may be more, but not less, than the NRC minimum amount specified in 10 CFR 50.75(c)(1), adjusted using a rate at least equal to that stated in 10 CFR 50.75(c)(2).

By letter dated March 4, 2009 (ADAMS Accession No. ML090700378), "Watts Bar Nuclear Plant, Unit 2—Operating License Application Update," Tennessee Valley Authority (TVA) submitted an update to its application that included certification of financial assurance for decommissioning of WBN, Unit 2, in an amount of $400.3 million (2008 dollars). In its submittal, TVA stated that it will establish a decommissioning trust fund within its Master Decommissioning Trust Agreement for WBN, Unit 2, before fuel load; the trustee of the fund will be New York Mellon Corporation. The NRC staff independently calculated the minimum funding amount required under 10 CFR 50.75(c)(1), as adjusted under 10 CFR 50.75(c)(2), and found the applicant's estimate for decommissioning funding assurance to be acceptable.

By letter dated August 26, 2009 (ADAMS Accession No. ML092470504), "Additional Information Regarding Financial Information Related to Operating License Application Update," TVA provided its response to the staff's request for additional information (RAI). The response stated TVA's intent to use an external sinking fund as the method to provide financial assurance for decommissioning. TVA is an electric utility, that sets its own rates and has the ability to use an external sinking fund as its sole means of providing decommissioning funding assurance, under 10 CFR 50.75(e)(ii)(A). An external sinking fund is a fund established and maintained by setting funds aside periodically in an account segregated from licensee assets and outside the administrative control of the licensee and its subsidiaries or affiliates in which the total amount of funds would be sufficient to pay decommissioning costs at the time permanent termination of operations is expected. An external sinking fund may be in the form of a trust, escrow account, or Government fund, with payment by certificate of deposit, deposit of Government or other securities, or other method acceptable to the NRC. The NRC staff reviewed TVA's plan to use an external sinking fund to provide decommissioning funding assurance and found that TVA has complied with the requirements in 10 CFR 50.75. The NRC staff's review was published in NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplement 22, dated February 2011 (ADAMS Accession No. ML110390197).

By letter dated September 10, 2015, "Decommissioning Funding Update," TVA provided an update to its Decommissioning Funding Plan (ADAMS Accession No. ML15253A867) for WBN, Unit 2, that included a revised decommissioning estimate in the amount of $517.7 million (2015 dollars) using the adjustment factors in 10 CFR 50.75(c)(2) required for updating the NRC minimum formula amount. The NRC staff found the decommissioning cost estimate for WBN, Unit 2, to be reasonable because WBN, Unit 2, is a PWR and the decommissioning cost estimate was independently calculated by staff using the minimum funding amount required under 10 CFR 50.75(c)(1), as adjusted under 10 CFR 50.75(c)(2). In its submittal (Enclosure 1), TVA also supplied evidence that it has executed the Sixth Amendment to the Master Decommissioning Trust Agreement on June 23, 2015; this established a separate fund for WBN, Unit 2, including an initial deposit into the fund in the amount of $3,402,638 on September 8, 2015, and a schedule of the anticipated annual deposits of funding amounts into the trust. TVA has chosen to use an external sinking fund to provide decommissioning funding assurance for WBN, Unit 2, as allowed in the regulations at 10 CFR 50.75(e)(1)(ii). This approach is consistent with that used for TVA's other nuclear units as discussed in TVA's most recent Decommissioning Funding Status Report. The NRC staff has reviewed this information and finds that TVA's submittal complies with the regulations at 10 CFR 50.75(c) and 10 CFR 50.75(e)(1)(ii), which requires TVA to estimate needed costs for decommissioning and set aside funds periodically in an account segregated from TVA assets for which the total amount of funds will be sufficient to pay WBN, Unit 2, decommissioning costs at the time of permanent cessation of operations is expected.

Based on staff's review of TVA's submittal dated September 10, 2015, NRC staff concludes that TVA has complied with the decommissioning funding assurance reporting requirements in 10 CFR 50.33(k) and the decommissioning funding assurance requirements in 10 CFR 50.75.

1.18 NRC Staff Conclusion

On the basis of the NRC staff's review of the application, as documented in the SER and its supplements, as well as the NRC staff's inspections, the NRC staff concludes that the requirements of 10 CFR 50.57, "Issuance of Operating License," sections 50.57(a)(1) to (a)(6), have been met for WBN, Unit 2, as summarized below.

(1) Construction of the facility has been substantially completed, in conformity with the construction permit and the application as amended, the provisions of the Atomic Energy Act (Act), and the rules and regulations of the Commission;

As discussed in Appendix GG "Final Memorandum on Facility Completion In Accordance With Inspection Manual Chapter 94302" of this SSER, "Region II inspection activities support that the construction of the WBN, Unit 2 facility has been substantially completed in conformity with the construction permit and the application as amended. This conclusion is based on completion of the construction inspections necessary to support this finding."

Based on the NRC staff's review of the application as documented in the SER and its supplements, and the results of the NRC staff's inspections, the NRC staff finds that that construction of WBN, Unit 2 has been substantially completed in conformity with the construction permit and the application as amended, the provisions of the Atomic Energy Act, and the Commission's regulations.

(2) The facility will operate in conformity with the application as amended, the provisions of the Act, and the rules and regulations of the Commission;

The NRC staff reviewed information provided by the applicant to ensure that the plant will operate in conformity with the application as amended, the applicable provisions of the Atomic Energy Act of 1954, as amended, and the applicable rules and regulations of the Commission.

As discussed in Appendix GG of this SSER, “Region II inspection activities support that WBN Unit 2 facility will operate in conformity with the application as amended. This is based on completion of the pre-operational testing inspections identified in IMC 2513, Appendix A, Light Water Reactor - Preoperational Testing Phase, that are necessary to support this finding.”

Based on the NRC staff’s review of the application as documented in the SER and its supplements, and the results of the NRC staff’s inspections, the NRC staff finds that WBN, Unit 2 will operate in conformity with the application as amended, the provisions of the Atomic Energy Act, and the Commission’s regulations.

(3) There is reasonable assurance that the activities authorized by the operating license can be conducted without endangering the health and safety of the public, and that such activities will be conducted in compliance with the regulations in 10 CFR Ch. I;

The NRC staff reviewed the application to assure that activities authorized by the license will not endanger the health and safety of the public. Specifically, the NRC staff evaluated the applicant’s analysis and conclusions about site-specific conditions, including the geography and demography of the site; nearby industrial, transportation, and military facilities; site meteorology; site hydrology; and site geology, seismology, and geotechnical engineering to ensure that issuance of the license will not endanger public health and safety. The review also evaluated the design of structures, components, equipment, and systems to ensure safe operation.

The review confirmed that radiological releases and human doses during both normal operation and accident scenarios will remain within regulatory limits, which supports the NRC staff’s conclusion that issuance of the license will not endanger the health and safety of the public.

As discussed in Appendix GG of this SSER, “Region II inspection activities support that there is reasonable assurance that activities authorized by the license will be conducted according to applicable regulations. This is based on completion of operational preparedness inspections items that were necessary to support this finding and conclusions from the Operational Readiness Assessment Team inspection (ORAT). The ORAT inspection (ADAMS Accession No. ML15226A212) concluded TVA adequately demonstrated the readiness of the facility and staff to safely begin operating the WBN Unit 2 facility.”

Based on the NRC staff’s review of the application as documented in the SER and its supplements, as well as the NRC staff’s inspections, the NRC staff finds that the activities authorized by the operating license can be conducted without endangering the health and safety of the public, and that such activities will be conducted in compliance with the applicable regulations.

(4) The applicant is technically and financially qualified to engage in the activities authorized by the operating license in accordance with the regulations in 10 CFR Ch. I;

The NRC staff reviewed information provided by the applicant regarding technical and financial qualifications.

a. Technical Qualification. The NRC staff reviewed information provided by the applicant regarding its technical qualifications. The review included an evaluation of the applicant's operating experience, organizational structure, and QA program. The review included the fact that the applicant operates WBN, Unit 1, which is of similar design to WBN, Unit 2. The applicant holds a 10 CFR Part 50 license for WBN, Unit 1 and has demonstrated its ability to build and operate a nuclear power reactor. The applicant has demonstrated the ability to choose and manage the oversight of nuclear steam supply system vendors, architect-engineers, and constructors of nuclear-related work. The NRC staff's review of the applicant's organizational structure concluded that its management, technical support, and operating organizations are acceptable. The NRC staff reviewed the QA program and found it acceptable. This QA program includes requirements that will be implemented by the applicant's engineering, procurement, and construction contractor. The NRC staff's evaluation of this information appears in Chapter 13 and 17 of the SER and its supplements. Based on the NRC staff's evaluation of the applicant's experience with building and operating a nuclear power plant, its operating organization, and its QA program, the staff finds that the applicant is technically qualified to engage in the activities authorized by the operating license in accordance with the regulation.

b. Financial Qualifications. The NRC staff reviewed information provided by the applicant about financial qualifications. The review included an evaluation of the financial qualifications, decommissioning funding assurance, foreign ownership, and nuclear insurance and indemnity. Applicable regulations and guidance considered by the NRC staff included 10 CFR Part 140, "Financial Protection Requirements and Indemnity Agreements"; 10 CFR 50.54(w), 10 CFR 50.33; "Contents of Applications; General Information"; and NUREG-1577, "Standard Review Plan on Power Reactor Licensee Financial Qualifications and Decommissioning Funding Assurance."

The NRC staff's evaluation of this information appears in Chapters 1, 21 and 22 of the SER and its supplements. As discussed in Section 21 of SSER 22, published February 2011 (ADAMS Accession No. ML110390197), the NRC staff concluded that TVA is an electric utility as defined by 10 CFR 50.2. Therefore, TVA is not subject to the requirements of 10 CFR 50.33(f). Based on the financial information provided by the applicant, the NRC staff concludes that the TVA has demonstrated that it possesses or has access to the financial resources necessary to meet estimated operation and construction costs. Therefore, the NRC staff concludes that TVA, is financially qualified to operate WBN, Unit 2 and to engage in the activities authorized by an operating license in accordance with the regulations.

(5) The applicable provisions of 10 CFR Part 140 of this chapter have been satisfied;

As discussed in Section 22 of this SSER, the NRC staff has determined that the applicant has satisfied the applicable requirements in 10 CFR Part 140.

(6) The issuance of the license will not be inimical to the common defense and security or to the health and safety of the public.

The NRC staff reviewed the application to assure that issuance of the license will not be inimical to the common defense and security or to public health and safety. Specifically, the NRC staff evaluated the applicant's analysis and conclusions about site-specific conditions, including the geography and demography of the site; nearby industrial, transportation, and military facilities; site meteorology; site hydrology; and site geology, seismology, and geotechnical engineering to ensure that issuance of the license will not be inimical to public health and safety. The review also evaluated the design of structures, components, equipment, and systems to ensure safe operation.

The review confirmed that radiological releases and human doses during both normal operation and accident scenarios will remain within regulatory limits, which supports the NRC staff's conclusion that issuance of the license will not be inimical to public health and safety. The review determined that the physical security to be implemented at the site is adequate to protect the facility, which supports the NRC staff's conclusion that issuance of the license will not be inimical to the common defense and security.

On the basis of the NRC staff's review of the application, as amended, as discussed in the SER and its supplements, operation of WBN, Unit 2 will not be inimical to the common defense and security or to public health and safety.

3 DESIGN CRITERIA – STRUCTURE, COMPONENTS, EQUIPMENT, AND SYSTEMS

3.8 Design of Seismic Category I Structures

3.8.3 Other Seismic Category I Structures

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the changes made in the Watts Bar Nuclear Plant (WBN), Unit 2 Final Safety Analysis Report related to this section up through Amendment 114 and found no new substantial information. The changes that were made were found to be editorial in nature such that the NRC staff's evaluations in the SER, and SSERs 14 and 16 still remain valid. Therefore, the NRC staff considers this section to be closed.

3.9 Mechanical Systems and Components

3.9.3 ASME Code Class 1, 2, and 3 Components, Component Structures, and Core Support Structures

3.9.3.3 Design and Installation of Pressure Relief Devices

By letter dated July 29, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15210A140), Tennessee Valley Authority (TVA), informed the NRC that it has chosen to use the EPRI motor-operated valve (MOV) performance prediction methodology (PPM) in lieu of dynamic testing of the WBN, Unit 2 pressurizer power-operated relief valve (PORV) block valves.

The NRC regulations require that MOVs important to safety be treated in a manner that provide assurance of their intended performance. Criterion 1 to Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50) states, in part, that structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The quality assurance program to be applied to safety-related components is described in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. In 10 CFR 50.55a, the NRC requires licensees to establish inservice testing programs in accordance with the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants*.

In response to concerns regarding MOV performance, on June 28, 1989, the NRC staff issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," (ADAMS Accession No. ML031150300) which requested that nuclear power plant licensees and construction permit holders ensure the capability of MOVs in safety-related systems to perform their intended functions by reviewing MOV design bases, verifying MOV switch settings initially and periodically, testing MOVs under design-basis conditions where practicable, improving evaluations of MOV failures and necessary corrective action, and trending MOV problems. The GL also stated that if testing at design-basis conditions is precluded by the existing plant configuration, an explanation should be documented including a description of the alternatives to the design-basis differential pressure testing or flow testing that will be used. The NRC staff requested that licensees complete the GL 89-10 program within approximately three refueling outages or 5 years from the date of issuance of the GL. Permit holders were requested to complete the GL 89-10 program before plant startup or in accordance with the above schedule, whichever was later. TVA's six month response to GL 89-10 stated that TVA planned to meet the GL 89-10 recommendations and to comply with the 5-year implementation schedule, i.e., by June 28, 1994 (ADAMS Accession No. ML082320614).

On September 18, 1996, (ADAMS Accession No. ML031110010), the NRC staff issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting each licensee to establish a program, or ensure the effectiveness of its current program, to verify on a periodic basis that safety-related MOVs continue to be capable of performing their safety functions within the current licensing bases of the facility.

By March 15, 1996, the NRC staff provided the results of its review of EPRI topical report TR-103237, "EPRI MOV Performance Prediction Program" Revision 1, (ADAMS Accession No. ML15142A761). The letter stated that the staff considers the methodology to be an acceptable way, with conditions and limitations, to predict the thrust and torque required to operate gate, globe, and butterfly valves within the scope of the MOV program.

By letter dated February 24, 2009, the NRC staff provided its final safety evaluation of the EPRI topical report TR-103237, "EPRI MOV Performance Prediction Program" Revision 2, (ADAMS Accession No. ML090430444). TR-103237 Revision 2 included several improvements to the methodology along with software upgrades versions 3.1, 3.2, and 3.3. The NRC staff review concluded that the method and software improvements were acceptable for referencing in licensing applications as discussed in the safety evaluation enclosed with the letter and that the safety evaluation defines the basis for the NRC staff's acceptance of the topical report.

As noted in Section 1 of this Supplemental Safety Evaluation Report (SSER), TVA did not compete WBN, Unit 2 at the time that WBN, Unit 1 was licensed. By letter dated August 3, 2007 (ADAMS Accession No. ML072190047), TVA notified the NRC of its intention to reactive the construction activities for WBN, Unit 2. Subsequently, by letter dated January 29, 2008 (ADAMS Accession No. ML080320443), TVA submitted the Regulatory Framework for the Completion of Construction and Licensing Activities for WBN, Unit 2. The January 29, 2008 letter contained three commitments related to the testing of MOVs:

- Commitment 18, GL 89-10, "Safety Related Motor-Operated Valve (MOV) Testing and Surveillance;"

- Commitment 19, GL 96-05, "Periodic Verification (PV) of Design Basis Capability of Safety-Related MOVs;" and

- Commitment 31, [NUREG-0737, Item] II.D.1, "Relief and Safety Valve Test Requirements."

The January 29, 2008 letter provided details regarding each of these commitments. Commitment 18 was to implement pressure testing and a surveillance program for safety-related MOVs, satisfying the intent of GL 89-10. Commitment 19 was to implement the

Joint Owner's Group recommended GL 96-05 MOV PV program and begin testing during the first refueling outage after startup. Commitment 31 contained four activities:

1. Testing of relief and safety valves;

2. Reanalysis of fluid transient loads for pressurizer relief and safety valve supports and any required modifications;

3. Modifications to pressurizer safety valves, PORVs, PORV block valves and associated piping; and

4. Change motor operated block valves.

By letter dated July 29, 2015, TVA stated that:

> In consideration of the performance of Hot Functional Testing at WBN, Unit 2 in 2015, TVA reviewed the test conditions associated with the dynamic testing of the PORV block valves. TVA determined that differential pressure testing creates an equipment and personnel hazard. Specifically, the equipment hazards are associated with the potential for overfilling the Pressurizer Relief Tank (PRT), subsequently failing the PRT rupture disks, thus creating a risk for personnel injury. Based on this review, TVA decided to use the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) analysis (EPRI TR-103237, Revision 1) (ML15142A761) in lieu of dynamic differential pressure testing for the WBN, Unit 2 Pressurizer PORV block valves (2-FCV-068-0332 and -0333).
>
> TVA used EPRI PPM software version 3.3 for this analysis.

With the limitations and conditions related to the specific application of the methodology described in the NRC staff's safety evaluations in response to TR-103237, the NRC staff concludes that the EPRI MOV Performance Prediction Program provides an acceptable methodology to predict the thrust and torque required to operate gate, globe, and butterfly valves within the scope of the EPRI program, and to bound the effects of load sensitive behavior on motor-actuator thrust output in lieu of dynamic valve testing. The NRC staff reviewed WBN, Unit 2 pressurizer PORV block valve make, model, type, and system parameters and concluded that the EPRI PPM program is applicable to the WBN, Unit 2 PORV block valves and that the licensee should consider the limitations and conditions discussed in the NRC staff's safety evaluation report for TR-103237. Therefore, the NRC staff finds the application of the EPRI PPM program for the pressurizer PORV block valves at WBN, Unit 2 acceptable.

6 ENGINEERED SAFETY FEATURES

6.1 Engineered Safety Feature Materials

6.1.3 Postaccident Emergency Cooling Water Chemistry

The Tennessee Valley Authority (TVA or the applicant) provided Amendment 114 to the final safety analysis report (FSAR) by letter dated September 11, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15279A332). The Amendment 114 of the FSAR changed the minimum amount of ice assumed in the post–loss of coolant accident (LOCA) sump pH analysis from 2.26×10^6 lb to 2.585×10^6 lb. This FSAR revision was based on a revised LOCA containment integrity analysis of record (AOR) documented in FSAR Amendment 113. The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the revised LOCA containment integrity analysis is provided in Section 6.2.1 of this supplemental safety evaluation report (SSER).

6.2 Containment Systems

6.2.1 Containment Functional Design

The containment functional design should meet the requirements of the following NRC regulations:

10 CFR 50 Appendix A-

- GDC 5 as it relates to sharing of structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

- GDC 16 as it relates to the containment and associated systems establishing a leak-tight barrier against the uncontrolled release of radioactivity to the environment and assuring that the containment design conditions important to safety are not exceeded for as long as the postulated accident requires.

- GDC 38 as it relates to the containment heat removal system safety function which shall reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any Loss-of-Coolant Accident (LOCA) and to maintain them at acceptably low levels.

- GDC 50 as it relates to the containment heat removal system which shall be designed so that the containment structure and its internal compartments can accommodate without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any LOCA.

10 CFR 50 Appendix J as it relates to the containment integrated leak rate test pressure which should be greater than or equal to the calculated peak containment internal pressure related to the design basis accident and specified in the technical specification.

The containment integrity analysis is performed to confirm that the requirements of the above regulations are met. The analysis consists of a LOCA mass and energy (M&E) release calculation which is an input to the containment pressure and temperature response calculation.

Changes in Containment Integrity Analysis in FSAR Amendment 112:

In a letter dated May 30, 2014 (ADAMS Accession No. ML14160A901), TVA submitted Amendment 112 that proposed changes to Watts Bar Nuclear Plant (WBN), Unit 2 FSAR. This letter was supplemented by letter dated December 17, 2014 (ADAMS Accession No. ML14352A248) which provided response to NRC staff requests for additional information (RAIs).

FSAR Amendment 112 revised the design basis blowdown energy of 317.3×10^6 British thermal units (Btu) and mass of 502.7×10^3 lb put into the containment to energy of 314.9×10^6 Btu and mass of 498.1×10^3 lb put into the containment in FSAR Section 6.2.1.1.1, fourth paragraph, item (1).

In SCVB-RAI-4 the applicant was requested to explain the reasons for the reduction in the LOCA blowdown M&E. In its response to SCVB-RAI-4 (ADAMS Accession No. ML14352A248), the applicant stated:

The subject integrated blowdown M&E data provided in the Amendment 111 contains data that was incorrectly applied. The correct Amendment 111 integrated blowdown energy and mass is 315.7×10^6 Btu and 499.8×10^3 lb, respectively.

The appropriate data for Amendment 112 is correct as presented, that is 'The design basis blowdown energy of 314.9×10^6 Btu and mass of 498.1×10^3 lb put into the containment.'

The reason for the reduction in the integrated M&E is due to a shorter blowdown transient time from 27.2 seconds to 26.8 seconds for the Amendment 112 reanalysis. The blowdown phase transient was directly affected by the corrections relative to the metal heat capacity calculation with respect to the steam generator tube (primary metal) and subsequent secondary side metal as a result of Nuclear Safety Advisory Letter (NSAL) 14-2, 'Westinghouse Loss-of-Coolant Accident Mass and Energy Release Calculation Issue for Steam Generator Tube Material Properties,' March 31, 2014. In addition, to mitigate the impact from the work performed in response to SCVB-RAI-3 (ADAMS Accession Number ML14352A248), a reduction in the conservative value for core stored energy was utilized. These changes also have an effect on downstream input for the blowdown calculation and transient time.

For an ice condenser containment design containment pressure analysis the blowdown integrated M&E release is used to initialize the LOTIC1 post-blowdown containment pressure response. Since the peak containment pressure occurs after the ice bed has melted out, the total integrated release (which is greater for the Amendment 112 analysis) is of more importance. The total integrated energy release (calculated based upon the WCAP-10325-P-A, Reference 1, evaluation model) has increased from 938.84×10^6 Btu (Amendment 111) to 949.05×10^6 Btu for the Amendment 112 reanalysis.

The NRC staff finds the proposed changes acceptable because the applicant reanalyzed the M&E with the following changes: (a) by performing sensitivity studies that resulted in an increase in the condenser ice mass and a shorter blowdown transient time in the reanalysis, (b) reduced conservatism in the core stored energy, and (c) included corrections in M&E release recommended by NSAL-14-2. The M&E analysis met the acceptance criteria 1 and 2 of SRP 6.2.1.3.

NOTE: The applicant subsequently revised the blowdown energy released into containment in the revision to FSAR Amendment 114. The NRC staff's evaluation of the revision to FSAR Amendment 114 is discussed later in this section.

FSAR Amendment 112 changed the initial conditions in the containment from a temperature of 100 °F in the lower and dead-ended volumes, 80 °F in the upper volume, and 15 °F in the ice condenser to 120 °F in the lower and dead-ended volumes, 110 °F in the upper volume, and 15 °F in the ice condenser in Section 6.2.1.3.3, assumption (10) under the heading "Containment Pressure Calculation."

In SCVB-RAI-3, the applicant was requested to refer to the initial ice condenser temperature assumption of 15 °F specified in assumption (10) above and the Technical Specification (TS) Surveillance Requirement (SR) 3.6.11.1 that states: "Verify maximum ice bed temperature is ≤27°F." The ice bed temperature is a key parameter for the ice condenser performance for pressure suppression, (i.e., assuming a lower ice bed temperature for the long-term pressure response is less conservative than using a higher temperature). For a conservative containment pressure calculation, the applicant was requested to justify using a nonconservative assumption of ice temperature of 15 °F instead of 27 °F.

In response to SCVB-RAI-3 (ADAMS Accession No. ML14352A248), the applicant performed a sensitivity (bounding) study by assuming the SR 3.6.11.1 maximum ice bed temperature of 27 °F. From the results of the sensitivity (bounding) analysis, the applicant determined that the peak containment pressure increases with a higher initial ice temperature and is also influenced by the time taken for ice bed to melt, which in turn depends on the initial ice mass and M&E release. A 27 °F initial ice temperature produces a higher containment peak pressure than with an initial ice temperature of 15 °F. The applicant performed the analysis with different initial ice masses until the results of the analysis closely matched the current FSAR analysis results for the peak containment pressure. The sensitivity studies determined that the initial ice mass should be increased by 70,000 lb (i.e., from 2.26 million lb to 2.33 million lb).

In its response to SCVB-RAI-3 (ADAMS Accession No. ML14352A248), the applicant provided the following revisions:

> FSAR Section 6.2.1.3.3 assumptions (2) and (10), and the last sentence under heading "Containment Pressure Calculation," reflecting ice mass changed from 2.24×10^6 lbs to 2.33×10^6 lbs, ice bed temperature change from 15 °F to 27 °F, and maximum calculated containment pressure change from 12.86 psig to 12.40 psig, and the approximate time at which the maximum pressure occurs change from: 4348 seconds to: 4346 seconds.

FSAR Section 6.7.6.1 Design Condition (2)(A)(ii) changing the minimum total weight of ice in columns from 2.24×10^6 lb to 2.33×10^6 lb.

FSAR Section 6.8.3, first paragraph, maximum calculated containment pressure change from: 12.86 psig to: 12.40 psig, and the approximate time at which the maximum pressure occurs change from: 4348 seconds to: 4346 seconds.

The NRC staff finds the changes in FSAR Sections 6.2.1.3.3, 6.7.6.1, and 6.8.3 acceptable based on the sensitivity analysis results performed with the revised initial ice mass, initial ice condenser temperature, and the revised initial compartment temperatures in assumption (10). The changes in this assumption, which revises the initial containment temperature for lower and dead-ended compartments from 100 °F to 120 °F and for the upper compartment from 80 °F to 110 °F, are conservative for the long-term peak pressure analysis.

NOTE: The applicant subsequently revised the updates to the FSAR provided in response to SCVB-RAI-3 in the revision to FSAR Amendment 114. The NRC staff's review of FSAR Amendment 114 is discussed later in this section.

Section 6.2.1.3.6 under heading "Long-Term LOCA Mass and Energy Releases", refers to WCAP-10325-P-A, "Westinghouse LOCA Mass and Energy Release Model for Containment Design March 1979 Version" (ADAMS Accession Number ML080640615) for the evaluation model used for the long term LOCA mass and energy release calculations.

In SCVB-RAI-5 the NRC staff identified Westinghouse issued Nuclear Safety Advisory Letters (NSALs)-06-6, -11-5, and -14-2 that reported errors in the WCAP-10325-P-A methodology that requires containment analyses should be corrected. The applicant was requested by the NRC staff to describe changes in the following containment analyses results using the corrected WCAP-10325-P-A methodology that incorporates corrections listed in the these NSALs: (a) containment peak pressure, (b) containment peak gas temperature for environment equipment qualification (EEQ), (c) containment peak wall temperature, (d) containment sump peak water temperature, (e) pump net positive suction head available (NPSHA) for the pumps that draw water from the containment sump during recirculation mode of safety injection and containment cooling, and (f) containment minimum pressure analysis for emergency core cooling system (ECCS) performance capability. The applicant was also requested by the NRC staff to add a statement in the FSAR stating the corrected version of WCAP-10325-P-A methodology which removed errors reported in NSALs-06-6, -11-5, and -14-2 was used for the containment LOCA M&E release analysis.

In response to SCVB-RAI-5 (ADAMS Accession No. ML14352A248), the applicant stated that the long-term containment pressure analysis scope affected by WCAP-10325-P-A M&E release is in FSAR Section 6.2.1.3.3, and the resulting impact of the NSALs on the containment peak pressure was an increase in the calculated peak pressure from 12.6 psig to a value of 12.86 psig. However, the revised analysis performed in response to SCVB-RAI-3 resulted in a lower peak containment pressure of 12.40 psig. The applicant also stated that there was no change to the associated peak containment temperature, and, likewise, there was no adverse impact on the peak sump temperature during the recirculation phase calculated for the LOCA analysis. In addition, neither the pump NPSHA nor the containment minimum pressure analysis for ECCS performance capability is impacted by the NSALs.

In response to SCVB-RAI-5, the applicant provided a markup of the first paragraph in FSAR Section 6.2.1.3.6, by inserting the following:

> A corrected version of WCAP-10325-P-A computer codes and input, which removed errors reported in References 29, 30 and 31 [NSAL-06-6, -11-5, and -14-2], was used for the containment LOCA M&E release analysis. The NSAL corrections are corrections to calculations in support of the approved methodology, and not a change in methodology.

The applicant provided revised FSAR Tables 6.2.1-3 and 6.2.1-4 on energy balances in Amendment 112. The applicant further revised these tables in response to SCVB-RAI-3. The applicant added the following references at the end of FSAR Section 6.2.1: (29) NSAL-06-6, "LOCA Mass and Energy Release Analysis," June 6, 2006, (30) NSAL-11-5, "Westinghouse LOCA Mass and Energy Release Calculation Issues," July 25, 2011, and (31) NSAL-14-2, "Westinghouse LOCA Mass and Energy Release Calculation Issue for Steam Generator Tube Material Properties," March 31, 2014.

The NRC staff finds the changes in FSAR Section 6.2.1.3.6, and Table 6.2.1-3 and 6.2.1-4 acceptable because the applicant confirmed that WCAP-10325-P-A methodology has been corrected from errors reported in Westinghouse NSAL-06-6, -11-5, and -14-2.

The applicant provided an updated FSAR Table 6.2.1-15 revising the Safety Injection (SI) delay time from 35.91 seconds to 36.13 seconds in Amendment 112.

The applicant provided revised FSAR Tables 6.2.1-16, "Double-Ended Pump Suction Guillotine Break—Blowdown Mass and Energy Releases," 6.2.1-17, "Double-Ended Pump Suction Guillotine Break—Reflood Mass and Energy Release—Minimum Safety Injection," 6.2.1-18, "Double-Ended Pump Suction Guillotine Break—Minimum Safety Injection Principal Parameters During Reflood," and 6.2.1-19, "Double-Ended Pump Suction Guillotine Break—Post-Reflood Mass and Energy Releases—Minimum Safety Injection" in Amendment 112.

The applicant provided markup of FSAR Table 6.2.1-25, "Double-Ended Pump Suction LOCA Sequence of Events," in Amendment 112, changing the following parameters:

- Accumulator Flow Starts time from 15.7 seconds to 15.6 seconds
- Assumed Initiation of ECCS time from 35.91 seconds to 36.13 seconds
- End of Blowdown time from 27.4 seconds to 26.8 seconds
- Accumulators Empty time from 66.782 seconds to 66.700 seconds
- End of Reflood time from 239.7 seconds to 239.8 seconds

The applicant provided revised FSAR Tables 6.2.1-26a, "Mass Balance," and 6.2.1-26b, "Energy Balance," in Amendment 112.

The applicant provided revised FSAR Figures 6.2.1-1, 6.2.1-2a, 6.2.1-2b, 6.2.1-3, 6.2.1-4, and 6.2.1-4a in Amendment 112. The applicant further revised these figures in response to SCVB-RAI-3 (ADAMS Accession No. ML14352A248).

The staff finds the changes in FSAR Section 6.2.1 Tables and Figures acceptable because they are based on the changes made in Section 6.2.1 Amendment 112 and responses to SCVB-RAI-3, -4, and -5 (ADAMS Accession No. ML14352A248).

The NRC staff concludes that the changes in Amendment 112 meet the requirements of 10 CFR Part 50 Appendix A: (1) GDC 16, because the applicant showed that the containment internal pressure and wall temperature during a design basis LOCA do not exceed their design limits, that is, internal design pressure of 15 psig or the administrative acceptance criterion of 13.5 psig, and the wall design temperature of 250 °F respectively, (2) GDC 38, because the applicant showed that the containment heat removal system would reduce the containment pressure and temperature rapidly, following a design basis LOCA and would maintain them at acceptable levels and (3) GDC 50, because the applicant showed that the containment heat removal system is designed so that the containment structure and its internal compartments can accommodate without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from design basis LOCA. Therefore the NRC staff finds the changes in FSAR Amendment 112 acceptable.

Changes in Containment Integrity Analysis in FSAR Amendment 114

In a letter dated August 13, 2015 (ADAMS Accession No. ML15225A382), TVA submitted a revised WBN, Unit 2, containment integrity analysis to address the following: (a) meeting 10 CFR Part 50, Appendix A, Criterion 5, for the shared essential raw cooling water (ERCW) system and component cooling system (CCS) between WBN Units 1 and 2, and (b) an issue reported in Westinghouse InfoGram IG-14-1, namely the density and specific heat values used for the reactor coolant system (RCS) metal mass do not bound the values published by the American Society of Mechanical Engineers (ASME). The applicant included markup of Amendment 113 of the FSAR reflecting the changes. The applicant submitted a supplement letter dated August 28, 2015 (ADAMS Accession No. ML15243A044) that provided responses to NRC staff RAIs and audit questions. The applicant subsequently included the markups in FSAR Amendment 114 submitted September 11, 2014. The NRC staff's evaluation of the proposed TSs for WBN, Unit 2, are discussed in Section 16 of this SSER.

FSAR Amendment 114 related to LOCA analysis, 10 CFR Part 50, Appendix A, Criterion 5, and Westinghouse InfoGram IG-14-1

FSAR Amendment 114 modified the following:

- the blowdown energy from 314.9 x 10^6 Btu and mass of 498.1 x 10^3 lb to energy of 315.5 x 10^6 Btu and mass of 498.9 x 10^3 lb as noted in item (1) in the fourth paragraph of FSAR Section 6.2.1.1.1,
- the initial ice in the ice condenser from 2.33 x 10^6 lb to 2.585 x 10^6 lb as noted in item (2) in the "Containment Pressure Calculation" in FSAR Section 6.2.1.3.3,
- residual heat removal (RHR) spray initiation from 4346.7 to 3600.0 seconds into the LOCA containment response transient as noted in item (12) in the "Containment Pressure Calculation" in FSAR Section 6.2.1.3.3,

- the heat transfer coefficient (UA) for the component cooling system heat exchanger from 5.778×10^6 Btu/hr-°F to 3.17×10^6 Btu/hr-°F as discussed in item (14) in the "Containment Pressure Calculation" in FSAR Section 6.2.1.3.3,

- the modeling of the ERCW flow to the component heat exchanger from 6250 to 3500 gallons per minute as noted in item (22) in the "Containment Pressure Calculation" in FSAR Section 6.2.1.3.3,

- the maximum containment pressure from 12.40 pounds per square inch, gauge (psig) occurring at approximately 4346 seconds to 11.73 psig occurring at approximately 3600 seconds, as noted in the last sentence in the "Containment Pressure Calculation" in FSAR Section 6.2.1.3.3 and FSAR Section 6.8.3,

- the analysis of the initial steam generator pressure to include an additional 13 psi internal steam generator pressure drop as noted in note 2 of FSAR Table 6.2.1-15,

- the sequence of events for a double-ended pump suction LOCA. The sequence was revised for the end of blowdown time from 26.8 to 27 seconds, the time to empty the accumulators from 66.700 to 66.2 seconds, and the end of reflood time from 239.8 to 243.6 seconds, as noted in FSAR Table 6.2.1-25,

- the minimum ice basket loading from 2.33×10^6 lb to 2.585×10^6 lb pounds of ice as noted in item (4) of the "Interface Requirements" in FSAR Section 6.7.4.1,

- the minimum total weight of ice in columns from 2.33×10^6 lb to 2.585×10^6 lb as noted in item (2)(A)(ii) of the "Design Conditions" in FSAR Section 6.7.6.1,

- Tables 6.2.1-3, 6.2.1-4, 6.2.1-16, 6.2.1-17, 6.2.1-18, 6.2.1-19, 6.2.1-26a, and 6.2.1-26b, and Figures 6.2.1-1, 6.2.1-2a, 6.2.1-2b, 6.2.1-3, 6.2.1-4, and 6.2.1-4a.

The changes in the above listed FSAR sections, tables, and figures are based on revision to the LOCA containment integrity AOR documented in Amendment 113.

The applicant performed the containment integrity analysis to confirm that the containment internal pressure, temperature, and the wall temperature do not exceed their design limits. The analysis should ensure that the containment heat removal systems can remove the most limiting LOCA or main steam line break (MSLB) M&E released into the containment without exceeding the WBN, Unit 2, containment internal design pressure of 15 psig or the administrative acceptance criterion of 13.5 psig, and the wall design temperature of 250 °F. The analysis should also ensure that the sump temperature change does not adversely impact the NPSHA for the pumps that draw fluid from the sump during the LOCA recirculation phase.

The analysis consists of an M&E release calculation that is an input to the containment pressure and temperature response calculation. The applicant performed the M&E analysis in accordance with the NUREG-0800, SRP 6.2.1.3. The purpose of revising the WBN, Unit 2 containment integrity AOR is due to the following main reasons:

(1) Correction of errors reported in Westinghouse InfoGram 14-1 would increase the stored energy of the RCS metal during normal plant operation, and consequently increases the M&E release into the containment during a design basis LOCA.

(2) Sharing of the CCS and the ERCW system flow by WBN, Units 1 and 2 during a normal shutdown cooling in one unit and simultaneous design basis LOCA in the second unit occurring prior to 48 hours from control rod insertion in the shutdown unit while it is in the hot shutdown mode, concurrent with a loss-of-offsite power (LOOP) in both units.

The applicant analyzed the most limiting scenario of loss of Train A concurrent with LOOP during which only one CCS HX ‘C’ is available to be shared between the units. In this scenario, which has the most limiting heat load on the single CCS HX, the LOCA is assumed to occur in the accident unit at 7 hours after the initiation of shutdown of the second unit. At this instant, the applicant calculated the CCS HX shutdown heat load of 89.4 million British thermal units (MBtu)/hr plus the LOCA containment heat load of 54.8 MBtu/hr. Because of sharing of the CCS HX between the units, this scenario results in a reduction of the following parameters of the CCS HX apportioned for containment heat removal in the LOCA unit: (a) the AOR value of ERCW flow and (b) the AOR value of UA (overall heat transfer coefficient × heat transfer area).

The applicant included the following other known changes in the containment integrity analysis: (a) initial RCS temperature uncertainty +7 °F, (b) 17×17 robust fuel assembly-2 (RFA-2) fuel (which may incorporate tritium-producing burnable absorber rods (TPBARs)) for decay heat, and (c) containment spray flow control valves (FCVs) increased opening stroke time to +13 seconds. The applicant also considered the impact of ±0.2-hertz variation in the emergency diesel generator (EDG) frequency and concluded its negligible impact on the LOCA M&E results.

In Amendment 114, the applicant revised the LOCA M&E release AOR using the NRC approved Westinghouse WCAP-10325-P-A (ADAMS Accession No. ML080640615) methodology and resolved the issues reported in Westinghouse InfoGram 14-1. The corrections consisted of using the revised RCS metal (stainless steel and low alloy carbon steel) density and specific heat that bounds the values given in the current ASME Boiler and Pressure Vessel (B&PV) Code 2010 Edition, Section II, Part D. The applicant used the RCS metal density value of 501 lbm/ft^3 which represents the density of stainless steel 304 and 316 at 70 °F and bounds the density (484 lbm/ft^3) of low alloy carbon steel at 70 °F given in Table PRD of the ASME Code Section II, Part D. For conservative M&E release analysis, the applicant used density of stainless steel (501 lbm/ft^3), which bounds the density of bulk of the metal mass (carbon steel) in the reactor vessel and the steam generators. The applicant stated that the steam generator tubes are not included because they are treated separately for a conservative LOCA M&E analysis. The ASME Code, Section II, Part D does not directly provide the metal specific heat values as a function of temperature, instead its Table TCD provides thermal diffusivity which is related to thermal conductivity, density, and specific heat by the following equation:

Thermal Diffusivity = (Thermal Conductivity) / (Specific Heat x Density)

From the above equation, while adding a 10% uncertainty, the applicant derived a conservative value of the RCS metal specific heat of 0.145 Btu/lbm°F.

The NRC staff reviewed the ASME B&PV Code, Section II, Part D, and confirmed that the RCS metal density of 501 lbm/ft^3 and specific heat of 0.145 Btu/lbm°F are conservative for the M&E release analysis because these are higher than the ASME values.

Resolving the issues reported in Westinghouse InfoGram IG-14-1 impacts the M&E release during the LOCA blowdown phase. The NRC staff finds the change in FSAR Section 6.1.3.3 acceptable because an increase in density and specific heat of the RCS metal reported in InfoGram IG 14-1 increases its stored sensible heat during normal plant operation and would therefore release greater M&E than the AOR during the LOCA blowdown phase and is conservative.

The containment peak pressure, temperature and sump fluid temperature occur during the long term LOCA post-reflood phase. The applicant used the revised M&E release output data for the analysis. The long term analysis consists of determining the containment pressure and temperature responses during the LOCA post-reflood phase and sump fluid temperature response during the LOCA sump recirculation mode.

For the M&E analysis, the applicant used the same inputs and assumptions as stated in Amendment 113, other than the changes noted above. The applicant replaced Tables 6.2.1-16, 6.2.1-17, 6.2.1-18, and 6.2.1-19 of Amendment 113 with revised M&E results tables in inserts C, D, E, and F by letters dated August 13, 2015 (ADAMS Accession No.ML15225A382) and August 28, 2015 (ADAMS Accession No. ML15243A044).

For the containment response analysis, the applicant used the revised M&E analysis results and used the same assumptions and inputs as in Amendment 114 with the following exceptions: (a) ice mass in the ice condenser changed from 2.33×10^6 lb to 2.585×10^6 lb, (b) UA of the CCS HX apportioned (virtual) for containment cooling changed from 5.778×10^6 Btu/hr-°F to 3.17×10^6 Btu/hr-°F, and (c) ERCW flow to the CCS HX apportioned (virtual) for containment cooling changed from 6250 gpm to 3500 gpm. The applicant calculated the real CCS HX UA = 6.82×10^6 Btu/hr-°F with an ERCW flow 9200 gpm and CCS flow of 10,166 gpm.

During its review, the NRC noted that the applicant split the CCS HX 'C' UA = 6.82×10^6 Btu/hr-°F into two virtual HXs, assigning one to the LOCA unit with a UA = 3.17×10^6 Btu/hr-°F and an ERCW flow of 3400 gpm, and the second to the shutdown unit. In response to the NRC staff question in a letter dated August 28, 2015 (ADAMS Accession No. ML15243A044) regarding the basis for determination of UA = 3.17×10^6 Btu/hr-°F, the applicant stated that the split was based on approximately an equal CCS mass flow fraction to the virtual HXs. The analysis results show that the peak containment pressure is 11.73 psig for the limiting double-ended pump suction break LOCA, assuming an ice bed mass of 2.585×10^6 lb. The peak pressure occurs at approximately 3600 seconds with ice bed melt-out at approximately 2959 seconds and the containment spray switchover time to sump recirculation mode 2718.7 seconds. The results are acceptable because peak calculated pressure is less than the design pressure of 15.0 psig as well as the administrative limit of 13.5 psig, and the margin between the ice bed melt-out time and spray switchover time (2959−2718.7 = 240.3 seconds) is greater than 150 seconds and therefore meets the GDC 16, and 38 requirements.

The NRC staff noted a significant difference in the heat loads on the two virtual CCS HXs (89.4 MBtu/hr on the shutdown unit versus 54.8 Btu/hr on the LOCA unit. The NRC staff requested the applicant reanalyze by splitting the real CCS HX (UA = 6.82×10^6 Btu/hr-°F) into two virtual HXs based on heat load fractions. With the revised split, and with the proposed revised total ERCW and CCS flows of 9200 gpm and 10,000 gpm, respectively, the applicant calculated UA = 2.64×10^6 Btu/hr-°F for the virtual LOCA unit and UA = 4.12×10^6 Btu/hr-°F for the virtual shutdown unit.

Since the WBN, Unit 2, containment response described above was performed with a virtual CCS HX UA = 3.17×10^6 Btu/hr-°F, while based on apportioning by heat load its UA = 2.64×10^6 Btu/hr-°F, the applicant performed a sensitivity study by changing its UA from 3.17×10^6 Btu/hr-°F to 2.00×10^6 Btu/hr-°F (which bounds the calculated UA = 2.64×10^6 Btu/hr-°F) and used the same ERCW flow of 3504 gpm. The result showed an increase in peak containment pressure from 11.73 to 11.76 psig, which is considered to be insignificant. The sensitivity study determined that the peak containment pressure is not sensitive to the UA of the virtual CCS HX assigned for the LOCA unit. The NRC staff finds the modeling results are consistent with (i.e., proportional to) the way containment heat is removed during an accident. Specifically, most of the containment heat removal is performed by the containment spray system compared to a small fraction removed by the RHR spray cooled by the CCS HX 'C'.

The NRC staff finds the containment integrity analysis acceptable because: (a) the calculated design basis LOCA peak containment pressure 11.73 psig is below the containment design pressure of 15 psig and the administrative limit of 13.5 psig, and also below the 10 CFR 50 Appendix J Integrated Leak Test Pressure P_a = 15 psig which is the same as the containment design pressure as stated in TS Section 5.2.7.19, and (b) the calculated maximum containment vapor temperature 234.3 °F is below the containment design temperature of 250 °F.

The applicant calculated 157.5 °F (Table 4.4.3-6 in the August 13, 2015 letter (ADAMS Accession No. ML15225A382), Attachment to Enclosure 1) as the maximum sump fluid temperature after switchover, which is a small increase from its current approximate value of 155 °F in FSAR Amendment 113 Figure 6.2.2-3. The increase in the peak sump fluid temperature increases the vapor pressure by 0.262 psi (0.6 ft water) which reduces the NPSHA available by 0.6 ft at the inlet of the RHR and containment spray pumps during the recirculation mode. The decrease in the NPSHA does not impact the operation of RHR and CS pumps because the minimum NPSH margin (NPSHA minus NPSH required) for the most limiting pump given in FSAR Amendment 113 Table 6.3-12 is 6.4 ft. The most limiting NPSH margin is conservative because the applicant did not take credit for the sump static water level in NPSH available calculation as stated in FSAR Amendment 113, Section 6.3.2.14 item (1).

Since the LOCA event requires the greatest amount of ice compared to other accidents and events, the analytical value of initial ice mass 2.585×10^6 lb based on LOCA results is acceptable for all other accidents and events.

The NRC staff concludes that containment integrity analysis for the sharing of CCS and ERCW systems between WBN, Units 1 and 2 in the event of a design basis LOCA in WBN, Unit 2 and an orderly shutdown of WBN, Unit 1, the design of WBN, Unit 2, as described and analyzed in TVA's FSAR through Amendment 114, meet the following criteria in 10 CFR Part 50 Appendix A:

- GDC 5, because the applicant showed that the sharing of the systems will not significantly impair their ability to perform their safety function of mitigating the increase in LOCA containment pressure and temperature in the LOCA unit,

- GDC 16, because the applicant showed that the WBN, Unit 2 containment design conditions important to safety are not exceeded during a design basis LOCA in WBN, Unit 2,

- GDC 38, because the applicant showed that the containment heat removal system would reduce the WBN, Unit 2 containment pressure and temperature rapidly, following a design basis LOCA and would maintain them at acceptable levels,

- GDC 50, because the applicant showed that the WBN, Unit 2 containment heat removal system is designed so that the containment structure and its internal compartments can accommodate without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from design basis LOCA.

<u>Additional FSAR Amendment 114 Revisions</u>

The applicant revised the design internal pressure referenced in FSAR Section 6.2.1.2 “Primary Containment System Design” from 13.5 psig to 15.0 psig, which corresponds to the maximum internal pressure of 15 psig and is consistent with FSAR Section 6.2.2.3. FSAR 6.2.2.3 states:

> The analyses were performed using the LOTIC code and show that the containment heat removal systems are capable of keeping the containment pressure below the containment maximum internal pressure of 15 psig, which corresponds to the code design internal pressure of 13.5 psig at 250 °F.

The NRC staff notes that the code design pressure remains as 13.5 psig.

The applicant revised the area of ice condenser lattice frames slab 13 referenced in FSAR Table 6.2.1-1 “Structural Heat Sinks” from 75,860 ft^2 to 75,865 ft^2 to represent the as-built configuration.

The applicant revised the decay heat at time 15 seconds referenced in FSAR Table 6.2.1-20 “Decay Heat Curve” from 0.477187 to 0.0477187. The NRC staff determined that the change did not invalidate any of the staff’s previous findings.

FSAR Amendment 114 revised FSAR Section 6.2.1.3.10, associated tables, and figures are based on a revision to the containment pressure and temperature response analysis for a main steam line break (MSLB) accident inside the containment. The change is due to an increase in the feedwater isolation time from 8.0 seconds in the analysis of record (AOR) to 13.5 seconds by the motor-operated main feedwater isolation valve (MFIV) during a MSLB and a single failure of a main steam isolation valve (MSIV). The following is a list of revisions in FSAR Amendment 114 related to this reanalysis.

FSAR Section 6.2.1.3.10, page 6.2.1-34, under the heading “Pipe Break Blowdowns-Spectra and Assumptions”, assumption 2 is revised from:

> Steam line isolation signals and feedwater line isolation signals are generated by either a low steam line pressure signal, high or high-high containment pressure signal, or high steam line pressure rate signal. An allowance of 8 seconds is assumed for steam line isolation including generation, processing, and delay of the isolation signal and valve closure. An allowance of 8 seconds is assumed for feedwater line isolation including generation, processing, and delay of the isolation signal and valve closure.

To:

> Steam line isolation signals and feedwater line isolation signals are generated by either a low steam line pressure signal, high or high-high containment pressure signal, or high steam line pressure rate signal. An allowance of 8 seconds is assumed for steam line isolation including generation, processing, and delay of the isolation signal and valve closure. An allowance of 8.5 seconds is assumed for feedwater line isolation by the air-operated feedwater regulation valve or 13.5 seconds by the motor-operated main feedwater isolation valve including generation, processing, and delay of the isolation signal and valve closure.

FSAR Section 6.2.1.3.10, page 6.2.1-34, under the heading “Pipe Break Blowdowns-Spectra and Assumptions”, assumption 6 is revised from:

> Failure of a main steamline isolation valve (MSIV), failure of a feedwater isolation valve (FIV), failure of auxiliary feedwater runout control protection, and failure of a safety injection train are considered.

To:

> Failure of a main steamline isolation valve (MSIV), failure of a feedwater regulation valve (FRV), failure of auxiliary feedwater runout control protection, and failure of a safety injection train are considered.

FSAR Section 6.2.1.3.10, page 6.2.1-35, under the heading “Single Failure Effects”, item (2) is revised from:

> Failure of a feedwater isolation valve could only result in additional inventory in the feedwater line which would not be isolated from the steam generator. The mass in this volume can flash into the steam generator and exit through the break. The feedwater regulating valve closes in no more than 6.5 seconds precluding any additional feedwater from being pumped into the steam generator. The additional line volume available to flash into the steam generator is that between the feedwater isolation valve and the feedwater regulating valve.

To:

> The additional mass inventory in the feedwater line that would not be isolated from the steam generator following main feedwater isolation can flash into steam and pass through the steam generator and exit out of the break. Failure of the air-operated feedwater regulation valve results in an increase of 5 seconds for main feedwater isolation by the motor-operated feedwater isolation valve, but also results in a decrease in the feedwater piping volume that is not isolated from the steam generator. The feedwater regulation valve closes in no more than 6.5 seconds and the feedwater isolation valve closes in no more than 11.5 seconds precluding any additional feedwater from being pumped into the steam generator.

FSAR Section 6.2.1.3.10, page 6.2.1-36, under the heading “Worst-Case Mass and Energy Releases,” description of case (1) is revised from: “Full double-ended rupture at 100.6% of nominal full power with a failure of a FIV. This represents the limiting DER case in terms of calculated peak temperature.” To: “Full double-ended rupture at 100.6% of nominal full power with a failure of a MSIV. This represents the limiting DER case in terms of calculated peak temperature.”

FSAR Section 6.2.1.3.10, page 6.2.1-38, under the heading “Large Break” is revised from:

> The limiting case among the double-ended ruptures, which yielded a calculated peak temperature of 324.3°F and a peak pressure of 10.3 psig, is the 1.4 ft^2 loop break at 100.6% of nominal full power with a failure of a main feedwater isolation valve. Figure 6.2.1-69 provides the upper and lower compartment temperature transients, and Figure 6.2.1-70 illustrates the lower compartment pressure transient. Table 6.2.1-39 contains the mass and energy release rates for the above case.

To:

> The limiting case among the double-ended ruptures, which yielded a calculated peak temperature of 324.4°F and a peak pressure of 10.3 psig, is the 1.4 ft^2 loop break at 100.6% of nominal full power with a failure of a main steamline isolation valve. Figure 6.2.1-69 provides the upper and lower compartment temperature transients, and Figure 6.2.1-70 illustrates the lower compartment pressure transient. Table 6.2.1-39 contains the mass and energy release rates for the above case.

FSAR Section 6.2.1.3.10, page 6.2.1-38, under the heading “Small Break” is revised from:

> The most severe transient in terms of superheat temperature duration for the small break spectrum is the 0.35 ft^2, 30% nominal full power, with AFW pump runout protection failure. The temperature transient with a peak temperature of 325.1°F and peak pressure of 6.59 psig for the case is presented in Figure 6.2.1-71, and the pressure transient is provided in Figure 6.2.1-72. Table 6.2.1-39 provides the mass and energy release rates for this case.

To:

> The most severe transient in terms of superheat temperature duration for the small break spectrum is the 0.35 ft^2, 30% nominal full power, with AFW pump runout protection failure. The temperature transient with a peak temperature of 325.0°F and peak pressure of 6.59 psig for the case is presented in Figure 6.2.1-71, and the pressure transient is provided in Figure 6.2.1-72. Table 6.2.1-39 provides the mass and energy release rates for this case.

FSAR Tables and Figures impacted by the above changes are: Tables 6.2.1-39, 6.2.1-41, 6.2.1-43, and 6.2.1-44, Figures 6.2.1-69, 6.2.1-70, 6.2.1-71, 6.2.1-72, 6.2.1-73, and 6.2.1-74

The most limiting case for the peak containment temperature is the full double-ended 4.6 ft^2 break area occurring at the nozzle on one steam generator, however the maximum effective break area is limited to1.4 ft^2 because of the presence of steam line flow restrictors in the steam generators. The feedwater isolation time increase by 5.5 seconds (from 8.0 seconds to 13.5 seconds) which results in increased mass and energy entering into the steam generator and thereby through the break is partially offset by a decrease in the feedwater piping volume that is not isolated from the steam generator. The large break limiting temperature case resulted in a peak containment temperature of 324.4°F and a peak pressure of 10.3 psig.

For the most limiting small steam line break of 0.35 ft^2, at 30% nominal full power, with auxiliary feedwater (AFW) pump runout protection failure, the peak temperature decreased from 325.1°F in the AOR to 325.0°F and peak pressure of 6.59 psig.

The applicant's revised MSLB analysis is acceptable because the increase in the peak containment temperature from 324.3°F (in the AOR) to 324.4°F for the large MSLB is bounded by the limiting small break AOR peak containment temperature of 325.1°F. The peak containment pressure of 10.3 psig for the limiting MSLB is acceptable because it is bounded by the LOCA peak containment pressure of 11.73 psig.

6.2.2 Containment Heat Removal Systems

FSAR Amendment 112 revised Sections 6.8.1 "Design Bases," 6.8.2 "System Description," and Section 6.8.3 "Safety Evaluation," in Section 6.8 "Air Return Fans." The revision to Section 6.8.1 changed the first two sentences from:

> This operation takes place at the appropriate time (Section 6.7) following a beyond-design-basis accident. The secondary purpose of the system is to limit hydrogen concentration in potentially stagnant regions by ensuring a flow of air from these regions.

To:

> This operation takes place at the appropriate time (Section 6.7) following a LOCA or other high energy line break within the containment. The secondary purpose of the system is to limit hydrogen concentration in potentially stagnant regions by ensuring a flow of air from these regions (Section 6.2.5).

The revision to Section 6.8.2 changed the last sentence of the first paragraph from:

> Air return fan suction side is equipped with a non-return damper which prevents flow from the lower compartment to the upper compartment during the initial stages of a beyond-design-basis accident.

To:

> Air return fan suction side is equipped with a non-return damper which prevents flow from the lower compartment to the upper compartment during the initial stages of a LOCA or other high energy line break.

The revision to Section 6.8.2 changed the first sentence of the fourth paragraph from: "The system is designed to operate continuously during degraded core conditions." to: "The system is designed to operate continuously during accident conditions."

The revision to Section 6.8.3 changed the first sentence of the first paragraph from:

> The design bases of the fans are to reduce containment pressure after blowdown from a severe accident pipe break, prevent excessive hydrogen concentrations in pocketed areas, and circulate air through the ice condenser.

To:

> The design bases of the fans are to reduce containment pressure after blowdown from a LOCA or other high energy line break, prevent excessive hydrogen concentrations in pocketed areas, and circulate air through the ice condenser.

The revision to Section 6.8.3 changed the last sentence of the second paragraph from: "A back-draft damper, normally closed, is located upstream of each deck fan to prevent reverse flow during the initial severe accident blowdown." to: "A back-draft damper, normally closed, is located upstream of each deck fan to prevent reverse flow during the initial LOCA or other high energy line blowdown."

The revision to Section 6.8.3 changed the first sentence of the fourth paragraph from: "The fans are designed to withstand the beyond-design-basis accident containment environment." to: "The fans are designed to withstand the post DBA environment and were shown to survive the beyond-design-basis accident containment environment (Section 6.2.5)."

The NRC staff finds the changes in Sections 6.8.1, 6.8.2, and 6.8.3 acceptable because they are consistent with WBN, Unit 1. In addition, for convenience, the applicant added reference to FSAR Section 6.2.5 in Sections 6.8.1 and 6.8.3, which describes the requirement for the containment air return system during beyond-design-basis accident conditions.

FSAR Section 6.8.5 "Instrumentation Requirements" was revised to change the first sentence

Section 6.8.5, change first sentence from:

> The essential instrumentation requirements are that at least one of the air return fans start at the appropriate time after a beyond-design-basis-accident and that the fan keeps running for one year.

To:

> The essential instrumentation requirements are that at least one of the air return fans start at the appropriate time after receipt of a Phase B isolation signal and that the fan is capable of running for one year.

The NRC staff finds the corrections in Section 6.8.5 did not change any previous NRC analysis and acceptance of the design of WBN Unit 2.

6.2.3 Secondary Containment Functional Design

<u>FSAR Amendment 112 revisions</u>

FSAR Amendment 112 revised several sections to reflect that the Auxiliary Building Gas Treatment System is functional but not required to mitigate a fuel handling accident (FHA). These changes are as follows:

FSAR Amendment 112 revised Section 6.2.3.2.3 "Auxiliary Building Gas Treatment System (ABGTS)," to add the following statement as a third paragraph:

> Although the ABGTS is available to minimize the consequences of a fuel handling accident, it is not required to function in order to meet control room and offsite dose limits based on the use of the Regulatory Guide (RG) 1.183, Revision 0 (Alternative Source Term) methodology.

Amendment 112 revised FSAR Section 6.2.3.3.1 "Secondary Containment Enclosures" by deleting "or a FHA inside containment" at two places in the first and one place in the second paragraph. In addition FSAR Amendment 112 added the following in the first paragraph of FSAR Section 6.2.3.3.1:

> The original design credited the secondary containment enclosures to mitigate the consequences of a FHA. Although these enclosures are available to minimize the consequences of a FHA, based on the use of the Regulatory Guide 1.183, Revision 0 (Alternative Source Term) methodology for a FHA, the structures are no longer required for mitigation of a postulated FHA.

FSAR Section 9.4.2.1 "Design Bases" added the following at the end of the third paragraph:

> Although the ABGTS is available to minimize the consequences of a fuel handling accident, it is not required to function in order to meet control room and offsite dose limits based on the use of the Regulatory Guide 1.183, Revision 0 (Alternate Source Term) methodology.

Also, the following was added at the end of second from last paragraph of FSAR Section 9.4.2.1:

> Although the ABGTS is available to minimize the consequences of a fuel handling accident, it is not required to function in order to meet control room and offsite dose limits based on the use of the Regulatory Guide 1.183, Revision 0 (Alternate Source Term) methodology.

FSAR Section 3.1.2.6 "Fuel and Radioactivity Control" was revised to add the following paragraph before the last paragraph under "Criterion 61 - Fuel Storage and Handling and Radioactivity Control"

> The Auxiliary Building Gas Treatment System (ABGTS) includes charcoal filtration which can be used to minimize radioactive material releases associated with a postulated spent fuel handling accident. The ABGTS system is not required to mitigate the consequences of a spent fuel handling accident.

The NRC staff's evaluation of a postulated FHA is provided in SSER 25, Section 15.4.5. As discussed in SSER 25, Section 15.4.5, the ABGTS is not credited in TVA's FHA analysis. Therefore, the proposed changes are consistent with the analysis previously evaluated by the NRC staff and are acceptable.

Amendment 112 revised FSAR Section 6.2.3.3.2, "Emergency Gas Treatment System (EGTS)," item (2), in the last paragraph under heading "Annulus Negative Pressure Control Capability" to change the rated flow rate for each train of the air cleanup subsystem from 4000 +10% cfm to 4000 ±10% cfm.

The NRC staff finds the EGTS flow tolerance of -10% acceptable because it is consistent with WBN, Unit 1 TS SR 3.6.9.4, which states: "Verify each EGTS train produces a flow rate ≥ 3600 cfm and ≤ 4400 cfm within 20 seconds from the initiation of a Containment Isolation Phase A signal.

Amendment 112 revised FSAR Table 6.2.3-3, "Failure Modes and Effects Analysis For Passive Failure for the ABGTS," to change "Remarks" for item 9 on page 6 of 27, items 10 and 11, on page 7 of 27, and item 12 on page 8 of 27 to remove "and both dampers fail closed on loss of control air" in the second sentence.

The safety-related ABGTS Train A and Train B dampers should fail close with the loss of non-safety-related control air. This is necessary for auxiliary building isolation or in the presence of high radiation in refueling area to isolate the fuel handling area exhaust fans and to establish boundary for ABGTS

6.2.4 Containment Isolation Systems

FSAR Amendment 112 made the following revisions to FSAR Table 6.2.4-1 "Watts Bar Nuclear Plant Containment Penetrations and Barriers:"

- Sheet 44 of 64; delete shield building penetration MK-71 for penetration 80.
- Sheet 57 of 64; replace shield building penetration MK-54 for penetration 99 with MK-34.
- Sheet 57 of 64; replace shield building penetration MK-54 for penetration 100 with MK-34.
- Change "see page" to "seepage" in Note (27)

Change Note (27) in FSAR Table 6.2.4-1 (Sheet 69 of 69)

FSAR Table 3.9-25 "Valves Required to be Active for Design Basis Events" was revised to change valves FCV-43-55, -58, -61, and -64 from gate to globe valves, and capitalize the first letter of containment in column titled "Function/Description" for valve FCV-43-55.

The NRC staff determined that the change did not invalidate any of the staff's previous findings.

6.2.5 Combustible Gas Control Systems

FSAR Section 3.8.2.2.3 “NRC Regulatory Guides” was revised to change the title of RG 1.7 from “Control of Combustible Gas Concentrations in Containment Following a Loss of Coolant Accident” to “Control of Combustible Gas Concentrations in Containment.”

The change is consistent with the current title of RG 1.7 and does not invalidate any previous NRC review.

6.2.6 Containment Leakage Testing

Amendment 112 revised FSAR Table 6.2.6-3 “Valves Exempted from Type C Leak Testing” to change the valve type for the following valves:

- On Sheet 1 of 6, penetration X-8A, FROM: FCV 3-164A, TO: LCV-3-164A
- On Sheet 1 of 6, penetration X-8D, FROM: FCV 3-171A, TO: LCV-3-171A
- On Sheet 2 of 6, penetration X-13C, FROM: FCV 1-23, TO: PCV 1-23
- On Sheet 4 of 6, penetration X-40B, FROM: LXC 3-148A, TO: LCV 3-148A

The NRC staff finds the corrections in the valve numbers do not invalidate any previous NRC review.

6.3 Emergency Core Cooling System

6.3.1 System Design

FSAR Amendment 112 revised Table 6.3-1 “Emergency Core Cooling System Component Parameters” (page 3 of 4) to:

- Add an asterisk to the heading labeled "Valves".
- Change the maximum stroke time for valves FCV-63-152 and FCV-63-153 from 12 seconds to 15 seconds.
- Change the maximum stroke time for valve FCV-63-1 from 20 seconds to 60 seconds.
- Change the maximum stroke time for valve FCV-74-3 from 17.1 seconds to 60 seconds.
- Change the maximum stroke time for valve FCV-74-21 from 17.1 seconds to 60 seconds.
- Change the maximum stroke time for valves FCV-63-93 and FCV-63-94 from 10 seconds to 40 seconds.
- Change the valve description for valve FCV-63-1 from “RWST to RHRPs Suction RWST to” to “RWST to RHRPs Suction”

- Change the valve description for valve FCV-74-3 from “RHRPs Suction” to “RWST to RHRPs Suction”

The NRC staff finds the changes do not invalidate any previous NRC review.

Amendment 112 revised FSAR Table 6.3-1 “Emergency Core Cooling System Component Parameters” (page 4 of 4) to:

- Add asterisks to the heading of the "Leakage Allowed" column and add a note to the bottom of the table indicating that specific allowable leak rates are defined on valve data sheets.

- Change “disc leakage” to “seat leakage” for valves a through f.

- Change the "Leakage Allowed" value for seat leakage per inch of nominal valve size for items a, b and c (Conventional Globe Valves, Gate Valves and Check Valves) from "3 cc/hr" to "0-10 cc/hr."

The first two changes in page 4 of 4 of Table 6.3-1 are editorial and do not invalidate any previous NRC review. The general change in the gate, globe and check valve seat leakage from "3 cc/hr" to "0-10 cc/hr" is a change in component design requirement. For the gate, globe, and check valves used for containment isolation, the applicant will be required to meet the test requirements Type C tests in 10 CFR Part 50 Appendix J. The NRC staff finds the changes do not invalidate any previous NRC review.

In response to SCVB-RAI-1 (ADAMS Accession No. ML14352A248), the applicant provided a markup of item (1) “Residual Heat Removal Pumps” by adding the following statement: “A containment pressure of zero psig (building pressure of 14.3 pounds per square inch, atmospheric) is used in calculating the most limiting (minimum) NPSHA.”

In response to SCVB-RAI-2 (ADAMS Accession No. ML14352A248), the applicant provided a markup of item (1) “Residual Heat Removal Pumps” by replacing the terminology “containment over pressure” with “containment accident pressure.” The NRC staff finds the changes do not invalidate any previous NRC review.

The NRC staff has reviewed the changes made to FSAR Section 6.3.2, “System Design” from Amendment 92 up to Amendment 114. The NRC staff has also compared FSAR Section 6.3.2 in Amendment 114 with the current Section 6.3.2 for WBN Unit 1. The NRC staff found most of the changes made were editorial in nature and, therefore, the NRC staff finds them to be acceptable. Those changes that were not editorial were related to updating the licensing basis for the modified ECCS sump strainer. By letter dated September 18, 2014 (ML14163A658), the NRC staff closed out its review of WBN, Unit 2’s response to Generic Letter 2004-02, “Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors.” Overall the NRC staff concluded that the information provided demonstrated that the debris will not inhibit the ECCS or containment spray system performance of its intended function in accordance with 10 CFR 50.46 to assure adequate long term core cooling following a design-basis accident. In Section 3.2.16 of the NRC staff’s evaluation, the NRC staff validated that the WBN Unit 2 FSAR was updated to include the licensing basis for the modified ECCS sump strainer. Based on the fact the changes made in this section were either editorial or previously reviewed as part of the Generic Letter 2004-02 review, the NRC staff considers the changes made to FSAR Section 6.3.2 to be acceptable.

6.3.3 Testing

The NRC staff has reviewed the changes made to FSAR Section 6.3.4, “Tests and Inspections” from Amendment 92 up to Amendment 114. The NRC staff also compared FSAR Section 6.3.4 in Amendment 114 with the current Section 6.3.4 for WBN Unit 1. The NRC staff found that all of the changes made were editorial in nature and therefore found acceptable.

6.4 Control Room Habitability

FSAR Amendment 112 revised Section 6.4.4.2 “Toxic Gas Protection” to modify the first sentence of the second from last paragraph to change the nitrogen stored in the tank in the yard east of the control building from 286,900 standard cubic feet (scf) to 856,621 scf.

The NRC staff finds the revision acceptable because the nitrogen storage tank volume change is a change in the design in the holding volume of the storage tank. The NRC staff finds the changes do not invalidate any previous NRC review.

6.5 Engineered Safety Feature (ESF) Filter Systems

6.5.1 ESF Atmosphere Cleanup System

FSAR Amendment 112 revised Table 6.5-1 “Regulatory Guide 1.52, Rev. 2, Section Applicability for the Emergency Gas Treatment System” (page 1 of 2) to change “form” to “from” in note 1 and changed one of the referenced RGs from 1.25 to 1.183 in note 2.

The change in note 1 changing the word “form” to “from” is editorial and does not invalidate any previous NRC review. The NRC staff finds the change in note 2 from 1.25 to 1.183 acceptable because the use of RG 1.183 is an option for the design of the EGTS adsorbers in RG 1.52 Revision 4, Section C.2.c.

7 INSTRUMENTS AND CONTROLS

7.5 <u>Safety-Related Display Instrumentation</u>

7.5.2 Postaccident Monitoring System

7.5.2.3 High-Range Containment Area Radiation Monitors

Disposition of Open Item (Appendix HH)

<u>Open Item 79</u>

Open Item 79 states:

> TVA should perform a radiated susceptibility survey, after the installation of the hardware but prior to the [radiation monitor (RM)]-1000 being placed in service, to establish the need for exclusion distance for the high range containment air radiation (HRCAR) monitors while using handheld portable devices (e.g., walkie-talkie) in the control room, as documented in Attachment 23 to TVA's letter, dated February 25, 2011, and item number 355 of TVA's letter, dated April 15, 2011.

By letter dated August 20, 2015 (ADAMS Accession No. ML15232A540), TVA provided the results of the August 3, 2015 electromagnetic interference (EMI)/radio frequency interface (RFI) survey that was conducted in the main control room (MCR) to address HRCAR monitors and other equipment in the MCR. This survey was conducted before and during the hot functional testing (HFT). Among other equipment, the survey included the results for the HRCAR monitors. In Enclosure 1, to the August 20, 2015 letter, the licensee provided the survey results and stated that the data were taken on two separate days. One set of data were obtained before HFT tests were conducted and the second set of data was obtained during the HFT tests.

The survey test spectrums are contained in Enclosure 1 to the August 20, 2015 letter. They show that the background field strength before and after HFT in the MCR are as follows:

> Before HFT –
> a. All but the cell phone signal is less than 80dBuV/m.
> b. The cell phone signal is less than 90dBuV/m.
>
> 2. During HFT –
> a. While the spectrum is slightly different the magnitudes are the same.

The above results show that the background electromagnetic compatibility (EMC) field strength in the MCR is very low. The field strength in the control room was observed to be less than 100 dBuV/m. Field strength of 100 dBuV/m is equivalent to a field strength of 0.1 Volts (V)/meter (m) at 1 m.

Enclosure 2 to the August 20, 2015, TVA letter provides the various facets of the test including the survey test results. These results are applicable to the Eagle 21 Process Protection System and the HRCAR monitors. This enclosure describes the purpose, the regulatory commitments, radiated survey test equipment, radiated survey methodology, acceptance criteria, analysis, results and conclusions, and references.

The test equipment antenna was placed in front of the HRCAR monitors in the MCR to scan frequencies from 10 kiloHertz to 1 gigaHertz and to monitor the radiated field strength values in the vicinity of the equipment including HRCAR monitors. The test results are included in the graphs provided in the August 20, 2015, letter.

TVA stated the acceptance criteria for the radiated EMI field strength before and during the HFT is 10 V/m or 140 dBuV/m. This acceptance criteria is based on TVA letter dated December 10, 2012 (ADAMS Accession No. ML12349A379). However, the NRC staff noted during teleconferences held on September 14 and 16, 2015, that the EMI/RFI tests conducted in that test report used the field strength of 10 V/m but these test sources were placed at a distance of 3 m and not next to the RM-1000 monitors as specified in the applicable acceptance criteria.

During the September teleconferences, TVA was requested to clarify how the field strength of 10V/m at a distance of 3 meters translates to the field strength at the face of or very near the face of the HRCAR monitors since TVA's August 20, 2015, letter stated that there is no exclusion distance for the HRCAR monitors. TVA proposed to run actual tests using the walkie-talkie radios and testing at all selectable frequencies at various distances to confirm whether an exclusion distance is needed or not. Confirmation of the successful walkie-talkie tests will also confirm that there is no RFI impact for the HRCAR monitors.

According to the TVA letter dated August 20, 2015, the maximum normal (with no external radiated emission sources e.g. no handheld portable devices) radiated field strength measured in the vicinity of HRCAR monitors before and during the HFT was found to be 0.1 V/m (100 dBuV/m). TVA also stated that extensive tests were done when TVA introduced Nextel walkie-talkies (radio phones) at another TVA site which produced a field strength of approximately 5 V/m at a distance of 1 meter. When these tests were performed on different equipment (Eagle 21, rod positioning equipment, process control equipment) no adverse effect was noticed even when the radio phones were placed next to the equipment. The Nextel phones were used at other TVA facilities for approximately 9 years without any observed performance anomalies. Based on these results, there were no required exclusion distance stated in the TVA letter of August 20, 2015. However, while these tests provide an indication of successful equipment testing, their results are not directly applicable to the WBN, Unit 2 HRCAR monitors.

In the October 8, 2015 letter (ADAMS Accession No. ML15281A471), TVA stated that testing was conducted at the WBN, Unit 2 plant site using Harris Models XG-75 and XG-100 which are the two radio models planned for use in the WBN, Unit 2 MCR. Model XG-100 is the higher power of the two radios and does not use radio repeaters. Both radio models were tested on 16 available channels. No disturbance was noticed on the HRCAR monitor at any distance starting from 3 feet (ft) to right next to the face of the HRCAR meter with the Harris XG-75 radio. No disturbance was noticed at a distance of 1 ft, 2 ft, or 3 ft when using the Harris XG-100 model radio. When the Harris XG-100 radio was tested immediately next to the face of the HRCAR monitor, some disturbance was noticed; however, no disturbance was noticed at a distance of 3 inches or more from the face of the HRCAR monitor.

TVA notes in its letter of October 8, 2015, that its plant training program instructs operators to prohibit the use of radios adjacent to the panels. TVA further stated that it is impractical to use the radio within 3 inches of the face of the panel where the HRCAR monitor is located. Further, TVA stated that HRCAR monitors do not have any actuation function and are used solely for indication. The NRC staff agrees that it is impractical to use the radios within 3 inches of the face of the panel mounted equipment. Since the only function of HRCAR monitors is indication even if there was some disturbance due to use of the radio at a distance of less than 3 inches it will not have any impact on plant safety. The NRC staff finds that based on the plant training program prohibiting the use of radio equipment adjacent to the MCR panels, and the impracticality of operating the radios within three inches of the panel where HRCAR monitors are mounted, it is acceptable for TVA to require no specified exclusion distance. Based on the satisfactory test results, in combination with no specified exclusion distance, the NRC staff finds the test results to be acceptable for WBN, Unit 2.

In the letter dated August 20, 2015 TVA stated that the background EMI/RFI field strength is assumed at 0.1 V/m whereas the measured EMI/RFI is always less than 0.1 V/m. TVA stated they have extensive operating experience to confirm that electronic equipment is unaffected at this low background EMI/RFI level. In addition, no adverse performance of the HRCAR equipment was observed before or during the HFT tests to confirm that background EMI/RFI field does not impact HRCAR monitors. The equipment was tested at 10 V/m at a distance of 3 meters which is significantly higher than the background EMI/RFI. The field test at WBN, Unit 2 confirmed that testing the walkie-talkies planned for use at WBN, Unit 2 at all selectable frequencies and at various distances had no negative impact on the HRCAR monitors in the control room even when the walkie-talkies were as close as 3 inches from the face of the HRCAR monitors. **Open Item 79 has been adequately addressed therefore this item is closed**.

7.7 <u>Control Systems Not Required for Safety</u>

7.7.1 System Description

7.7.1.4 Distributed Control System

Disposition of Open Item (Appendix HH)

<u>Open Item 83</u>

Open Item 83 states: “TVA should confirm to the NRC staff the completion of the data storm test on the distribution control system.”

TVA provided its test plan for conducting a data storm test in a letter dated July 10, 2015 (ADAMS Accession No. ML15196A515). This test plan describes the test requirements, test methodology, and the acceptance criteria for demonstrating that the nonsafety related Foxboro (Invensys) intelligent automation distributed control system (DCS) will continue to function with a failed communication network without any plant upset.

The NRC staff evaluated the content of the TVA test plan, as well as performed an audit of the detailed test procedure associated with this test plan. The plan stated that two phases (loss of network and data storm) of network storm testing were to be administered. The TVA test plan provided in the July 10, 2015, letter did not describe the portion of the test plan for responding to a loss of network, since this test was to be performed under a separate test. Regarding the data storm test, however, the plan describes the administration of a simulated data storm, to include the following: a broadcast storm and a multicast storm. The broadcast storm attempts to overwhelm the network with continuous data traffic at maximum speed, using a packet generator to send data onto the network with no specific address. This test is designed to validate the performance of the network switch data limiters. The multicast storm also attempts to overwhelm the network with continuous traffic at maximum speed, by using a packet generator to send data to specific media access control addresses. This test forces the DCS to attempt to process the network data and demonstrate that the addressed controller pairs continue to function properly independent of the network traffic. Also, the data storm testing consisted of one broadcast storm and one multicast storm injected at each network switch with all broadcast and multicast suppression capability disabled, and one broadcast and multicast storm injected at each network switch with the suppression capability enabled.

TVA committed to perform the network data storm test with the DCS system installed and functional, prior to final commissioning. The DCS performance was to be monitored during the tests. System performance information and data would be accessed through monitoring of critical attributes of each control processor, including control processor loading, processor overruns, and the generation of system alarms.

The test plan defined the acceptance criteria, which required a demonstration that the DCS is capable of continuing to retain its capability to perform process control functions as detailed in SSER-23 Section 7.7.1.4.4.1 items (1) through (8) during a simulated broadcast or multicast data storm. This demonstration is to be documented, in part, through monitoring of control system output demand signals. The test plan also required a demonstration that any failure that might occur within a single control processor of a pair does not propagate beyond the Foxboro intelligent automation mesh network from one segment to another.

In its letter of October 9, 2015, (ADAMS Accession No. ML15282A537) TVA transmitted the results of this testing. The test report identified that all phases of the data storm test were successfully administered. During the DCS data storm test, at least one of the controllers in each set of DCS controller pairs serving each of the control functions continued to perform its required test set-up function. There were no control processor pairs where both processors failed during any section of data storm testing, enabling the DCS to continue to perform its required control functions, even with the storm suppression capability disabled. The NRC staff evaluated the completed test report and results. The NRC staff finds that the required test acceptance criteria were sufficiently met to demonstrate that the simulated multicast and broadcast data storms on the DCS network did not result in a complete loss of any of the DCS control functions, and that any test anomalies or deficiencies were appropriately addressed. Therefore the NRC staff concludes that the test plan and test results successfully demonstrate that the DCS will continue to perform its required functions in the presence of a simulated data storm affecting the communication network without any plant upset. **Based on its review, the NRC staff considers Open Item 83 to be closed.**

8 ELECTRIC POWER SYSTEMS

8.3 <u>Onsite Power Systems</u>

8.3.1 Onsite AC Power System Compliance with GDC 17

8.3.1.1 Non-safety Loads Powered from the Class 1E AC Distribution System

During the Nuclear Regulatory Commission (NRC) staff's review of essential raw cooling water (ERCW) and component cooling system (CCS), a potential vulnerability was identified by the NRC staff where sufficient cooling to both units during a specific postulated scenario could not be assured. As these systems are shared between Watts Bar Nuclear Plant (WBN), Units 1 and 2, in order to address the NRC staff's concern, the Tennessee Valley Authority (TVA) submitted a license amendment request for WBN, Unit 1 and updated the final safety analysis report (FSAR) for WBN, Unit 2. The NRC staff approved the WBN, Unit 1 amendment request by letter dated October 19, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15275A042). The WBN, Unit 1 amendment considered dual unit operation and the accompanying safety evaluation documents the NRC staff's review.

By letter dated September 11, 2015 (ADAMS Accession No. ML15279A332) TVA provided Amendment 114 to the FSAR for WBN, Unit 2, which included revisions to FSAR Section 8.3.1.1 to address this issue. FSAR amendment 114, Section 8.3.1.1 for WBN, Unit 2 is consistent with the WBN, Unit 1 approved amendment, which considered dual unit operation, and is therefore acceptable.

9 AUXILIARY SYSTEMS

9.2 Water Systems

9.2.1 Essential Raw Cooling Water and Raw Cooling Water System

During the Nuclear Regulatory Commission (NRC) staff's review of essential raw cooling water (ERCW) and component cooling system (CCS), a potential vulnerability was identified by the NRC staff where sufficient cooling to both units during a specific postulated scenario could not be assured. As these systems are shared between Watts Bar Nuclear Plant (WBN), Units 1 and 2, in order to address the NRC staff's concern, the Tennessee Valley Authority (TVA) submitted a license amendment request for WBN, Unit 1 and updated the final safety analysis report (FSAR) for WBN, Unit 2. The NRC staff approved the WBN, Unit 1 amendment request by letter dated October 19, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15275A042). The WBN, Unit 1 amendment considered dual unit operation and the accompanying safety evaluation documents the NRC staff's review.

By letter dated September 11, 2015 (ADAMS Accession No. ML15279A332) TVA provided Amendment 114 to the FSAR for WBN, Unit 2, which included revisions to FSAR Section 9.2.1 to address this issue. FSAR amendment 114, Section 9.2.1 for WBN, Unit 2 is consistent with the WBN, Unit 1 approved amendment, which considered dual unit operation, and is therefore acceptable.

9.2.2 Component Cooling System (Reactor Auxiliaries Cooling Water System)

During the NRC staff's review of ERCW and CCS, a potential vulnerability was identified by the NRC staff where sufficient cooling to both units during a specific postulated scenario could not be assured. As these systems are shared between WBN, Units 1 and 2, in order to address the NRC staff's concern, TVA submitted a license amendment request for WBN, Unit 1 and updated the FSAR for WBN, Unit 2. The NRC staff approved the WBN, Unit 1 amendment request by letter dated October 19, 2015 (ADAMS Accession No. ML15275A042). The WBN, Unit 1 amendment considered dual unit operation and the accompanying safety evaluation documents the NRC staff's review.

By letter dated September 11, 2015 (ADAMS Accession No. ML15279A332) TVA provided Amendment 114 to the FSAR for WBN, Unit 2, which included revisions to FSAR Section 9.2.2 to address this issue. FSAR amendment 114, Section 9.2.2 for WBN, Unit 2 is consistent with the WBN, Unit 1 approved amendment, which considered dual unit operation, and is therefore acceptable.

9.2.6 Condensate Storage Facilities

During the NRC staff's review of ERCW and CCS, a potential vulnerability was identified by the NRC staff where sufficient cooling to both units during a specific postulated scenario could not be assured. As these systems are shared between WBN, Units 1 and 2, in order to address the NRC staff's concern, TVA submitted a license amendment request for WBN, Unit 1 and updated the FSAR for WBN, Unit 2. The NRC staff approved the WBN, Unit 1 amendment request by letter dated October 19, 2015 (ADAMS Accession No. ML15275A042). The WBN, Unit 1 amendment considered dual unit operation and the accompanying safety evaluation documents the NRC staff's review.

By letter dated September 11, 2015 (ADAMS Accession No. ML15279A332) TVA provided Amendment 114 to the FSAR for WBN, Unit 2, which included revisions to FSAR Section 9.2.6 to address this issue. FSAR amendment 114, Section 9.2.6 for WBN, Unit 2 is consistent with the WBN, Unit 1 approved amendment, which considered dual unit operation, and is therefore acceptable.

9.5 Other Auxiliary Systems

9.5.1 Fire Protection

In Supplemental Safety Evaluation Report (SSER) 26 the NRC staff documented its review of the as-designed Fire Protection Report (FPR) submitted by TVA for (WBN), Units 1 and 2. SSER 26 stated:

> On the basis of its review of TVA's as-designed FPR and TVA's supplemental information as referenced by this evaluation, the NRC staff concludes that the fire protection program for WBN, with the exception of Unit 1 specific OMAs [operator manual actions], meets 10 CFR 50.48(a) and GDC [General Design Criterion] 3 of Appendix A to 10 CFR Part 50, and is consistent with Sections III.G, III.J, III.L, and III.O of Appendix R to 10 CFR Part 50 and Appendix A to BTP [branch technical position] (APCSB) 9.5-1, May 1976, with properly justified deviations and exceptions. Therefore, the NRC staff finds the as-designed FPR acceptable, contingent on the completion of the confirmatory items identified in Section 8.0 of this evaluation **(Open items 140, 141, 142, and 143, Appendix HH)**. NRC approval of the Unit 1 OMAs is documented in SSER 18, October 1995, of NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant Units 1 and 2."

Subsequent to the issuance of SSER 26, TVA submitted a revised FPR. Appendix FF of this SSER documents the NRC staff's review of the revised WBN FPR. On the basis of its review of TVA's as-constructed FPR and TVA's supplemental information as referenced by this evaluation, the NRC staff concludes that, subject to the completion of the action in WBN, Unit 2 license condition 2.C(9) (as described in section 4.3(b) of the staff's evaluation in Appendix FF of this SSER), the fire protection program for WBN, with the exception of WBN, Unit 1 specific OMAs, meets Title 10 of the *Code of Federal Regulations* (10 CFR) 50.48(a) and GDC 3 of Appendix A to 10 CFR Part 50, and is consistent with Sections III.G, III.J, III.L, and III.O of Appendix R to 10 CFR Part 50 and Appendix A to BTP (APCSB) 9.5-1, May 1976, with properly justified deviations and exceptions. Therefore, the NRC staff concludes that the as-constructed FPR is acceptable. NRC approval of the WBN, Unit 1 OMAs is documented in SSER 18, October 1995, of NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant Units 1 and 2." Therefore, the NRC staff considers **Open items 140, 141, 142, and 143 closed**.

10 STEAM AND POWER CONVERSION SYSTEM

10.4 Other Features

10.4.9 Auxiliary Feedwater System

During the Nuclear Regulatory Commission (NRC) staff's review of essential raw cooling water (ERCW) and component cooling system (CCS), a potential vulnerability was identified by the NRC staff where sufficient cooling to both units during a specific postulated scenario could not be assured. As these systems are shared between Watts Bar Nuclear Plant (WBN), Units 1 and 2, in order to address the NRC staff's concern, the Tennessee Valley Authority (TVA) submitted a license amendment request for WBN, Unit 1 and updated the final safety analysis report (FSAR) for WBN, Unit 2. The NRC staff approved the WBN, Unit 1 amendment request by letter dated October 19, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15275A042). The WBN, Unit 1 amendment considered dual unit operation and the accompanying safety evaluation documents the NRC staff's review.

By letter dated September 11, 2015 (ADAMS Accession No. ML15279A332) TVA provided Amendment 114 to the FSAR for WBN, Unit 2, which included revisions to FSAR Section 10.4 to address this issue. FSAR amendment 114, Section 10.4 for WBN, Unit 2 is consistent with the WBN, Unit 1 approved amendment, which considered dual unit operation, and is therefore acceptable.

11 RADIOACTIVE WASTE MANAGEMENT

11.7 NUREG-0737 Items

11.7.1 Wide-Range Noble Gas, Iodine, and Particulate Effluent Monitors (II.F.1.1, II.F.1.2.a, and II.F.1.2.b)

Supplemental Safety Evaluation Report (SSER) 22 identified Section 11.7.1 status as "Open." Section 11.7.1 relates to TMI Action Items II.F.1.1, II.F.1.2.a, and II.F.1.2.b. TMI Action Items Action Item II.F.1.1 requires in part, accident monitoring procedures to be available to ensure adequate calibration and operation of monitoring equipment for noble gas, iodine/particulate sampling, containment high range, containment pressure, containment water level, and containment hydrogen as specified in Regulatory Guide 1.97. NRC Inspection Report 05000391/2015609, dated October 21, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15287A199) Section OA.1.1 states that the inspectors determined that accident monitoring procedures are available to ensure adequate calibration and operation of monitoring equipment for noble gas, iodine/particulate sampling, containment high range, containment pressure, containment water level, and containment hydrogen. Therefore, the Nuclear Regulaotry Commission (NRC) staff considers TMI Action Item II.F.1.1 closed.

TMI Action Item II.F.1.2.a requires that requires the installation of noble gas monitors that have the capability to detect and measure concentrations of noble gas fission products in plant gaseous effluents during and following an accident. NRC Inspection Report 05000391/2015608 dated October 21, 2015 (ADAMS Accession No. ML15287A166) Section OA.1.4 documented inspections activities of TMI Action Item II.F.1 related to noble gas monitors. The NRC's inspection report identified that eight radiation monitoring systems to be inspected within the scope of this requirement still required action to complete calibrations and verifications of electrical wiring and controls. In addition the NRC's report contained non-cited violations which required proper installation of three misoriented main steam line monitors. NRC Inspection Report 05000391/2015609, dated October 21, 2015 (ADAMS Accession No. ML15287A199) Section OA.1.2 states that the inspectors determined that corrective actions were sufficient to address the non-cited violations involving improperly configured main steam line radiation monitors. In addition, the calibrations and verifications of radiation monitor output functions were sufficient to show that the outstanding actions to accomplish the installations of noble gas monitoring systems have been completed as required by TMI Action Item II.F.1. Therefore, the NRC staff considers TMI Action Item II.F.1.1.2.a related to noble gas monitoring closed.

TMI Action Item II.F.1.2.b requires applicants to provide onsite laboratory facilities for analyses of radiological samples and to establish a capability to sample gaseous effluent streams to detect post-accident releases of radioactive iodine. NRC Inspection Report 05000391/2013607, dated September 30, 2013 (ADAMS Accession No. ML13273A512) Section OA.1.8 states that a sufficient capability had been established to implement post-accident sampling of particulates as guided by TMI action II.F.1, Iodine Particulate Sampling. Therefore, the NRC staff considers TMI Action Item II.F.1.1.2.b closed.

11.7.2 Primary Coolant Outside Containment (III.D.1.1)

SSER 22 identified Section 11.7.2 status as “Open.” Section 11.7.2 relates to TMI Action Item III.D.1.1. TMI Action Item III.D.1.1 requires applicants to implement a program to reduce leakage from systems outside containment that would or could contain highly radioactive fluids during a serious transient or accident to as-low-as practical levels. The Watts Bar Nuclear Plant (WBN), Unit 2, proposed technical specification 5.7.2.4 addresses TMI action item III.D.1.1. The NRC staff’s review of the proposed technical specifications for WBN, Unit 2 is documented in SSER 29, Section 16. Therefore, the NRC staff considers TMI Action Item III.D.1.1 closed.

12 RADIATION PROTECTION

12.7 NUREG-0737 Items

12.7.1 Plant Shielding (II.B.2)

Amendment 97 revised the list of areas for which operators need access during an accident (vital areas) in Final Safety Analysis Report (FSAR) Section 12.3.2.2, adding three and deleting the post-accident sample sink. The staff requested additional information related to the dose consequences of these vital missions, including plant layout drawings depicting radiation zones during accident conditions and access/egress routes. By letters dated June 3, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML101600509), and December 10, 2010 (ADAMS Accession No. ML103480708), TVA provided dose calculations and plant layout drawings (maps) depicting the access, and egress from, WBN vital areas. In response to a NRC staff request for additional information, TVA supplemented this information in a letter dated February 25, 2011 (ADAMS Accession No. ML110620687). TVA committed to clarify the calculational basis, and establish corresponding implementing procedures, contained in the February 25, 2011, letter, which are subject to verification by the NRC inspection program.

By letter dated June 17, 2015 (ADAMS Accession No. ML15170A473), TVA identified an additional vital area, (concerning starting pumps in the emergency core cooling system and emergency raw water system during an accident) that may be required to support dual unit operations. In a supplemental submittal dated July 14, 2015 (ADAMS Accession No. ML15197A357), TVA provided calculations, including plant layouts and access/egress paths estimating the mission dose for the operators completing this vital mission.

The NRC staff concludes that TVA has demonstrated by design calculations that the actions necessary to mitigate the consequences of a design-basis accident at WBN, Unit 2, will maintain occupational doses to plant operators within the dose criteria of General Design Criterion 19, per the guidance contained in NUREG-0737, Item II.B.2. Therefore, the NRC staff concludes that the shielding design for WBN, Unit 2, is acceptable.

12.7.2 High Range In-Containment Monitor (II.F.1.2.c)

Supplemental Safety Evaluation Report (SSER) 22 identified Section 12.7.2 status as "Open." Section 12.7.2 relates to TMI Action Item II.F.1.2.c. TMI Action Item II.F.1.2.c requires applicants to install high range monitoring instrumentation with the capability to detect and measure the radiation level within containment during and following an accident. NRC Inspection Report 05000391/2015609, dated October 21, 2015 (ADAMS Accession No. ML15287A199) Section OA.1.3 states that the calibrations and verifications of radiation monitor output functions were sufficient to show that the outstanding actions to accomplish the installations of containment high range monitoring systems have been completed as required by TMI Action Item II.F.1.2.c. Therefore, the NRC staff considers TMI Action Item II.F.1.2.c closed.

12.7.3 In-Plant Radioiodine Monitor (III.D.3.3)

SSER 22 identified Section 12.7.3 status as "Open." Section 12.7.3 relates to TMI Action Item III.D.3.3. TMI Action Item III.D.3.3 required each applicant to provide instrumentation for accurately determining in-plant airborne radioiodine concentrations to minimize the need for unnecessary use of respiratory protection equipment. NRC Inspection Report 05000391/2012605 dated August 7, 2012 (ADAMS Accession No. ML12220A536), Section OA.1.14, states that based on a review of the applicant's final completion and inspection efforts, the inspectors determined that the measures implemented by the applicant were sufficient to address the requirements of TMI Action Item III.D.3.3. Therefore, the NRC staff considersTMI Action Item III.D.3.3 closed.

15 ACCIDENT ANALYSES

15.3 Limiting Accidents

15.3.1 Loss-of-Coolant Accident (LOCA)

Nuclear Safety Advisory Letters Concerning Heat Flux Hot Channel Factor

As discussed in Section 16 of this SSER, the license authorizing operation of Watts Bar Nuclear Plant (WBN), Unit 2 includes technical specifications (TSs), which are derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.34. Among the requirements in the TS 5.9.5 for WBN, Unit 2 is a requirement to establish core operating limits prior to the initial and each reload cycle, or prior to any remaining portion of a cycle, and to document those limits in the Core Operating Limits Report (COLR). The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the Nuclear Regulatory Commission (NRC), and those methods are listed in TS 5.9.5.b. As relevant here, one limit required to be calculated in accordance with NRC approved methods and documented in the COLR is the Heat Flux Hot Channel Factor, which is used in Limiting Condition for Operation 3.2.1. Per TS 5.9.5.b.3, the NRC will require TVA to use the following code:

> WCAP-10216-P-A, Revision 1A, “Relaxation of Constant Axial Offset Control F(Q) Surveillance Technical Specification,” February 1994 (W Proprietary). (Methodology for Specifications 3.2.1 - Heat Flux Hot Channel Factor (W(Z) Surveillance Requirements For F(Q) Methodology) and 3.2.3 - Axial Flux Difference (Relaxed Axial Offset Control).)

In Nuclear Safety Advisory Letter, NSAL-09-5 Revision 1, "Relaxed Axial Offset Control FQ Technical Specification Actions," dated September 24, 2009, and in Nuclear Safety Advisory Letter, NSAL-15-1, "Heat Flux Hot Channel Factor Technical Specification Surveillance," dated February 3, 2015, Westinghouse alerted licensee of potential problems with the calculation of the Heat Flux Hot Channel Factor, and Westinghouse Electric Corporation (Westinghouse) suggested changes to the existing plants TSs. By letter dated September 30, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15274A328) TVA provided a technical and regulatory evaluation of how the WBN, Unit 2 proposed TSs address NSAL-09-5, Revision 1 and NSAL-15-1. TVA concluded in its evaluation that the WBN, Unit 2 proposed TS 3.2.1 completely addresses the issues identified in both of these NSALs.

On October 9, 2015, in response to the NRC staff’s questions associated with how TVA addressed the issues identified in the NSALs, TVA (1) provided a license condition where the margins provided in TS 3.2.1 will be evaluated each fuel cycle to assure that the related assumptions in the accident analyses are maintained, and (2) submitted a summary of a Westinghouse margin assessment report for Cycle 1 providing additional information related to the proposed TS 3.2.1.

The proposed license condition requires TVA to perform cycle-specific evaluations of the margins of the Required Actions in TS 3.2.1 Condition B, and states:

> TVA will verify for each core reload that the actions taken if $F_Q^W(Z)$ is not within limits will assure that the limits on core power peaking $F_Q(Z)$ remain below the initial total peaking factor assumed in the accident analyses.

The results of this verification will be documented in the final Reload Safety Evaluation that the vendor provides WBN, Unit 2 for each core reload, which will be reviewed by TVA, and is a quality assurance record as defined in 10 CFR 50, Appendix B, and available for NRC inspection.

While the NRC staff has not come to a final decision on any actions required for already-licensed plants using different versions of TS 3.2.1 that are impacted by the NSALs, the NRC staff has reached a decision for WBN, Unit 2. Specifically, as detailed in Section 16 of this SSER, the proposed TS, which include provisions to address the NSALs, are acceptable. Further, the additional analyses imposed though the new license condition will provide additional assurances that the actions taken under TS 3.2.1 are appropriate.

15.5 NUREG-0737 Items

15.5.5 Small-Break LOCA Methods (II.K.3.30) and Plant-Specific Calculations (II.K.3.31)

Supplemental Safety Evaluation Report (SSER) 22 identified Section 15.5.5 status as “Open.” Section 15.5.5 relates to TMI Action Items II.K.3.30 and II.K.3.31 which required that applicants verify and document that small break loss of coolant accident analysis be compliant with 10 CFR Part 50 Appendix K and 10 CFR 50.46. NRC Inspection Report 05000391/2011603 dated May 16, 2011 (ADAMS Accession No. ML111370702), Section OA.1.15, states that the inspectors reviewed various completed actions associated with TMI action items II.K.3.30 and II.K.3.31 to verify the adequacy of the applicant’s actions. The inspectors concluded that the applicant’s efforts were sufficient to satisfy the intent of the respective TMI action items. Therefore, the NRC staff considers TMI Action Items II.K.3.30 and II.K.3.31 closed.

16 TECHNICAL SPECIFICATIONS

16.1 Introduction

Regulatory Standard

An applicant for an operating license must propose technical specifications (TSs). Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.36(a)(1),

> Each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications in accordance with the requirements of this section. A summary statement of the bases or reasons for such specifications, other than those covering administrative controls, shall also be included in the application, but shall not become part of the technical specifications.

When the NRC issues an operating license, that license will include technical specifications. As stated in 10 CFR 50.36(b),

> Each license authorizing operation of a production or utilization facility of a type described in § 50.21 or § 50.22 will include technical specifications. The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to § 50.34. The Commission may include such additional technical specifications as the Commission finds appropriate.

With respect to the content of the technical specifications, as stated in 10 CFR 50.36(c)(1) to (c)(8), TSs will include items in several categories, including: (1) safety limits, limiting safety system settings, and limiting control settings, (2) limiting conditions for operation, (3) surveillance requirements, (4) design features, and (5) administrative controls.

Information in the Application

The Tennessee Valley Authority (TVA) stated that the proposed Watts Bar Nuclear Plant (WBN), Unit 2 TSs were developed from the NUREG-1431, "Standard Technical Specifications [STSs] – Westinghouse Plants," Revision 0 and then incorporating the WBN, Unit 1 TS substantial amendments though Amendment 70.

TVA submitted Developmental Revision I of the WBN, Unit 2 TSs by letter dated June 16, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14169A525), and was made available to the Nuclear Regulatory Commission (NRC) staff for comment as a "proof and review" revision.

TVA submitted Developmental Revision J by letter dated July 6, 2015 (ADAMS Accession No. ML15187A461), which incorporated responses to the NRC staff's requests for additional information and comments on revision I and incorporated recent amendments to the WBN, Unit 1 TSs. The recent amendments included use of alternate qualified offsite power circuits, a revision to the diesel generator frequency band, and additional TSs to address shared use of cooling water systems between units. A supplement to Revision J, submitted by letter dated September 4, 2015 (ADAMS Accession No. ML15247A564), added bases changes omitted from Revision J, incorporated late identified changes, and improved the added specifications. The applicable NRC staff reviewed Developmental Revision J and the supplement and identified final administrative issues that were resolved in the final revision to the WBN, Unit 2 TSs that were submitted by TVA in a letter dated September 23, 2015 (ADAMS Accession No. ML15267A183). The final revision additionally addressed a generic potentially non-conservative power distribution limit. TVA certified that the final revision WBN, Unit 2 TSs were accurate.

16.2 Evaluation

The NRC staff's review of the proposed TSs for WBN, Unit 2 was completed per the guidance in NUREG-0800 "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, " Section 16.0 "Technical Specifications" (ADAMS Accession No. ML070380224) and NUREG-1431, "Standard Technical Specifications, Westinghouse Plants, Revision 4 (STS)" (ADAMS Accession No. ML12100A222).

The review of the proposed WBN, Unit 2 TSs was informed by the years of operational experience with the essentially-the-same technical specifications for WBN, Unit 1. This is in line with the Commission's expectations. In a July 25, 2007, Staff Requirements Memorandum SECY-07-0096, "Possible Reactivation of Construction and Licensing Activities for the Watts Bar Nuclear Plant Unit 2," (ADAMS Accession No. ML072060688) the Commission approved the NRC staff's recommendations for the approach to licensing TVA, WBN, Unit 2. The Commission supported a licensing review approach that employed the current licensing basis for WBN, Unit 1 as the reference basis for the review and licensing of WBN, Unit 2.

Review of the WBN, Unit 2 TSs was conducted by comparing the proposed WBN, Unit 2 TSs to the current TSs for WBN, Unit 1. Changes were allowed where necessary to accommodate unique features of WBN, Unit 2 and to support dual unit operation. Additions and changes to the WBN, Unit 2 TSs were evaluated using the appropriate requirements and guidance.

The NRC staff evaluated the WBN, Unit 2 TSs by confirming that the WBN, Unit 2 TSs were substantially the same as the WBN, Unit 1 TSs, through amendment 101 and including the recent WBN, Unit 1 amendments submitted to support dual unit operations in accordance with SRM SECY-07-0096.

In WBN, Unit 2 Developmental TSs Revisions A through J, the licensee proposed various changes to the WBN, Unit 2 TSs and to the Final Safety Analysis Report to bring the WBN, Unit 2 TSs into fidelity with current TSs of WBN, Unit 1. The NRC staff paid special attention to items unique to WBN, Unit 2 and any changes needed to support dual unit operation. The NRC staff requested additional information and commented on the various revisions.

Where additions and changes in the TSs were necessary due to uniqueness in design, the NRC staff both ensured that the changes were necessary for inclusion into the TSs per the four criteria of 10 CFR 50.36(c)(2)(ii) and were consistent with the guidance of NUREG-0800 and NUREG-1431. The NRC staff evaluated the additional restrictions on plant operation to ensure that they enhance plant safety.

Therefore, the NRC staff confirmed that format and content of the proposed TSs are consistent with the WBN, Unit 1 TSs. Differences caused by the unique design features of WBN, Unit 2 and due to dual unit operation were evaluated for compliance with 10 CFR 50.36 and agreement with the guidance of NUREG-1431, Revision 4. Since the WBN, Unit 1 TSs comply with 10 CFR 50.36, and the proposed WBN, Unit 2 TSs are either (1) the same as WBN, Unit 1's or (2) TVA adequately explained unit differences, the NRC staff concludes that the proposed WBN, Unit 2 TSs also will comply with 10 CFR 50.36.

16.3 Conclusion

Overall on the basis of the staff's review of the WBN, Unit 2 TSs, as discussed above, the NRC staff concludes that the WBN, Unit 2 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 NRC staff. Therefore, the NRC staff concludes that the WBN, Unit 2 TSs satisfy 10 CFR 50.36 and are acceptable.

17 QUALITY ASSURANCE

17.6 MAINTENANCE RULE

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.65(a)(1) (the "maintenance rule"):

> Each holder of an operating license for a nuclear power plant … shall monitor the performance or condition of structures, systems, or components, against licensee-established goals, in a manner sufficient to provide reasonable assurance that these structures, systems, and components …are capable of fulfilling their intended functions.

The above regulation only applies to a holder of an operating license, whereas TVA currently holds a construction permit for Watts Bar Nuclear Plant (WBN), Unit 2, but does have an operating license for WBN, Unit 1. However, to issue an operating license for WBN, Unit 2, the NRC must first make the findings of 10 CFR 50.57(a)(1) to (a)(6), including the finding of 10 CFR 50.57(a)(2) ("facility will operate in conformity with … the rules and regulations of the Commission") and 50.57(a)(3)(ii) (reasonable assurance that activities authorized by the license will be conducted in compliance with the Commission's regulations). Accordingly, the Nuclear Regulatory Commission (NRC) staff reviewed if the Tennessee Valley Authority (TVA) would be meeting 10 CFR 50.65(a)(1) after an operating license was issued for WBN, Unit 2.

In TVA's regulatory framework, it committed to implementing the maintenance rule program for WBN, Unit 2 systems at least one month prior to fuel load for all systems, structures, and components (SSCs). By letter dated July 27, 2015, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15209A458) TVA stated that it considered this commitment met on March 3, 2014, with the implementation of Technical Instruction 0-TI-119, "Maintenance Rule Performance Indicator Monitoring, Trending, and Reporting – 10 CFR 50.65."

WBN, Unit 1 has been maintaining its program required by 10 CFR 50.65, and the NRC has been routinely inspecting the program, since the 10 CFR 50.65 took effect in 1996. By letter dated July 2, 2010 (ADAMS Accession No. ML101720050), the NRC staff documented the detailed results of its overall evaluation of TVA's construction refurbishment plan. The refurbishment plan was developed to ensure that the design and licensing basis, including original equipment design specifications, would be met. In its evaluation, the NRC staff found that WBN, Unit 2 SSCs that are shared between WBN, Units 1 and 2 and that are in operation to support WBN, Unit 1 were already covered by the existing program and met the requirements of 10 CFR 50.65 for WBN, Unit 1. The NRC staff concluded that TVA's plan provided reasonable assurance that the structures, systems, and components are capable of fulfilling their intended functions relative to WBN, Unit 2.

From June 22 to June 26, 2015, the NRC staff performed an inspection at the WBN, Unit 2 site of the readiness of TVA to operate WBN, Unit 2 and safely integrate WBN, Unit 2 into the current organization that is responsible for the safe operation of WBN, Unit 1. By letter dated August 14, 2015 (ADAMS Accession No. ML15226A212), the NRC staff published the findings of its operational readiness assessment team (ORAT) inspection. During the inspection, the NRC reviewed TVA's actions taken under 0-TI-119. The NRC's ORAT also looked at maintenance and quality assurance support activities, including the maintenance organization, maintenance effectiveness, and work management and prioritization. The inspection concluded that site maintenance and quality organizations can support startup of WBN, Unit 2, maintenance has been effective, and TVA has adequately demonstrated their ability to prioritize and complete work for a two unit site.

Based on the above, the NRC staff concludes that there is reasonable assurance that TVA's maintenance rule program, as applied to WBN Unit 2, will be conducted in accordance with 10 CFR 50.65.

22 FINANCIAL PROTECTION AND INDEMNITY REQUIREMENTS

22.3 Operating Licenses

Open Item 25

Open Item 25 states:

> Prior to the issuance of an operating license (OL), the Tennessee Valley Authority (TVA) is required to provide satisfactory documentation that it has obtained the maximum secondary liability insurance coverage pursuant to 10 CFR 140.11(a)(4), and not less than the amount required by 10 CFR 50.54(w), with respect to property insurance, and the NRC staff has reviewed and approved the documentation.

By letter dated October 2, 2015, the Tennessee Valley Authority (TVA) submitted "Watts Bar, Unit 2 - Financial Protection Requirements and Indemnity Agreements - Insurance Status Second Supplement," (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15272A394), to meet the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 140 and 10 CFR 50.54(w).

The provisions of the Price-Anderson Act (PAA), Section 170 of the Atomic Energy Act, and the Commission's regulations in 10 CFR 140, "Financial Protection Requirements and Indemnity Agreements," require, in part, each holder of a license issued pursuant to 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," to have and maintain nuclear energy liability insurance (also known as financial protection) to pay for claims of bodily injury and property damage resulting from a nuclear incident. Specifically, 10 CFR 140.11(a)(4) requires each licensee for a reactor with a rated capacity of 100,000 kilowatts or more to have and maintain financial protection in an amount equal to the sum of primary financial protection ($375 million) and the amount available as secondary financial protection to satisfy the PAA requirements. During the period of construction, and prior to the period of operation, however, an applicant for a license to operate a nuclear reactor who holds a construction permit for a large operating reactor is only required to comply with the insurance requirements in 10 CFR 140.13, "Amount of financial protection required of certain holders of construction permits and combined licenses under 10 CFR part 52." As required by 10 CFR 140.13, an applicant shall have and maintain financial protection in the amount of $1 million. By letter dated April 29, 2010, "Watts Bar Nuclear Power Plant (WBN Unit 2 – Financial Protection Requirements and Indemnity Agreement – Insurance Status)" (ADAMS Accession No. ML101250300), TVA submitted a copy of the certificate of insurance for Watts Bar Nuclear Plan (WBN) Unit 2 to demonstrate that they meet the requirements under 10 CFR 140.11(a)(4) and 10 CFR 140.13. Based on its review of this information, the staff concludes that TVA has met the requirements for primary financial protection.

By letter dated January 24, 2013, "Watts Bar Nuclear Plant Unit 2 – Documentation of Liability Insurance Coverage Requested for Supplemental Safety Evaluation Report (SSER) Open Item 25," (ADAMS Accession No. ML13030A032), TVA submitted documentation to meet the secondary financial protection requirements under 10 CFR 140.11(a)(4). The documentation provided by TVA entitled, "Certificate of Insurance Declarations and Bond for Payment of Retrospective Premiums," serves as a contract between TVA and American Nuclear Insurers, and requires TVA to pay into the secondary financial insurance pool should a nuclear incident occur. Based on its review of this information, the staff concludes that TVA has met the requirement under 10 CFR 140.11(a)(4).

As required by 10 CFR 140.21, each reactor licensee should be able to demonstrate its financial capacity to pay into the secondary tier of financial protection for each reactor it is licensed to operate and insure pursuant to 10 CFR 140.11(a)(4); $121.255 million per incident and up to $18.963 million per year. By letter dated October 2, 2015, TVA submitted certified financial documents demonstrating a cash flow (i.e., cash available to a company after all operating expenses, taxes, interest charges, and dividends have been paid) can be obtained, and would be available, for payment of retrospective premiums within three (3) months after this submittal. TVA's submittal also demonstrates the financial capacity to provide secondary financial protection for its entire nuclear fleet, which includes WBN, Unit 2 and six other plants. Based on its review of this information, the staff concludes that TVA has met the requirements under 10 CFR 140.21 for proof of financial capacity to pay into the secondary tier of financial protection.

As required by 10 CFR 50.54(w), each reactor licensee must obtain onsite property insurance to cover costs associated with stabilizing the reactor and decontaminating the reactor and reactor site in the event of a nuclear incident. Onsite insurance must have a minimum coverage limit for each reactor site of either $1.06 billion or whatever amount of insurance is generally available from private sources, whichever is less. By letter dated September 24, 2015, "Watts Bar Nuclear Plant Unit 2 - Financial Protection Requirements and Indemnity Agreements - Insurance Status Supplement (ADAMS Accession No. ML15268A528) TVA submitted a copy of their onsite insurance policy provided by Nuclear Electric Insurance Limited, which demonstrates that it possesses financial protection to cover the licensee's obligation to stabilize and decontaminate the reactor and the reactor site in the event of a nuclear incident. Therefore, the staff concludes that TVA has met the requirements under 10 CFR 50.54(w) for onsite insurance.

Finally, the NRC has an indemnity agreement with TVA and will amend the existing agreement to include WBN, Unit 2 concurrent with the issuance of the Operating License.

In consideration of TVA's submittals, the NRC staff concludes that TVA has adequately addressed the provisions of the Price-Anderson Act (Section 170 of the Atomic Energy Act) and the applicable Commission regulations in 10 CFR 140 and 10 CFR 50.54(w) for WBN, Unit 2. **Open Item 25 has been adequately addressed therefore this item is closed**.

APPENDIX A CHRONOLOGY OF RADIOLOGICAL REVIEW OF WATTS BAR NUCLEAR PLANT, UNIT 2, OPERATING LICENSE REVIEW

Public correspondence exchanged between the U.S. Nuclear Regulatory Commission (NRC) and the Tennessee Valley Authority (TVA) during the review of the operating license (OL) application for Watts Bar Nuclear Plant (WBN), Units 1 and 2, is available through the NRC's Agencywide Documents Access and Management System (ADAMS) or the Public Document Room (PDR). This correspondence includes that occurring subsequent to TVA's letter notifying the NRC of its decision to reactivate construction of WBN, Unit 2, which had been in a deferred status under the Commission's Policy Statement on Deferred Plants.

Web-based ADAMS (WBA) is the latest interface to ADAMS. This search engine enables searching the ADAMS repository of official agency records (Publicly Available Records System and Public Legacy libraries) for publicly available regulatory guides, NUREG-series reports, inspection reports, Commission documents, correspondence, and other regulatory and technical documents written by NRC staff, contractors, and licensees. WBA permits full-text searching and enables users to view document images, download files, and print locally. New documents become accessible on the day they are published, and are released periodically throughout the day. ADAMS documents are provided in Adobe Portable Document Format.

The NRC PDR reference staff is available to assist with ADAMS. Contact information for the PDR staff is on the NRC website at http://www.nrc.gov/reading-rm/contact-pdr.html.

APPENDIX E PRINCIPAL CONTRIBUTORS TO SSER 29

M. Farnan, NRR/DE/EPNB
R. Pedersen, NRR/DRA/ARCB
C. Moulton, NRR/DRA/AFPB
D. Frumkin, NRR/DRA/AFPB
E. Olvera, NRR/DIRS/IFAIB
P. Snyder, NRR/DSS/STSB
J. Poole, NRR/DORL/LPWB
G. Singh, NRR/DE/EICB
D. Rahn, NRR/DE/EICB
D. Woodyatt, NRR/DSS/SCVB

APPENDIX FF FIRE PROTECTION PROGRAM SAFETY EVALUATION WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2

1.0 INTRODUCTION

The Tennessee Valley Authority (TVA) is the licensee for Watts Bar Nuclear Plant (WBN), Unit 1, and is the applicant for an operating license for WBN, Unit 2.

Pursuant to 10 CFR 50.48, *Fire Protection*:

> (a)(1) Each holder of an operating license … must have a fire protection plan that satisfies Criterion 3 of appendix A to [10 CFR part 50]. This fire protection plan must:
>
> > (i) Describe the overall fire protection program for the facility;
> >
> > (ii) Identify the various positions within the licensee's organization that are responsible for the program;
> >
> > (iii) State the authorities that are delegated to each of these positions to implement those responsibilities; and
> >
> > (iv) Outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage.
>
> (2) The FPP must also describe specific features necessary to implement the program described in paragraph (a)(1) of this section such as--
>
> > (i) Administrative controls and personnel requirements for fire prevention and manual fire suppression activities;
> >
> > (ii) Automatic and manually operated fire detection and suppression systems; and
> >
> > (iii) The means to limit fire damage to structures, systems, or components important to safety so that the capability to shut down the plant safely is ensured.

TVA submitted the As-Designed Fire Protection Report (FPR) for WBN, Units 1 and 2, to the U.S. Nuclear Regulatory Commission (NRC) by letter dated December 18, 2010, as revised and supplemented by letters dated December 20, 2010; January 14, March 16 and 31, May 6, 18, and 26, June 7 and 17, July 1 and 22, August 5 and 15, September 30, October 28, November 21 and 30, 2011; March 13, April 12, 17, and 26, May 9 and 30, June 7 and 27, July 19, September 13, December 20, 2012; February 7 and 28, and March 13, 2013. TVA submitted the As-Constructed FPR for WBN, Units 1 and 2, by letter dated June 24, 2015, as revised and supplemented by letters dated August 27, and October 7, 2015.

The FPR describes the measures that are established at WBN to implement a defense in depth fire protection program in plant areas important to safety. The objective of these measures is to: (1) prevent fires from starting; (2) detect rapidly, control, and extinguish promptly those fires that do occur; and (3) provide protection for SSCs important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant.

In the FPR, TVA stated that "the purpose of the Fire Protection Report (FPR) is to consolidate a sufficiently detailed summary of the WBN regulatory required Fire Protection Program into a single document and to reflect the design as-constructed at the time of fuel load." The FPR describes the operational phase of the fire protection program. The FPR comprises the following parts:

- Part I is an introduction to the FPR and contains a summary table of fire protection features throughout the plant.

- Part II contains the overall fire protection plan. The fire protection plan describes (1) the WBN fire protection organization, (2) plant fire protection features, (3) the plant's fire prevention program, (4) the plant's emergency response organization, (5) plant operating requirements for fire protection features and systems, and (6) the testing and inspection requirements for these plant fire protection features.

- Part III contains an overview of the post-fire safe shutdown (FSSD).

- Part IV discusses alternate shutdown.

- Part V describes operator manual actions (OMAs) and repairs.

- Part VI summarizes the fire hazards analysis for each fire area by describing the physical characteristics of the fire area, combustible loadings and anticipated fire severity, and fire suppression and detection capability available in each plant area. Part VI also describes how the plant would achieve post-FSSD if a serious fire occurred in the fire area.

- Part VII documents deviations from regulatory criteria and guidance documents and presents engineering evaluations related to the adequacy of specific fire protection features, including Operator Manual Actions (OMAs) required for safe shutdown.

- Parts VIII and IX describe conformance with the guidelines in Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1 and in Sections III.G, III.J, III.L, and III.O of Appendix R to 10 CFR Part 50, respectively.

- Part X contains a discussion of TVA's compliance with National Fire Protection Association codes.

TVA's fire protection program is required to comply with the following:

- General Design Criterion (GDC) 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities"

- 10 CFR 50.48, "Fire protection," paragraph (a)

In addition to these requirements, TVA committed in the FPR that its fire protection program has been developed to comply with, and is based on:

- Sections III.G, III.J, III.L, and III.O of Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979," to 10 CFR Part 50

- Appendix A to Auxiliary Power Conversion Systems Branch's Branch Technical Position 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976."

Because the operating licenses for WBN were not issued prior to January 1, 1979, TVA is not required to comply with 10 CFR Part 50 Appendix R, but has committed to do so. In the FPR, TVA describes inconsistancies with Appendix R as deviations. In this evaluation, these instances will be described as alternatives from the Appendix R information. The NRC staff determined that TVA's reliance on the information in Appendix A to BTP (APCSB) 9.5-1, was acceptable since it was the guidance in place on April 18, 1977, when TVA first submitted a fire hazards analysis to the NRC for review.

In the FPR, TVA additionally stated that the applicable guidelines used as the basis for the plan included, in part, the following:

- NRC letter entitled, "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," dated June 20, 1977

- Generic Letter (GL) 81-12, "Fire Protection Rule (45 FR 76602, November 19, 1980)," dated February 20, 1981, and its associated clarification letter, dated March 22, 1982;

- GL 82-21, "Technical Specifications for Fire Protection Audits," dated October 6, 1982;

- GL 83-33, "NRC Positions on Certain Requirements of Appendix R to 10 CFR 50," dated October 19 1983;

- GL 86-10, "Implementation of Fire Protection Requirements," dated April 24, 1986;

- GL 88-12, "Removal of Fire Protection Requirements from Technical Specifications," dated August 2, 1988.

The following NRC guidance was used for specific topics:

- NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire," issued October 2007, for WBN Unit 2 OMA evaluations

- NRC Regulatory Guide (RG) 1.189, "Fire Protection for Operating Nuclear Power Plants," Revision 0, issued April 2001, for extension of the "annual" fire protection audit interval

- NRC RG 1.189, "Fire Protection for Nuclear Power Plants," Revision 2, issued October 2009, for OMA and multiple spurious operation (MSO) evaluations.

Accordingly, the NRC staff reviewed the entire fire protection program (except as noted otherwise) using the agency's fire protection requirements and review guidance. Because WBN consists of two units of identical design, this evaluation applies to the fire protection program for both WBN, Unit 1, and WBN, Unit 2 (except as noted otherwise).

The NRC staff's review did not include Part VII, Section 7, "Unit 1 Operator Manual Actions [OMAs]," of the FPR. The NRC's approval of the WBN, Unit 1, OMAs is documented in Supplemental Safety Evaluation Report (SSER) 18, NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Units 1 and 2," dated October 1995.

In Staff Requirements Memorandum SECY-07-0096, "Possible Reactivation of Construction and Licensing Activities for the Watts Bar Nuclear Plant Unit 2," dated July 25, 2007, the Commission directed the NRC staff to use the existing WBN, Unit 1, licensing basis as the reference basis for the WBN, Unit 2, review. To that end, where applicable, the NRC staff used the WBN, Unit 1, approvals, as documented in SSER 18, issued October 1995, and SSER 19, issued November 1995, to NUREG-0847, as the basis for its approvals in this evaluation, instead of the agency's current guidance. The NRC staff used the agency's current guidance as the basis for approval for the WBN, Unit 2, OMAs, associated circuits, MSO, fire water system design demand, the auxiliary control room, and radiant energy shields.

The NRC staff met with TVA on January 19, February 3 and 15, March 29, April 22, May 12, June 30, July 12 and 28, August 31, November 16, and December 21, 2011, February 2, 2012, January 28, June 26, July 16 and 31, August 28, October 8 and 29, and November 12, 2014, and February 11, and April 1, 2015, to discuss technical issues related to WBN's fire protection program and its implementation.

The NRC staff conducted an audit at WBN from October 25-27, 2011, which it documented in a report dated December 20, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML113500239). The NRC staff conducted an additional audit at WBN on July 21 and 22, 2015, which it documented in a report dated August 27, 2015 (ADAMS Accession No. ML15239A794).

Unless otherwise noted, all information cited in this evaluation is from the WBN FPR dated June 24, 2015, as supplemented (ADAMS Accession Nos. ML15175A508, ML15239A794, and ML15280A508).

This safety evaluation is based on the as-constructed FPR, and it replaces, in its entirety, the dual unit fire protection safety evaluation published in SSER 26, which was based on the as-designed FPR.

2.0 FIRE PROTECTION PROGRAM

2.1 Purpose and Scope

The purpose of the NRC staff's review of is to determine of TVA meets the Commission's controlling regulations on fire protection in 10 CFR 50.48. The regulation at 10 CFR 50.48(a)(1) requires the following:

> Each holder of an operating license must have a fire protection plan that satisfies Criterion 3 of appendix A [to 10 CFR 50.] This fire protection plan must:
>
> (i) Describe the overall fire protection program for the facility;
>
> (ii) Identify the various positions within the licensee's organization that are responsible for the program;
>
> (iii) State the authorities that are delegated to each of these positions to implement those responsibilities; and
>
> (iv) Outline the plans for fire protection, fire detection and suppression capability, and limitation of fire damage.

The regulation at 10 CFR 50.48(a)(2) requires:

> The plan must also describe specific features necessary to implement the program described in [10 CFR 50.48(a)(1)] such as --
>
> (i) Administrative controls and personnel requirements for fire prevention and manual fire suppression activities,
>
> (ii) Automatic and manually operated fire detection and suppression systems; and
>
> (iii) The means to limit fire damage to structures, systems, or components [(SSCs)] important to safety so that the capability to shut down the plant safely is ensured.

Last, the regulation at 10 CFR 50.48(a)(3) requires:

> The licensee shall retain the fire protection plan and each change to the plan as a record until the Commission terminates the reactor license. The licensee shall retain each superseded revision of the procedures for 3 years from the date it was superseded.

2.1.1 Summary of TVA's 10 CFR 50.48(a)(1) conformance

In Fire Protection Report (FPR) Part I, Section 2.0, "Purpose," Tennessee Valley Authority (TVA) stated that the purpose of the FPR is to provide a detailed summary of the Watts Bar Nuclear Plant (WBN) fire protection program in a single document. The FPR is thus the "fire protection plan" document that is required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(a). Section 9.5.1 of the WBN Final Safety Analysis Report (FSAR) incorporates the FPR by reference. In FPR Part I, TVA states that it will be updated in conjunction with the FSAR.

TVA's plan provided information on 10 CFR 50.48(a)(1)(i) in FPR Part II, Section 9, "Emergency Response," Section 10, "Control of Combustibles," and Section 11, "Control of Ignition Sources." TVA's plan provided information on 10 CFR 50.48(a)(1)(ii) in FPR Part II, Section 7, "Fire Protection Organization/Programs," and Section 14, "Fire Protection Systems and Features Operating Requirements," and in FPR Part VI. TVA's plan provided information on 10 CFR 50.48(a)(1)(iii) in FPR Part II, Section 7, "Fire Protection Organization/Programs," and in FPR Parts III, IV, V, and VI. TVA's plan provided information on 10 CFR 50.48(a)(1)(iv) above in FPR Part II, Section 12, "Description of Fire Protection Systems and Features."

The NRC staff's evaluations of compliance with 10 CFR 50.48(a)(1)(i), (a)(1)(ii), and (a)(1)(iii) are evaluated in Section 2 of this evaluation. The NRC staff's evaluation of how the plan meets 10 CFR 50.48(a)(1)(iv) is in Sections 2 through 5 of this evaluation.

2.1.2 Summary of TVA's 10 CFR 50.48(a)(2) conformance

TVA's plan provided information on 10 CFR 50.48(a)(2)(i) in FPR Part II, Section 9, "Emergency Response," Section 10, "Control of Combustibles," Section 11, "Control of Ignition Sources," and Section 13, "Fire Protection System Impairments." TVA's plan provided information on 10 CFR 50.48(a)(2)(ii) in FPR Part II, Section 12, "Description of Fire Protection Systems and Features." TVA's plan provided information on 10 CFR 50.48(a)(2)(iii) in FPR Part II, Section 12, "Description of Fire Protection Systems and Features," and in FPR Parts III, IV, V, and VI.

The NRC staff assesses how TVA meets 10 CFR 50.48(a)(2)(i) in Section 2 of this evaluation. The NRC staff considers how TVA meets 10 CFR 50.48(a)(2)(ii) in Section 4 of this evaluation. Finally, the NRC staff confirms how TVA meets 10 CFR 50.48(a)(2)(iii) in Sections 3 and 5 of this evaluation.

2.1.3 Summary of TVA's 10 CFR 50.48(a)(3) conformance

The first part of the regulation at 10 CFR 50.48(a)(3) requires the licensee to retain the fire protection plan and each change to the plan as a record until the reactor license is terminated. In FPR Part I, Section 2 "Purpose," TVA stated that the FPR will be updated in conjunction with updates to the WBN FSAR. The U.S. Nuclear Regulatory Commission (NRC) staff concludes that this is an acceptable method of retaining plan records, because the FSAR is maintained and updated in accordance with 10 CFR 50.59, "Changes, Tests, and Experiments," and 10 CFR 50.71(e), respectively, which have similar retention requirements and therefore meets the requirements of 10 CFR 50.48(a)(3).

The second part of the regulation at 10 CFR 50.48(a)(3) requires the licensee to retain revisions to procedures for three years from the date they are supperceded. In FPR Part II, Section 6 "Fire Protection Quality Assurance," TVA described that quality assurance for the fire protection program provided as part of the overall WBN Quality Assurance program. In its letter dated October 7, 2015 (ADAMS Accession No. ML15280A508), TVA confirmed that fire protection program related records and procedures are retained in accordance with the requirements of 10 CFR 50.48(a)(3). The NRC staff concludes that this meets the requirements of 10 CFR 50.48(a)(3).

2.2 Fire Protection Organization

As described in FPR Part II, Section 7, TVA's fire protection organization consists of corporate management oversight and an onsite plant implementation organization. Responsible TVA corporate managers include the Chief Operating Officer and Chief Nuclear Officer, the Vice President Nuclear Engineering, the Senior Vice President, Operations, and the Corporate Program Manager. The onsite implementation organization includes the Site Vice President, the Plant Manager, the Director, Operations, the Fire Operations Supervisor, the Fire Marshal, and the Site Engineering Director.

The NRC staff reviewed the responsibilities and authorities of each position responsible for the fire protection program, as described in FPR Part II, Sections 7.1 through 7.2.4, and concluded that there is reasonable assurance that the key responsibilities for implementing the fire protection program at WBN have been delegated to appropriate positions within TVA's organization, and that the authorities delegated to each position to implement these responsibilities are appropriate.

Based on its review of the FPR, the NRC staff concludes that TVA's fire protection organization does not take any exceptions to Position A.1 of Appendix A to BTP (APCSB) 9.5-1, and therefore, is acceptable.

2.3 Fire Protection Quality Assurance Program

FPR Part II, Section 6.0, contains TVA's description of the quality assurance (QA) program for fire protection at WBN. TVA stated that it used the guidance established by Appendix A to BTP (APCSB) 9.5-1 and the NRC's letter dated June 20, 1977, "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls, and Quality Assurance," to develop a QA program for fire protection features that protects post-FSSD capability and safety-related SSCs. The FPR states that the WBN fire protection QA program uses the applicable parts of TVA-NQA-PLN89-A, "Tennessee Valley Authority Nuclear Quality Assurance Plan."

TVA implemented a program that performs independent audits and inspections of the WBN fire protection program. TVA stated that its program is based on the guidance in Generic Letter (GL) 82-21. The FPR states that TVA's Nuclear Assurance organization is responsible for conducting the fire protection-related audits.

In TVA's letter dated May 6, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11129A158), in response to the NRC staff's request for additional information (RAI) FPR II-26, TVA stated that the frequency of the GL 82-21 annual fire protection audit has been changed to 24 months. TVA stated in its letter dated August 28, 2002 (ADAMS Accession No. ML022460173), that the plant implemented this change using a performance-based schedule. In TVA's letter dated September 30, 2011 (ADAMS Accession No. ML13060A225), in response to the NRC staff's RAI FPR II-26.1, TVA stated that the change is being monitored on a fleetwide basis, and that deficiencies found during the biennial audits would result in increasing the frequency of the audits. The NRC staff concludes that this is consistent with Position 1.7.10.1 of Revision 0 to RG 1.189, and, therefore, is acceptable.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's fire protection QA program does not take any exceptions to Position C of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

2.4 Fire Protection Administrative and Technical Controls

2.4.1 Fire Protection Program Changes, Review and Approval

TVA stated in FPR Part I, Section 2.0, that "the Fire Protection Report has been developed in accordance with the guidelines of NRC Generic Letter 86-10...and NRC Generic Letter 88-12...." TVA elected to follow the guidance in GL 88-12 and incorporate the standard fire protection license condition as listed in GL 86-10. In addition to including, by reference, the NRC safety evaluations that approved the plant fire protection program, this license condition allows TVA to make changes to the approved program without prior approval of the NRC if those changes would not adversely affect the plant's ability to achieve and maintain safe shutdown in the event of a fire.

Based on its review of the information submitted by TVA, the NRC staff concludes that no exceptions were taken to the positions in GL 88-12, and it is therefore, acceptable.

2.4.2 Fire Protection Administrative Controls

2.4.2.1 Control of Combustibles

FPR Part II, Section 10.0, describes TVA's program to control combustibles. The WBN combustible control program objectives are to (1) provide instruction and guidelines during general employee training on the application and use of combustible materials at WBN, (2) control the application and use of chemicals, (3) perform periodic plant housekeeping inspections and have housekeeping tours by management and the onsite fire protection organization, (4) control in situ combustibles through the design/modification review and installation process, and (5) control transient combustibles through the implementation of administrative controls.

TVA stated that it established a plant-wide administrative procedure to control transient combustibles. Implementation of this procedure will establish administrative controls for the handling of combustible materials such as fire-retardant wood, paper, plastic, and flammable and combustible gases and liquids. In addition, through its combustible control program, TVA established combustible control zones in the plant. TVA considers these zones to be subdivisions of fire areas and to limit fire spread by providing open space free of transient combustibles between redundant FSSD equipment or cables. Transient combustibles may not be stored in these zones unless an adequate fire protection engineering evaluation or compensatory measures, or both, are implemented.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's program to control combustibles does not take any exceptions to Positions B.2 and B.3.c of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

2.4.2.2 Control of Ignition Sources

TVA established a program for controlling ignition sources such as welding, cutting, grinding, and the use of open flame. TVA's program specifies that the issuance of "hot work" permits be reviewed and approved based on plant conditions and a prior inspection of the proposed work area. The ignition source on a hot work permit is valid for only one job. Before the start of work, the work area is made "fire safe." In addition, TVA's program establishes a hot work fire watch for all ignition source work activities that are performed in safety-related and safe shutdown areas of the plant, with the exception of the specific ignition source activities of underwater welding, work in outside areas (on fences, light poles, etc.), and electric soldering. These fire watches, in addition to performing their duties during the hot work activities, will remain in the area for a minimum of 30 minutes after the work has been completed to ensure that potential residual ignition conditions do not exist.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's program to control ignition sources does not take any exceptions to Positions B.3.a and B.3.b of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

2.4.3 Compensatory Measures

Compensatory measures described in FPR Part II are used to compensate for degraded or nonfunctional fire protection systems or features. Primarily, these compensatory measures take the form of both roving and continuous fire watches.

FPR Part II, Section 13.1.B states, "A roving fire watch consists of a trained individual in an affected location at 60 minute intervals with a 15 minute margin to accommodate and handle unforeseen circumstances and to report and/or resolve potential fire hazards in a location. Roving fire watches are required as a compensatory action in all modes of plant operation (i.e., Modes 1 through 6 or core empty)." The NRC staff concludes that this takes no exceptions to Positions B.3 and B.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

As described in FPR Part II, Section 13.1.A, a continuous fire watch possesses the following attributes: (1) the trained person performing the fire watch must be in the fire area at all times; (2) the fire area must not contain any impediment to restrict the movements of the fire watch; and (3) each compartment within the fire area must be patrolled at least once every 15 minutes with a margin of 5 minutes. The NRC staff concludes that this takes no exceptions to Positions B.3 and B.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

In the FPR, TVA identified specific exceptions to the above guidance for roving and continuous fire watches. In FPR Section 13.1.A, TVA identified continuous fire watch routes in more than one fire area that it classifies as exceptions to a continuous fire watch remaining within one fire area. As a basis for acceptability, TVA identified the following characteristics: (1) one or more rooms in different fire areas whose proximity to one another and their limited size warrant the combining of them into one continuous fire watch route, (2) a time study that confirms the route can be covered in 15 minutes without putting undue exertion on the person performing the fire watch, and (3) in each instance, these routes require the Fire Protection Supervisor's approval to ensure that the conditions that formed a basis for the time study have not changed in such a manner as to invalidate the time study. In the event that the automatic suppression or detection systems in the above areas cannot be restored within the time specified by FPR Part II, Section 14.0, TVA stated that the continuous fire watch patrols would not be allowed to include more than one fire area. Based on the information submitted by TVA, the NRC staff concludes that this takes no exceptions to Positions B.3 and B.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

The WBN FPR states that continuous fire watches are only required when the affected unit is in Mode 1 (power operation) through Mode 4 (hot shutdown). In FPR Part II, TVA stated that, when one unit is in Modes 5, 6, or core empty, locations where a continuous fire watch would be required may be combined and patrolled by a roving fire watch when approved by the Fire Protection Supervisor, if a fire in those locations could not affect the other unit, if it is in Modes 1 through 4. Based on the information submitted by TVA, the NRC staff concludes that this takes no exceptions to Positions B.3 and B.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

In FPR Part VII, Section 6.1, TVA summarized its evaluation of not performing certain compensatory measures for out of service fire protection features (for example, smoke detectors, sprinklers) for the reactor building equipment hatches when these rooms are inaccessible high radiation areas, that is, while the associated unit is operating. Section 6.3.1.2 of this evaluation provides the NRC staff evaluation and approval of this configuration.

In addition, in the FPR Part II, Section 13.1, TVA identified other alternative compensatory measures that may be used at WBN in lieu of the above standard compensatory measures. In all cases, in which an alternative compensatory measure is used for a degraded or nonfunctional fire protection feature, TVA stated that it will perform an evaluation that demonstrates technical equivalency to the standard compensatory measure identified in FPR Part II, Section 14.0. TVA described the following alternatives that may be considered when supported by an appropriate technical evaluation: (1) providing additional or alternative fire protection equipment, (2) installing temporary or portable fire detection systems in conjunction with an hourly roving fire watch, (3) installing closed circuit television cameras and monitors in areas when special circumstances, such as personal safety or as-low-as reasonably-achievable (ALARA; radiological) concerns, preclude the use of a human fire watch in the area, and (4) taking credit in continuously manned areas for the constant manning in lieu of establishing either continuous or roving compensatory fire watches when the responsible individuals accept this responsibility. Based on its review of the information submitted by TVA, the NRC staff concludes that these alternatives take no exceptions to Positions B.3 and B.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

2.4.4 Fire Protection Technical Controls

In FPR Part II, Section 14, TVA established functionality requirements for the following fire protection features: (1) fire detection instrumentation, (2) water supply, (3) water-based fire suppression systems, (4) carbon dioxide (CO_2) suppression systems, (5) fire detection supervisory equipment, (6) fire hose stations and associated preaction control valves, (7) fire hydrants, (8) fire-rated assemblies, and (9) emergency battery lighting units.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's functionality requirement program for plant fire protection features does not take any exceptions to Positions B.1, B.3, and B.5 of Appendix A to BTP (APCSB) 9.5-1, and, therefore, is acceptable.

GL 88-12 provides guidance for removing fire protection limiting conditions for operation and surveillance frequencies associated with fire detection systems, fire suppression systems, fire barriers, and administrative controls that address fire brigade NRC staffing from the plant's technical specifications (TSs) and incorporating this information into the FSAR. In addition, GL 88-12 refers to GL 81-12, which requested licensees to provide TSs for equipment used for safe shutdown capability that is not currently covered by existing TSs. In its fire protection plan, TVA confirmed that the plant equipment used to achieve and maintain post-FSSD from either inside or outside the main control room (MCR) is included in either the plant TSs or the FPR.

Table 14.10, "Fire Safe Shutdown Equipment," of FPR Part II, Section 14, lists the FSSD equipment not included in the plant's TSs. TVA established testing and inspection requirements which assist in evaluating the functionality of the non-TS-related FSSD equipment and instrumentation. In FPR Part II, Section 14.0, TVA established the requirements with this equipment or instrumentation nonfunctional. TVA requires, with one or more of the required items of equipment listed in Table 14.10 nonfunctional (or a breaker or valve not in its safe shutdown position), that the plant restore the equipment to the functional status within 30 days, or that it either (1) place the equipment in the condition required for FSSD, (2) provide a backup means of instrumentation monitoring, (3) provide an alternative means of achieving post-FSSD (along with an evaluation justifying the alternative), or (4) be in Mode 3 within 6 hours and Mode 4 within the following 12 hours.

Also in FPR Part II, Section 14.0, TVA established the requirements for actions when specified pressurizer power-operated relief valve (PORV) block valves are in a closed position (with power maintained) with the plant in Modes 1, 2, or 3. Control of the pressurizer block valve is maintained from the MCR so that it can be opened by the MCR operator if needed. The block valve will be returned to the open position as soon as possible, but no later than the end of the next refueling outage, in accordance with WBN Technical Specification 3.4.11 for a "simmering" PORV. Fire watches are established in specific auxiliary building rooms where the specific block valve cable is in the train credited for reactor coolant system pressure control, so that a fire in these areas can be detected in the early stages of growth and the block valve opened if needed.

Based on the information provided in FPR Part II, the NRC staff concludes that TVA's removal of fire protection features from the plant's TSs and relocation to the FPR as operating requirements is consistent with the guidance in GL 88-12 and GL 81-12, and, therefore, is acceptable.

In addition, in FPR Part II, Section 14, TVA established testing and inspection requirements for the following fire protection features: (1) fire detection instrumentation, (2) water supply, (3) water-based fire suppression systems, (4) CO_2 suppression systems, (5) fire detection supervisory equipment, (6) fire hose stations and associated preaction control valves, (7) fire hydrants, (8) fire-rated assemblies, (9) emergency battery lighting units, and (10) the FSSD equipment identified in Table 14.10.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's surveillance and test program for plant fire protection features does not take any exceptions to Position B.5 of Appendix A to BTP (APCSB) 9.5-1, and, therefore, is acceptable.

2.5 Fire Brigade and Fire Response

2.5.1 Organization

FPR Part II, Section 9.1, "Fire Brigade NRC Staffing," states that a fire brigade composed of at least five members will be maintained on site at all times. In the FPR, TVA stated that these five members will consist of the fire brigade leader and four fire brigade members. In addition, neither the shift operations supervisor nor the other members of the operations shift crew needed to perform a safe shutdown of the WBN units will be included in the fire brigade.

TVA also stated that in addition to the five members of the fire brigade, an incident commander is available to direct each shift fire brigade. The incident commander has sufficient knowledge of plant safety systems to understand the effects of fire and fire suppression on safe shutdown capability. The incident commander is not the on-duty shift manager, unit supervisor, or shift technical advisor.

TVA stated that before initial training and annually thereafter its fire brigade program requires each fire brigade member to undergo a medical review and to receive medical approval to perform strenuous physical activities related to firefighting and to wear special respiratory equipment.

TVA stated that the fire brigade may comprise fewer than five members for a period of time not to exceed 2 hours, to accommodate unexpected conditions such as an unplanned absence or brigade response to a nonfire emergency.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's fire brigade staffing and organization does not take any exceptions to Positions B.4 or B.5 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

2.5.2 Training

FPR Part II, Section 9.3 "Training and Qualifications," states that TVA's fire brigade training program consists of initial training, recurrent training, and annual fire brigade training.

The initial training program includes (1) instruction and practical exercises in fire extinguishment and the use of firefighting equipment, (2) identification of fire hazards and types of fires that could occur in the plant, (3) identification of the location of firefighting equipment in each fire area of the plant, (4) instruction on the proper use of plant firefighting equipment, (5) instruction on the proper use of communications, lighting, ventilation, and emergency breathing apparatus, (6) instruction on the toxic characteristics of the products of combustion, and (7) instruction and practical exercises in fighting fires inside buildings and tunnels. In addition to initial training, the program instructs the fire brigade on firefighting procedures and procedure changes, the plant firefighting plan, with emphasis on each individual's responsibility, and the latest plant modifications and changes affecting the firefighting plans.

The recurrent training consists of classroom instruction meetings held every 3 months. These meetings repeat the initial training subjects over a 2 year period. Each member of the fire brigade is required to attend this training in order to remain qualified. TVA preplans fire brigade drills to establish the objectives, and the fire brigade training instructor or the instructor's designee conducts these drills. The onsite fire brigade drills are conducted as follows: (1) a minimum of one drill per fire brigade shift will be conducted every 92 days, (2) a minimum of one unannounced drill will be conducted per fire brigade shift per year, and (3) at least one drill per fire brigade shift will be conducted on the backshift. Each fire brigade member is required to attend at least two drills per year.

TVA holds annual training for each fire brigade member. TVA stated that this training provides instruction, under actual firefighting conditions, on the proper methods for fighting various types of fires similar in magnitude, complexity, and difficulty to those that could be encountered in the plant. This training includes actual fire extinguishment and the use of firefighting equipment under strenuous conditions. TVA stated that if a brigade member misses or does not complete a training session, either annual or quarterly; the member is placed in an ineligible status, when their current training expires, until the training is completed.

In addition to the annual fire brigade training, TVA holds annual briefings for the local fire departments to ensure their continued understanding of their role in the event of a fire emergency at the site. TVA also holds an annual drill for the local fire department and the plant fire brigade. The local fire department briefings and drills are held for those departments that have active aid agreements with the plant.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's fire brigade training program does not take any exceptions to Positions B.5.b and B.5.c of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

2.5.3 Equipment

In the FPR, TVA stated that firefighting equipment is provided throughout the plant and is strategically placed near the fire hazards present or anticipated. TVA stated that delays in the fire brigade obtaining firefighting equipment are minimized because of the distribution and availability of this equipment throughout the plant. TVA further stated that firefighting equipment may be staged adjacent to, or at the access to, areas/locations to facilitate equipment availability or to address equipment surveillance test concerns relative to life safety and ALARA practices.

The equipment available to the fire brigade includes: (1) motorized firefighting apparatus, (2) portable ventilation equipment, (3) fire extinguishers, (4) self-contained breathing apparatus, (5) fire hose, nozzles, and fittings, (6) foam equipment, (7) personal protective equipment, (8) communications equipment, (9) portable lighting, and (10) ladders specifically dedicated for firefighting.

Based on its review of the information submitted by TVA, the NRC staff concludes that no exceptions were taken to Position B.5.d of Appendix A to BTP (APCSB) 9.5-1 and therefore, TVA's fire brigade is acceptably equipped.

2.5.4 Fire Emergency Procedures and Prefire Plans

As described in the FPR, TVA's fire emergency procedures and prefire plans specify the actions that the individual who discovers a fire are to take and the actions that the emergency response organization are to consider (e.g., control room operators and the plant fire brigade). These procedures provide different levels of response based on whether actual fire/smoke conditions are reported or whether a fire detection system annunciation occurs. (For example, a single fire detection system zone annunciation in a cross-zoned area will not carry the same level of response as a cross-zone annunciation in the same area.)

TVA stated that it implemented prefire plans to provide guidance, depending on the particular circumstances, to aid in firefighting efforts. TVA developed prefire plans to support the firefighting activities in plant areas important to safety. Specifically, these plans are developed for safety-related areas, FSSD areas, and areas that present a hazard to safety-related equipment or plant shutdown.

The prefire plans provide the following information to the fire brigade: (1) plant equipment in the fire area, (2) access and egress routes to the fire area, (3) firefighting strategy and tactics, (4) locations of fire protection features and equipment, (5) special fire, toxic, and radiological hazards in the area, (6) special precautions, and (7) ventilation methodology.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's proposed fire brigade preplans and fire emergency procedures conform to the guidance in the NRC letter dated June 20, 1977 (the contents of the June 20, 1977 NRC letter can be found attached to NRC letter dated August 4, 1977, ADAMS Accession No. ML031280293) and the requirements of 10 CFR 50.48(a)(2) and, therefore, are acceptable.

3.0 GENERAL PLANT FIRE PROTECTION AND SAFE SHUTDOWN FEATURES

The NRC staff evaluated TVA's fire protection program for compliance with 10 CFR 50.48(a), as described in Section 2.1 of this evaluation. TVA evaluated their program against the guidance in Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1. The NRC staff determined that TVA's reliance on the information in Appendix A to BTP (APCSB) 9.5-1, was acceptable since it was the guidance in place on April 18, 1977, when TVA first submitted a fire hazards analysis to the NRC for review. In addition to TVA's evaluation to Appendix A to BTP (APCSB) 9.5-1, since TVA used guidance published prior to 1981, TVA also committed to meet Sections III.G, III.J, and III.O, of 10 CFR Part 50, Appendix R, to assure safe shutdown capability. This section of the evaluation describes the NRC staff's evaluation of TVA's compliance with portions of 10 CFR 50.48(a)(1)(iv) and 10 CFR 50.48(a)(2)(iii). As discussed below, the NRC staff's review found that the Watts Bar fire protection program meets the requirements of 10 CFR 50.48(a).

3.1 Fire Protection Design

3.1.1 Building and Compartment Fire Barriers

Tennessee Valley Authority (TVA) stated that the fire-rated assemblies at Watts Bar Nuclear Plant (WBN) are part of the passive fire protection features that ensure that one set of redundant fire safe shutdown (FSSD) components necessary to achieve and maintain FSSD remains free of fire damage. At WBN, fire-rated assemblies consist of fire barriers, raceway protection, fire doors, fire dampers, and penetration seals.

At WBN, fire areas are defined by rated wall and floor/ceiling assemblies. TVA stated that fire areas are separated by wall and floor/ceiling assemblies that are 2- or 3-hour equivalent fire barriers that are bounded by Underwriters Laboratories, Inc., (UL)-rated designs. In Fire Protection Report (FPR) Part II, Sections 12.10 and 12.10.1, TVA states that the walls that separate buildings and walls between rooms that contain safe shutdown systems are fire-rated assemblies. Rooms within each fire area may be separated from other rooms in the same fire area by regulatory or nonregulatory fire barriers. Where barriers are needed between rooms, TVA stated that only fire-rated barriers with a minimum 2-hour rating are relied upon, except for portions of the main control room (MCR) complex that have 1-hour rated barriers. Sections 6.2.3, 6.2.5, 6.2.6, and 6.2.7 of this evaluation provide U.S. Nuclear Regulatory Commission (NRC) staff evaluations of exceptions to fire barrier ratings.

In general, the fire barriers comprising compartment walls and floors/ceilings at WBN are constructed of reinforced concrete or concrete block. The reinforced concrete fire barriers and concrete block barriers are at least 8 inches thick. TVA's evaluation of reinforced concrete barriers used information from Section 6, Chapter 5, of the National Fire Protection Association (NFPA) *Fire Protection Handbook*, 17th Edition (hereafter referred to as the Handbook). This section of the Handbook correlates fire rating and thickness of reinforced concrete. On this basis, Figure 6-5G in the Handbook shows that 6 inches of reinforced concrete has a fire resistance of approximately 4 hours. The concrete block barriers are only used when barriers are required to have a fire rating of 2 hours or less. TVA's evaluation of these fire barrier designs concludes these are similar to UL-listed concrete block barrier designs (Design Nos. U904, U905, U906, and U907), which are 2- to 4-hour fire-rated.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's proposed technical basis for the fire resistive capability of fire area boundaries offers an equivalent level of fire safety to that of Position D.1.j of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

3.1.2 Fire Barriers Used To Separate Redundant Safe Shutdown Functions within the Same Fire Area

Cable raceways that require separation due to redundant trains located in the same fire area, excluding primary containment and secondary containment (the annulus), are separated by either 1- or 3-hour fire-rated barrier systems. TVA uses a 1-hour fire-rated barrier system if automatic detection and automatic suppression are installed in the areas and uses a 3-hour fire-rated barrier system if automatic suppression is not installed in the area. Cable raceways that require separation due to redundant trains inside the reactor building, which includes primary containment (WBN Unit 1 only) and secondary containment (i.e., the annulus) (both units), rely on radiant energy shields (RESs) or automatic detection and suppression to provide separation. RESs are addressed in Section 6.1.2 of this evaluation.

In FPR Part II, Section 12.10.2, TVA stated that the 1- and 3-hour fire-rated barriers were tested in accordance with the guidance in Supplement 1, "Fire Endurance Test Acceptance Criteria for Fire Barrier Systems Used to Separate Redundant Safe Shutdown Trains within the Same Fire Area," to Generic Letter (GL) 86-10. This guidance includes test parameters, thermocouple placement, conduit and cable tray configurations, hose stream tests, and ampacity derating. TVA also evaluated fire barriers for seismic considerations. Configurations of raceway fire barriers that are not consistent with the testing have been evaluated to ensure that untested configurations are bounded by tested configurations. TVA has procedural controls for evaluating field changes to designed configurations. TVA stated that personnel who perform such field changes are to be cognizant of the important parameters.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's use of the guidance in Supplement 1 to GL 86-10, with the consideration of seismic events, bounding of untested configurations, and procedures to control field changes, offers an equivalent level of fire safety to that of Position D.3 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

3.1.3 Equipment Hatches and Stairwells

TVA stated that at WBN equipment hatches in the floor or fire barriers in the ceiling can be categorized as follows:

- precast concrete plugs
- steel covers
- open hatches and stairwells

TVA stated that the precast concrete plugs are associated with radiation shielding and, as fire barriers, are equivalent to the floor or ceiling fire barrier in which they are located. TVA stated that the steel covers are of substantial construction and that they provide an effective barrier to prevent fire from propagating from one side of the barrier to the other. In addition, because the covers are not fire rated, they are either provided with a draft stop and water curtain around them or redundant safe shutdown components on either side have been separated from each other by a cumulative horizontal distance of 20 feet or more. In either case, automatic fire suppression and detection are provided on both sides of the equipment hatch cover.

FPR Part VII, Section 2.6.4, summarizes TVA's evaluation of the nonrated equipment hatches separating the control building and turbine building. Section 6.2.7.4 of this evaluation provides the NRC staff evaluation and approval of this configuration.

TVA stated that, in areas in which open hatches and stairwells are located, redundant shutdown trains are either separated by at least 20 feet horizontally, one train has been protected by a 1-hour fire barrier, or a water curtain has been installed around the opening. In any case, fire detection and automatic suppression systems are located on both sides of the openings. Further, TVA stated that the only exceptions to this arrangement are on elevation 676 feet and in the refueling area of the auxiliary building.

FPR Part VII, Section 2.6.3, summarizes TVA's evaluation of the nonrated open hatches and stairwells that do not fully meet the NRC staff guidance. Section 6.2.7.3 of this evaluation provides the NRC staff evaluation and approval of this configuration.

FPR Part VII, Section 3.1, summarizes TVA's evaluation of the lack of area wide fire detection and automatic suppression in fire areas containing redundant FSSD equipment and cables. Section 6.1.7 of this evaluation provides the NRC staff evaluation and approval of this configuration.

FPR Part VII, Section 4.5, summarizes TVA's evaluation of the lack of fire detection in the refueling area. Section 6.2.1 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's design criteria and bases related to the equipment hatches and stairwells are in accordance with the guidelines of Positions D.1.j and D.4.f of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

3.1.4 Fire Doors

In FPR Part II, Section 12.10.4, TVA stated that fire door assemblies (doors, frames, and hardware) are provided for door openings required as part of fire barriers. Fire doors have been evaluated in accordance with NFPA 80-1975, "Standard for Fire Doors and Fire Windows." Fire doors are normally provided with closing mechanisms. In addition, TVA stated in FPR Part VII, Section 4.1, that some fire doors have been altered by the addition of signs and security hardware, or have been damaged and repaired on site. Closing mechanisms and latches provided on doors are inspected to ensure proper functioning. Special purpose doors (e.g., flood, heavy equipment) installed in fire barriers have been evaluated by a fire protection engineer for acceptability.

TVA installed UL-listed fire door assemblies (doors, frames, and hardware) in door openings that are required as part of fire barriers. These door assemblies are either A-labeled (3-hour), for 3-hour fire barriers, or B-labeled (1-1/2-hour), for fire barriers having a fire rating of 2 hours or less. Furthermore, TVA stated that security hardware incorporated into a fire door assembly does not adversely impact the fire rating of the assembly in accordance with NRC staff guidance in Section 3.2.3 of GL 86-10.

Sliding fire doors are provided in selected locations, such as rooms protected with gaseous fire suppression systems. In areas not protected by gaseous fire suppression systems, these sliding fire doors are closed by a fusible link. TVA stated that, in areas protected by automatic carbon dioxide (CO_2) suppression systems, fire doors close upon CO_2 system actuation or by thermal actuation of a thermal link.

TVA stated that special purpose doors (e.g., air lock doors, equipment doors, and submarine-type doors) cannot be purchased as labeled fire-rated doors. FPR Part VII, Section 4.1, summarizes TVA's evaluation of these types of fire door in light of the NRC staff guidance. Section 6.2.2 of this evaluation provides the NRC staff evaluation approval of this exception.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's design criteria and bases related to the installation of fire doors in fire barrier assemblies are in accordance with the guidelines of Position D.1.j, of Appendix A to BTP (APCSB) 9.5-1 relating to the fire doors and, therefore, are acceptable.

3.1.5 Fire Dampers

Fire dampers are used to maintain the required ratings of fire-rated barriers (walls, partitions, and floors) when they are penetrated by ductwork, with the goal of preventing the propagation of fire through ducts. TVA stated that fire dampers are provided in heating, ventilation, and air conditioning (HVAC) ducts that penetrate required fire barriers. Some duct penetrations do not have fire-rated dampers and are unprotected openings. Fire dampers are provided with appropriately rated fusible links based on the ambient temperatures in the location. Fire dampers in safety-related HVAC systems may have double fusible links installed if required by a single failure analysis. Furthermore, TVA stated that ventilation openings through fire barriers required to comply with NRC regulations are protected by fire dampers having a rating equivalent to that required of the barrier. TVA stated that fire dampers have been evaluated per the guidance of NFPA 90A-1975, "Standard for the Installation of Air-Conditioning and Ventilating Systems," although TVA did not specifically commit to that standard.

In selected areas protected by automatic CO_2 suppression systems, these dampers also close during the CO_2 system discharge. These fire dampers that provide CO_2 suppression system isolation capability are actuated by a release mechanism when the CO_2 system activates, if not actuated by a thermal link prior to CO_2 system discharge.

In FPR Part VII, Section 3.4, TVA stated that there are two instances of large fire dampers that do not meet NRC staff guidance. Section 6.2.8 of this evaluation provides the NRC staff evaluation and approval of these configurations.

FPR Part VII, Section 3.5, summarizes TVA's evaluation of the fire damper in the volume control tank (VCT) rooms' fire door from the NRC staff guidance. Section 6.2.10 of this evaluation provides the NRC staff evaluation and approval of this configuration.

FPR Part VII, Section 6.2, summarizes TVA's evaluation of relaxing the surveillance frequencies for fire dampers in high radiation or contaminated areas. Section 6.3.2 of this evaluation provides the NRC staff evaluation and approval of this configuration.

FPR Part VII, Section 4.7, summarizes TVA's evaluation of 1-1/2-hour rated fire dampers in 3-hour rated fire barriers. Section 6.2.7.5 of this evaluation provides the NRC staff evaluation and approval of these exceptions.

Based on its review of the information submitted by TVA, the NRC staff concludes that fire dampers at WBN are installed consistent with Positions D.1.j and D.4.i of Appendix A to BTP (APCSB) 9.5-1, and, therefore, are acceptable.

3.1.6 Fire Barrier Penetration Seals

3.1.6.1 Electrical and Mechanical Penetration Seals

In FPR Part II, Section 12.10.6, TVA discussed seals that are installed in areas in which plant commodities, such as pipes, cable trays, conduits, etc., pass through fire rated barriers. TVA tested these seals to the time-temperature curve in American Society for Testing and Materials (ASTM) standard ASTM E119, "Standard Test Methods for Fire Tests of Building Construction and Materials," at an independent fire testing laboratory with experience in the testing of penetration seals.

The testing showed that the penetration seals could withstand the fire endurance test without the passage of flame or gases hot enough to ignite cable or fire stop material on the unexposed side for a period equal to the required fire rating. In addition, for seals required to meet other plant design bases requirements, such as radiation shielding, HVAC pressure differential, and/or flood, they were tested for such capability.

TVA stated that electrical and mechanical penetration seal configurations at WBN have withstood a hose stream test in accordance with Institute of Electrical and Electronics Engineers (IEEE) 634-1978, "Cable-Penetration Fire Stop Qualification Test," or ASTM E-814-83, "Standard Test Method for Fire Tests of Penetration Firestop Systems," without the hose stream causing an opening through the penetration seal that would permit a projection of water beyond the unexposed side.

TVA stated that the 1-, 2-, and 3-hour fire-rated mechanical penetrations were tested in accordance with ASTM E-814-83, for the fire rating. Penetrant service temperature and any thermal or mechanical movement of the penetrant were also considered in the testing of the mechanical penetration seals.

TVA stated that 1-, 2-, or 3-hour fire-rated electrical penetration seals were tested in accordance with IEEE 634-1978. Transmission of heat through the penetration seal was limited to 700 °F or the lowest auto-ignition temperature of cable in the penetration, whichever is lower.

Conduit penetrations that were poured in place during plant construction have internal seals. TVA stated that internal seal materials, design, and locations in walls and floor/ceiling assemblies have been evaluated as equivalent to tested configurations. For conduits with external seals (e.g., the conduits passing through a sleeve larger than the conduit), the external seal meets the same criteria as stated for electrical penetration seals.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection information presented in the FPR conforms to the guidelines of Positions D.1.j and D.3.d of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

3.1.6.2 Internal Conduit Fire Barrier Penetration Seals

TVA stated that conduits that pass through fire barriers are provided with internal smoke and gas seals. TVA stated that these seals have a minimum of 3 inches of silicone foam and 1 inch of ceramic fiber damming installed at the bottom or back side of the foam seal. TVA further stated that conduits that terminate in closed junction boxes or other noncombustible sealed enclosures do not need internal smoke seals, except for conduits in the auxiliary and secondary containment envelope boundary. In addition, TVA stated that an electrical cubicle, such as in a motor control center (MCC) or in a switchgear cabinet, is considered combustible and therefore would have internal conduit seals at or near the fire barrier. Conduits that are routed through the fire area and that do not terminate in the area do not have internal seals.

For lengths of conduit that extend less than 1 foot beyond the plane of a fire barrier, regardless of diameter, a fire seal is installed. For other combinations of diameters and lengths of conduit, TVA uses a graded approach for the installation of internal conduit seals, as provided in FPR Part II, Section 12.10.6. For smaller diameter conduits, a short length of conduit from the barrier is sufficient to restrict smoke or hot gases. For larger diameter conduits, longer lengths of conduit from the barriers are needed to adequately restrict the travel of smoke or hot gases.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's criteria for the installation of internal conduit fire and smoke seals are equivalent to the guidelines of Positions D.1.j and D.3.d of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

3.2 <u>Safe Shutdown Capability</u>

3.2.1 Separation of Safe Shutdown Functions

In order to ensure that one train of equipment remains free of fire damage, where components of redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside the containment, TVA stated that equipment, components, cables, and associated circuits of redundant, safe shutdown systems are separated in accordance with the following separation criteria in Section III.G.2(a) through Section III.G.2(c) of Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50:

(a) Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier;

(b) Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area; or

(c) Enclosure of cable and equipment and associated nonsafety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area;

For safe shutdown components located inside the containment building, TVA used one of the means noted above, or one of the following means to achieve separation between trains:

- fire detectors and automatic fire suppression installed in the area; or
- separation of equipment, components, and associated circuits of redundant systems by a RES

In order to conform to the fire protection and safe shutdown train separation criteria as described in Section III.G.2(b) of Appendix R to 10 CFR Part 50 listed above, TVA took credit for a safe shutdown analysis volume (AV) evaluation methodology and also took credit for enhanced automatic fire suppression consisting of preaction sprinklers located at the ceiling level and below obstructions in the large general plant areas, and areawide ionization smoke detection.

TVA used the AV methodology in order to subdivide a large fire area and then subject it to a detailed safe shutdown analysis in accordance with Appendix R to 10 CFR Part 50 and ensure that one train of safe shutdown capability remains free of fire damage.

Under TVA's AV methodology, an AV can consist of an entire fire area or a portion of a larger fire area. When the AV is a portion of the fire area, it can consist of multiple rooms, a single room, portions of a room (normally defined by column line locations), or any combination of the above. Each AV that involves only a portion of a room includes a 20 foot wide (minimum) "buffer zone" between it and the adjacent AV. The buffer zones are analyzed as part of the larger AV and as a separate AV. Every portion of a fire area is part of at least one AV.

In performing the safe shutdown analyses, safe shutdown components and cables are assigned to each AV containing the component. Additionally, components located in the buffer zones are assigned to an AV for the buffer zone.

TVA's safe shutdown analysis is performed assuming that all components and cables in the AV are damaged by the postulated fire. A set of safe shutdown equipment is then selected and corrective actions designated to ensure safe shutdown functions can be maintained with the selected equipment.

Some AVs in the plant use the electrical raceway fire barrier system (ERFBS) for redundant trains located within a single AV. The ERFBS extends to the boundary of the AV to assure separation between redundant trains within the AV. For large AVs, this may not be a barrier; rather it may be the column line or other indicator of the edge of the AV.

In order to provide reasonable assurance that WBN satisfied the technical guidance in Section III.G, "Fire Protection of Safe Shutdown Capability," of Appendix R to 10 CFR Part 50, TVA identified and used the following types of AV, as described with figures in FPR Part III, Section 10.3:

- *Fire Area* - The fire area is separated from other adjacent areas by rated barriers (walls, floors, and ceilings) that are sufficient to withstand the hazards associated with the area and, as necessary, to protect equipment in the area from a fire outside the area.

- *Single Room within a Fire Area* - A room may be separated from other adjacent rooms in a fire area by regulatory fire barriers (walls, floors, and ceilings) that have a 1-hour or greater fire rating.

- *Combination of Rooms within a Fire Area* - The combination of rooms in the AV are separated from other AVs within the same fire area by regulatory fire barriers that are rated for at least 1-hour

- *Sections of Large General Areas* - AVs consisting of sections of large general areas are separated from each other by "buffer zones" that are wider than 20 feet. In large general areas where buffer zones are used that include intervening combustibles, enhanced automatic suppression and detection systems are installed in the large general area. Where AVs are separated from other AVs by buffer zones, a fire in one of the AVs would not be expected to pass through the buffer zone and affect equipment in the AV on the other side of the buffer zone. TVA uses combinations of overlapping AVs in its analysis.

- *Sections of Large Rooms* - For AVs that consist of large room sections separated by an overlap region that is greater than 20 feet, the overlap region is considered to be part of both AVs. If the overlap region contains intervening combustibles, enhanced automatic suppression and detection systems are installed in the large room.

For large general areas and large rooms that have either buffer zones or overlap regions, refer to Section 6.1.4 of this evaluation for additional information regarding fire protection in those regions.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's criteria for providing fire protection for safe shutdown functions provide an equivalent level of fire safety to Section III.G of Appendix R to 10 CFR Part 50 and therefore, is acceptable.

3.2.2 Safe Shutdown - General Plant Areas

TVA's methodology for assessing compliance with the separation/protection criteria described in Section III.G of Appendix R to 10 CFR Part 50 consisted of:

(a) determining the functions required to achieve and maintain safe shutdown

(b) producing shutdown logic diagrams that define minimum sets of systems capable of accomplishing each shutdown function

Each plant system or subsystem function relied on to accomplish the above safe shutdown functions is identified. A separate designator is assigned to each plant system or subsystem function to ensure consistency between analysis documents and calculations. Each designator is identified as a safe shutdown "Key." The safe shutdown logic diagram (FPR Figure III-5) depicts the safe shutdown system and/or system function, associated Key number, and logical relationships between systems and Keys used to demonstrate compliance with the criteria in Appendix R to 10 CFR Part 50.

(c) grouping specific plant locations into fire areas

(d) identifying for each area, one or more paths through the shutdown logic diagrams that satisfy each required shutdown function

(e) Developing functional criteria that defined the required equipment for the shutdown paths

(f) Identifying power and control cables for shutdown-related equipment and associated circuits that are not isolated from shutdown cabling

For each safe shutdown key, cable block diagrams were developed for each safe shutdown component to identify cables required to ensure that the component can perform its safe shutdown function. Raceways that contain these required cables were then identified, and their locations documented. An interaction is defined as a place in the plant where redundant safe shutdown paths are not separated in accordance with the requirements in Section III.G.2 of Appendix R to 10 CFR Part 50. Whenever an interaction was identified, it was documented and evaluated for its impact on safe shutdown capability. An appropriate resolution was then determined and documented.

(g) Resolutions may consist of modifications, use of alternate equipment, operator manual actions (OMAs), fire barrier or RES installation, post-fire repairs, engineering evaluations prepared in accordance with the guidance in GL 86-10, or deviation requests.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's methodology for assessing compliance with the separation/protection criteria in Section III.G of Appendix R to 10 CFR Part 50, is acceptable.

3.2.3 Safe Shutdown Analysis

TVA stated that its safe shutdown analysis demonstrated that sufficient redundancy exists for systems needed for hot and cold shutdown. The safe shutdown analysis included components, cabling, and support equipment needed to achieve hot and cold shutdown.

TVA stated that for hot shutdown, at least one train of the following safe shutdown systems would be available: (1) auxiliary feedwater (AFW) system, (2) steam generator (SG) power-operated relief valves (PORVs), (3) reactor coolant system (RCS), and (4) chemical and volume control system. For cold shutdown, at least one train of the residual heat removal (RHR) system would be available. TVA stated that the RHR system provides the capability to achieve cold shutdown within 72 hours after a fire, and would be used for long-term decay heat removal. The availability of these systems includes the components, cabling, and support equipment necessary to achieve cold shutdown. Support equipment includes the diesel generators (DGs) and associated electrical distribution system, the essential raw cooling water (ERCW) system, the component cooling system (CCS), and the necessary ventilation systems.

TVA stated that an electrical separation study was performed to ensure that at least one train of such equipment is available in the event of a fire in areas that might affect these components. Safe shutdown equipment and cabling were identified and traced through each fire area from the component to the power source. Associated circuits whose fire-induced spurious operation could affect safe shutdown were identified by a system review to determine those components whose maloperation could affect safe shutdown capability. The potential for multiple spurious operation (MSO) was also analyzed. Further discussion of the MSO is presented below in Section 3.9, "Assessment of Multiple Spurious Operations."

TVA stated that alternative shutdown measures are required only for fires in the control building. If a fire disables the MCR or requires the abandonment of the MCR, the auxiliary control room (ACR), which is located in a separate fire area in the auxiliary building, would be available to achieve and maintain the plant in hot standby and subsequent cold-shutdown conditions. The control functions and indications provided at the ACR panel are electrically isolated or otherwise separate and independent from the MCR. Further discussion of the alternative shutdown capability is presented below in Section 3.3, "Alternative Shutdown."

Based on its review of the information submitted by TVA, the NRC staff concludes that the systems identified by TVA for achieving and maintaining safe shutdown in the event of a fire as described in Section III.G of Appendix R to 10 CFR Part 50 are acceptable.

3.2.4 Systems Required for Safe Shutdown

TVA stated that shutdown of the reactor and reactivity control is initially performed by control rod insertion. Long term reactivity control is provided by adding borated water from the refueling water storage tank (RWST). RCS inventory is maintained by varying charging and letdown flow through the RCS makeup and letdown paths. Decay heat removal during hot shutdown is accomplished by establishing secondary-side pressure control and supplying water to two of the four SGs from one of the redundant motor- or turbine-driven AFW pumps. Long-term heat removal to establish and maintain cold-shutdown conditions is provided by the RHR system.

TVA stated that primary system pressure is controlled by the pressurizer heaters (if available) or by varying pressurizer level in combination with control of RCS temperature using SG PORVs.

Based on its review of the information submitted by TVA, the NRC staff concludes that the systems selected by TVA are capable of satisfying the post-fire safe shutdown criteria in Sections III.G and III.L of Appendix R to 10 CFR Part 50, and therefore, are acceptable.

3.3 <u>Alternative Shutdown</u>

3.3.1 Areas in Which Alternative Shutdown Is Required

TVA's analysis identified that alternative shutdown capability is required for control building fires that also require shutdown from outside of the MCR. For these fires, cold shutdown must be achieved within 72 hours. TVA also indicated that it evaluates the alternative shutdown capability in accordance with Sections III.G.3 and III.L of Appendix R. OMAs to support alternative shutdown are addressed in the same manner as OMAs discussed in Section 3.5.2, “OMAs for SSCs That Are Important to Safe Shutdown,” of this evaluation, below.

3.3.2 Alternative Shutdown System

The alternative shutdown system uses existing plant systems and equipment identified in Section 3.2 above, and an ACR complex. TVA stated that the analysis indicates that for control building fires, no repairs are required to implement the alternative shutdown capability.

A loss of offsite power is required to be postulated for those locations that require alternative shutdown. TVA stated that the systems used during alternative shutdown can be powered by both onsite and offsite power.

The ACR complex is physically independent of the control building. Where required, electrical isolation of controls and indications provided for the ACR is achieved through the actuation of isolation/transfer switches. The ACR complex is divided into five independent rooms consisting of a Train A and Train B transfer switch room for each unit and the ACR. The ACR serves as the central control point during alternative shutdown from outside the MCR, and provides control and monitoring capability for redundant trains (Trains A and B) of equipment required to achieve safe shutdown.

TVA also analyzed the potential for MSOs. Section 3.9 of this evaluation further discusses MSOs.

3.3.3 Alternative Shutdown Conclusion

Based on its review of the information submitted by TVA, the NRC staff concludes that the alternative shutdown system is consistent with Sections III.G.3 and III.L of Appendix R to 10 CFR Part 50, and therefore, is acceptable.

3.4 <u>Alternative Shutdown Performance Goals</u>

TVA stated that the alternative shutdown system described in Sections 3.4.1 through 3.4.5 of this evaluation, was designed to enable the achievement of alternative shutdown performance goals outlined in Section III.L of Appendix R to 10 CFR Part 50.

3.4.1 Reactivity Control

Initial reactivity control is provided by the control rods, which are inserted by the reactor protection system. Additional reactivity margin is provided by injecting borated water from the RWST into the RCS via the charging pumps. Source range monitoring instrumentation is available in the ACR to monitor reactivity and to ensure adequate reactivity margin.

3.4.2 Reactor Coolant Inventory

Control of the RCS inventory requires maintaining the reactor coolant pump (RCP) seal integrity and RCS pressure boundary integrity and providing RCS makeup and letdown.

RCP seal cooling is required to maintain seal integrity and to prevent an uncontrolled loss of reactor coolant inventory. Diverting a portion of the charging flow to the RCP seals achieves RCP seal cooling. Isolating the normal and excess letdown lines, in turn, isolates the RCS pressure boundary. To prevent depressurization of the RCS, the plant ensures that the solenoid valves in the reactor vessel head vent system remain closed.

RCS inventory is controlled by varying charging and letdown flow through RCS makeup and letdown paths. One of the redundant centrifugal charging pumps (CCPs) is required to provide makeup inventory to the RCS. The VCT is required to provide a short-term supply of water for makeup of RCS inventory and RCP seal cooling. A suction path from the RWST is required to provide a long-term source of borated water for RCS makeup. If necessary, inventory may be removed from the RCS by way of the pressurizer PORVs, discharging to the pressurizer relief tank (PRT), or discharging through the RCS head vent valves.

Reactor coolant makeup is usually available immediately following reactor trip from the charging system, except in a few fire locations where it is available within 75 minutes following reactor trip. TVA stated that an analysis was performed which demonstrates that makeup due to RCS leakage is not required for 75 minutes. TVA stated that for these scenarios, maintaining the RCS integrity is necessary to achieve adequate inventory control. The inadvertent opening of boundary isolation valves, such as the reactor head vent valves and RHR suction isolation valves, has been precluded, and adequate RCP seal integrity is maintained to assure safe shutdown.

3.4.3 Decay Heat Removal

RCS temperature from power operation to hot-shutdown conditions is controlled by the rate of heat removal from the reactor coolant to the secondary-side coolant and from hot shutdown to cold shutdown via direct heat transfer by the RHR system to the ultimate heat sink. During RCS cooldown to RHR entry conditions, heat will be removed from the reactor and transferred to the SGs via natural circulation. The removal of decay heat for cooldown from reactor trip to hot standby conditions requires one AFW pump supplying water to two of the four SGs. The required makeup water supply can come from either the condensate storage tank (CST) or from ERCW.

The CST is normally aligned to the suction of the AFW pumps. WBN is supplied with two motor-driven AFW pumps per unit with only one per unit required for safe shutdown. The turbine-driven AFW pump (one per unit) is designed to deliver a sufficient flow to all four SGs and maintain SG water levels at the lower limit of the wide range level indicator, although it is not required for alternative shutdown from the ACR.

The RHR system is required to provide the long-term heat removal capability necessary to establish and maintain cold-shutdown conditions. The establishment of RHR cooling requires one RHR pump, a heat exchanger, and the associated flowpath to provide RCS coolant flow to the primary side of the RHR heat exchanger; one CCS pump and its associated flowpath to provide cooling to the secondary side of the RHR heat exchanger; and one ERCW pump and its associated flowpath to supply cooling water to the CCS heat exchanger. If the diesel generators (DGs) are required to supply required power, an additional ERCW pump would be required for cooling purposes.

TVA's post-fire shutdown analysis states that the pressurizer heaters are the preferred method of controlling RCS pressure, and will be used if available. If the pressurizer heaters are not available, RCS pressure can be controlled by controlling pressurizer level by using other systems, such as the charging system, or controlling RCS temperature using SG PORVs.

3.4.4 Process Monitoring

Direct indication of process variables including reactor coolant hot-leg temperature, reactor coolant pressure, pressurizer level, SG level and pressure, source range flux, charging header pressure and flow, VCT level indication, and decay heat removal system flow are provided in the ACR.

TVA requested an alternative to Appendix R for instrumentation necessary to achieve alternative shutdown. Specifically, TVA has not provided wide-range SG level, tank level indication for the condensate and RWSTs, and RCS cold-leg temperature. Section 6.1.1 of this evaluation provides the NRC staff evaluation and approval of this configuration.

3.4.5 Support Functions

The FPR and the associated shutdown logic diagram (FPR Figure III.5) identify the emergency power distribution system, offsite power system, ERCW system, CCS, HVAC to areas containing essential FSSD equipment, and control room chillers as required support functions.

TVA stated that this essential HVAC is provided for the control, auxiliary, DG, and reactor buildings. Portions of the systems in each building that service safe shutdown equipment required for compliance with Appendix R have been analyzed to ensure that at least one path of the required systems will be available for an Appendix R fire. These systems include the primary safety-related portions of the control building; the auxiliary building HVAC system for the 480-V transformer rooms and for the general floor area on the 713.0-foot elevation; the turbine-driven AFW pump room; the DG HVAC systems including the DGs, associated batteries, and electrical boards; and the containment air cooling systems. All other areas of the plant that contain equipment required for safe shutdown per Appendix R have been evaluated and determined that acceptable temperatures will be maintained for the required equipment to perform its intended function if HVAC is lost.

3.4.6 Alternative Shutdown Performance Goals Conclusion

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's treatment of alternative shutdown performance goals is consistent with Section III.L of Appendix R to 10 CFR Part 50, and therefore, is acceptable.

3.5 <u>Operator Manual Actions</u>

TVA's post-FSSD analysis, and associated cable interaction studies, identified some fire areas where operator actions may be required to take manual control of equipment outside of the MCR to compensate for fire-induced equipment failures. Actions taken by operators within the MCR are described by TVA as Operator Actions, and are not considered OMAs (see Section 3.5.3 of this evaluation, below). TVA classified OMAs into two general categories: (1) manual actions for safe shutdown success path structures, systems, and components

(SSCs) and (2) manual actions for SSCs important to safe shutdown. Repairs for cold shutdown were also evaluated by TVA, but are not considered OMAs.

TVA referenced Revision 2 to RG 1.189 for the discussion of the distinction between safe shutdown success path SSCs and SSCs important to safe shutdown.

WBN, Unit 1, OMAs were approved in NRC SSER 18, prior to operation of WBN, Unit 1. TVA stated that OMAs for future required for safe shutdown SSCs, or such OMAs for WBN, Unit 1, implemented since the SSER 18, will be submitted to the NRC for approval, consistent with the language in the FPR.

3.5.1 OMAs for Safe Shutdown Success Path SSCs

In FPR Part V, Section 2.0, TVA stated that OMAs for SSCs in the safe shutdown success path require prior NRC approval. The position that OMAs for SSCs in the safe shutdown success path require prior NRC approval is consistent with the guidance in Revision 2 to RG 1.189, and is summarized in FPR Part V, Section 2.1.2.1.A. The TVA evaluations of WBN Unit 2 OMAs for success path SSCs are included in FPR Part VII, Section 8. Section 6.1.9 of this evaluation provides the NRC staff approval of these OMAs.

3.5.2 OMAs for SSCs That Are Important to Safe Shutdown

In FPR Part V, Section 2.0, TVA stated that OMAs for SSCs that are important to safe shutdown do not require prior NRC review and approval. The position that OMAs for SSCs that are important to safe shutdown do not require prior NRC approval is consistent with the guidance in Revision 2 to RG 1.189, and is summarized in FPR Part V, Section 2.1.2.1.B. Area-specific evaluations for any area where WBN, Unit 2, OMAs involving important-to-safe-shutdown equipment that are needed to be performed in the area of fire origin are evaluated in Section 3.5.6 below.

TVA discussed the feasibility and reliability analysis criteria for evaluating OMAs. In FPR Part V, Section 2.1, TVA stated that these criteria are based on NUREG-1852.

For all important-to-safe-shutdown SSC manual actions, TVA considered defense-in-depth features, such as fire prevention (transient combustible and hot work controls), fire detection and suppression, and area separation. TVA also included consideration of the need for and the time involved in donning self-contained breathing apparatus when evaluating these OMAs. For any area crediting an OMA with less than 2 hours of required time, and that also lacks robust defense-in-depth fire protection features, additional time margin is included in addition to the nominal acceptance criteria.

TVA considers the following factors in its evaluation of these OMAs: (1) time, (2) environmental factors (smoke, lighting, noise, etc.), (3) necessary equipment, (4) procedures, and (5) staffing. Each of the factors included acceptance criteria. For example, all OMAs have an allowable time of 10 minutes or greater with 100-percent margin. Factors that could cause delays in the performance of the OMA have also been considered. Factors such as lighting and communications are supported by plant calculations.

TVA evaluated the access routes necessary to perform the OMAs. Because some areas of the plant are separated into separate AVs, it is possible that OMAs may occur in a portion of a fire area that is remote to the portion where fire damage could affect safe shutdown equipment. In this event, additional access routes have been evaluated. TVA walked down these alternative access routes and determined that they are viable.

TVA used current NRC guidance to develop acceptance criteria for OMAs for SSCs that are important to safe shutdown. TVA incorporated a review of defense-in-depth, feasibility, and reliability in its analysis.

TVA identified a few important-to-safe-shutdown OMAs that do not meet the general criteria in FPR Part V, Section 2.1.2.1.B.a and Section 2.1.2.1.B.b. For those cases, TVA performed a more detailed defense-in-depth analysis and also ensured that there is at least 50 percent time margin. Any new important-to-safe-shutdown OMAs that fall into this category will be analyzed in the same manner. This exception is rarely used and includes additional analysis of defense-in-depth features and, therefore, is acceptable.

Based on its review of the information submitted by TVA, the NRC staff concludes that OMAs for SSCs important to safe shutdown include consideration of defense-in-depth, feasibility, and reliability, and, therefore, this approach is acceptable.

3.5.3 Actions Related to Main Control Room Abandonment

3.5.3.1 Operator Actions Prior to Main Control Room Abandonment

TVA evaluated operator actions taken prior to MCR abandonment due to fire in FPR Part V, Section 2.3. TVA operators will, prior to leaving the control room, attempt seven actions for each reactor to prepare for staffing the ACR. For each reactor, the FPR describes that control room procedures direct operators to perform these seven actions prior to MCR abandonment:

(1) trip reactor,

(2) trip reactor coolant pumps (RCPs),

(3) close the block valves upstream of the pressurizer power operated relief valve (PORV) and close the PORVs,

(4) close the Main Steam Isolation Valves (MSIVs),

(5) close the Main Feedwater Isolation Valves,

(6) close the Steam Generator Power Operated Relief Valves (SG PORVs), and

(7) open supply valves from the refueling water storage tank to the centrifugal charging pumps.

TVA relies on tripping the reactor ((1) above) and tripping the RCPs ((2) above) through operator action within the control room prior to abandonment. TVA indicated that there are two independent switches in the control room located about 20 feet apart that are available to trip the reactor and that the RCP breakers and RCP start bus breakers are 30 feet apart within the control room and will be tripped by plant operators prior to abandoning the control room. The distance between these switches provides assurance that they both will not be impacted by a fire within the control room prior to control room abandonment. TVA stated that performing these actions from the control room prior to abandonment will ensure that the plant parameters that are impacted by tripping these systems will remain consistent with the performance goals in 10 CFR Part 50, Appendix R, Section III.L.

Operators will attempt to close the pressurizer PORVs and the associated block valves prior to abandoning the control room ((3) above). If the operators are not successful in closing these valves and a spurious actuation occurs that opens a pressurizer PORV, the analysis considered cases where safety injection actuates and where safety injection fails to actuate. If safety injection actuates, plant operators have adequate time to staff the ACR and mitigate the effects of safety injection before the 10 CFR Part 50, Appendix R, Section III.L, performance goals have been violated. If safety injection does not actuate, TVA evaluated the plant response to a spuriously opened PORV. TVA's analysis concluded that the plant response to a spuriously opened PORV without safety injection will result in violating the 10 CFR Part 50, Appendix R, Section III.L, process variable performance goals, but procedures and protected equipment are available to assure that the plant would not reach an unrecoverable condition. TVA stated that the plant would not violate the 10 CFR Part 50, Appendix R, III.L, process variable performance goals if either the actions performed in the control room prior to abandonment, or the automatic features, are successful. TVA analyzed that sufficient procedures and equipment are available to prevent an unrecoverable condition from occurring if the control room actions and automatic features fail and the 10 CFR Part 50, Appendix R, III.L, process variable performance goals are violated.

If the MSIVs ((4) above) or main feedwater isolation valves ((5) above) are not closed from the control room prior to abandonment, a safety injection signal could occur. TVA's evaluation determined that a reactor trip would create conditions that would initiate signals to cause automatic closure of these valves. In the event that the automatic signal is challenged by the fire, plant procedures include steps to mitigate the safety injection from the ACR. TVA stated that plant parameters will remain consistent with the performance goals in 10 CFR Part 50, Appendix R, Section III.L if either the actions performed in the control room prior to abandonment, or the automatic features, are successful. TVA also stated that if the control room actions and automatic features fail, mitigating safety injection from the ACR will assure meeting the 10 CFR Part 50, Appendix R, Section III.L, process variable performance goals.

Operators will attempt to close the SG PORVs prior to abandoning the control room ((6) above). If the operators are not successful in closing these valves and a spurious actuation occurs that opens a SG PORV, a safety injection signal could occur. TVA's evaluation determined that multiple spurious signals are required to open these valves, and that they fail closed. In the event that the spurious signals that would open one of these valves are caused by fire damage, plant procedures include steps to mitigate the safety injection from the ACR, and to take manual control of these valves, if necessary. TVA stated that plant parameters will remain consistent with the performance goals in 10 CFR Part 50, Appendix R, Section III.L if either the actions performed in the control room prior to abandonment, or the manual control of the valves, are successful. TVA also stated that if the control room actions and manual control fail, mitigating safety injection from the ACR will assure meeting the 10 CFR Part 50, Appendix R, Section III.L, process variable performance goals.

TVA stated that operators will also attempt to open the supply valves to the CCPs from the RWST prior to abandoning the control room ((7) above). Opening these valves will help to ensure that the CCPs have a suitable water supply. If the normal supply to the CCPs is impacted by a fire, there is an automatic signal generated to open the RWST feed to the CCPs. In the event that both the control room operator action and the automatic actuation fail due to fire damage, TVA has abnormal operating procedures available to assure safe shutdown capability. TVA stated that performing these actions from the control room prior to abandonment and relying on the automatic transfer would ensure that CCPs will not be impacted. In the event that these features fail, TVA stated that procedures are in place to ensure that the plant does not reach an unrecoverable condition.

In addition, TVA assumes that a fire in the MCR would be characterized by slow growth and be detected in its early stages by control room operators or installed smoke detection systems. Fires in other areas of the control building may require MCR abandonment, such as in the cable spreading room or auxiliary instrument room, etc. The control building areas other than the MCR have installed detection and automatic suppression systems that reduce the likelihood of a large fire, or have an alternative documented in FPR Part VII, Section 2.3, and evaluated in Section 6.1.3 of this evaluation. In the event that a fire were to occur in the panel where the above controls are located, other controls in the MCR could serve the same function, or controls are available outside the control room that can be operated in sufficient time to prevent the adverse actions listed above.

In NRC request for additional information (RAI) FPR V-16, the NRC staff expressed a concern that a fire in portions of the control building that lack fire detection and automatic suppression could impact equipment important to safe shutdown. In TVA's letter dated August 5, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11227A257), TVA stated that, in the control building, the PORV block valve controls are only routed through areas that have detection and automatic suppression. Other circuits routed through the control building are either routed through areas with fire detection and automatic suppression, or areas with detection and limited combustibles and ignition sources.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA considered the credible fire scenarios, separation of controls or automatic features, and the other installed defense-in-depth features to determine that these control room actions are feasible and, therefore, are acceptable.

3.5.3.2 Operator Actions and OMAs Following Control Room Abandonment

TVA provided specific consideration for actions taken following a control room abandonment. TVA stated in FPR Part V, Section 2.1.2.1.C that actions taken at the ACR and OMAs performed as part of a control room abandonment have at least 10 minutes of allowed time and 100-percent time margin.

There are a few actions that do not have this allowable time and time margin, specifically, OMA 1638 for Unit 1 and OMA 1639 for Unit 2. These actions are performed by the control room operator on the way to the ACR. So for these actions, there is no time delay for the arrival of an auxiliary operator. This is a very short time action—5 minutes—and TVA demonstrated that the action can be performed in less than 1 minute. TVA also indicated that there are alternative methods to achieve the same result as the preferred path that is provided by these OMAs. Since this action is performed by a control room operator (not a recalled auxiliary operator), there is over 100-percent time margin, and there are alternative (nonpreferred) methods to perform this function if the OMA fails, the NRC considers this action acceptable.

Based on its review of the information submitted by TVA, the NRC staff concludes that, based on allowable time, time margin, and available alternative methods, actions performed by operators following a control room abandonment are acceptable.

3.5.4 Safe Shutdown Procedures and Manpower

TVA developed a fire response procedure, Abnormal Operating Instruction (AOI)-30.1, “Plant Fires,” which describes operator response and mitigating actions for plant fires. TVA also developed room-specific procedures as part of AOI-30.2, “Fire Safe Shutdown,” for rooms where OMAs may be required to mitigate damage to plant safe shutdown equipment. AOI-30.2 is supported by controlled plant calculations. The procedures include operator-by-operator actions for a fire in any room of the plant that would require OMAs to shut down the plant.

TVA walked down the OMAs for both WBN, Unit 1, and WBN, Unit 2. In some cases, TVA used a bounding approach that involved timing more challenging or involved OMAs, and using that timing for less challenging OMAs. Additionally, OMAs needed after 2 hours into the fire were not walked down, since 2 hours corresponds to the time frame for additional personnel to arrive at the plant in response to an event. TVA postulates that significant plant fires are interior to the plant; therefore, operators who are called back are not expected to have difficulty getting to the plant.

TVA stated that, upon confirmation of a fire, such as actuation of cross-zoned fire detection, high-pressure fire pump auto-start, CO_2 fire extinguishing system actuation, or plant staff observation, steps are initiated that include recalling auxiliary unit operators needed to perform OMAs to their assembly location. TVA performed recall exercises and determined that auxiliary unit operators begin to be available within about 3 minutes. The fire detection systems are likely to annunciate to the control room before a fire impacts plant operation, such that for WBN, auxiliary unit operator recall is expected to occur prior to tripping the plant and declaring the Appendix R event.

TVA stated that the start of the time “clock” for the performance of OMAs is the tripping of the plant. Prior to tripping the reactor, the plant is considered to be in a stable operating condition. Once the trip is initiated, the clock starts and preventive OMAs are performed to prevent spurious equipment operation and to ensure safe shutdown can be accomplished. In the event that an Appendix R event coincides with a plant trip, without prior detection or recall of the auxiliary unit operators, there is still available margin for the most time-critical manual actions to be performed. This is based on the 100-percent available margin for every manual action, no manual action needed in less than 10 minutes, and the 3-minute recall time for the first auxiliary unit operator.

TVA analyzed the possibility that a fire could cause a plant trip prior to recalling operators to the control room. TVA postulated three trip scenarios and concluded that the available fire protection features of fire detection, automatic suppression, and physical separation will allow time for the MCR to recall the auxiliary equipment operators prior to an automatic trip.

TVA stated that there are some rooms that lack fire detection, but it evaluated these areas and determined that there were no OMAs needed for FSSD in these areas. For these areas, TVA will rely on normal and emergency operating instructions in the event of a fire, and OMAs and fire response procedures are not used.

Most of WBN's OMAs are preventive; however, some reactive OMAs must be taken upon fire damage to SSCs rather than reactor trip. TVA stated that for these reactive type actions, the normal plant operating procedures provide an appropriate reactive response to fire damage. TVA analyzed the available FSSD equipment on an area-by-area basis to assure that sufficient safe shutdown equipment is free of fire damage such that safe shutdown can be achieved using equipment that is free of fire damage.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's safe shutdown procedure structure, including both preventive and reactive OMAs, has been evaluated to ensure safe shutdown capability and, therefore, is acceptable.

3.5.5 Repairs

TVA stated that repair activities (e.g., lifting/cutting leads, installing jumpers, and fuse replacement) are not required to achieve and maintain hot standby conditions. TVA identified the following three generic repairs to be performed to achieve cold shutdown:

- RHR Room Cooler Repair,
- RHR/RCS High-Low Pressure Boundary Valve Repair
- Long Term RCS Inventory Reduction.

Cold-shutdown repair activities include the installation of electrical jumpers, the installation of portable air supplies, and the installation of replacement cables and components if needed due to fire damage. TVA identified the specific activities to be performed and developed repair procedures to implement this capability. Additionally, materials necessary to accomplish the repairs are available on site.

Based on its review of the information submitted by TVA, the NRC staff concludes that the repair activities developed by TVA to achieve cold shutdown conditions are consistent with Appendix R to 10 CFR Part 50 and therefore, are acceptable.

3.5.6 WBN Unit 2 OMAs Involving Fire Area Re-Entry

TVA examined WBN Unit 2 OMAs that involve re-entry into plant fire areas in FPR Part VII, Section 8.4. This section discusses actions involving important to safe shutdown equipment, whereas Section 6.1.9 of this evaluation addresses OMAs involving equipment required for safe shutdown.

TVA indicated that all WBN Unit 2 rooms that involve re-entry to perform OMAs for important to safe shutdown equipment are equipped with fire detection and automatic suppression. Areas that do not have complete automatic suppression coverage are discussed in Section 6.1.7 of this evaluation. In addition, TVA stated that all such OMAs have more than 60 minutes for the licensee staff to extinguish the fire and to operate the equipment within the room. TVA determined that the equipment within the room of fire origin is unlikely to be damaged such that the equipment could not be operated following a postulated fire in that room. TVA performed feasibility and reliability evaluations of the OMAs.

Based on its review of the information submitted by TVA, the NRC staff concludes that there is sufficient defense-in-depth available, detection and automatic suppression is installed, and that the manual action provides sufficient margin to assure safe shutdown capability. Therefore, the NRC staff concludes that such re-entry into rooms to perform OMAs involving important to safe shutdown components is acceptable.

3.6 <u>Associated Circuits</u>

TVA examined the potential impact of fire damage on associated circuits of concern. TVA categorized associated circuits as follows:

- Type I – common power source,
- Type II – spurious actuation,
- Type III – common enclosure.

TVA stated that it identified these associated circuits of concern in accordance with GL 81-12, the NRC staff's clarification to GL 81-12, and GL 86-10.

3.6.1 Circuits Associated by Common Power Source

TVA stated that, for circuits associated by a common power source, it identified all circuits supplied from a power source (i.e., switchgear, MCCs, and load centers) that also powers a circuit of equipment required for post-FSSD. For the identified circuits, TVA verified the coordination of electrical protection devices (e.g., fuses, circuit breakers, or relays) to ensure that a fire-induced fault on a branch circuit of a required supply will be cleared by at least one branch circuit protective device before the fault current can propagate to cause a trip of any feeder breaker upstream of the required supply.

In its letter dated August 5, 2011 (ADAMS Accession No. ML11227A257), in response to RAI FPR III-17, TVA stated that a list of the design change packages had been issued to ensure that the WBN, Unit 2, circuits are adequately protected with fuses/breakers to address common power supply and common enclosure associated circuits of concern. In its letter dated June 24, 2015 (ADAMS Accession No. ML15175A508), TVA stated that these actions have been completed.

TVA evaluated circuits associated by a common power source for multiple high impedance faults (MHIFs). TVA stated that MHIFs are evaluated in accordance with the base case conditions in Appendix B.1 to Nuclear Energy Institute (NEI) 00-01, "Guidance for Post Fire Safe Shutdown Circuit Analysis," Revision 2, issued May 2009, as endorsed by Section 5.5.2 of Revision 2 to RG 1.189. The base case set of conditions, if met, provides reasonable assurance that MHIFs will not occur. The FPR, Part III, Section 7.4, analysis provided the NEI 00-01 base case conditions with the corresponding WBN compliance method for each base case condition. The FPR states: "WBN meets the NEI 00-01, Appendix B.1 base case criteria which establish applicability of the base case to individual plant designs." WBN did not take any exceptions to the base cases. In a letter dated June 27, 2012 (ADAMS Accession No. ML12181A531), TVA provided a list of supporting calculations for the FPR, Part III, Section 7.4, MHIF analysis.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's method of evaluating circuits associated by a common power source is consistent with the NRC guidance in the GLs identified in Section 3.6 of this evaluation above, and in Appendix B.1 to NEI-00-01, as endorsed by RG 1.189, and, therefore, is acceptable.

3.6.2 Circuits Associated by Spurious Operation

TVA stated that cables that are not part of safe shutdown circuits may be damaged by the effects of postulated fires. This cable damage may consequently prevent the correct operation of safe shutdown components, or result in the maloperation of equipment which would directly prevent the proper performance of the safe shutdown systems. The effects of spurious operations may be conceptually divided into two subclasses as follows:

(1) maloperation of safe shutdown equipment due to control circuit electrical interlocks between safe shutdown circuits and other circuits (e.g., the numerous safe shutdown equipment automatic operation interlocks from process control and instrument circuits)

(2) maloperation of equipment that is not defined as part of the safe shutdown systems, but that could prevent the accomplishment of a safe shutdown function (e.g., inadvertent depressurization of the RCS or the main steam system by spurious opening of boundary valves)

TVA performed an evaluation of Appendix R to 10 CFR Part 50 events to ensure that any failure of associated circuits of concern by spurious operation will not prevent safe shutdown. Credible electrical faults considered in the analysis included open circuit, short circuit (conductor-to-conductor), short to ground, and cable-to-cable (hot-short) including 3-phase hot-shorts for high/low pressure interface valves. The analysis also considered that the normally ungrounded 125 VDC power distribution system may become grounded due to fire damage.

TVA indicated that these Type II associated circuits of concern outside of containment are analyzed in accordance with the criteria in Sections III.G.2.a, III.G.2.b, and III.G.2.c of Appendix R to 10 CFR Part 50 as required circuits. Inside containment, the Type II associated circuits of concern are analyzed in accordance with the criteria in Sections III.G.2.d, III.G.2.e, and III.G.2.f of Appendix R to 10 CFR Part 50 as required circuits.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's approach to analyze circuits associated by spurious operation, in accordance with the sections of Appendix R to 10 CFR Part 50 listed above, is acceptable.

3.6.3 Circuits Associated by Common Enclosure

To address the common enclosure associated circuit concern, TVA evaluated all circuits that may share a common enclosure (e.g., cable tray, conduit, panel or junction box) with a circuit required by Appendix R to 10 CFR Part 50. On the basis of its evaluation, TVA concluded that the electrical protective equipment provided will ensure that electrical faults and overloads will not result in any more cable degradation than would be expected when operating conditions are below the setpoint of the electrical protective device.

TVA stated that the plant addressed associated circuits by common enclosure by ensuring that all required existing (prior to 1995) circuits in buildings with safe shutdown components are electrically protected with a fuse or breaker that will actuate prior to the jacket of existing faulted cables from reaching their auto-ignition temperature. Additionally, for new circuits, associated circuit electrical fault protection is provided to ensure that the fuse or breaker will operate prior to the temperature of the insulation reaching its insulation damage temperature.

In its letter dated August 5, 2011 (ADAMS Accession No. ML11227A257), in response to RAI FPR III-17, TVA stated that a list of the design change packages had been issued to ensure that the WBN Unit 2 circuits are adequately protected with fuses/breakers to address common power supply and common enclosure associated circuits of concern. In its letter dated June 24, 2015 (ADAMS Accession No. ML15175A508), TVA stated that these actions have been completed.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's methodology for assessing circuits associated by common enclosure is consistent with the NRC guidance in the GLs identified in Section 3.6 of this evaluation, and, therefore, is acceptable.

3.7 Current Transformer Secondaries

Section III.G.2 of Appendix R to 10 CFR Part 50 requires that fire induced open circuits be analyzed where they could prevent operation or cause maloperation of components required for post-FSSD.

If a fire at a remote location causes the secondary circuit of a current transformer (CT) to open, the event could generate ionized gases or additional fires, or both, in other locations and could propagate fire to additional fire areas.

TVA evaluated the fire hazards due to a fire-induced open circuit in the secondary circuits of CTs installed in high energy panels (i.e., 6.9 kV switchgear) of the required power systems. An evaluation of three types of CT circuits used in the auxiliary power system has been done: (1) ground fault, (2) differential relaying, and (3) protective relaying.

The CT circuits are contained in their respective panels for the Appendix R to 10 CFR Part 50 required and nonrequired 480 V switchgear and the 6.9 kV switchgear. Therefore, the fire would have to be localized in the switchgear assembly for the CT secondary circuit to be opened by a fire. This would prevent the CT circuits from causing fire propagation to other fire areas.

The 6.9-kV CT circuit that is connected to protective relaying and a current transducer is also contained within the switchgear panel. The output of the current transducer is connected to a remote indicator, and the current transducer is an electrical isolator. Additionally, the output-to-input of the current transducer has been tested for 1500-VAC differential. Electrical isolation also exists for the Watt & volt-amperes-reactive transducers used on the 6.9-kV switchgear at WBN.

The board differential relaying circuits are totally internal to the switchgear panels, except for the following three exceptions:

(1) The circuits between the 6.9 kV switchgear emergency supply feeders and the DGs are included in the interaction analysis as required circuits. The protective relays are designed to operate and clear these circuits in case of fire damage.

(2) The common station service transformers transformer differential relaying circuits are also included in the interaction analysis as required circuits. The current imbalance created by an open CT circuit causes the protective differential relay to open the supply circuit breaker, which removes primary power to the CT, clearing the circuit, within the time required for protective relay and breaker operation.

(3) The circuits between the 6.9 kV start and unit boards are not required circuits. Similar to item (2) above, current imbalance in the protective differential relay of the nonrequired circuits would open the supply circuit breaker.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's approach to evaluating the fire hazards due to fire-induced open circuits in the secondary of CTs installed in high energy panels is in accordance with Section III.G.2 of Appendix R to 10 CFR Part 50, and therefore, is acceptable.

3.8 <u>High/Low-Pressure Interfaces</u>

TVA stated that GL 81-12, GL 86-10, and Information Notice (IN) 87-50, "Potential LOCA at High- and Low-Pressure Interfaces from Fire Damage," dated October 9, 1987, describe special considerations for high/low pressure interfaces that are necessary to meet TVA's commitment to Appendix R to 10 CFR Part 50.

In accordance with GL 81-12, the following information is necessary to ensure that high/low pressure boundary interfaces are adequately protected for the effects of a single fire:

(1) Identify each high/low pressure interface that uses redundant electrically controlled devices (such as two series motor operated valves) to isolate or preclude rupture of any primary coolant boundary.

(2) Identify the essential cabling for each device.

(3) Identify each location where the identified cables are separated by a barrier having less than a 3-hour fire rating.

(4) For the areas identified in (3) above (if any), provide the bases and justification.

GL 86-10 states that, in the case of high/low pressure interfaces, the following must be considered: (1) a hot short on all three phases of three phase AC circuits in the proper sequence to cause spurious operation of a motor, and (2) two hot shorts of proper polarity without grounding on ungrounded DC circuits resulting in spurious operation.

The information in IN 87-50 states that, because the high pressure from the reactor coolant system could result in failure of the low pressure piping, at least one isolation valve must remain closed despite any damage that may be caused by fire for those low pressure systems that connect to the reactor coolant system.

Based on the above, TVA performed a review of the systems credited for safe shutdown to identify potential high/low pressure interfaces. These interfaces were evaluated to identify valves that, if spuriously opened, would expose low pressure piping to high pressure resulting in failure of the low pressure system.

The control system for RHR valves has been designed to prohibit opening unless the reactor coolant pressure is low enough to prevent RHR piping failure. However, if these valves opened spuriously, exposure of RHR piping to high pressure may cause failure of the RHR system piping and render the system inoperable. Therefore, the RHR/RCS isolation valves (1/2-FCV-74-1, -2, -8, and -9) are considered high/low pressure interface valves.

Excess letdown is not required for safe shutdown. However, the spurious opening of these valves could expose downstream piping to excess pressure that may cause failure resulting in the rupture of the primary coolant boundary. Therefore, the excess letdown isolation valves (1/2-FCV-62-55, and -56) are considered high/low pressure interface valves.

Normal letdown is not required for safe shutdown. However, spurious opening of these valves may cause failure to maintain RCS inventory control. Therefore, the normal letdown isolation valves (1/2-FCV-62-69A and -70A) are considered high/low pressure interface valves.

The safety injection system (SIS)/RHR interface valve with the RCS is located in piping that connects the SIS with the RHR system at a point between the RCS/RHR isolation valves. The SIS is not required for safe shutdown. However, the spurious opening of valve 1/2-FCV-63-186 along with either 1/2-FCV-74-1-A or -9-B could expose the SIS piping to damaging pressure. Therefore, this valve is considered a high/low pressure interface.

The pressurizer PORV and reactor head vent isolation valves are designed to function at high RCS operating pressure. They provide a safe shutdown function by initially remaining closed for RCS inventory control purposes. The pressurizer PORVs also provide RCS pressure control during cooldown. The primary method of RCS inventory control during cooldown is to maintain pressurizer level while makeup is provided by injecting borated water through the RCP seals as part of seal cooling and the RCS cooldown rate is adjusted by controlling SG level and pressure to provide RCS volume shrinkage equal to the volume of fluid injected through the RCP seals. The reactor head vent isolation valves (where available) and the pressurizer PORVs can also be used to reduce RCS inventory. Discharge from the RCS through these valves is directed to the inlet of the PRT. The inlet lines are sized to accommodate vent/relief discharge flow without piping or component failure. Continuous blowdown to the PRT may eventually cause spillage of excess coolant to containment through the PRT rupture disks. Therefore, the pressurizer PORVs and block valve combinations, and reactor head vent isolation valves, are considered high/low interface valves.

To prevent fire-initiated cable faults from causing a spurious operation of the RHR isolation valves, all four of the motor-operated valves in the RHR suction line are kept closed (prefire condition) with the corresponding MCC breaker in the open position. The return lines are isolated by two series check valves in each line and a common motor-operated valve.

In its letter dated May 30, 2012 (ADAMS Accession No. ML12153A374), TVA stated that procedural controls for isolation of all potentially spurious RCS letdown paths, including pressurizer PORVs and reactor head vents, provide assurance (through the use of MCR actions for WBN, Unit 2, and MCR actions and an OMA for WBN, Unit 1) that isolation of normal and excess letdown paths will be achieved.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's approach for high/low pressure interfaces meets Appendix R to 10 CFR Part 50 and follows the guidance in GL 81-12 and GL 86-10, and IN 87-50, and therefore, is acceptable.

3.9 <u>Assessment of Multiple Spurious Operations</u>

In FPR Part III, Section 11.0 "Multiple Spurious Operation (MSO) Evaluation," TVA stated that Revision 2 to RG 1.189 formalized the guidance for addressing multiple fire induced circuit failures, or MSOs and multiple concurrent hot shorts. TVA further stated that this process was followed to address fire-induced spurious failures for WBN Unit 1. In a letter dated August 20, 2010 (ADAMS Accession No. ML102360283), TVA stated that the MSO scenarios requiring resolution for WBN Unit 1 would be implemented under the timing requirements prescribed by the NRC in Enforcement Guidance Memorandum 09-002, "Enforcement Discretion for Fire Induced Circuit Faults."

By letter dated November 5, 2010 TVA submitted TVA MSO Evaluation R-1976-20-001, "Watts Bar Nuclear Plant Unit 2 Multiple Spurious Operation Evaluation, Revision 1" (ADAMS Accession No. ML103160419). TVA stated that multiple fire-induced spurious failures were evaluated at WBN Unit 2 as described in Revision 2 to RG 1.189. TVA further stated that, based on the results of the MSO expert panel conducted at the plant for WBN Unit 1, various scenarios were identified and were reviewed for WBN Unit 2. Appendix B, "Unit 2 Resolutions," and Appendix C, "Unit 1/Common Resolutions," of the above report provided resolutions for specific unresolved MSO scenarios that affect WBN Unit 2.

In a letter dated February 7, 2013 (ADAMS Accession No. ML130440108), TVA stated that the above MSO scenarios requiring resolution for WBN Unit 1 have been resolved and incorporated into Appendix B and Appendix C to Revision 2 to MSO Evaluation R-1976-20-001.

TVA included Revision 3 to MSO Evaluation R-1976-20-001, as an enclosure to its letter dated September 18, 2014 (ADAMS Accession No. ML14265A449). In this revision, TVA indicated that, in a number of cases, the actions related to the WBN Unit 2 MSO scenarios requiring resolution in Appendix B had been completed.

In Section 4 of the MSO Evaluation (Revisions 1, 2, and 3), TVA stated that MSO scenarios selected for Sequoyah Nuclear Plant, Units 1 and 2, and for WBN Unit 1 were evaluated to determine if the scenarios were applicable to WBN Unit 2 and how WBN Unit 2 complied with each scenario. Sequoyah Nuclear Plant, Units 1 and 2, and WBN Units 1 and 2, have similar physical and systems designs. All four units are Westinghouse four-loop pressurized water reactors with wet ice condenser containments and would be expected to have similar MSO scenarios. Additionally, the Sequoyah Nuclear Plant, Units 1 and 2, MSO scenarios were analyzed from a dual unit perspective.

In a letter dated June 24, 2015 (ADAMS Accession No. ML15175A508), TVA stated that all MSO scenarios resolution actions for WBN Unit 2 have been completed. Finally, in FPR Part III, Section 11.0, TVA stated that the WBN Unit 1 MSO evaluation is documented in TVA calculation XDN00000020110002, "WBN Unit 1 Multiple Spurious Operation Review for RG 1.189 Revision 2," and that the WBN Unit 2 MSO evaluation is documented in TVA calculation

EDQ0009992012000085, "Appendix R - WBN Unit 2 Multiple Spurious Operation (MSO) Evaluations."

Based on its review of the information submitted by TVA, the NRC staff concludes that by evaluating multiple fire-induced spurious failures in accordance with the guidance in Revision 2 to RG 1.189 and by using MSO scenarios from Sequoyah Nuclear Plant, Units 1 and 2, and WBN Unit 1 when addressing WBN Unit 2 and dual-unit scenarios, TVA's approach is an acceptable means for addressing MSO failures.

3.10 Smoke Control and Ventilation

FPR Part VIII, Section D.4, and FPR Part X, Section 3.2.9, discuss smoke control and ventilation. TVA stated that plant ventilation systems at WBN are not specifically designed to exhaust smoke or corrosive gases. TVA further stated that a combination of the normal ventilation exhaust systems and portable fans are used to remove smoke from specific rooms during and after firefighting activities. Nonrecirculating ventilation systems are provided for fire areas that may contain airborne radioactive materials. Smoke from fires that might occur in areas containing radioactive materials is monitored for radioactivity.

Based on its review of the information submitted by TVA, the NRC staff concludes that smoke control and ventilation for fire protection purposes at WBN are installed consistent with Position D.4 of Appendix A to BTP (APCSB) 9.5-1, and, therefore, is acceptable.

3.11 Lighting and Communications

TVA stated that fixed, self-contained lighting units with individual 8-hour minimum battery power supplies are provided in areas that must be manned for safe shutdown, and in access and egress routes to and from all fire areas containing controls for equipment required for safe shutdown. TVA stated that an assessment of the emergency lighting at OMA locations and the access routes to OMA locations has been performed to assure the adequacy of the lighting. These walkdowns were performed under local or general area blackout conditions and were used to document the adequacy of the lighting levels.

In FPR Part VII, Section 2.7, TVA requested an alternative to its commitment for emergency lighting criteria inside the reactor building, yard area, and the turbine building. Section 6.1.6 of this evaluation provides the NRC staff's evaluation of this alternative.

Based on its review of the information submitted by TVA, the NRC staff concludes that the emergency lighting is consistent with Section III.J of Appendix R to 10 CFR Part 50 and the guidelines contained in Section D.5.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

TVA provided several means of communication to support safe shutdown operations, including (1) telephones, (2) a code, alarm, and paging system, (3) sound-powered phones, and (4) two-way radios. The two-way radio system consists of multiple radio repeaters, portable radios, and redundant distributed antenna systems. The radio cabinets, power cables, and redundant fixed repeaters are widely separated so that one fire cannot affect all the radios. The radios have redundant diesel and battery backed power supplies. There are antennas for the radios located on the auxiliary building exhaust stack, in addition to internal distributed antenna systems in the control and turbine buildings. Additionally, two widely separated trunk lines feed the radio signal to redundant distributed antenna systems in the auxiliary building.

The two-way radio system is the primary means of communication for performing manual shutdown actions and for fire brigade firefighting operations. Some plant areas lack full radio coverage; however, coverage is available immediately outside of these rooms. Sound-powered phones are available in the ACR and local stations to supplement the radio system and support alternative shutdown.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's means of communications do not take any exceptions to Positions D.5.c and D.5.d of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

4.0 FIRE PROTECTION SYSTEMS

The NRC staff evaluated TVA's fire protection program for compliance with 10 CFR 50.48(a), as described in Section 2.1 of this evaluation. TVA evaluated their program against the guidance in Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1. The NRC staff determined that TVA's reliance on the information in Appendix A to BTP (APCSB) 9.5-1, was acceptable since it was the guidance in place on April 18, 1977, when TVA first submitted a fire hazards analysis to the NRC for review. In addition to TVA's evaluation to Appendix A to BTP (APCSB) 9.5-1, since TVA used guidance published prior to 1981, TVA also committed to meet Sections III.G, III.J, and III.O, of 10 CFR Part 50, Appendix R, to assure safe shutdown capability. This section of the evaluation describes the NRC staff's evaluation of TVA's compliance with 10 CFR 50.48(a)(2)(ii) and portions of 10 CFR 50.48(a)(1)(iv). As discussed below, the NRC staff's review found that the Watts Bar fire protection program meets the requirements of 10 CFR 50.48(a).

4.1 Water Supply and Distribution

Tennessee Valley Authority (TVA) described the fire water supply system at Watts Bar Nuclear Plant (WBN) in Fire Protection Report (FPR) Part II, Section 12.1, "Water Supply." TVA also described the system in its response by letter dated August 5, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11227A257), to request for additional information (RAI) FPR II-45. TVA stated that the high-pressure fire protection (HPFP) water system is common to both units and that it consists of four electric motor-driven pumps and one diesel engine-driven pump.

TVA stated that the electrically driven pumps are seismic Category I high-pressure vertical turbine motor-driven pumps in accordance with Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code). Each pump is rated at 1,590 gallons per minute (gpm) at 130 pounds per square inch, gauge (psig). TVA calculated the maximum required fire water demand based on the largest automatic suppression system demand and hose streams, and it stated that each of these pumps can supply 50 percent of the required flow. The pumps are located in the seismic Category I intake pumping station (IPS) with a 3-hour-rated fire barrier that separates two fire pumps from the other two fire pumps.

TVA stated that a 100-percent capacity, Underwriters Laboratories, Inc., (UL)-listed, diesel fire pump is remotely located in the yard near the WBN, Unit 1, cooling tower. TVA stated that the diesel fire pump is capable of developing a flow of 2,500 gpm (100 percent capacity) at 125 psig and 3,750 gpm (150 percent capacity) at 81 psig.

TVA stated that the water supply for the electric fire pumps is taken from the Tennessee River and the diesel fire pump takes its water from the WBN, Unit 1, cooling tower basin. TVA stated that the Tennessee River is essentially unlimited and that the WBN, Unit 1, cooling tower basin can provide a minimum of 2 hours supply at 150 percent of the capacity of the diesel pump.

TVA stated that the electric pumps are automatically started by activation of the fire detection systems associated with installed automatic water-based suppression systems. Also, the electric pumps can be started manually from either the main control room (MCR) or the appropriate 480-V shutdown board. The diesel pump automatically starts on low system pressure or can be manually started from the MCR or locally at the pump. The diesel pump can only be stopped locally at the pump.

TVA stated that each electric fire pump is powered from a separate 480-V shutdown board and that, in the event of loss of offsite power, each 480-V shutdown board is automatically connected to a separate emergency diesel generator (DG). Indications of fire pump motor running condition and loss of line power on the line side of the switchgear are provided in the MCR for each electric pump. The diesel fire pump also sends annunciation signals to the MCR.

TVA stated that the electric fire pumps also serve as a backup water supply to the auxiliary feedwater (AFW) system in the event of a flood above plant grade (called "flood mode"). TVA stated that, as a result, this requires the use of pumps that meet the requirements in Section III of the ASME Code as opposed to traditional fire pump installations that are UL-listed or factory mutual-approved pumps in accordance with National Fire Protection Association (NFPA) 20-1993, "Standard for the Installation of Centrifugal Fire Pumps," for electric driven pumps. In FPR Part VII, Section 5.1, TVA stated the following:

(1) pump curve verification tests have been performed to include multiple diverse points on the pump curve to replicate fire pump test requirements as opposed to the single point verification applicable to ASME Code Section III pumps;

(2) TVA performed hydraulic calculations to demonstrate that the pumps provide adequate flow and pressure to the most hydraulically remote suppression systems;

(3) the electrical circuits for pump power and control meet IEEE Class 1E standards and, even though the pumps do not start on pressure drop in the piping system, they do start on activation of the fire detection systems associated with pre-action suppression systems; and

(4) the fire pumps can only be manually stopped from the MCR, which is continuously manned, or the shutdown board rooms in the auxiliary building.

Based on the above information submitted by TVA, the U.S. Nuclear Regulatory Commission (NRC) staff concludes that, while not designed to the guidelines in NFPA 20, the electric fire pump configuration will not negatively affect the performance of the fire protection system, and meets the purpose of the guidelines of Section E.2.c of Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1 and, therefore, is acceptable.

TVA stated that the diesel fire pump installation and its associated controller are installed in accordance with NFPA 20-1993. Based on the information submitted by TVA that states that the diesel fire pump and associated controller are installed in accordance with NFPA 20-1993, the NRC staff concludes that the installation of the diesel fire pump is acceptable.

TVA stated that a self-cleaning strainer capable of handling 100-percent flow is provided on the discharge side of each pair of electric fire pumps. The strainers are located in the IPS and conform to the requirements in Section III of the ASME Code for seismic Category I components. For the diesel fire pump, TVA stated that mechanical screens are provided on the supply side and a strainer on the discharge.

TVA stated that the HPFP system is interconnected to the raw cooling water (RCW) and raw service water (RSW) systems. Automatic isolation valves are provided to isolate the RCW system and selected RSW loads from the HPFP system when any fire pump is started to reduce the RSW load on the HPFP system to ensure adequate flow and pressure are available. During normal operation, HPFP system pressure is maintained by the RCW pumps.

The HPFP system mains consist of both cement-lined iron yard mains and unlined steel safety headers. The steel safety headers serve as a backup water supply to the AFW system in "flood mode," as noted above. TVA stated that the details of the "flood mode" are documented in several places in the final safety analysis report (FSAR), for example, FSAR Section 2.4.14.2, "Plant Operation during Floods above Grade." The piping inside buildings is unlined steel. The buried steel piping has an exterior coating to prevent corrosion. The electric fire pumps feed the steel headers and the iron yard main. The diesel pump feeds the iron yard main. The two loops (iron and steel) are connected at the IPS (via normally open valve 0-FCV-26-17) and at two remote points in the auxiliary building (via normally open valves 0-FCV-26-15 and 0-FCV-26-16). TVA stated that pressure control is provided by a pressure control valve downstream of the four electric pumps and downstream of the diesel pump.

TVA stated that sectional isolation valves are provided on the iron yard main to allow maintenance on portions of the system while the plant maintains its firefighting capability. In addition, TVA stated that the sectional isolation valves in the underground and building loops are locked or sealed in position and that surveillance is performed to ensure proper system alignment. The plant has not installed any sectional valves on the underground portions of the steel safety headers, but there are isolation valves for each header in the intake pumping station (IPS) and auxiliary building. Because the two headers are redundant and because they are also connected to the iron yard main through valves in the auxiliary building, the plant could isolate either main and would still have two sources of fire water available.

TVA stated that all post-indicator-type valves are either sealed or locked open with a key-operated "breakaway" type lock. TVA further stated that curb box valves are not locked open, but TVA considers these valves to be tamper-resistant because they cannot be operated without a special "key" tool that is not generally available.

In the FPR, TVA stated that the WBN fire water supply system is able to provide the designed firefighting capacity either with one electric pump and the diesel pump unavailable or with the hydraulically least demanding portion of any loop main out of service. TVA further stated that the design flow demand consists of design flow to the largest sprinkler or water spray system plus design flow to nonisolated RSW loads and 500 gpm for hose streams.

TVA stated that, in most plant buildings, suppression systems and hose station standpipe systems are separately connected to the yard main or to headers within buildings and are fed from each end of the building, so that a single failure cannot impair both the primary (automatic suppression) and secondary (manual suppression) systems at the same time. TVA further stated that in the Unit 1 and Unit 2 reactor buildings and the intake pumping station, the primary suppression systems consist of fixed, installed systems (hose stations and some automatic suppression) supplied from one main supply header. In these buildings, hose stations from an adjoining area serve as the backup suppression systems, and are supplied from a separate, independent main supply header.

As result of the concern with microbiologically induced corrosion (MIC) and other corrosion issues, TVA instituted a permanent monitoring program for assuring the performance of the standpipe and suppression systems. TVA stated that this testing is performed at the hydraulically most remote hose stations every 3 years. TVA uses the calculated design basis pressure and flow requirements for these hose stations as the basis to monitor system performance.

TVA's design calculation reduces the actual unlined steel pipe inside diameter by 0.8 inches and uses a Hazen-Williams C factor of 55 for the sections of piping that are normally wetted. TVA stated that the purpose of these piping restrictions and the C factor of 55 are to account for the 40-year service life of the pipe. The data collected from these tests will be compared to the calculated values and trended to detect system failure.

TVA stated that all raw water systems, including the HPFP, are chemically treated in a manner that is consistent with nuclear industry practice. TVA stated that this treatment includes oxidizing biocide, nonoxidizing biocide, phosphate, and zinc. TVA further stated that the oxidizing and nonoxidizing biocides are used to control Asiatic clams, zebra mussels, slime, and MIC; the phosphate is used to sequester iron from existing corrosion products; and the zinc acts as a mild corrosion inhibitor for the carbon steel surfaces. As described in TVA's letter dated August 5, 2011 (ADAMS Accession No. ML11227A257), in response to RAI FPR VII-2.1, the nonoxidizing biocide treatments are coordinated with periodic system flushes in order to distribute the biocide to normally stagnant portions of the system.

TVA stated that two programs have been implemented to combat pipe corrosion. First, TVA implemented the Corrosion Control Program, which primarily monitors pipe wall thickness using ultrasonic techniques, replacing lengths of pipe when minimum wall thickness cannot be maintained. Additionally, TVA stated that a WBN Buried Piping Plan has been established in support of Nuclear Energy Institute 09-14, "Guideline for the Management of Underground Piping and Tank Integrity." TVA described this program as providing for the risk ranking of buried piping relative to installed conditions (e.g., design and construction practices, as well as soil characteristics) and consequences of a failure of the piping. TVA stated that these programs are intended to provide assurance in the integrity of the HPFP system boundaries.

In addition, TVA performed a code compliance review against NFPA 24-1973, "Outside Protection," as documented in FPR Part X. No substantial exceptions were identified.

Based on its review of the information submitted by TVA, the NRC staff concludes that, with the exception of the system design demand, the fire water supply system conforms to the guidelines of Sections E.2 and E.3.a of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable. Regarding the system design demand, the NRC staff concludes that it conforms to the NRC's current guidance found in Position 3.2.1 of RG 1.189, Revision 2 and, therefore, is acceptable.

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

In FPR Part III, Section 10.3.1, TVA stated that all analysis volumes (AVs) that contain redundant safe shutdown equipment are protected to ensure that the plant maintains its safe shutdown capability. In most cases, the means of protection is consistent with Section III.G.2 of Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50. For instance, in areas in which cables of redundant safe shutdown equipment are located in an AV and could be damaged by fire, the plant ensures the function by installing a 1-hour electrical raceway fire barrier system (ERFBS) on one train with automatic fire detection and suppression or by installing a 3-hour ERFBS in areas that do not provide fire detection and suppression. TVA also stated that, if separation between rooms in the same fire area is less than 3-hour rated, the plant either provides automatic detection and suppression systems or identifies and justifies exceptions.

Where TVA uses an alternative to their commitment to meet Section III.G.2, with respect to coverage of suppression and detection systems, TVA performed evaluations to demonstrate that an adequate level of protection is provided. Section 6.1.7 of this evaluation provides the NRC staff evaluation and approval of these alternatives.

In FPR Part VII, Section 2.4, TVA described a methodology used to resolve situations where redundant trains are separated by more than 20 feet, but without 20 feet free of intervening combustibles. Section 6.1.4 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Where provided, TVA stated that sprinkler systems and fixed water spray systems are designed in accordance with the applicable guidance in NFPA 13-1975, “Standard for Installation of Sprinkler Systems,” and NFPA 15-1973, “Standard for Water Spray Fixed Systems.”

In addition, TVA performed a code compliance review and identified several areas in which the sprinkler and fixed spray systems differed from the code. The important exceptions to the NFPA 13-1975 code identified were as follows:

- Fire department pumper connections for the sprinkler system are only provided to buildings with one connection to the underground fire main. (NFPA 13, Section 2-7). The NRC staff concludes that this arrangement meets the intent of the provision.

- Strainers are provided in the supply to each pre-action sprinkler system in lieu of following flushing guidance. (NFPA 13, Section 3-37.3.) The NRC staff concludes that this arrangement meets the intent of the provision.

- Sprinklers are not provided below the open grating above the high-pressure fire pump flow control valve on elevation 692 feet in the WBN Unit 1 penetration room (Room 692.0-A7). TVA stated that the combustible loading in this fire area is insignificant. This grating is approximately 5 feet wide by 15 feet long and is 15 feet above the room floor. Two sprinklers are installed approximately 3 feet above the grating. Plant procedures prohibit the storage of material on these grated walkways, so the gratings would be free of foreign obstructions. Due to the size of the grating (4 in. by 1 in.), flow from the sprinklers is not expected to be restricted by the grating. (NFPA 13, Section 4-4.11.) The NRC staff concludes the current sprinkler configuration in the Unit 1 penetration room is acceptable.

The NRC staff reviewed the other code exceptions from NFPA 13 that TVA proposed in FPR Part X, and determined that the exceptions will not affect the performance of the systems and, therefore, are acceptable.

With respect to NFPA 15, TVA did not take any exceptions to the code for the water spray systems protecting outdoor transformers, the hydrogen trailer, turbine hydrogen seal oil unit, or the turbine lube oil reservoir. TVA used the guidance of NFPA 13 and 15 to design the directional fusible nozzle water spray systems used to protect certain charcoal filters and the reactor coolant pumps.

TVA stated that automatic preaction sprinklers are provided in areas in which it is important to prevent accidental discharge of water. Operation of the preaction sprinkler system is initiated by a signal from the fire detection system in the area. Actuation can also be initiated manually by mechanical operation at the deluge valve. In addition, selected preaction systems at WBN have manual actuation stations placed at strategic locations remote from the valve. These systems are provided with air supervision if the piping downstream of the system control valve supplies more than 20 sprinkler heads.

TVA stated that, where manually activated suppression systems are installed, the piping network isolation valve is maintained in the closed position. Personnel are alerted to a problem in these areas by the fire detection system and, after confirming there is a fire, personnel open the appropriate isolation valve to allow water into the system. Water is then applied to the fire when the heat from the fire melts the fusible element in the sprinkler head. Water flow is subsequently stopped by manually closing the associated isolation valve.

In FPR, Part VIII, TVA stated that drainage is provided to remove the expected fire protection water flows or control the accumulation of water such that the water will not cause unacceptable damage to equipment in the area. TVA further stated that additional drainage can be achieved by diverting water into adjacent rooms. Finally, TVA stated that water draining from areas that may contain radioactivity is sampled and analyzed before being discharged into the environment.

TVA stated that standpipes, hose stations, and portable fire extinguishers are provided throughout the control building, but fixed fire suppression systems are not provided for all rooms. TVA justified the lack of fixed automatic suppression capability by stating that the control building is a single fire area with fire detection provided throughout the control building except in certain areas, and that there are no alternative shutdown cables or equipment located in the control building, thereby satisfying the design intent of maintaining safe shutdown capability for a postulated fire event by providing an alternate design concept. Based on TVA's justification, the NRC staff concludes TVA's approach to be acceptable. See Section 3.3 of this evaluation for a discussion of alternate shutdown, and Section 6.1.3 for a detailed discussion of the lack of areawide automatic suppression in the control building.

In all cases, TVA stated that an adequate level of protection is provided via a combination of limited combustible materials, administrative controls, fire-rated barriers, spatial separation, and active fire protection systems. Where exceptions or alternatives to NRC staff guidance, rules, or design standards exist, TVA stated that it has performed evaluations to ensure that an adequate level of protection is provided. The NRC staff reviewed TVA's approach to the use of sprinkler and water spray fire suppression systems, and concludes that TVA's design criteria and bases are consistent with Positions E.2 and E.3.c of Appendix A to BTP (APCSB) 9.5-1 and the defense-in-depth concept described in Appendix R to 10 CFR Part 50, and, therefore, are acceptable.

4.2.1.2 Gas Suppression Systems

TVA stated in FPR Part II that automatic total flooding carbon dioxide (CO_2) suppression systems are provided for the auxiliary instrument rooms and computer room in the control building; and in the lube oil storage room, diesel engine rooms (4), fuel oil transfer room, and 480-V board rooms (4), located in the DG building.

TVA stated that the CO_2 systems are designed and installed in accordance with NFPA 12-1973, "Carbon Dioxide Extinguishment Systems," the code of record for these systems. Further, TVA stated in its letter dated March 16, 2011 (ADAMS Accession No. ML13060A403), in response to RAI FPR II-6, that the systems installed in the computer room, DG electrical board rooms, lube oil storage room, and fuel oil transfer room are installed for property protection purposes only, and do not have soak time requirements. In addition, TVA stated that the systems are appropriate for the anticipated hazards and that it performed system dump tests to ensure agent concentration, agent reserve, and functionality of the distribution system.

TVA stated that a signal from either the fire detection system or a pushbutton station activates the area alarms, CO_2 discharge timer (which actuates the master control valve), and the area selector valve permitting the CO_2 to be discharged into the selected area. In addition, the system can be manually operated via the electromanual pilot valve for each hazard protected on the loss of power to the system. In designing these systems, TVA considered personnel safety by providing the predischarge alarm to notify anyone in the area that CO_2 is going to be discharged, and by adding an odorant to the CO_2 to warn personnel that the system has been discharged.

In addition, TVA stated that the actuation of these systems causes selected fire dampers and doors to the protected area to close and the selected heating, ventilation, and air conditioning (HVAC) fans to the area to shut down, ensuring that the minimum concentration of CO_2 is maintained and preventing fire spread from the area of fire origin. TVA also stated that it performed full discharge tests for representative rooms in conjunction with door fan pressurization tests to validate CO_2 concentration and soak times.

The CO_2 storage tank for supplying CO_2 to systems that protect the DG building is located in the DG building. The DGs are protected from the effects of a postulated failure of this tank by an 18-inch-thick reinforced concrete wall. The vent path for the tank room for the storage tank compartment is through a set of double doors that lead into a stairwell then, if needed, through another set of double doors which open to the atmosphere from the stairwell.

The CO_2 for the balance of the plant is supplied from a storage tank in an underground vault in the yard. TVA stated that the system is designed such that failure of the system cannot pose a threat to any safety-related areas or structures.

The NRC staff reviewed TVA's approach to the use of automatic CO_2 fire suppression systems and concludes that TVA's design criteria and bases are consistent with Positions D.4.i and E.5 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

4.2.2 Manual Suppression Capability

4.2.2.1 Hose Stations

In FPR Part II, TVA stated that hose stations for manual firefighting are located throughout the plant to ensure that an effective hose stream can be directed to any safety-related area in the plant. TVA further stated that the system is designed according to the guidance of NFPA 14-1974, “Standpipe and Hose System for Sizing, Spacing, and Pipe Support Requirements,” except for those hose stations in certain areas of the plant in which TVA requested an exception to exceed the 100-foot hose spacing limitation. These exceptions are discussed in Section 6.2.4 of this evaluation.

In addition, TVA performed a code compliance review and identified several areas in which the manual firefighting hose stations and standpipe system differed from the code. TVA also performed evaluations to justify these exceptions. The significant NFPA 14 code exceptions identified and associated justifications are:

- The standpipes located on elevations 676.0 feet, 692.0 feet, 713.0 feet, 729.0 feet, 757.0 feet, 772.0 feet, and 782.0 feet of the auxiliary building are supplied by a 3-inch pipe rather than the 4-inch pipe, and elevation 755.0 feet of the control building has 2-1/2-inch supply piping. TVA stated that it verified by hydraulic calculation that these pipe sizes are adequate. (NFPA 14, Section 212.)
- Six standpipes (0-26-677, 0-26-690, 1-26-674, 1-26-675, 2-26-674, and 2-26-675) are not provided with header isolation valves. TVA stated that these systems can be isolated using sectionalizing valves and that this would not preclude the ability to provide hose stream coverage in the locations normally served by these standpipes. (NFPA 14, Sections 413 and 622.)
- Pressure reducing devices are not installed at the hose stations. TVA justified this by stating that the hose stations are for fire brigade use, and the fire brigade personnel are trained in the use of high pressure fire hoses. TVA further stated that the hoses and related fittings are maintained to accommodate the expected system pressures. (NFPA 14, Section 442.)
- High pressure valves, pipes, and fittings are not used, even though system spikes of up to 190 psi occur due to pump start surges. TVA stated that the piping and fittings can withstand the working pressures of the system and that the system is in accordance with American National Standards Institute B31.1, “Code for Pressure Piping,” system requirements. (NFPA 14, Sections 625, 631, and 641.)
- Water flow alarms are not provided on all standpipes. TVA stated that the hose stations are provided for fire brigade use. Other site personnel are trained to report fires before using firefighting equipment (if they have been trained in its use). Therefore, TVA concluded that sufficient notification of standpipe use will be provided to the MCR without water flow alarms. (NFPA 14, Section 67.)

The NRC staff reviewed TVA’s proposed exceptions from NFPA 14 and determined that they will not affect the performance of the hose stations and the standpipes. Therefore, the NRC staff concludes that the exceptions are acceptable.

In FPR Part VIII, TVA stated that drainage is provided to remove the expected fire protection water flows or control the accumulation of water such that the water will not cause unacceptable damage to equipment in the area. TVA further stated that additional drainage can be achieved by diverting water into adjacent rooms. Finally, TVA stated that water draining from areas that may contain radioactivity is sampled and analyzed before being discharged into the environment.

TVA stated in the FPR that hose station nozzles appropriate for the expected hazards (e.g., electrically safe) are provided for each hose station. In addition, TVA stated, in FPR Part VIII, and in its letter dated August 5, 2011 (ADAMS Accession No. ML11227A257), in response to RAI FPR II-41.1 and RAI FPR VII-17.1, that provisions have been made to supply water at sufficient pressure and capacity to the standpipes, hose stations, and hose connections for manual firefighting in areas required for safe plant shutdown in the event of a safe-shutdown earthquake.

Based on its review of the information submitted by TVA, the NRC staff concludes that the standpipe system and hose stations align with the guidance in Positions E.3.d and E.3.e of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

4.2.2.2 Fire Extinguishers

TVA stated that portable fire extinguishers of a size and type compatible with specific hazards are strategically located throughout the plant for use by trained personnel. TVA also stated that fire brigade members and fire watch personnel have been trained on the location of extinguishers for firefighting operations through the extinguisher inspection program. In addition, TVA stated that fire extinguishers are inspected on a quarterly basis.

TVA's proposed application and strategic distribution of portable fire extinguishers throughout the plant is consistent with the guidance contained in Position E.6 of Appendix A to BTP (APCSB) 9.5-1, and provides reasonable assurance that fire extinguishers will be readily available and quickly accessed in the event of a fire emergency. Therefore, the NRC staff concludes that TVA's proposed application and strategic distribution of portable fire extinguishers is acceptable.

4.3 Fire Detection Capability

In FPR Part III, Section 10.3.1, TVA stated that all AVs containing redundant safe shutdown equipment are protected to ensure safe shutdown capability is maintained. In most cases, the means of protection is consistent with 10 CFR Part 50, Appendix R, Section III.G.2. For instance, where cables of redundant safe shutdown equipment are located in an AV and could be damaged by fire, the function is ensured either by the installation of 1-hour ERFBS on one train with automatic fire detection and suppression, or a 3-hour ERFBS where fire detection and suppression are not provided. TVA also stated that if separation between rooms in the same fire area is less than 3-hour rated, automatic detection and suppression systems are provided or exceptions are identified and justified.

In cases where coverage of suppression and detection systems does not align with the criteria of 10 CFR Part 50, Appendix R, Section III.G.2, TVA performed evaluations to demonstrate that an adequate level of protection is provided. Section 6.1.7 of this evaluation provides the NRC staff evaluation and approval of these configurations.

In FPR Part VII, Section 2.4, “Intervening Combustibles,” TVA described a methodology used to resolve situations where redundant trains are separated by more than 20 feet, but without 20 feet free of intervening combustibles. Section 6.1.4 of this evaluation provides the NRC staff evaluation and approval of this configuration.

As described by TVA in FPR Part II, the fire detection system consists of initiating devices, local control panels, a remote transmitter-receiver providing a remote multiples function, computerized multiplex central control equipment, and a power supply. A central processing unit (CPU) of the computerized multiplex central control equipment communicates with the local control panels via the remote transmitter/receiver units over looped circuits. TVA stated that, where detection is provided for the protection of safety-related or fire safe shutdown equipment, Class A, four-wire, supervised circuits link the fire detectors to the local control panels and annunciate status change to a constantly attended location. In addition, a second CPU is provided in a constantly attended location as an alternate for the primary processor.

TVA stated that the fire detection system uses photoelectric, ionization, and thermal detectors. The fire detection system also monitors duct detectors and devices for monitoring fire suppression system piping integrity, water or CO_2 flow, and diesel fire pump status. The fire detection system gives an audible and visual alarm, and also annunciates in the control room.

TVA stated that, where detection systems are provided, the detection systems are designed in accordance with the applicable guidance of the NFPA 72D-1975, “Installation, Maintenance and Use of Proprietary Signaling Systems,” and NFPA 72E-1974, “Automatic Fire Detectors.” In addition, TVA performed a code compliance review and identified several areas in which the systems differed from the code. The significant NFPA 72D and NFPA 72E code exceptions identified were as follows:

(a) The operation and supervision of fire alarms is not the primary function of the system operators (i.e., the control room operators). The operators are responsible for all control room alarms and controlling the plant. (NFPA 72D, Section 1223.) This is acceptable to the NRC staff, because, consistent with the role and training of the operators, a fire alarm actuation is an event that will be responded to, and will not be ignored.

(b) TVA committed to confirm that the fire detection monitoring panel in the MCR meets the definition of listed in proposed WBN Unit 2 license condition 2.C(9), which states:

> By May 31, 2018, TVA shall report that a listing organization acceptable to the NRC (as the Authority Having Jurisdiction) has determined that the fire detection monitoring panel in the main control room either meets the appropriate designated standards or has been tested and found suitable for the specified purpose.

“Listing organization” is defined in NFPA 72 (2010 edition) as one that is:

> …concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

(NFPA 72D, Sections 1213 and 2022) The NRC staff concludes that this is acceptable because it will confirm that a listing organization acceptable to the NRC determines that the fire detection monitoring panel in the MCR either meets the appropriate designated standards or has been tested and found suitable for the specified purpose, ensuring that the panel is in alignment with the NFPA code.

(c) Actions upon receipt of a fire alarm signal; the fire brigade is not immediately notified. TVA stated that, upon receipt of an alarm from a detection system, an individual (auxiliary or fire operator) is dispatched to the area to determine the cause of the alarm. If a fire exists, the individual notifies the MCR, and control room operators notify the plant fire brigade. If both detection zones alarm of a cross-zoned detection system, the fire brigade is notified immediately. (NFPA 72D, Section 1251.) The NRC staff concludes that this arrangement is acceptable because it allows false alarms to be addressed while maintaining rapid response by the site fire brigade to actual fires.

(d) The fire alarm system uses the emergency diesel generators as the automatic secondary power supply. The uninterruptible power supply backup and batteries inside the fire detection monitoring panel supply selected devices within the panel. (NFPA 72D, Sections 2223, 2224, and 2231). The NRC staff concludes that this arrangement is acceptable because it provides a reliable source of backup electrical power.

(e) Signal attachments and circuits (pressure switches) can be removed or tampered with and not cause an alarm. The site personnel access control system and the work control system provide assurances that work on such devices is properly controlled and documented. (NFPA 72D, Section 3423). The NRC staff concludes that this is acceptable because these devices are not installed in areas accessible to the general public, where tampering is a concern.

(f) Sprinkler system control valves are not electrically supervised; instead, the valves are locked open or sealed open and periodically inspected instead. TVA stated that administrative controls, including second party verification of position and strict site-access and work controls, will ensure that valves are in the correct position. (NFPA 72D, Section 3442.) The NRC staff concludes that this is acceptable because it provides assurance that the valves will be in the correct positions when needed.

(g) Both visual and recorded displays meet the code, but records are not preserved for later inspection. Plant procedures have reporting requirements for conditions adverse to quality. These procedures require an adverse condition report to be completed before the end of the shift on which the problem was identified. Documentation from the fire alarm printout would be available to support the adverse condition report. (NFPA 72D, Section 4111.) The NRC staff concludes that this arrangement is acceptable because it will support the reconstruction of the sequence of events.

(h) The transmission of an alarm signal to the fire detection monitoring panel from a wire-to-wire short circuit cannot be recorded. TVA stated that a wire-to-wire short will generate a trouble signal which requires corrective action and associated compensatory measures as laid out in FPR Part II, Section 14. (NFPA 72D, Sections 4112 and 4311.) The NRC staff concludes that this is acceptable because this situation initiates corrective actions and compensatory measures, which include roving or continuous fire watches.

(i) Some areas do not have installed detection as required by Appendix R to 10 CFR Part 50 or Appendix A to BTP (APCSB) 9.5-1. TVA evaluated these areas in FPR Part VII, Section 3.1. (NFPA 72E, Section 2-6.5). The NRC staff concludes that this is acceptable because of the nature of the spaces as described in Section 6.1.7 of this evaluation.

(j) Smoke detectors in the high ceiling areas of the plant are not installed alternately on two levels. TVA addressed the issue of high ceilings by reducing the spacing of the detectors at the ceiling level. This reduced spacing is used on auxiliary building elevations 692 feet, 713 feet, 737 feet, 757 feet, and the waste packaging room. (NFPA 72E, Section 4-4.5.2.) The NRC staff concludes that this is acceptable because stratification is not a concern due to the ventilation system.

(k) TVA uses duct detectors in lieu of area detectors in the reactor building upper and lower compartment coolers to provide protection specifically for the coolers. TVA stated that the regulatory guidance for detectors are met for the remainder of the reactor building. (NFPA-72E, Section 8-1.1.2). The NRC staff concludes that this is acceptable because these detectors are installed to protect these specific pieces of equipment (e.g., the compartment coolers) and not the general area.

(l) Duct detectors are not provided per NFPA 90A guidance, which requires that activation of a detector automatically stops the ventilation system. Instead, fans serving the area of the plant containing the fire are shut down manually to ensure that air flow will not prevent fire dampers from closing. (NFPA-72E, Section 8-1.2.1.) The NRC staff concludes that this is acceptable because it accomplishes the goal of the provision. Additionally, the HVAC system has been designed as described in WBN FSAR Chapters 3, 6, and 9, and approved by the NRC.

The NRC staff reviewed TVA's proposed exceptions from NFPA 72D and NFPA 72E, and determined that they will not affect the performance of the affected systems or the ability of the plant to achieve and maintain safe shutdown. Therefore, the NRC considers the exceptions acceptable. The NRC staff concludes that TVA's design criteria and bases for the installed systems are consistent with Position E.1 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

In all cases, TVA stated that an adequate level of protection is provided via a combination of limited combustible materials, administrative controls, fire rated barriers, spatial separation, and active fire protection systems. Where exceptions or alternatives to NRC staff guidance, rules, or design standards exist, TVA stated that it has performed evaluations to ensure that an adequate level of protection is provided. The NRC staff reviewed TVA's approach to the use of fire detection systems and concludes that TVA's design criteria and bases are consistent with Position E.1 of Appendix A to BTP (APCSB) 9.5-1 and the defense-in-depth concept described in 10 CFR Part 50, Appendix R, and, therefore, are acceptable.

5.0 FIRE PROTECTION FOR SPECIFIC PLANT AREAS AND HAZARDS

The NRC staff evaluated TVA's fire protection program for compliance with 10 CFR 50.48(a), as described in Section 2.1 of this evaluation. TVA evaluated their program against the guidance in Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1. The NRC staff determined that TVA's reliance on the information in Appendix A to BTP (APCSB) 9.5-1, was acceptable since it was the guidance in place on April 18, 1977, when TVA first submitted a fire hazards analysis to the NRC for review. In addition to TVA's evaluation to Appendix A to BTP (APCSB) 9.5-1, since TVA used guidance published prior to 1981, TVA also committed to meet Sections III.G, III.J, and III.O, of 10 CFR Part 50, Appendix R, to assure safe shutdown capability. This section of the evaluation describes the NRC staff's evaluation of TVA's compliance with portions of 10 CFR 50.48(a)(1)(iv) and 10 CFR 50.48(a)(2)(iii). As discussed below, the NRC staff's review found that the Watts Bar fire protection program meets the requirements of 10 CFR 50.48(a).

5.1 <u>Containment</u>

Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1 includes guidance for fire protection in containment. In its letter dated May 26, 1995 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073230888), Tennessee Valley Authority (TVA) stated that a major fire hazard within containment is the lube oil in the reactor coolant pumps (RCPs). If oil leaks from the RCPs, an oil collection system is available to collect the oil for each RCP as described below. This system on each RCP is designed to collect oil from all potential leakage locations, including the RCP oil lift pump, system piping, overflow lines, the lube oil cooler, oil fill and drain lines, flanged connections on the oil lines, and the lube oil reservoirs.

The RCPs, lubricating oil systems, oil spray shields, oil collection basins, drain piping, and containment sump are designed to seismic Category I requirements so that they will not fail during a safe shutdown earthquake.

Each of the four RCPs is protected by an automatic fire suppression and detection system. A heat collection hood is installed directly above the RCP motors. In the event of an RCP motor fire, the heat collection hood acts as a ceiling, that forces the heat to stall around the detectors and the suppression nozzles, thus reducing the response time of these fire protection devices.

Section 6.1.8 of this evaluation provides the U.S. Nuclear Regulatory Commission (NRC) staff's evaluation and approval of the RCP oil collection system configuration and associated fire protection features.

TVA stated that areas of divisional interaction within the annulus areas are protected by automatic fixed water-spray systems and photoelectric smoke detectors. Ionization duct detectors are provided for each lower containment cooling unit and each upper compartment cooling unit. In addition, ionization smoke detectors are provided for the exhaust ducts serving the containment purge and air exhaust systems and the emergency gas treatment system.

TVA stated that a standpipe and hose system is provided in each containment to complement the installed automatic suppression systems. The standpipe systems are normally dry and admit water when a remote control device installed at each hose station is manually operated.

TVA stated that radiant energy shields (RESs) are relied on to separate cables and associated nonsafety circuits of redundant trains. TVA evaluated the combustibility of older RES materials in Fire Protection Report (FPR) Part VII, Section 2.2, "Non-Combustible Radiant Energy Shields." Section 6.1.2 of this evaluation provides the NRC staff's evaluation of this configuration. In FPR Part II, Section 12.10.2, TVA stated that the RESs installed in the Watts Bar Nuclear Plant (WBN), Unit 2, annulus and in the installations added to the WBN, Unit 1, annulus during the 2012 refueling outage are constructed from a compliant material. TVA also stated that there are no RESs in the WBN, Unit 2, primary containment.

TVA stated that the RCP oil collection system complies with Section III.O, "Oil collection system for reactor coolant pump," of Appendix R to Title 10 of the *Code of Federal Regulations* Part 50 with the exception of an alternative to allow for minor amounts of oil that become entrained in the ventilation air to escape the oil collection system. TVA evaluated the RCP oil collection system in FRP Part VII, Section 2.8, "Reactor Coolant Pump Oil Collection System." See Section 6.1.8 of this evaluation for a detailed evaluation and approval of the configuration.

Based on its review of the information provided by TVA the NRC staff concludes that the fire protection features for containment conform to the guidance in Position F.1 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.2 Control Room Complex

5.2.1 Control Room

Appendix A to BTP (APCSB) 9.5-1 includes guidance for fire protection in the main control room (MCR). The MCR is common to both units and contains circuits for safe shutdown for fires outside of the control building. TVA designated the control building, which contains the MCR, an alternative shutdown area. As a result, independent alternative shutdown capability has been provided for this area. Discussion of alternative shutdown is located in FPR Part IV and Section 3.3 of this evaluation. The entire control building is considered a single fire area and is separated from other fire areas (e.g., the auxiliary building, turbine building) by 3-hour fire barriers, as documented in FPR Part VI.

In FPR Part VII, Section 2.6.4, TVA evaluated the effect of nonrated metal hatch covers between the mechanical equipment rooms and the turbine building. Section 6.2.7.4 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

FPR Part VIII summarizes the fire barriers that separate the MCR from the balance of the control building. The MCR is separated from adjacent rooms on the same elevation in the control building by 1-hour rated fire barriers. These barriers contain two hollow metal security doors that are similar in construction to 1-1/2-hour rated fire doors, although they are not specifically fire-rated. The doors between the control room and the turbine building and the control room and auxiliary building are 3-hour fire-rated doors. The MCR and the cable spreading room are not separated by a rated fire barrier.

FPR Part VIII describes the use of cables in the MCR. TVA stated that (1) wiring for lighting terminates in the lighting fixtures, (2) instrumentation and control wiring that enters the control room terminates inside panels or control boards, and (3) cables are not routed through the control room from one area to another area.

In FPR Part VIII, TVA described manual firefighting operations. TVA stated that fire extinguishers are provided in the MCR. Standpipe and hose stations are located in the stairwells at each end of the MCR. TVA also stated that the hose stations have electrically qualified nozzles in alignment with the expected hazards.

TVA stated that ionization smoke detectors are provided in selected cabinets and smoke detection is installed in the MCR ventilation system intakes. TVA further stated that fire alarms in other parts of the plant, as well as the MCR, alarm and annunciate in a constantly attended location in the MCR.

FPR Part VIII also summarizes smoke control features for the MCR. The MCR ventilation air intakes are provided with remotely controlled dampers to prevent smoke from entering the control room. Manual venting of the control room can be achieved by using portable smoke ejectors available on site and by opening the doors of the MCR. TVA also stated that breathing apparatuses are available for the control room NRC staff.

TVA evaluated the impact of not providing an automatic suppression system (as required for alternative shutdown locations) in the MCR and corridor in FPR Part VII, Section 2.3. Section 6.1.3 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

In FPR Part VII, Section 4.1, TVA evaluated MCR doors C49 and C50 for altering the doors by adding signs and security hardware or by repairing onsite damage. Section 6.2.2 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

Based its review of the information submitted by TVA, the NRC staff concludes that an equivalent level of safety to the separation guidance in Position F.2 of Appendix A to BTP (APCSB) 9.5-1 has been achieved by TVA because of (1) the installed detection and suppression in the cable spreading room, (2) the low combustible loading and installed automatic suppression and detection in adjacent non-MCR control building areas, (3) the provision for alternative shutdown for control building fires through use of the independent auxiliary control room (ACR) complex, and (4) the fire safe shutdown (FSSD) evaluation that demonstrates the use of the ACR to achieve post-FSSD, and therefore, is acceptable.

5.2.2 Auxiliary Control Room

TVA designated the control building as an alternative shutdown area. FSSD activities take place outside of the control building for large or damaging fires in the control building. The ACR at WBN provides independent alternative shutdown capability for control building fires. Discussion of alternative shutdown is located in FPR Part IV and Section 3.3 of this evaluation.

TVA stated that the ACR is independent from the control building, which includes the cable spreading room, MCR, and auxiliary instrument room. The ACR is located in the auxiliary building, and is divided into five independent, dedicated rooms. Each room is separated from the others and from the rest of the auxiliary building by at least 2-hour rated fire barriers and from the control building by 3-hour rated fire barriers. The five independent rooms consist of a Train A and a Train B transfer switch room for each unit and a common ACR containing multiple instrumentation and control panels for both units. Ionization smoke detectors and preaction sprinkler systems are provided in each of the five rooms. Standpipe and hose stations are provided for manual firefighting activities in the ACR complex from adjacent Rooms 757.0-A2 and -A24.

In FPR Part IV, TVA described the ACR as designed to control the FSSD activities after control has been established at the ACR following MCR abandonment. Systems requiring operator manipulations have the controls located in the ACR along with their associated transfer switches located in the adjacent transfer switch rooms. TVA stated that operators are periodically trained in shutdown procedures from the ACR. TVA further stated that the instruments and controls located in the ACR are separated from, or can be electrically isolated from, the corresponding instrumentation and controls located in the control building.

In FPR Part VII, Section 2.4, TVA evaluated the effect for intervening combustibles, such as insulation on cables in trays and Thermo-Lag® in the ACR. Section 6.1.4 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the installed fire protection features are consistent with the NRC's current guidance in Position 6.1.6, "Alternative and Dedicated Shutdown Panels," in Revision 2 to RG 1.189 and, therefore, are acceptable.

5.3 Cable Spreading Room

The cable spreading room is common to both units and contains circuits for redundant safe shutdown features. TVA designated the control building, which contains the cable spreading room, an alternative shutdown area. As a result, independent alternative shutdown capability has been provided for this area. Discussion of alternative shutdown is located in Part IV of the FPR and Section 3.3 of this evaluation.

TVA stated that the cable spreading room is separated from the adjacent buildings by 3-hour rated barriers. TVA also stated that fire brigade access to the cable spreading room is provided by doors from the turbine building and from enclosed stairways within the control building. TVA stated that portable extinguishers that are located inside and immediately outside the cable spreading room are available. Additionally, standpipe and hose stations are provided from the two stairwells and from the turbine building.

In the FPR Part VIII, TVA summarized the fire protection features for the cable spreading room and stated that these features provide full coverage detection and automatic suppression. The automatic preaction sprinkler system has a ceiling layer and an intermediate layer of sprinklers under the grating and staggered between the upper level heads. TVA further stated that the installed cables are designed to allow wetting without faulting.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the cable spreading room do not take any exceptions to Position F.3 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.4 Switchgear Rooms

TVA stated that the Trains A and B 6.9 kV and 480 V switchgear rooms are located within the auxiliary building, but separated from each other and from other rooms within the auxiliary building by 2-hour fire rated barriers and from the control building by 3-hour fire rated barriers.

Except as noted below, each room is provided with a full area coverage automatic preaction sprinkler system that is actuated by a cross-zoned areawide ionization smoke detection system. Water spray shields have been installed to protect safety related electrical equipment against the effects of inadvertent or advertent actuation of the automatic suppression system. Additionally, standpipe and hose stations are provided for each of the switchgear rooms.

TVA evaluated the impact of the lack of total area suppression in the 480 V Board Rooms 1B (Room 772.0 A2; Fire Area 33) and 2B (Room 772.0 A15; Fire Area 45) in FPR Part VII, Section 3.1. Section 6.1.7 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the essential switchgear rooms provide an equivalent level of fire safety to Position F.5 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.5 Battery Rooms

TVA stated in FPR Part VIII, that the required Vital Battery Rooms I through IV are separated from all other plant areas by 3-hour fire-rated barriers. The Fifth Vital Battery Room is a spare that can be used for any of the other four vital batteries. TVA further stated that the Fifth Vital Battery Room is separated from other plant areas by 2-hour fire-rated barriers that exceed the hazards to which they could be exposed.

TVA also stated that ceiling vents are provided for each battery room with a direct exhaust to outside the building to maintain the concentration of hydrogen below 2 percent by volume within the battery rooms. Additional details of these exhaust systems are available in WBN, Unit 2, Final Safety Analysis Report Section 9.4.3.2.5, "Auxiliary Board Rooms Air-Conditioning Systems."

TVA provided a summary of the fire protection features for the battery rooms in FPR Part VIII. TVA stated that full coverage automatic smoke detection and manually actuated sprinkler system are provided for Vital Battery Rooms I to IV. Smoke detection and an automatic preaction sprinkler system are provided for the Fifth Vital Battery Room. With regard to manual firefighting, TVA stated that hose stations and portable fire extinguishers are available for fire brigade use.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the battery rooms do not take exceptions to Position F.7 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.6 Turbine Lubrication and Control Oil Storage and Use Areas

TVA stated in FPR Part VI that a fire in the turbine building would not impact equipment required to achieve safe shutdown, and that Trains A and B systems and components would be utilized without mitigating actions. TVA further stated that cable tray and door penetrations through the 3-hour fire rated fire barrier separating the turbine building from the control building are sealed with 3-hour fire-rated penetration seals and are provided with automatic water curtain protection on the turbine building side. TVA stated in FPR Part VIII that the penetration seals are located approximately 5 feet above the elevation of the turbine building floor, limiting the access of any turbine oil to the penetration seals.

TVA stated in FPR Part VIII that turbine building oil reservoir hazards are protected by fixed water spray systems. Additionally, standpipe and hose stations are provided on each elevation of the turbine building.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the turbine building provide an equivalent level of safety as the guidelines in Position F.8 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.7 Diesel Generator Areas

5.7.1 Diesel Generator Building

In the FPR Part VIII, TVA stated that the diesel generator (DG) building is remotely located and is not adjacent to any other safety-related building or structure, and that each DG and its associated equipment are separated from each other by 3-hour fire barriers.

TVA described the automatic fire suppression systems installed in these areas as follows. Each DG area is provided with full coverage detection that alarms and annunciates in the control room and alarms locally. Automatic, total flooding CO_2 suppression systems protect each DG, the associated day tanks, and the electrical board room. TVA also stated that the DG building pipe gallery and corridor are protected by a preaction sprinkler system. For manual suppression, TVA stated that standpipes and hose stations are available on both elevations of the DG building, with backup from hydrants in the yard.

TVA stated that the two 550-gallon day tanks are located in the same room as the associated tandem DG.

TVA evaluated the impact of a 1-1/2-hour rated fire damper in the 3-hour fire-rated floor separating the Unit 1 A-A DG exhaust room from the DG building corridor in FPR Part VII, Section 4.7. Section 6.2.7.5.1 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the DG building are consistent with Position F.9 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.7.2 FLEX Diesel Generator Rooms

In the FPR Part VIII, TVA stated that two additional DGs are located in separate rooms on the roof of the auxiliary building. These two rooms are separated from all other plant areas, and each other, by 3-hour fire barriers. These DGs have been installed to mitigate Beyond Design Basis Accidents, and are neither safety-related, nor required for safe shutdown.

TVA stated that the FLEX DG rooms are protected by a thermal fire detection system and a preaction sprinkler system. For manual suppression, TVA stated that standpipes and hose stations are available outside the rooms on the auxiliary building roof.

TVA stated that each of the FLEX DGs has a double-walled 185-gallon fuel tank mounted on the same skid as the DG.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the FLEX DG rooms do not take any exceptions to Position F.9 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.8 Diesel Generator Fuel Oil Storage Areas

In FPR Part VIII, TVA stated that the aboveground diesel fuel oil storage tanks are located more than 50 feet from any safety-related building or structure, and that they are located within a diked area sized to contain leaks or spills of fuel oil.

TVA further stated that the 7-day fuel oil storage tanks for each DG are buried under the floor of the DG building. The only portions of the tanks that are not buried are the manway access openings to each tank within the diesel rooms and in the common corridor outside the diesel rooms. TVA evaluated the impact of these nonrated manway access openings in the FPR Part VII, Section 4.4, "Fire Barriers between DG [Diesel Generator] Storage Tank and DG Corridor." Section 6.2.9 of this evaluation provides the NRC staff evaluation and approval of this configuration.

TVA evaluated the impact of an untested penetration assembly in the fire barrier between the fuel oil transfer pump room and the DG corridor in the FPR Part VII, Section 4.6, "Fire Barriers between Fuel Oil Transfer Pump Room and Diesel Generator Building Corridor." Section 6.2.5 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the diesel fuel oil storage areas are consistent with Position F.10 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.9 Safety-Related Pump Areas

5.9.1 CCS Pump Area

As described in TVA's response dated May 26, 2011 (ADAMS Accession No. ML111520119), to request for additional information (RAI) FPR VII-3, the component cooling system (CCS) pumps are located in the same fire area in the auxiliary building on elevation 713.0 feet. The two Train A CCS pumps are separated from the two Train B pumps, and the spare, by a partial-height fire barrier.

TVA evaluated the partial-height fire barrier between the CCS pumps and the ensuing redundant train separation issues in FPR Part VII, Section 2.5. Section 6.1.5 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

TVA stated in FPR Part VII, that the area containing the CCS pumps is provided with automatic preaction sprinkler system protection at the ceiling and under the grated mezzanine over the CCS pumps as well as full coverage automatic smoke detection. Further, in FPR Part VI, TVA stated that hose stations are available to support manual firefighting.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the CCS pumps are consistent with Position F.11 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.9.2 Charging Pumps

As described in the FPR Part VI, each charging pump is located in its own 2-hour fire-rated compartment. TVA stated that the pump rooms and the corridor outside these rooms are protected by full coverage detection and an automatic preaction sprinkler system. However, detection and suppression is not extended into the entrance labyrinth of the charging pump rooms. Further, TVA stated that hose stations are located in the corridor leading to these rooms and are available to support manual firefighting inside the pump rooms.

TVA evaluated the impact of the lack of total area suppression and detection in the FPR Part VII, Section 3.1, "Lack of Total Area Suppression and Detection." Section 6.1.7 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the charging pumps provide an equivalent level of safety to Position F.11 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.9.3 AFW Pumps

As described in the FPR Part VI, the two turbine-driven auxiliary feedwater (AFW) pumps (one for each Unit) are located in the auxiliary building on elevation 692.0 feet. Each pump is located in its own 2-hour fire-rated fire compartment. TVA stated that each pump room is provided with full coverage automatic detection and an automatic preaction sprinkler system. Further, TVA stated that hose stations are located in the corridor leading to these rooms and are available to support manual firefighting inside the pump rooms.

As described in TVA's response dated May 26, 2011 (ADAMS Accession No. ML111520119), to RAI FPR VII-3, the motor-driven AFW pumps (two per Unit) are located on opposite ends of the auxiliary building on elevation 713.0 feet. TVA stated that there is approximately 126 feet separating the Unit 1 and Unit 2 AFW pumps. TVA further stated that the area in which these pumps are located is protected by an automatic preaction sprinkler system and that automatic fire detection is provided throughout the area. TVA stated in FPR Part VI that hose stations are available in the area to support manual firefighting operations.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features provided for the motor- and turbine-driven AFW pumps provide an equivalent level of fire safety to Position F.11 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.9.4 RHR Pumps

As described in the FPR Part VI, each residual heat removal (RHR) pump is located in its own 2-hour fire-rated fire compartment. Each RHR pump room is a separate fire area and none of the rooms contain redundant trains of equipment or cables. TVA stated that the corridor outside these rooms has full coverage fire detection installed. In each pump room, fire detection is installed, except in the entrance labyrinths. TVA stated that the combustible loading in these rooms is insignificant, consisting mainly of the lube oil associated with the pump and valve. TVA stated that for each fire area, the capability to achieve safe shutdown has been demonstrated through analysis. Therefore, a fire in any of these fire areas will not endanger other safety-related equipment required for safe plant shutdown. Further, TVA stated that hose stations are located in the corridor leading to these rooms and are available to support manual firefighting inside the individual RHR pump rooms.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the RHR pumps provide an equivalent level of fire safety to Position F.11 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.9.5 ERCW Pumps

As described in FPR Part VI, the redundant essential raw cooling water (ERCW) pumps are separated by 3-hour fire-rated barriers. These pumps are also separated from the traveling screen pumps by 3-hour barriers. However, these barriers have open scuppers at the base of the wall of the ERCW pump rooms.

TVA stated in FPR Part VI that heat detectors are installed over the ERCW pumps and that no redundant FSSD cables or equipment are installed in these areas. Further, TVA stated that manual fire suppression capability is available through use of hose stations installed in the ERCW strainer room and the screen wash pump room.

TVA evaluated the impact of the open scuppers in the fire barriers that separate the pumps from the traveling screens in the FPR Part VII, Section 2.6.2, “Justification for Scupper Openings.” Section 6.2.7.2 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for the ERCW pumps provide an equivalent level of fire safety to Position F.11 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.10 Other Plant Areas

5.10.1 Areas without Exceptions or Evaluations

The NRC staff reviewed TVA’s compliance with the following positions of Appendix A to BTP (APCSB) 9.5-1, as documented in FPR Part VIII:

- Position F.4 – “Plant Computer Room”
- Position F.6 – “Remote Safety-Related Panels”
- Position F.15 – “Decontamination Areas”
- Position F.16 – “Safety-Related Water Tanks”
- Position F.17 – “Cooling Towers”
- Position F.18 – “Miscellaneous Areas”

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features provided in these areas provide an equivalent level of fire safety as the guidance in these sections of Appendix A to BTP (APCSB) 9.5-1, and, therefore, are acceptable.

5.10.2 Areas with Exceptions or Evaluations

The NRC staff reviewed TVA's conformance with the following positions of Appendix A to BTP (APCSB) 9.5-1, as documented in FPR Part VIII:

- Position F.12 – "New Fuel Area"
- Position F.13 – "Spent Fuel Pool Area"
- Position F.14 – "Radwaste Building"

TVA evaluated the impact of the lack of installed fire detection for areas related to Positions F.12 and F.13 in FPR Part VII, Section 4.5. Section 6.2.1 of this evaluation provides the NRC staff's evaluation and approval of this configuration.

TVA evaluated the impact of 1-1/2-hour rated fire dampers in 3-hour-rated fire barriers for areas related to Position F.14 in FPR Part VII, Section 4.7. Section 6.2.7.5.2 of this evaluation provides the NRC staff evaluation and approval of this configuration.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire protection features for these areas provide an equivalent level of fire safety to Positions F.12, F.13, and F.14 of Appendix A to BTP (APCSB) 9.5-1 and, therefore, are acceptable.

5.11 <u>Specific Hazards</u>

5.11.1 Hydrogen Piping

TVA stated in the FPR that a 1-inch seismically designed hydrogen line is routed through the auxiliary building on elevation 713.0 feet to each Unit's volume control tank. Two isolation valves are installed in the hydrogen supply line outside the auxiliary building. These valves close automatically when the downstream flow rate reaches 50 standard cubic feet per minute (scfm). TVA stated that any hydrogen leakage less than 50 scfm will be diffused and carried away by the auxiliary building ventilation system, keeping the hydrogen concentration in any given area below the lower explosive limit.

Based on its review of the information submitted by TVA, the NRC staff concludes that the hydrogen supply piping in the auxiliary building does not take any exceptions to Position D.2.b of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

5.11.2 Transformers Installed Inside Buildings

TVA stated that transformers located inside of buildings are either dry type or medium voltage transformers that contain "high fire point" transformer liquid. The use of dry type transformers is consistent with the NRC guidance in Appendix A of BTP 9.5-1, Element D.1.g, but the use of transformers with "high fire point" silicone fluid is not included as part of the guidance.

In TVA's response dated August 5, 2011 (ADAMS Accession No. ML11227A257), to RAI VIII-21, TVA provided its justification for the use of the "high fire point" silicone fluid in lieu of the noncombustible liquid described in Appendix A to BTP 9.5-1. TVA stated that the noncombustible transformer liquids contained polychlorinated biphenyl (PCB) fluids. PCB fluids are considered noncombustible, but constitute an occupational health and safety, as well as environmental, concern if leaked or spilled. Therefore, TVA decided to remove PCB fluids from the plant. Although the "high fire point" liquid is considered combustible, it is not considered flammable in accordance with the definition of flammable and combustible provided by NFPA 30-1973, "Flammable and Combustible Liquids Code."

TVA stated that all areas where these transformers are located have sprinkler protection. Based on the vendor information provided by TVA in Attachment 4 of its letter dated September 30, 2011 (ADAMS Accession No. ML13060A225), sprinkler systems are effective at extinguishing silicone fluid fires. TVA also considered dikes to contain the volume of the silicone fluid if it were to leak from the transformers.

In its response dated September 30, 2011, to RAI VIII-21.1, TVA provided additional information regarding the installation of transformers containing "high fire point" silicone fluid. The NRC staff questioned the location of these transformers in plant areas that constitute buffer zones between analysis volumes, since the transformers were not described as being located in the buffer zones. TVA confirmed, in its RAI response, that the transformers are not located in buffer zones for large fire areas except for in the electrical equipment room in the intake pumping station (IPS).

The transformers in the electrical equipment room in the IPS have dikes, are protected with automatic fire suppression systems, and there is 20 feet of separation between the transformers and the redundant FSSD train. TVA stated that the 20 feet of separation has intervening combustibles, but the combustibles are not continuous. Therefore, in the event that a transformer fire were to occur in this area, automatic suppression and spatial separation is available to assure that safe shutdown capability is assured.

Based on its review of the information submitted by TVA, the NRC staff concludes that TVA's use of dry type transformers in plant areas is consistent with Appendix A of BTP 9.5-1, Element D.1.g, and, therefore, is acceptable. The use of "high fire point" silicone fluid in transformers in plant areas is acceptable where the transformers are installed in areas with automatic sprinkler systems and spatial separation, either buffer zones or 20 feet without continuous intervening combustibles, and where transformers have dikes large enough to contain the volume of the transformer fluid.

6.0 ALTERNATIVES, EXCEPTIONS, AND EVALUATIONS

The NRC staff evaluated TVA's fire protection program for compliance with 10 CFR 50.48(a), as described in Section 2.1 of this evaluation. TVA evaluated their program against the guidance in Appendix A to Branch Technical Position (BTP) (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1. The NRC staff determined that TVA's reliance on the information in Appendix A to BTP (APCSB) 9.5-1, was acceptable since it was the guidance in place on April 18, 1977, when TVA first submitted a fire hazards analysis to the NRC for review. In addition to TVA's evaluation to Appendix A to BTP (APCSB) 9.5-1, since TVA used guidance published prior to 1981, TVA also committed to meet Sections III.G, III.J, and III.O, of 10 CFR Part 50, Appendix R, to assure safe shutdown capability. This section of the evaluation describes the NRC staff's evaluation of TVA's proposed exceptions and alternatives to the guidance in the BTP and to their commitment to the information in 10 CFR Part 50, Appendix R. As discussed below, the NRC staff's review found that the exceptions and alternatives were acceptable.

6.1 Alternatives and Evaluations Related to Criteria in Appendix R to 10 CFR Part 50

6.1.1 Alternative – Required Instrumentation for Alternative Shutdown

TVA committed to maintain safe shutdown capability during and after a fire in accordance with Section III.L of Appendix R to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50. Section III.L.2.d of Appendix R to 10 CFR Part 50 states that the process monitoring function for alternative shutdown be capable of providing direct readings of the process variables necessary to perform and control a plant cooldown.

TVA has not provided instrumentation in the auxiliary control room (ACR) for (1) tank level indication for the condensate storage tank (CST) or the refueling water storage tank (RWST), (2) wide-range steam generator (SG) level indication, and (3) cold-leg temperature (T_C) indication. TVA evaluated these alternatives in FPR Part VII, Section 2.1. TVA's justification for omitting this instrumentation is given below.

The CST level indication is not considered essential in the ACR because automatic switchover of the auxiliary feedwater (AFW) pump suction from the CST to the essential raw cooling water (ERCW) header is independent of the control building and therefore would be available when control is established in the ACR.

The RWST level indication is not considered essential in the ACR because the RWST contains almost 20 times the inventory required for cold shutdown. Because the RWST is primarily used as makeup water for contraction resulting from cooldown over a period of hours, the excess inventory in the RWST is considered sufficient without level indication in the ACR.

Wide-range SG level indication is not provided in the ACR. Instead, the narrow-range SG level and AFW flow indication to each SG are provided in the ACR and are sufficient for use in safe shutdown procedures whenever the ACR is utilized. This instrumentation also provides input to the automatic control utilized to maintain SG level during plant shutdown from the ACR. Although wide-range instrumentation is available in the main control room (MCR), no automatic control or safety system inputs are derived from this instrumentation. Therefore, the AFW flow indication is sufficient for the operator to confirm that adequate post-trip SG inventory is available in the event that SG level falls below the range of the narrow range indicators that are located in the ACR.

Cold-leg temperature indication is not provided in the ACR. Cold-leg temperature is used for monitoring natural circulation. Rather than using T_C, TVA monitors natural circulation by inferring T_{SAT}, the saturation temperature corresponding to the secondary-side SG pressure. In the natural circulation mode of operation, the difference between the hot-leg and cold-leg temperature ($T_H - T_C$) provides an effective indication of when natural circulation is established and whether it is being maintained. T_{SAT} will be used to monitor natural circulation in the reactor coolant loop in the operating range from full power to the hot standby condition. To demonstrate that T_{SAT} will accurately monitor natural circulation in the operating range from hot standby to cold shutdown, TVA analyzed the correlation between T_{SAT} and T_C while a reactor was brought to cold-shutdown condition.

TVA stated that the Westinghouse Owners Group document "Emergency Response Guidelines, Generic Issue on Natural Circulation," Revision 1, provides specific guidelines on how an operator can verify that natural circulation has been established without T_C being available. The Westinghouse Owners Group recommends the use of the following criteria for verifying natural circulation: (1) reactor coolant system is subcooling (conversion of pressurizer pressure to T_{SAT} and subtracting T_H), (2) T_H is stable or decreasing, and (3) SG pressure is stable or decreasing. The instrumentation needed to use these methods of verifying natural circulation is available to the operator in the ACR. Therefore, the installed indication is sufficient to compensate for the lack of T_C indication in the ACR.

10 CFR Part 50, Appendix R, Section III.L.2.d states that the process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the reactivity control function, the reactor coolant makeup function, and the reactor heat removal function. The direct reading of process monitoring functions are required to ensure that during postfire shutdown, the reactor coolant system process variables are maintained within those predicted for a loss of normal AC power and that there is no effect on fission product boundary integrity (i.e., no fuel clad damage, no rupture of any primary coolant boundary, and no rupture of the containment boundary). Although TVA has not provided instrumentation in the ACR for (1) tank level indication for the CST or RWST, (2) wide-range SG level indication, and (3) cold-leg temperature (T_C) indication, the NRC staff concludes that these alternatives are acceptable because (1) the CST level indication is not considered essential in the ACR because of the automatic switchover of the AFW pump suction from the CST to the ERCW, and this has no impact on the performance and control of the reactivity control function, the reactor coolant makeup function, and the reactor heat removal function; the RWST level indication is not considered essential in the ACR because the RWST contains almost 20 times the inventory required for cold shutdown and this has no impact on the performance and control of the reactivity control function, the reactor coolant makeup function, and the reactor heat removal function, (2) the narrow-range SG level and AFW flow indication to each SG are provided in the ACR and are sufficient for use in safe shutdown procedures whenever the ACR is utilized and this results in no impact on the performance and control of the reactivity control function, the reactor coolant makeup function, and the reactor heat removal function, and (3) natural circulation is monitored by inferring T_{SAT}, the saturation temperature corresponding to the secondary-side SG pressure and in the natural circulation mode of operation, the difference between the hot-leg and cold-leg temperature ($T_H - T_C$) provides an effective indication of when natural circulation is established and whether it is being maintained, and this has no impact on the performance and control of the reactivity control function, the reactor coolant makeup

function, and the reactor heat removal function. Therefore, the NRC staff concludes that there is reasonable assurance that the reactor coolant system process variables will be maintained within those predicted for a loss of normal AC power and that there would be no effect on fission product boundary integrity (i.e., no fuel clad damage, no rupture of any primary coolant boundary, and no rupture of the containment boundary).

6.1.2 Alternative – Noncombustible Radiant Energy Heat Shields

TVA committed to maintain safe shutdown capability during and after a fire in accordance with Section III.G of Appendix R to 10 CFR Part 50. Section III.G.2.f of Appendix R to 10 CFR Part 50 states that inside non-inerted containments, separation of cables and equipment and associated non-safety circuits of redundant trains by a noncombustible RES is an acceptable method of ensuring that a redundant train of equipment and circuits are protected from a fire.

The acceptance criteria included in previous revisions to NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition,” Chapter 9, “Auxiliary Systems,” Section 9.5.1.1, “Fire Protection Program,” have been removed and have been incorporated in Revision 2 of RG 1.189. Section 6.1.1.1, “Containment Electrical Separation,” of RG 1.189 states the following:

> Inside noninerted containments, one of the fire protection means specified in Regulatory Position 5.3.1.1, or one of the following, should be provided:
>
> a. separation of cables and equipment and associated nonsafety circuits of redundant trains by a horizontal distance of more than 6.1 m [meters] (20 feet) with no intervening combustibles or fire hazards,
>
> b. installation of fire detectors and an automatic fire suppression system in the fire area, or
>
> c. separation of cables and equipment and associated nonsafety circuits of redundant trains by a noncombustible radiant energy shield [RES] having a minimum fire rating of 30 minutes, as demonstrated by testing or analysis.

The version of the Standard Review Plan at the time of publication of Generic Letter (GL) 86-10 was Branch Technical Position (BTP) Chemical Engineering Branch (CMEB) 9.5-1.

Section 3.7.1, to GL 86-10 states the following:

> The guidelines in BTP CMEB 9.5-1, Section C.7.a.(1)b. indicate that these shields should have a fire rating of ½ hour. In our opinion any material with a ½ hour fire rating should be capable of performing the required function.

TVA evaluated this alternative in FPR Part VII, Section 2.2. The RESs installed inside the WBN, Unit 1, reactor building are constructed of Minnesota Mining and Manufacturing (3M) M20C in the WBN, Unit 1, primary containment, and primarily of 3M M20A in the WBN, Unit 1, annulus (there are also compliant RESs constructed of 3M E54C in the Unit 1 containment). TVA stated that site calculations EPM-BFS-041895 and EPM-BFS-053195 provide the design basis for the number of layers of M20A and M20C required to provide approximately ½ hour RESs for electrical raceways containing circuits required for fire safe shutdown (FSSD). These calculations were based on fire tests performed by 3M to Underwriters Laboratories, Inc. (UL), Subject 1724, "Fire Tests for Electrical Circuit Protective Systems." The fire exposure used in the tests is the standard time-temperature curve from American Society for Testing and Materials (ASTM) E119.

TVA had a series of fire resistance tests performed on the material at Omega Point Laboratories for combustibility of the installed materials. The 3M M20A and M20C did not meet the criteria for noncombustibility per ASTM E136, "Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 ° C." Additional fire tests to the criteria in ASTM E1354, "Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter," were performed with various RES materials. The results indicated that the peak heat release rate (HRR) and the total heat release rate (THR) for the 3M M20A and M20C was lower than that of Marinite board. Since Marinite board is accepted in GL 86-10 as an acceptable RES material, and the 3M materials used at WBN have lower HRR and THR than Marinite board, the 3M materials are also considered sufficiently noncombustible for use as RES.

10 CFR Part 50, Appendix R, Section III.G.2.f states that inside non-inerted containments, separation of cables and equipment and associated non-safety circuits of redundant trains by a noncombustible RES is an acceptable method of ensuring that a redundant train of equipment and circuits are protected from a fire. This separation of cables and equipment is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although the 3M M20A and M20C RES used by TVA was tested and determined to not meet the criteria for non-combustibility, the NRC staff concludes that the RES constructed of 3M M20A used in WBN, Unit 1 annulus, and 3M M20C used in WBN, Unit 1 Containment are acceptable because the licensee demonstrated that these RESs have a minimum approximate fire rating of 30 minutes in accordance with RG 1.189, Position 5.3.1.1, and because testing indicated that these RESs have a lower heat release rate and total heat release than materials that are considered acceptable RES per GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.1.3 Alternative – Lack of Automatic Fire Suppression in Alternative Shutdown Locations

TVA committed to maintain safe shutdown capability during and after a fire in accordance with Section III.G of Appendix R to 10 CFR Part 50. Section III.G.3 of Appendix R to 10 CFR Part 50 states that fire detection and a fixed fire suppression system shall be installed in the areas, rooms, or zones requiring alternative or dedicated shutdown capability.

TVA requested an alternative to Appendix R for a number of control building rooms that lack fixed fire suppression, and some rooms that also lack fire detection.

The control building is separated from the ACR and adjacent plant areas by equivalent 3-hour fire rated barriers except for the equipment hatch in the ceiling separating the control building from the turbine building. The justification for the hatch opening through the ceilings of Rooms 692.0-C1 and 692.0-C10 to the turbine building is evaluated in Section 6.2.7.4 of this evaluation. The turbine building is separated from the ACR and adjacent plant areas by equivalent 3-hour fire rated barriers. This separation provides assurance that safe shutdown capability is assured for a fire in the control building.

All the control building rooms that lack fixed fire suppression have limited ignition sources and low or insignificant combustible loading. In addition, all of the rooms have standpipes and hose stations available for manual firefighting. Only a few rooms lack full area detection. These rooms are stairwells, shower rooms, the telephone room, and the space above the living area on the 755.0 foot elevation. Frequent use of the stairwells would lead to discovery of a fire in its early stages and would also reduce the likelihood that combustibles could accumulate there. The other rooms all are described as having negligible combustible loading.

10 CFR Part 50, Appendix R, Section III.G states that fire detection and a fixed fire suppression system shall be installed in the areas, rooms, or zones requiring alternative or dedicated shutdown capability. These systems are required to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA is proposing that certain control building rooms continue to not have fire detection and/or fixed fire suppression systems, the NRC staff concludes that this is acceptable because these rooms have low or insignificant combustible loading, have limited ignition sources, and have standpipes and hose stations for manual firefighting capability. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.1.4 Alternative – Intervening Combustibles

TVA committed to maintain safe shutdown capability during and after a fire in accordance with Section III.G of Appendix R to 10 CFR Part 50. Section III.G.2.b of Appendix R to 10 CFR Part 50 states that separation of redundant trains of safe-shutdown cables and equipment by a horizontal distance of more than 20 feet with no intervening combustibles. In addition, fire detection and an automatic fire suppression system shall be installed in the area.

In FPR Part VII, Section 2.4, TVA requested an alternative to Section III.G of Appendix R to 10 CFR Part 50 for 20 feet horizontal distance with no intervening combustibles for safe shutdown components and cables in the auxiliary building and the intake pumping station (IPS) electrical equipment room. WBN stated that safe-shutdown components in the auxiliary building and IPS electric equipment room are in compliance with Section III.G.2.b of Appendix R to 10 CFR Part 50, except that intervening combustibles are located between the redundant components.

The intervening combustibles in the auxiliary building are primarily in the form of insulation on cables in open ladder type cable trays and Thermo-Lag fire barrier material. The remaining in situ combustible loading consists of plastics in electrical panels, junction boxes, etc., and lubricating oil in pumps, motors, and valves. The intervening combustibles in the IPS electric equipment room are mainly in the form of insulation on cables in open ladder type cable trays and transformer silicone liquid. The remaining in situ combustible loading consists of lubricating oil in small pumps and plastics associated with electrical panels, junction boxes, etc.

Discussion of the nature of the transformer silicon liquid can be found in Section 5.11.2 of this evaluation.

The presence of these intervening combustibles is a concern because they add to a fire's intensity at the ceiling and they could serve as a path for fire propagation between the redundant safe-shutdown trains.

For intervening combustibles in the auxiliary building, TVA stated that existing sprinkler heads, which are capable of fully developing spray patterns at the ceiling, provide acceptable floor coverage if there are no intermediate obstructions in their patterns, which are greater than 48 inches wide. Additional intermediate sprinklers are provided for 48 inch wide obstructions and for combinations of obstructions that, when overlapped, constitute a 48 inch wide obstruction, that overlap or combinations of obstructions have less than a 4 inch flue space between them when viewed from immediately below. No combination of obstructions may traverse the 4 inch flue space and block more than 2 feet of any 8 feet of flue space. To mitigate the effects of an exposure fire from transient combustibles at the floor level, TVA stated that floor level sprinkler coverage is provided under intermediate obstructions for up to a 30 foot wide path where spatially separated redundant FSSD components exist.

TVA stated that for intervening combustibles in the IPS electrical equipment room, sprinkler protection has been provided at the ceiling level. Due to the presence of obstructions such as heating, ventilation, and air conditioning (HVAC) ducts, cable trays, pipes, and supports, these systems have been upgraded. Sprinkler heads were added to provide full coverage at the ceiling level and to compensate for large intermediate-level obstructions. To mitigate the effects of an exposure fire from transient combustibles at the floor level, TVA provided floor-level sprinkler coverage under intermediate obstructions for up to a 30-foot-wide path for spatially separated redundant FSSD components.

TVA concluded that, if a fire were to occur, these sprinkler systems would develop effective spray patterns at the ceiling, and the water would cascade down through the cable trays in the intervening spaces. The cooling effect of these sprinklers, once actuated, would help cool the layer of hot gas at the ceiling, prevent the formation of a high temperature plume, and cool the room. The sprinklers under the intermediate level obstructions would actuate to ensure that floor level coverage is provided under the obstructions. In addition, the coverage provided by the ceiling sprinklers would produce sufficient cooling to reduce the likelihood that fire will propagate across the intervening space between the redundant trains.

10 CFR Part 50, Appendix R, Section III.G.2.b states that separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards and that fire detectors and an automatic fire suppression system shall be installed in the fire area. This separation of cables and equipment and the installation of fire detectors and an automatic fire suppression system is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA is proposing to have less than 20 feet horizontal distance with no intervening combustibles for safe-shutdown components and cables in the auxiliary building and IPS electrical equipment room, the NRC concludes that this is acceptable because the intervening combustibles are limited to cable insulation on open ladder type cable trays and thermo-lag fire barrier material, and because the coverage provided by the ceiling sprinklers would produce sufficient cooling to reduce the likelihood that fire would

propagate across the intervening space between the redundant trains. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.1.5 Alternative – Partial Fire Wall between CCS Pumps

TVA committed to maintain safe shutdown capability during and after a fire in accordance with Section III.G of Appendix R to 10 CFR Part 50. Section III.G.2.b of Appendix R to 10 CFR Part 50 states that one compliance strategy is the separation of cables and equipment and associated nonsafety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area. Section III.G.2.c states that another compliance strategy is the enclosure of cables and equipment and associated nonsafety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

In FPR Part VII, Section 2.5, TVA requested an alternative to Appendix R for redundant component cooling system (CCS) pumps that are protected by fire detectors and an automatic fire suppression system, but are separated by a partial-height and -width noncombustible wall.

The five CCS pumps are located in Fire Area 8, Room 713.0-A1, in subsections 713.0-A1A1, -A1A2 and -A1A3, on elevation 713.0 feet of the auxiliary building. The two Train B pumps are separated from both Train A pumps and the spare pump by a noncombustible wall which extends 3 feet above the highest point of the pumps. A ceiling-level preaction sprinkler system is provided for cable tray and general area coverage. Automatic sprinkler coverage has also been provided under the pipe-break barrier for the Unit 1 motor-driven AFW pumps and under the mezzanine for all five CCS pumps. Cross-zoned ionization smoke detectors are provided to actuate the preaction suppression systems and give early warning of a fire.

The combustibles in Room 713.0-A1 consist of lube oil in the pumps, motors, and valves; plastics associated with the electrical panels, boxes and lights, insulation on cables routed in cable trays; and anticipated amounts of radwaste trash and laundry. The fire severity for this room is classified as moderately severe. However, TVA stated that approximately 95 percent of the in situ combustible loading in this area is due to the insulation on cables routed in cable trays and the Thermo-Lag fire barrier material. The majority of the remaining combustible loading in the immediate area of the CCS pumps is due to the approximately 6 gallons of lube oil associated with each CCS pump and approximately 45 gallons of lube oil associated with each of the two Unit 1 AFW pumps. The cables are protected electrically with appropriately sized circuit protective devices (breakers and fuses) that will actuate on electrical faults prior to the jacket material of faulted cables reaching their auto-ignition temperature. A fire due to transient combustibles located near the edge of the partial-height fire barriers would not pose a threat to more than one CCS pump due to the lack of combustibles. Additionally, raceways containing the redundant cables for the CCS pumps are separated by 20 feet or more or by noncombustible barriers.

10 CFR Part 50, Appendix R, Section III.G.2.b states that separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards and that fire detectors and an automatic fire

suppression system shall be installed in the fire area. 10 CFR Part 50, Appendix R, Section III.G.2.c states that enclosure of cables and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating and that fire detectors and an automatic fire suppression system shall be installed in the fire area. This separation of cables and equipment and the installation of fire detectors and an automatic fire suppression system is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA is proposing the use of a partial-height and -width noncombustible wall as the fire barrier for redundant CCS pumps, the NRC staff concludes that its use is acceptable because a fire would be detected and suppression would begin prior to it becoming a threat to the redundant pumps on the other side of the noncombustible barrier, and until the fire is suppressed, the noncombustible barrier would shield the pumps from radiant heat on one side and from fire on the other side. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.1.6 Alternative – Emergency Lighting

TVA committed to provide emergency lighting to assure safe shutdown capability is maintained during and after a fire in accordance with Section III.J of Appendix R to 10 CFR Part 50. Section III.J of Appendix R to 10 CFR Part 50 states that emergency lighting units with at least an 8-hour battery power supply be provided in all areas needed for operation of safe-shutdown equipment and for necessary access and egress routes. In FPR Part VII, Section 2.7, TVA requested an alternative for emergency lighting in each containment, the turbine building, the yard, and areas impacted by fire where operator manual actions (OMAs) are performed in the impacted area ("post-fire" areas).

Dedicated and maintained portable battery powered lights are used in lieu of installed battery pack lighting units in both containments. Emergency diesel generator-backed standby lighting is installed and maintained for the turbine building. Security diesel generator (DG)-backed standby lighting is installed and maintained for the yard. To perform actions the nuclear assistant unit operators (NAUOs) carry portable lighting to supplement yard and turbine building diesel-backed lighting systems to provide additional task lighting capability.

Based on its review of the information submitted by TVA, the NRC staff concludes that the use of installed standby lighting and hand-held portable lighting units for the yard and turbine building is an acceptable alternative to the lighting criteria required by Section III.J, of Appendix R to 10 CFR Part 50, and, therefore, is acceptable.

OMAs requiring entry into primary containment would only result from fire damage to the residual heat removal (RHR) isolation valves or cables near the valves which are located inside lower containment. The OMAs to align the RHR isolation valves may be performed anytime within 2 hours after reactor trip. This allows ample time to extinguish the fire, obtain the portable lanterns, and operate the valves. As described above, WBN has dedicated hand-held portable lighting units for use in supporting manual firefighting and safe shutdown OMAs for fires in the lower containment, in addition to the portable lighting normally used by NAUOs.

A fire affecting the RHR isolation valves could damage lighting circuits in the immediate vicinity, but would not be expected to disable all lower containment lighting, since different circuits are used at each elevation. Additionally, two standby lighting circuits, with fixtures strategically located throughout lower containment, provide lighting in case of fire damage to the normal lighting cabinet.

TVA's concerns regarding the installation of 8-hour emergency lighting units inside containment include the reduced life of the batteries in the high temperature and humidity environment experienced inside the primary containment. Also, ALARA concerns would limit testing and maintenance to reactor outages, since access into the primary containment during plant operations is restricted.

Based on its review of the information submitted by TVA, the NRC staff concludes that, based on the complications of testing and maintaining 8-hour fixed emergency lighting units, and TVA's design description of the installed lighting in the lower containment complemented by the dedicated hand-held portable lighting units, the installation of 8-hour emergency lighting units is unnecessary to provide access and egress to the manual action sites and perform safe shutdown actions in primary containment. Therefore, the use of installed lighting and hand-held portable lighting units for this area is an acceptable alternative to the lighting criteria required by Section III.J of Appendix R to 10 CFR Part 50.

For OMAs for post-fire areas there is emergency lighting installed on the route to the area. The operators have access to dedicated, hand-held portable lanterns that are maintained for OMAs in these areas. In addition, OMAs are not needed for 60 minutes following the fire, which will allow for time for the operators to arrive and prepare to perform the OMA (see Sections 3.5.6 and 6.1.9 of this evaluation). Portable lanterns stored outside of the post-fire area would not be impacted by fire, whereas installed emergency lighting units within the area may not be available due to fire damage. Therefore, the use of dedicated, hand-held portable lanterns for post-fire areas is an acceptable alternative to the lighting criteria required by Section III.J of Appendix R to 10 CFR Part 50.

10 CFR Part 50, Appendix R, Section III.J states that emergency lighting units with at least an 8-hour battery power supply be provided in all areas needed for operation of safe-shutdown equipment and for necessary access and egress routes. Emergency lighting is required to ensure that safe shutdown capability is maintained during and after a fire. Although TVA is proposing portable battery powered lights in the containment, emergency diesel powered standby lighting in the turbine building, and hand-held portable lights carried by the NAUOs, the NRC staff concludes that these alternatives acceptable because they will provide adequate lighting to allow OMAs to be performed. Therefore, the NRC staff concludes that there is reasonable assurance that the emergency lighting provided will maintain safe shutdown capability during and after a fire.

6.1.7 Evaluation – Lack of Total Area Suppression and Detection

TVA committed to meet Section III.G.2 of Appendix R to 10 CFR Part 50 for hot shutdown capability, which states that when redundant trains of cables or equipment necessary for post-FSSD are installed in the same fire area, fire detectors and automatic fire suppression must be installed, unless one train is protected by a 3-hour-rated fire barrier. Position 5 of the Attachment to GL 86-10 states that, to meet Section III.G.2 of Appendix R to 10 CFR Part 50, less than full area coverage may be adequate to comply with the regulation if the suppression and detection installed is sufficient to protect against the hazards of the fire area.

In FPR Part VII, Section 3.1, TVA evaluated portions of fire areas that contain both trains of safe shutdown success paths, but do not have full coverage fire detection and suppression installed. The WBN plant has some fire areas that include multiple subdivisions, called rooms. These rooms may not be separated from the other rooms within the fire area by rated fire barriers.

The NRC staff found that for fire areas composed of multiple rooms, the rooms which contain redundant safe shutdown equipment have either 3-hour-rated barriers to protect one train of the safe shutdown equipment, or the rooms are equipped with fire detection and automatic suppression, and have some spatial separation between trains (see Section 3.2.1 of this evaluation). Therefore, these rooms are not considered to be credible exposure hazards to the other rooms in the fire area that have redundant safe shutdown equipment.

Some of the rooms contain safe shutdown equipment, but there is not redundant safe shutdown equipment required for hot shutdown in the room. In other cases, the safe shutdown equipment is needed for cold shutdown or for alternative shutdown. In still other cases, the safe shutdown equipment is not used to provide for plant safe shutdown for a fire in the room; that is, it is relied upon for a fire elsewhere in the plant. In any of these cases, safe shutdown equipment is available outside of the room if there is a fire in the room, and any exposure hazard in the room to another room would be mitigated by the protection in the other room.

Based on the information provided by TVA, there are rooms that lack full area fire detection and suppression that do not contain redundant safe shutdown equipment needed for hot shutdown and do not constitute exposure hazards to other rooms within the fire area. The NRC staff reviewed this information and concludes that this is acceptable.

The descriptions in the evaluations state that the plant provided only one train of FSSD equipment and cables in Centrifugal Charging Pump (CCP) Rooms 1B-B (Room 692.0-A10; Fire Area 6), 2A-A (Room 692.0-A23; Fire Area 68), and 2B-B (Room 692.0-A22; Fire Area 67). However, Fire Areas 6, 67, and 68 consist solely of the single CCP room. Because these rooms do not contain redundant trains of equipment or cables, the NRC staff did not review these evaluations.

Rooms that contain redundant cables or equipment necessary for post-FSSD

480-V Board Rooms 1B (Room 772.0-A2; Fire Area 33) and 2B (Room 772.0-A15; Fire Area 45)

In FPR Part VII Section 3.1.8, TVA stated that in 480-V Board Rooms 1B (Room 772.0-A2; Fire Area 33) and 2B (Room 772.0-A15; Fire Area 45), preaction sprinkler systems are provided throughout both rooms except for the portion of each room that contains one set of vital battery inverters and chargers. Additionally, ionization detection is installed throughout both rooms. TVA further stated that the redundant inverters and chargers and associated cables are separated by a minimum of 42 feet and are located at opposite ends of each room. Additionally, TVA stated that other redundant components in the rooms are located within the suppressed area of each room and are separated in accordance with Section III.G.2 of Appendix R to 10 CFR Part 50. A fire in the unsprinklered locations in these rooms would be detected by the installed fire detection systems before propagating significantly. If the fire propagated rapidly before the fire brigade arrived, individual sprinklers in the protected portions of the rooms would operate to limit the spread of fire and to protect the redundant systems until the fire was controlled and suppressed by the plant fire brigade.

10 CFR Part 50, Appendix R, III.G.2 states that when redundant trains of cables or equipment necessary for post FSSD are installed in the same fire area, fire detectors and automatic fire suppression must be installed, unless one train is protected by a 3 hour rated fire barrier. This separation of cables and equipment and the installation of fire detectors and an automatic fire suppression system is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA is proposing the use of partial preaction sprinkler protection in the 480-V Board Rooms 1B and 2B, the NRC staff concludes that this is acceptable because a fire in the unsprinklered locations in these rooms would be detected by the fire detection systems before propagating significantly, individual sprinklers in the protected portions of the rooms would operate to limit the spread of fire and to protect the redundant systems until the fire was controlled and suppressed by the plant fire brigade. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

Unit 1 Penetration Room (Room 692.0-A7; Fire Area 5) and Unit 2 Penetration Room (Room 692.0-A25; Fire Area 70)

In FPR Part VII Sections 3.1.1.a and 3.1.9.a, TVA stated that in Unit 1 Penetration Room (Room 692.0-A7; Fire Area 5) and Unit 2 Penetration Room (Room 692.0-A25; Fire Area 70), preaction sprinkler systems and ionization smoke detection systems are provided throughout both rooms except for the portion of each room that consists of the containment spray and RHR valve vault. TVA further stated that the walls, floors and ceilings, of each vault are reinforced concrete at least 6 inches thick with a steel liner. These portions of the rooms are not normally accessible due to the access opening being covered by a heavy steel hatch. TVA stated that the rooms and the vaults have insignificant fire loadings and no credible ignition sources. Finally, TVA stated that the vaults have been included in the safe shutdown analysis, and the valves would not be needed to achieve and maintain hot shutdown conditions. The Unit 1 area needs an 1140 minute required time OMA to achieve cold shutdown, whereas Unit 2 does not need an OMA for a fire in this area to achieve cold shutdown.

10 CFR Part 50, Appendix R, III.G.2 states that when redundant trains of cables or equipment necessary for post FSSD are installed in the same fire area, fire detectors and automatic fire suppression must be installed, unless one train is protected by a 3 hour rated fire barrier. This separation of cables and equipment and the installation of fire detectors and an automatic fire suppression system is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA is proposing the use of partial fire detection and suppression protection in the Unit 1 and Unit 2 Penetration rooms, the NRC staff concludes that this is acceptable because of the minimal fire loading in the rooms, the inaccessibility of the vaults, the lack of exposed combustibles and ignition sources in the vaults, the separation of the unprotected locations from the balance of the rooms which would prevent fire spread into or out of these areas, and inclusion of these configurations in the WBN safe shutdown analysis. Therefore, the NRC staff concludes that there is reasonable

assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.1.8 Evaluation – Reactor Coolant Pump Oil Collection System

TVA committed to meet Section III.O of Appendix R to 10 CFR Part 50. This section states, in part, that reactor coolant pumps (RCPs) be equipped with an oil collection system if the containment is not inerted during normal operation and that the system be capable of collecting lube oil from all potential pressurized and unpressurized leakage sites in the RCP lube oil system.

In FPR Part VII, Section 2.8, TVA stated that the RCP oil collection system must function in an area with significant ventilation airflows from both the control rod drive mechanism cooling units and the RCP motor itself. A minor leak in the lubrication system that causes oil to drip in an area where the ventilation airflow is strong can result in the oil's becoming entrained in ventilation air, which in turn could prevent the leak from ever entering the collection system. The need for ventilation around the RCP dictates that some ventilation flow areas must be present in areas around the lube oil system and the oil collection system. In designing the oil collection system, it is not feasible in all instances to prevent minor amounts of oil from becoming entrained in the ventilation air and escaping the collection system. This oil may become a thin film on the piping mirror insulation and supports in the vicinity of the RCPs.

TVA described the RCP oil collection systems in a letter dated May 26, 1995 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073230888). TVA used the following design criteria as the basis for the oil collection systems.

The oil collection system on each RCP collects oil from all potential leakage locations, including the RCP oil lift pump, system piping, overflow lines, the lube oil cooler, oil fill and drain lines, flanged connections on the oil lines, and the lube oil reservoirs. Each RCP oil collection system consists of spray shields/deflectors, a collection basin, a lift pump collection tray, a lower bearing collection tray and drain, drain piping, and a closed, vented container (reactor building floor and equipment drain sump).

The drain piping from each RCP's oil collection basin is directed to a drain header. The drain header runs through the shield wall and into the raceway area inside primary containment and runs through the floor into the 1600-gallon capacity sump. As required by Appendix R, the sump is a closed container and is equipped with a flame arrester on the vent line. Each unit's sump has sufficient capacity to hold the entire RCP oil inventory of all four RCPs.

TVA stated that up to 17 gallons of oil could collect in the lower motor support housing before beginning to drain to the collection system. The RCPs are equipped with control loop level indication that would initiate an alarm in the MCR if 2 or more gallons of lube oil are lost from the RCP. Collection of oil within the lower motor support housing is acceptable since the oil, and possible fire, would be contained within the RCP and would not impact surrounding equipment such that safe shutdown could be affected. In addition, the RCP is equipped with a water-based fire suppression system such that a fire at the RCP would have automatic suppression available.

The RCP pumps, lubricating oil systems, oil spray shields, oil collection basins, drain piping, and containment sumps are designed to seismic Category I requirements so as not to fail during a safe-shutdown earthquake.

Each of the four RCPs is protected by a fixed fire suppression and detection system. A heat collection hood is installed directly above the RCP motors. Each of the RCPs is protected by a separate closed-head preaction automatic water spray system that is installed under this hood. Each system has a ring header containing eight nozzles. The header is located approximately 4 feet above the top of the RCP motor and the nozzles, which actuate at 500 ° F, are oriented so as to provide optimum coverage of the RCP motor from above. In addition, there are four rate-compensating/fixed-temperature spot-type thermal detectors located above the RCP motors on the bottom side of the heat-collection hood. These detectors are Class A supervised, have a thermal rating of between 200 ° F and 225 ° F and are alarmed and annunciated in the MCR. In the event of a fire, this hood acts as a ceiling, forcing the heat to stall around the detectors and the suppression nozzles, thus reducing the response time of these fire protection devices.

10 CFR Part 50, Appendix R, Section III.O states, in part, that reactor coolant pumps (RCPs) be equipped with an oil collection system (if the containment is not inerted during normal operation) and that the system be capable of collecting lube oil from all potential pressurized and unpressurized leakage sites in the RCP lube oil system. This oil collection system is required to minimize the possibility of a severe lube oil fire from occurring during normal or design basis accident conditions. Although TVA is proposing to allow collection of oil in the lower motor support housing and to allow minor amounts of oil to escape the oil collection system and become a thin film on piping mirror insulation and supports in the vicinity of the RCPs, the NRC staff concludes that these deviations are acceptable because large leakages would be alarmed to the control room and the RCP cubicles are equipped with detection and fixed fire suppression. Therefore, the NRC staff concludes that there is reasonable assurance that the oil collection system will minimize the possibility of a lube oil fire from occurring during normal or design basis accident conditions.

6.1.9 Evaluation – WBN Unit 2 Operator Manual Action Feasibility and Reliability

TVA committed to meet Section III.G of Appendix R to 10 CFR Part 50. Section III.G of Appendix R to 10 CFR Part 50 provides a number of acceptable methods of providing reasonable assurance that one of the safe-shutdown trains is free of fire damage using a combination of physical separation, fire wraps, fire detection, and fire suppression. Section III.G of Appendix R to 10 CFR Part 50, does not permit the use of OMAs as a means of assuring that a safe-shutdown train is free of fire damage, although NRC approval may be granted for the use of OMAs. Discussion of OMAs needed for equipment important for safe shutdown is included in Section 3.5.2 of this evaluation. Discussion of the treatment of recall time for auxiliary unit operators to perform these actions is discussed in Section 3.5.4 of this evaluation. TVA stated that some OMAs in this evaluation serve two roles. These OMAs may address important-to-safe-shutdown and required-for-safe-shutdown situations. This section reviews only the required-for-safe-shutdown aspects. See Section 3.5 of this evaluation for a discussion of the important-to-safe-shutdown acceptance criteria.

TVA developed evaluations based on the information in NUREG-1852, “Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire,” to demonstrate that OMAs are capable of accomplishing various safe shutdown functions and terminating spurious equipment operations that have the potential to interfere with safe shutdown. TVA also described the fire protection defense-in-depth features, which include fire prevention, fire detection, and fire suppression, within each room that reduce the likelihood that an OMA would be needed. The NRC staff reviewed the OMAs for the rooms and zones listed in the table below.

The following table describes, by room or zone, the margin available for the OMA and the defense-in-depth features. TVA used the information from NUREG-1852 in determining the feasibility and reliability of manual actions. The following criteria were used to consider feasibility and reliability: (1) Adequate Time Available to Perform Actions and (2) Adequate Time Available to Ensure Reliability. Manual actions that had at least 40 minutes of margin were considered feasible and reliable. If a postulated fire has been evaluated to have the potential to cause a plant trip, 5 minutes has been added to the performance time in the margin calculation. Margin in this context is:

Time when OMA is needed	−	Demonstrated time to perform OMA	=	Margin

TVA also considered: (1) Environmental Factors, (2) Equipment Functionality and Accessibility, (3) Available Indications, (4) Communications, (5) Portable Equipment, (6) Personnel Protection Equipment, and (7) Procedures and Training. TVA stated that the above criteria do not adversely affect the performance of the action for the OMAs evaluated in this section. The diagnosis time for OMAs is discussed in Section 3.5.4 of this evaluation.

OMAs that have less than 40 minutes of margin have been identified in the table below. Any OMA with less than 40 minutes of margin references a note that includes an evaluation of the time margin and defense-in-depth features.

Fire protection defense-in-depth features, such as fire prevention, fire detection, and fire suppression, apply to each of these rooms. Most rooms have full area fire detection and automatic fire suppression. For those rooms that lack full fire detection and automatic fire suppression, the NRC staff evaluated these areas specifically below. This evaluation uses the available defense-in-depth information and information about the OMA to determine if having less than full area suppression and detection is acceptable. Using full area suppression and automatic detection as criteria for OMAs is not intended to imply that they are required; rather, the NRC staff deemed full detection and automatic suppression as a robust level of protection. Less than full detection and automatic suppression received a more detailed review by the NRC staff.

The table below is an analysis of OMAs based on the room or zone of fire origin. OMAs that have been evaluated by TVA to meet NUREG-1852 and have at least 40 minutes of margin are considered to be acceptable without additional evaluation, if the postulated fire occurs in a room equipped with fire detection and automatic suppression. Exceptions to these factors are discussed in notes that refer to information explained below the table.

Part VII Evaluation	**Room/ Zone**	**Exceptions to Full Area Detection and Automatic Suppression**	**OMA #**	**Exceptions to 40 Minutes of Margin**	**Notes**
8.3.1	692.0-A1B	None	1159 & 1160	OMA involves re-entry	Note 1
8.3.2	692.0-A22	No detection or suppression in the entrance labyrinth	1159 & 1160	None	Note 2
8.3.3	692.0-A25	No detection or suppression in the valve vault	1065	None	Note 2
			1066	OMA involves re-entry	Note 1
8.3.4	713.0-A1A	No suppression over the boric acid tanks	1022	None	Note 2
			1023	None	Note 2
8.3.5	713.0-A1B	No suppression over the boric acid tanks	1016	None	Note 2
			1023	None	Note 2
			1615 & 1275	Less than 40 minutes of margin	Note 3
8.3.6	713.0-A27	None	1022	None	
			1023	None	
8.3.7	2ANN	None	1023	None	
8.3.8	737.0-A1A	None	1022	None	
			1023	None	
8.3.9	737.0-A1B	None	1016	None	
			1024	None	
			1540 & 1542	Less than 40 minutes of margin	Note 4
8.3.10	737.0-A1C	None	1023	None	
8.3.11	737.0-A1N	No total area suppression and detection in the air locks	1016	None	Note 5
			1024	None	Note 5
			1535 & 1536	Less than 40 minutes of margin	Note 6
8.3.12	737.0-A5M	None	1023	None	
8.3.13	737.0-A5N	None	1023	None	
8.3.14	737.0-A5S	None	1022	None	
			1023	None	
8.3.15	737.0-A9M	None	1022	None	

Part VII Evaluation	Room/ Zone	Exceptions to Full Area Detection and Automatic Suppression	OMA #	Exceptions to 40 Minutes of Margin	Notes
			1023	None	
8.3.16	737.0-A9N	None	1022	None	
			1023	None	
8.3.17	737.0-A9S	None	1022	None	
			1023	None	
8.3.18	737.0-A12	None	1024	None	
8.3.19	757.0-A1	None	1016	None	
			1024	None	
8.3.20	757.0-A2	None	1185	None	Note 7
			1184	None	Note 7
			1712	None	
			1713	None	
			1577	None	
8.3.21	757.0-A3	Fire sprinkler system is manual, not automatic	1024	None	Note 8
8.3.22	757.0-A4	Fire sprinkler system is manual, not automatic	1022	None	Note 8
			1023	None	Note 8
8.3.23	757.0-A5	None	1016	None	
			1024	None	
8.3.24	757.0-A9	None	1185	None	Note 7
			1184	None	Note 7
			1712	None	
			1713	None	
			1577	None	
8.3.25	757.0-A10	None	1016	None	
			1024	None	
8.3.26	757.0-A16	None	1022	None	
			1023	None	
8.3.27	757.0-A17	None	1037	None	Note 9
			1038	None	Note 9
8.3.28	757.0-A21	None	1023	None	
			1516	Less than 40 minutes of margin	Note 10
8.3.29	757.0-A22	Fire sprinkler system is manual not automatic	1016	None	Note 8
			1024	None	Note 8
8.3.30	757.0-A23	Fire sprinkler system is manual not automatic	1022	None	Note 8
			1023	None	Note 8
8.3.31	757.0-A24	None	1037	None	Note 9
			1038	None	Note 9
8.3.32	757.0-A26	None	1024	None	
8.3.33	757.0-A27	None	1022	None	

Part VII Evaluation	Room/ Zone	Exceptions to Full Area Detection and Automatic Suppression	OMA #	Exceptions to 40 Minutes of Margin	Notes
			1023	None	
8.3.34	757.0-A28	None	1016	None	
			1024	None	
8.3.35	772.0-A1	None	1022	None	
			1023	None	
8.3.36	772.0-A2 East	No suppression between column lines A6-A8/Q-R	1016	None	Note 11
			1024	None	Note 11
8.3.37	772.0-A2 West	No suppression between column lines A6-A8/Q-R	1022	None	Note 11
			1023	None	Note 11
8.3.38	772.0-A4	Fire sprinkler system is manual not automatic	1022	None	Note 8
			1023	None	Note 8
8.3.39	772.0-A5	None	1016	None	
8.3.40	772.0-A6	None	1023	None	
8.3.41	772.0-A8	None	1016	None	
			1022	None	
			1023	None	
			1024	None	
8.3.42	772.0-A9	None	1022	None	
			1023	None	
8.3.43	772.0-A10	None	1022	None	
			1023	None	
8.3.44	772.0-A11	None	1024	None	
8.3.45	772.0-A12	None	1023	None	
8.3.46	772.0-A13	Fire sprinkler system is manual not automatic	1016	None	Note 8
			1024	None	Note 8
8.3.47	772.0-A14	Fire sprinkler system is manual not automatic	1022	None	Note 8
			1023	None	Note 8
			1148	None	Note 8
8.3.48	772.0-A15 East	No suppression between column lines A8-A10/Q-R	1016	None	Note 11
			1024	None	Note 11
8.3.49	772.0-A15 West	No suppression between column lines A8-A10/Q-R	1016	None	Note 11
			1024	None	Note 11
			1495	Less than 40 minutes of margin	Note 12
			558 & 622	None	Note 11
			1665 & 1666	Less than 40 minutes of margin	Note 13
			1664	None	Note 11

Part VII Evaluation	Room/ Zone	Exceptions to Full Area Detection and Automatic Suppression	OMA #	Exceptions to 40 Minutes of Margin	Notes
			1669 & 1670	Less than 40 minutes of margin	Note 14
			1667 & 1668	Less than 40 minutes of margin	Note 15
8.3.50	772.0-A16	None	1022	None	
			1023	None	
8.3.51	782.0-A1	None	1016	None	
			1024	None	
8.3.52	782.0-A2	None	1016	None	
			1024	None	
8.3.53	782.0-A3	None	1022	None	
			1023	None	
8.3.54	782.0-A4	None	1022	None	
			1023	None	
8.3.55	DBIPS-A	No detection or suppression in duct bank	1023	Less than 40 minutes margin	Note 16
8.3.56	DBIPS-B	No detection or suppression in duct bank	1024	Less than 40 minutes of margin	Note 16
8.3.57	IPS-A	Partial detection, no suppression	1023	None	Note 17
8.3.58	IPS-B	Partial detection, no suppression	1024	None	Note 17
8.3.59	IPS-C (East)	None	1024	None	
8.3.60	IPS-C (Middle)	None	1024	None	
8.3.61	IPS-C (West)	None	1023	None	

Note 1 - Applies where re-entry of the fire area was considered after 60 minutes. Areas involving re-entry have automatic fire suppression. Areas involving re-entry have more than 40 minutes of margin, from the plant trip, but less than 40 minutes if 60 minutes is needed to suppress the fire before re-entering. In other cases, the OMA may be needed in a room, but not the same room, on the same elevation as the postulated fire. In this event, TVA considered the possible environmental effects of the fire and concluded that those factors would not prevent the performance of the OMA. These areas have full suppression and detection, or have been evaluated and approved in Section 6.1.7 of this evaluation, therefore this is considered acceptable by the NRC staff.

Note 2 – Note 2 applies to multiple areas, as described in FPR Part VII, Section 3.1. TVA performed an analysis of the fire hazards in the area and determined that they do not warrant the installation of fire detection and automatic suppression. These areas are typically pipe chases, tunnels, tank rooms, entrance labyrinths, corridors, or portions of larger rooms where the majority of the room is protected. The evaluation and approval of these areas' lack of full area fire detection and automatic suppression is provided in Section 6.1.7 of this evaluation. Based on the available defense-in-depth features as evaluated in Section 6.1.7 of this evaluation, and the minimum 40 minutes of margin, the staff concludes that this reduced protection is acceptable.

Note 3 – OMAs 1275 and 1615, in zone 713.0-A1B, lack 40 minutes of margin. Zone 713.0-A1B is part of a room that lacks area wide detection and automatic suppression. The room has a floor area of over 17,000 square feet and has a ceiling height of 23 feet. The primary combustible in this room is insulation on cables. The suppression system does not extend over the boric acid tank area. TVA designated the area around the tank a combustible control zone. The actions must be completed in 20 minutes. The demonstrated time was less than 7 minutes, resulting in over 13 minutes of margin. Based on the installed defense-in-depth features, the size of the fire area, and over 13 minutes of time margin, the NRC staff concludes that this OMA is acceptable for this specific room.

Note 4 - OMAs 1540 and 1542, for a fire in zone 737.0-A1B, must be completed within 20 minutes. Demonstration of each pair of actions indicated a travel and performance time of less than 2 minutes, resulting in over 18 minutes of margin in each case. Zone 737.0-A1B is a portion of a room which has a primary combustible of cable insulation, a floor area of over 23,000 square feet, and a nominal ceiling height of 19 feet. TVA determined that a plant trip could be caused by a fire in this zone, which may have the potential of not having the necessary operators in the control room at the time of the plant trip. TVA included a 5 minute reduction in margin time to account for this possibility. The room is equipped with fire detection and an automatic sprinkler system. Based on the installed defense-in-depth features and over 13 minutes of time margin, the NRC staff concludes that these OMAs are acceptable for this specific room.

Note 5 – The room 737.0-A1 has area wide detection and suppression. However, the fire area lacks total area suppression and detection because there is neither detection nor suppression in the air locks (Rooms 737.0-A4 and 737.0-A11). FPR Section 3.1.7 states that the air locks do not contain fire safe shutdown components. Therefore, the lack of total area suppression and detection in the air locks is acceptable.

Note 6 - OMAs 1535 and 1536, for a fire in zone 737.0-A1N, must be completed within 20 minutes. Demonstration of each pair of actions indicates a travel and performance time of less than 3 minutes, resulting in over 17 minutes of margin in each case. Zone 737.0-A1N is a portion of a room which has a primary combustible of cable insulation, a floor area of over 23,000 square feet, and a nominal ceiling height of 19 feet. The fire area is equipped with fire detection and an automatic sprinkler system, except in the air locks which lack fire safe shutdown components, as discussed in Note 5. Based on the installed defense-in-depth features and over 17 minutes of time margin, the NRC staff concludes that these OMAs are acceptable for this specific room.

Note 7 – A fire in room 757.0-A2 or 757.0-A9 has the potential to challenge the ability to operate steam generator relief valves to control steam generator pressure. TVA implemented OMAs 1184 and 1185 to manipulate nitrogen stations to manually control pressure in the steam generators in the event that the fire detection and automatic fire suppression systems installed in rooms 757.0-A2 and 757.0-A9 do not prevent fire damage. The fire barrier(s) between the fire rooms and the OMA location (757.0-A24) have installed backdraft dampers that close when the ventilation system is shut down. Proceduralized manual shutdown of the ventilation system will allow the backdraft dampers to close. Despite this, TVA considered the possibility that smoke from the fire affected room could enter the OMA location, creating a challenge to the operator performing the OMA. The operator sent to perform the OMA will have SCBA to allow performance of the OMA even if a limited amount of smoke enters the OMA location. TVA assumes that plant fires will be suppressed in 60 minutes. Thus, TVA assumed that performance of the OMA begins at 60 minutes to account for fire suppression activities to have completely suppressed the fire. There is 75 minutes for the operator to perform the OMA. The OMA has been demonstrated to take less than 8 minutes. Based on the installed defense-in-depth features, the operator actions to shut down ventilation to close the backdraft dampers, and the available time to perform the OMA, the NRC staff concludes that these OMAs are acceptable for these rooms.

Note 8 - Rooms 757.0-A3, 757.0-A4, 757.0-A22, 757.0-A23, 772.0-A4, 772.0-A13, and 772.0-A14, are equipped with ionization fire detection systems and manually actuated fire sprinkler systems, rather than the automatic fire sprinkler system. These vital battery board rooms are described as having battery and instrument boards, transformers, control panels, and junction boxes. Electrical components have circuit protection. Transient combustibles are controlled by plant procedures. OMAs in these rooms and zones have at least 40 minutes of time margin. Based on the installed ionization fire detection systems, the manually actuated fire suppression systems, the limited combustibles, and the available time margin, the NRC staff concludes that this is acceptable.

Note 9 – A fire in room 757.0-A17 or 757.0-A24 has the potential to challenge the ability to operate steam generator relief valves to control steam generator pressure. TVA implemented OMAs 1037 and 1038 to manipulate nitrogen stations to manually control pressure in the steam generators in the event that the fire detection and automatic fire suppression systems installed in rooms 757.0-A17 and 757.0-A24 do not prevent fire damage. The fire barrier(s) between the fire rooms and the OMA location (757.0-A21) have installed backdraft dampers that close when the ventilation system is shut down. Proceduralized manual shutdown of the ventilation system will allow the backdraft dampers to close. Despite this, TVA considered the possibility that smoke from the fire affected room could enter the OMA location, creating a challenge to the operator performing the OMA. The operator sent to perform the OMA will have SCBA to allow performance of the OMA even if a limited amount of smoke enters the OMA location. TVA assumes that plant fires will be suppressed in 60 minutes. Thus, TVA assumed that performance of the OMA begins at 60 minutes to account for fire suppression activities to have completely suppressed the fire. There is 75 minutes for the operator to perform the OMA. The OMA has been demonstrated to take less than 8 minutes. Based on the installed defense-in-depth features, the operator actions to shut down ventilation to close the backdraft dampers, and the available time to perform the OMA, the NRC staff concludes that these OMAs are acceptable for these rooms.

Note 10 - OMA 1516 for a fire in room 757.0-A21, must be completed within 20 minutes. Demonstration of the action shows a travel and performance time of less than 3 minutes. This provides over 17 minutes of margin for this action. The room is equipped with fire detection and an automatic sprinkler system. The room has a floor area of 2244 square feet with a nominal ceiling height of 14 feet. TVA determined that a plant trip could be caused by a fire in this zone, which may have the potential of not having the necessary operators in the control room at the time of the plant trip. TVA included a 5 minute reduction in margin time to account for this possibility. Based on the installed defense-in-depth features and over 12 minutes of time margin, the NRC staff concludes that this OMA is acceptable for this specific room.

Note 11 - Zones 772.0-A2 East and West, are in room 772.0-A2, the 480V Board Room 1B, and zones 772.0-A15 East and West, are in room 772.0-A15, the 480V Board Room 2B. A 315 square foot portion in each of the rooms that contains the vital battery inverters and charger does not have automatic suppression. The combustible in that portion of each room is insulation on cables in one cable tray. In addition, there is one conduit wrapped with Thermo-Lag 770 in room 772.0-A2, which is considered a combustible. Section 6.1.7 of this evaluation includes a discussion of the partial suppression in these zones. Based on the small size of the unprotected area, the detection and automatic suppression throughout the other portions of the area, and at least 40 minutes of available margin, the NRC staff concludes that this is acceptable.

Note 12 – OMA 1495 for a fire in room 772.0-A15 West, lacks 40 minutes of time margin, and the room lacks full automatic suppression. The lack of automatic suppression is discussed in Note 11, which describes that detection is installed throughout the area, the area without suppression is small, and if a fire were to occur it would be controlled by suppression outside of the 315 square foot unprotected portion. Section 6.1.7 of this evaluation includes a discussion of the partial suppression in these zones. This OMA must be performed within 20 minutes, and the demonstrated performance time for the OMA is less than 2 minutes. TVA evaluated the OMA and concluded that the OMA would not be impacted if a fire were to occur in the unprotected area. Based on the small size of the unprotected area, TVA's evaluation that an unsuppressed fire would not impede the manual action, and at least 18 minutes of time margin, the NRC staff concludes that this is acceptable.

Note 13 – OMAs 1665 and 1666 for a fire in room 772.0-A15 West, lack 40 minutes of time margin, and the room lacks full automatic suppression. The lack of automatic suppression is discussed in Note 11, which describes that detection is installed throughout the area, the area without suppression is small, and if a fire were to occur it would be controlled by suppression outside of the 315 square foot unprotected portion. Section 6.1.7 of this evaluation includes a discussion of the partial suppression in these zones. These OMAs must be performed within 45 minutes, and the demonstrated performance time for the OMA is less than 8 minutes. TVA evaluated the OMA and concluded that the OMA would not be impacted if a fire were to occur in the unprotected area. Based on the small size of the unprotected area, TVA's evaluation that an unsuppressed fire would not impede the manual action, and at least 37 minutes of time margin, the NRC staff concludes that this is acceptable.

Note 14 – OMAs 1669 and 1670 for a fire in room 772.0-A15 West, lack 40 minutes of time margin, and the room lacks full automatic suppression. The lack of automatic suppression is discussed in Note 11, which describes that detection is installed throughout the area, the area without suppression is small, and if a fire were to occur it would be controlled by suppression outside of the 315 square foot unprotected portion. Section 6.1.7 of this evaluation includes a discussion of the partial suppression in these zones. These OMAs must be performed within 20 minutes, and the demonstrated performance time for the OMA is less than 5 minutes. TVA evaluated the OMA and concluded that the OMA would not be impacted if a fire were to occur in the unprotected area. Based on the small size of the unprotected area, TVA's evaluation that an unsuppressed fire would not impede the manual action, and at least 15 minutes of time margin, the NRC staff concludes that this is acceptable.

Note 15 – OMAs 1667 and 1668 for a fire in room 772.0-A15 West, lack 40 minutes of time margin, and the room lacks full automatic suppression. The lack of automatic suppression is discussed in Note 11, which describes that detection is installed throughout the area, the area without suppression is small, and if a fire were to occur it would be controlled by suppression outside of the 315 square foot unprotected portion. Section 6.1.7 of this evaluation includes a discussion of the partial suppression in these zones. TVA evaluated that the OMAs are needed within 22 minutes, but more specifically TVA's analysis indicates that there is 30 minutes to perform the operator manual actions for WBN Unit 2 to prevent steam generator overfill. In addition, TVA indicated that some controls, such as tripping pumps that contribute to steam generator overfill have their cables traced for a fire in this area. The analysis assumes that the pumps are not tripped, so tripping the pumps would allow more time to successfully complete the OMA before overfilling the steam generators. Based on the small size of the unprotected area, greater than 13 minutes available to perform the actions, and actions available in the control room to slow the overfilling of the steam generators, the NRC staff concludes that this is acceptable.

Note 16 - DBIPS-A and DBIPS-B, the IPS Duct Banks, have no detection or suppression and lack 40 minutes of time margin. These areas have no credible ignition sources for the installed cables in the area. Since these are underground electrical conduit banks, no transient combustibles are expected. The manual actions that may be needed for fires in these duct banks are OMAs 1023 (DBIPS-A) and 1024 (DBIPS-B). OMA 1023 (DBIPS-A) has 46 minutes of margin, and OMA 1024 (DBIPS-B) has 45 minutes of margin. Since these areas do not have fire detection, TVA allows for 10 minutes for visual fire validation, which results in over 35 minutes of margin when visual fire validation time is included. Based on the limited ignition sources for these underground duct banks, and the available time margin, the NRC staff concludes that this is acceptable.

Note 17 – Fire areas 58 and 59 (IPS-A and IPS-B), the Intake Pumping Station areas A and B, have fire detection over the ERCW pumps and in each of the ERCW strainer rooms. Each has a floor area in excess of 3500 square feet and a ceiling height of at least 13 feet. The combustibles in the areas consist of the insulation on cables in trays, oil associated with the pumps, transformers, and electrical panels. The areas do not contain redundant safe shutdown equipment. OMAs 1023 (IPS-A), and 1024 (IPS-B) have at least 40 minutes of time margin. Based on the partial detection, the size of the rooms, and the available time margin, the NRC staff concludes that this is acceptable.

Conclusion –Manual Actions

The NRC staff reviewed the information submitted by TVA regarding these specific OMAs and the fire scenarios that would cause them to be performed. The NRC staff concludes that, based on the fire protection defense-in-depth features and the feasibility and reliability of the OMAs, performance of these manual actions provides reasonable assurance that the capability to safely shut down will be available, and is, therefore, acceptable.

6.1.10 Evaluation – Fire Hazards Analysis in Lieu of 10 CFR Part 50, Appendix R, Section III.G.2 Separation

In FPR Part VII, Section 2.9, TVA stated that there are rooms at WBN that lack the separation described by Section III.G.2 of Appendix R to 10 CFR Part 50. For these rooms, TVA relied upon a fire hazards analysis (FHA) and an analysis of the safe shutdown capability rather than OMAs. In many cases these rooms are part of larger fire areas.

For all the rooms included as part of this evaluation, transient combustibles and ignition sources have been reported by TVA to be controlled by plant procedures. TVA provided a justification why certain ignition sources were not considered credible ignition sources. In addition, separation between adjacent rooms has been evaluated, and TVA concluded that no credible fire could spread either from or to adjacent rooms. TVA reported that room fires affecting the FSSD equipment would neither initiate nor require a plant trip.

10 CFR Part 50, Appendix R, Section III.G.2 states, requires, in certain circumstances, separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating, or by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards, along with fire detectors and an automatic fire suppression system. This separation of cables and equipment and the installation of fire detectors and an automatic fire suppression system is required in order to limit fire damage to one train of systems necessary to achieve and maintain hot shutdown conditions and to ensure that systems necessary to achieve and maintain cold shutdown can be repaired within 72 hours. Although TVA has some areas that lack the required separation, the NRC staff concludes that these areas are acceptable.

6.1.10.1 Rooms without Credible Ignition Sources and Redundant Trains

- Rooms 692.0-A29 and 692.0-A30 – Boric Acid Evaporator Package Rooms A and B
- Rooms 729.0-A1 and 737.0-A6 – WBN Unit 1 South Main Steam Valve Room and Air Lock
- Room 729.0-A2 – WBN Unit 1 North Main Steam Valve Room
- Room 729.0-A6 – Nitrogen Storage Area
- Room 729.0-A10 – WBN Unit 2 North Main Steam Valve Room
- Rooms 729.0-A11 and 737.0-A10 – WBN Unit 2 South Main Steam Valve Room and Air Lock
- Room 729.0-A12 – WBN Unit 1 Steam Valve Instrument Room A
- Room 729.0-A13 – WBN Unit 2 Steam Valve Instrument Room B
- Rooms 729.0-A15 and 763.5-A2 WBN Unit 2 Additional Equipment Building

TVA evaluated fire protection defense-in-depth for these rooms. These rooms have been reported to have minimal combustible loading consisting of plastics associated with small components or grease and oil associated with valves. Cables related to FSSD are installed within these rooms within conduit. Air lines that have a related FSSD function may be installed within these areas and are of welded steel construction. TVA evaluated air operated components, such as solenoid valves, based on the fire hazards in the areas and determined that there is no credible fire that would impact the valves. Also, for areas where such air operated components are installed, TVA determined that the system capacity is sufficient to allow for the loss of a device without impacting system functionality. Other than cables within conduit, welded steel air piping, and air operated components, no other FSSD equipment is installed in these rooms. TVA evaluated the installed equipment in these rooms and concluded that there are no credible in situ ignition sources. Other ignition sources and transient combustibles are controlled in accordance with plant procedures. TVA determined that, even without any installed fire detection or suppression, no fire scenarios could credibly affect the cables or air lines that are involved in plant safe shutdown. TVA determined that for each of these areas, if fire damage were to occur to the installed equipment a plant trip would not be initiated or required.

The NRC staff concludes that the lack of separation in these rooms is acceptable because of the fire protection defense-in-depth features, the limited combustibles, ignition sources and combustible controls, and because of no credible fire scenarios affecting FSSD equipment that would either initiate or require a plant trip.

6.1.10.2 Room 757.0-A13 – Refueling Floor and New Fuel Storage Vault

The refueling floor has two fixed ignition sources installed, specifically two auxiliary air compressor units and equipment associated with hydraulic cranes and hoists. The air compressors, although credible ignition sources, are more than 20 feet separated from each other with no intervening combustibles. Therefore, a fire affecting one compressor would not be expected to affect the other compressor. A failure of one of the compressors could cause the air supply system to lose supply pressure. The other train would be available. In addition, a low pressure alarm on the affected system would be annunciated in the MCR.

The crane and hoist are in operation only when plant personnel are operating them. Therefore, any fire would be quickly identified by personnel in the immediate vicinity, and this would provide assurance that other FSSD equipment would not be damaged.

The new fuel storage vault has negligible combustibles and no credible ignition sources.

The NRC staff concludes that the lack of separation in this room is acceptable because of the fire protection defense-in-depth features, the limited combustibles and combustible controls, the separation between redundant trains within the room with no intervening combustibles, the continuous staffing when cranes and hoists are used, and because there are no credible fire scenarios affecting FSSD equipment that would either initiate or require a plant trip.

6.1.10.3 Room 757.0-A14 – Unit 2 Reactor Building Access Room and Room 757.0-A15 – WBN Unit 2 Reactor Building Equipment Hatch

In contrast to the other rooms evaluated, these rooms have more than minimal combustible loading. The combustible loading is composed primarily of thermoset cable. The electrical circuits in the cables have circuit protection that reduces the likelihood of a self-ignited cable fire. TVA reported that there are no credible ignition sources in these rooms. In addition, each of these rooms is equipped with fire detection and automatic fire suppression systems.

For each of these rooms TVA identified five sets of redundant components. Each set of components is discussed below.

SGs 2 and 3 Main Steam Isolation Valves – The main steam isolation valves (MSIVs) are normally energized and fire damage that deenergizes the train will cause the MSIVs to close. Closed is the normal safe shutdown configuration. The fire damage failure mode of concern is a sustained hot short that keeps the MSIVs open.

In the unlikely event that damage causes a sustained hot short, given the limited ignition sources, full area detection and automatic suppression, the main steam system can be isolated from the MCR using the steam load valves.

RCP Seal Injection – An instrument cable for control circuits for the valve that controls the charging flow is located in these rooms near the ceiling. Based on the limited ignition sources and installation of an automatic fire suppression system, fire damage at the ceiling of these rooms is unlikely. In the unlikely event that the control circuits are damaged and the control valve spuriously operates, the indication is available and MCR operators could operate the valve using a different pressurizer level input or manually.

Control Cable for SG 3 PORV – A control cable for SG 3 power-operated relief valve (PORV) is routed through these rooms. A hot short to the control cable would cause the PORV to close, and not to be used for safe shutdown. In the unlikely event that a fire were to start, given the limited ignition sources, and the fire was not extinguished by the installed fire suppression system, the location of the cable in conduit over 20 feet above the floor provides assurance that cable damage would not occur.

Main Feedwater Isolation for SGs 2 and 3 – Main feedwater isolation valve control cables are installed in conduit in these rooms. Fire damage to these cables could interfere with the isolation of main feed water. In the unlikely event that a fire were to start, given the limited ignition sources, and the fire was not extinguished by the installed fire suppression system, operators in the MCR would still have available indication and controls over other valves that would be available to isolate the main feedwater flow.

Main Feedwater Bypass Line Isolation Valve Circuits for SGs 2 and 3 – Main feedwater bypass lines could remain open upon concurrent hot shorts of the control cables. In the unlikely event that a fire were to start, given the limited ignition sources, and fire was not extinguished by the installed fire suppression system, the control valves could still be closed by operator actions from the MCR.

The NRC staff concludes that the lack of separation in these rooms is acceptable because of the fire protection defense-in-depth features, the limited ignition sources, the available detection and suppression systems, and the height of the cables above the floor, or the alternative ways of meeting the safe shutdown goals using MCR actions.

6.1.10.4 WBN Unit 2 Containment Rooms

- Room 2RIR – WBN Unit 2 Reactor Instrument Room
- Rooms 2RA1, 2RA2, 2RA3, and 2RA4 – WBN Unit 2 Accumulator Rooms 1, 2, 3, and 4

- Rooms 2RF1 and 2RF2 – WBN Unit 2 Reactor Building Fan Rooms 1 and 2

- Rooms 2RI-1, 2RI-2, 2RI-3, and 2RI-4 – WBN Unit 2 Reactor Building Inside Crane Wall Rooms

- Rooms 2RO-1, 2RO-2, 2RO-3, and 2RO-4 – WBN Unit 2 Reactor Building Outside Crane Wall Rooms

TVA stated that these rooms have stronger combustible controls than other plant areas, since these areas are considered combustible control zones. In addition, many of these areas are inaccessible during power operations and involve the climbing of ladders for entry, which will reduce the likelihood of transient combustibles and ignition sources. TVA stated that none of these rooms have credible in situ ignition sources. TVA provided a discussion that concluded fires in adjoining rooms would not affect the FSSD equipment in these rooms, due to either the types and quantities of combustibles in the adjoining rooms, or installed automatic suppression and detection in the adjoining rooms. TVA stated that a fire in one of these rooms affecting FSSD equipment would neither initiate nor require a plant trip.

In addition to defense-in-depth features described above, the FSSD capability has one or more of the additional features that provide(s) additional assurance that a fire in one of these rooms will not challenge plant safe shutdown:

- redundant cables are separated by at least 2 feet horizontally

- cables are installed in conduit,

- alternate systems are available in the control room to shut down the plant,

- spurious actuations are avoided by the use of dedicated conduit with no other energized conductors,

- spurious actuations are avoided since they would only occur if there were a proper polarity two or three phase hot short,

- targets are high above the floor, at least 10 feet, and/or

- redundant trains may be located in the analysis volume (AV), but not in the room being evaluated.

The NRC staff concludes that the lack of separation in these rooms is acceptable because of the limited combustibles and ignition sources, the failure of the FSSD equipment or cables would not initiate or require a plant trip, and because the redundant safe shutdown circuits have one or more of the additional criteria described above.

6.1.10.4 Conclusion for section 6.1.10

Therefore, the NRC staff concludes that, for the areas described above, there is reasonable assurance that fire damage would be limited to one train of systems necessary to achieve and maintain hot shutdown conditions and that systems necessary to achieve and maintain cold shutdown would be able to be repaired within 72 hours.

6.2 Exceptions and Evaluations Related to BTP (APSCB) 9.5-1, Appendix A Guidance

6.2.1 Exception – Fire Detection in Refueling Room and New Fuel Storage Vault

TVA committed to follow the guidance in Positions F.12 and F.13 of Appendix A to BTP (Auxiliary Power Conversion Systems Branch (APCSB)) 9.5-1, which states that fire detectors should be installed in new fuel and spent fuel pool areas. Contrary to the guidance, the refueling room (Room 757.0-A13), which includes the New Fuel Storage Vault (elevation 741.5 feet), is not provided with a detection system.

TVA states that the refueling room is constructed of reinforced concrete. This room has a large open area with a floor area of approximately 16,000 square feet and a nominal ceiling height of 56 feet. The walls, floor, and penetration seals have a fire resistance rating of 2 hours or greater. The doors are not UL-listed doors, but have been evaluated as equivalent to fire-rated doors as listed in the FPR Part II, Table 14.8.1 (Fire Doors). The dampers have a rating of 1.5 or 3 hours, based on the rating of the barrier they are installed in, in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation systems."

During normal operations, the in situ combustible loading in the refueling room and the new fuel storage vault is insignificant, resulting in an equivalent fire severity of less than 5 minutes. There are no ignition sources in the new fuel storage vault. The combustible materials in the refueling room are widely dispersed, which further diminishes the magnitude of a postulated fire. The combustibles consist of InstaCote (a plastic type fuel transfer canal coating); lube oil in air compressors; hoists and cranes; plastics associated with the electrical equipment, panels, fuel pool boundary, lighting and boxes; rubber fire hose; and anticipated amounts of radwaste trash and laundry. TVA further stated that transient combustibles in the room are controlled by WBN procedure NPG-SPP-18.4.7, "Control of Transient Combustibles." The potential ignition sources in the room are panels, air compressors, transformers, and lighting cabinets. The only ignition sources that could impact an FSSD component or cable are the Trains A and B auxiliary air compressors.

The room is manned during an outage, which can assist in the early detection of a fire. The new fuel storage vault is only accessible from the refueling room, and that access is normally closed with a steel hatch cover. The cover is removed when new fuel is received and stored until needed for a refueling outage. Due to the high ceiling and limited amount of combustibles, a fire in this area may not have sufficient energy to create the necessary air currents to carry the smoke to the ceiling. In this situation, the smoke detectors at the ceiling level may not be able to provide early detection in the event of a fire.

Standpipe and hose stations are provided in the refueling room and in adjacent rooms.

The Trains A and B auxiliary air compressors supply backup air to the Trains A and B air header if the normal air supply from the station air compressors is unable to maintain minimum pressure on the air header. A fire involving either of the auxiliary air compressors would not impact the normal air supply or the other auxiliary air compressor. The worst case fire scenario would be a loss of one train of auxiliary control air, which would not require either unit to shut down. The other FSSD circuits are routed in conduits in the refueling floor area and are outside the fire zone of influence of the compressors. Therefore, a fire in the refueling room will not impact FSSD capability.

Appendix A to BTP (APCSB) 9.5-1, Positions F.12 and F.13 state that fire detectors should be installed in new fuel and spent fuel pool areas. Fire detectors are required in these areas to ensure a fire would be promptly detected so that manual suppression activities could be initiated thereby limiting fire damage. Although TVA is proposing that the refueling room (including the new fuel storage vault) not be equipped with a detection system, the NRC staff concludes that this is acceptable because of the size of the refueling room, the limited amounts of in situ and transient combustibles, the separation of the room from other plant areas by fire-rated barriers, and the routing of FSSD circuits in conduits away from credible ignition sources. Therefore, the NRC staff concludes that there is reasonable assurance that fire damage would be limited were a fire to occur in these areas.

6.2.2 Exception – Fire Doors

TVA committed to the guidance in Position D.1.j in Appendix A to BTP (APCSB) 9.5-1, which states that door openings should be protected with equivalently rated fire doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory.

In FPR Part VII, Section 4.1, TVA stated that, contrary to the guidance, a number of fire doors have been altered by the addition of signs and security hardware, or have been damaged and repaired on site. Additionally, special-purpose doors, such as flood doors and pressure doors, are not UL labeled.

The fire doors that are not listed or labeled as fire-rated assemblies have been evaluated to the guidance of National Fire Protection Association (NFPA) 80-1975, “Fire Doors and Windows,” by TVA or nationally recognized laboratories for fire door assemblies. The evaluation criteria for fire door assemblies are documented and controlled by WBN General Engineering Specification-73, “Installation, Modification and Maintenance of Fire Protection Systems and Features.”

FPR Part II, Table 14.8.1, lists the plant fire doors and the doors’ fire rating in hours. The table identifies doors that are not UL listed as having been evaluated and identified as equivalent to fire-rated doors or they have been evaluated as being acceptable. A number of the fire doors at WBN have been altered by the addition of signs and security hardware or have been damaged and repaired. Examples of other fire doors that are not UL rated are special purpose doors such as flood doors and pressure doors, security doors in the MCR that are constructed of heavy welded steel construction, and hollow core metal swinging doors.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that door openings should be protected with equivalently rated fire doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory. The protection of door openings in this manner is required to limit fire damage to the area where the fire occurred. Although TVA is proposing the use of doors that may not have been tested and approved by a nationally recognized testing laboratory, the NRC staff concludes that these doors are acceptable because they were evaluated to the guidance of NFPA 80-1975, and WBN General Engineering Specification-73 controls and documents the installation, modifications, and maintenance of all fire doors. Therefore, the NRC staff concludes that there is reasonable assurance that these doors would limit fire damage to the area where the fire occurred.

6.2.3 Exception – Openings in Fire Walls

TVA committed to the guidance in Section D.1.j of Appendix A to BTP (APCSB) 9.5-1, which states that fire barriers should be capable of withstanding the fire hazards to which they could be exposed. NRC GLs and guidance documents state that penetrations in walls, floors, and ceilings forming part of a fire barrier should be protected with seals or closure devices having a fire resistive rating equivalent to that required of the barrier.

In FPR Part VII, Section 4.2, TVA stated that there is a 6-inch-wide by 3-inch-deep gutter that penetrates each stairwell enclosure (Stairwells C1 and C2) from the corridor (Room 692.0-C11) in the control building.

These two stairwells are located at the opposite ends of the corridor (approximately 70 feet apart). The gutter penetrates the walls separating the stairwells from the corridor. Located in the gutter, there is one floor drain in each stairwell and two floor drains in the corridor.

The in situ combustible loading for the corridor is low and results in an equivalent fire severity of less than 20 minutes. The corridor is provided with a preaction sprinkler system that is actuated by an ionization type smoke detection system. Standpipe and hose stations are in the two stairwells, and portable extinguishers are provided in the corridor.

The in situ combustible liquids on elevation 692.0 feet of the control building are 35 gallons of lube oil associated with each of the two electrical board room chiller packages. The chiller packages are located in the Unit 2 mechanical equipment room, which is not part of Stairwells C1 or C2 or the corridor. However, the room is separated from Stairwell C2 by a 2-hour-rated reinforced concrete wall. The combustibles in the Unit 2 mechanical equipment room consist of lube oil in the chillers, plastics associated with the electrical panels, boxes, lights, and insulation on piping. The in situ combustible loading in this room is low resulting in an equivalent fire severity of less than 5 minutes. This room also has full detection and suppression installed.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that fire barriers should be capable of withstanding the fire hazards to which they could be exposed. This requirement for fire barriers ensures that the fire barrier will limit fire damage to the area where the fire occurred. Although TVA is proposing to allow a 6-inch-wide by 3-inch-deep gutter that penetrates each stairwell enclosure (Stairwells C1 and C2) from the corridor (Room 692.0-C11) in the control building. use of doors that may not have been tested and approved by a nationally recognized testing laboratory, the NRC staff concludes that these doors are acceptable because they were evaluated to the guidance of NFPA 80-1975, and WBN General Engineering Specification-73 controls and documents the installation, modifications, and maintenance of all fire doors. Therefore, the NRC staff concludes that there is reasonable assurance that these doors would limit fire damage to the area where the fire occurred.

6.2.4 Exception – Manual Hose Stations

TVA committed to the guidance in Section E.3.d of Appendix A to BTP (APCSB) 9.5-1, which states that interior manual hose installations should be able to reach any location with at least one effective hose stream. To accomplish this, standpipes with hose connections equipped with a maximum of 75 feet of 1-1/2-inch woven jacket lined fire hose and suitable nozzles should be provided.

In FPR Part VII, Section 4.3, TVA stated that there are manual hose stations with more than 75 feet of 1-1/2-inch UL listed or factory mutual-approved fire hose located throughout the plant. The pressure loss in fire hoses due to conditions such as friction with the inner wall of the hose and turbulent water flow is directly proportional to the length of the hose. If the pressure loss is excessive, the hose stream may not be effective.

To justify the use of hoses of greater than 75 feet in length up to 100 feet in length, TVA stated that these installations are consistent with the guidelines of NFPA 14-1974, "Standard for the Installation of Standpipe and Hose Systems," which allow up to 100 feet of hose connected to the standpipe.

For hose stations with more than 100 feet of hose, TVA stated that although those specific hose stations may not have been tested, hose stations at a higher elevation in the respective buildings were tested at a minimum of 65 psig at 500 gpm at a 2.5-inch hose connection. Also, TVA calculated that there is 6 psi additional pressure loss for each additional 25-foot section of hose. TVA stated, in its letter dated May 30, 2012 (ADAMS Accession No. ML12153A374), that the tested hose stations are 31.5 feet higher in elevation than the hose stations with the additional hose. TVA calculated that 31.5 feet of elevation equates to approximately 13.5 psig of additional pressure at the lower elevation. This additional pressure on lower elevations would provide sufficient additional pressure to compensate for the approximately 6 psi of pressure loss for each of the two additional hose sections and, therefore, would provide sufficient pressure and flow to meet the guidance of NFPA 14-1974.

Appendix A to BTP (APCSB) 9.5-1, Position E.3.d, states that interior manual hose installations should be able to reach any location with at least one effective hose stream, and that to accomplish this, standpipes with hose connections equipped with a maximum of 75 feet of 1-1/2-inch woven jacket lined fire hose and suitable nozzles should be provided. Manual hose installations to reach any location are required to ensure that there is a means to limit fire damage to SSCs important to safety so that the capability to safely shutdown the plant is maintained. Although the licensee is providing more than 75 feet of 1-1/2 inch fire hose on some hose stations, the NRC staff concludes that this is acceptable because NFPA 14-1974 allows up to 100 feet of hose, and because the licensee has demonstrated that for hose stations with 125 feet of hose installed, there is sufficient pressure and flow to reach any location with one effective hose stream which also meets the requirements of NFPA 14-1974. Therefore, the NRC staff concludes that there is reasonable assurance that the manual hose installation would limit fire damage to SSCs important to safety in order to maintain safe shutdown capability.

6.2.5 Exception – Fire Barrier Penetration between Fuel Oil Transfer Pump Room and the Diesel Generator Building Corridor

TVA committed to the guidance in Position D.1.j of Appendix A to BTP (APCSB) 9.5-1, which states that penetrations in 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 barrier ratings.

In FPR Part VII, Section 4.6, TVA stated that the fire barrier separating the fuel oil transfer pump room (Room 742.0-D8) from the DG building corridor (Room 742.0-D9) is a 2-hour-rated fire barrier and has a penetration containing a steel box. This penetration is not a tested fire-rated penetration assembly.

The fire barrier separating the fuel oil transfer pump room and the corridor is constructed of 8-inch-thick reinforced concrete block and is fire-rated for 2 hours. The annular gap between the block wall and the box is filled with concrete grout, but no sealant material is installed within the box. The box back (inside the fuel oil transfer pump room) is a steel plate. The front of the panel is a steel plate with cutouts for three metal junction boxes.

The in situ combustible loading of the fuel oil transfer pump room is approximately 3,730 Btu/ft^2 and is due to insulation on cables associated with panel 0-L-162, hand switches, an emergency lighting unit, and foam plastic insulation. The in situ combustible loading of the corridor is approximately 77,700 Btu/ft^2 of which approximately 96 percent is due to insulation on cables in cable trays. The other in situ combustibles are dispersed throughout the corridor and do not present a direct exposure hazard to the box. The corridor width at the panel is approximately 6 feet. The door into the 2B-B DG is across from the box and the door to the fuel oil transfer pump room is next to the box. The end of the corridor is less than 6 feet from this door. TVA stated that this arrangement minimizes the probability of transient combustibles being stored near the box.

The fuel oil transfer pump room is provided with a fire detection system and a total flooding automatic CO_2 suppression system. The detection system alarms in the MCR and actuates the suppression system. The corridor is provided with a fire detection system and an automatic sprinkler system. The detection system alarms in the MCR and actuates the suppression system.

The top of the box is located approximately 13 feet below the ceiling. TVA stated that, in light of this distance and the location of the box at the end of the corridor, the detection system should alarm the MCR and actuate the suppression system before a hot gas layer could challenge the box.

TVA stated that the fuel oil transfer pump room and the corridor (analysis volume AV-081B) do not contain components required for safe shutdown in the event of a fire in these rooms. The small amount of in situ combustibles and the lack of free floor space limit the quantity of transient combustibles, thereby limiting the severity of a postulated fire in the room. The failure of a fuel oil line or pump that resulted in a fire is addressed by the total flooding, automatic CO_2 suppression system that will also control a postulated transient fire until the fire brigade responds.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations in 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 and that the fire hazard in each area should be evaluated to determine barrier requirements. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to shutdown the plant safety is maintained. Although TVA is proposing the use of an unrated penetration in a 2 hour rated barrier between the fuel oil transfer pump room and the DG building corridor, the NRC staff concludes that this configuration is acceptable because the unrated penetration is configured in such a way as to prevent the passage of flames, hot gases, or water from the corridor to the fuel oil transfer pump room or vice versa; because neither area contains components requirement for safe shutdown; because fire severity in either room is limited; and, because automatic suppression is provided. Therefore, the NRC staff concludes that there is reasonable assurance that the unrated penetration would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.6 Exception – Undampered Penetrations between the Unit 1 Penetration Room and the Unit 1 Annulus and the Unit 2 Penetration Room and the Unit 2 Annulus

In FPR Part VII, Section 3.2, TVA stated that the walls separating the Unit 1 penetration room (Room 713.0-A6) from the Unit 1 Annulus and the Unit 2 penetration room (Room 713.0-A19) from the Unit 2 Annulus are 3-hour rated fire barriers. The containment purge air system return and exhaust ducts penetrate these walls in three places. The penetrations are not provided with fire dampers.

TVA provided the following details regarding these configurations:

- The ducts are constructed of 0.25 inch thick steel plates and welded schedule 10 pipe.
- The connection between the duct and the purge air system is protected by 3M M20A wrap in Room 713.0-A6 and 3M E54C wrap in Room 713.0-A19. Both wraps provide 3-hour fire resistance.
- The ducts are rigidly attached to the concrete wall.
- The penetrations are not straight-through, instead the openings in the concrete wall are offset to provide radiation protection.
- The ducts have no openings in the pipe chase.
- There is automatic detection and suppression installed in the annuluses and pipe chases.
- The two annuluses and the areas under the ducts in the pipe chases are combustible control zones.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations for ventilation systems should be protected by a standard "fire door damper" where required. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing that no fire dampers be installed in the containment purge air system return and exhaust ducts in the fire barriers between the WBN Unit 1 penetration room (Room 713.0-A6) and the WBN Unit 1 Annulus, and the WBN Unit 2 penetration room (Room 713.0-A19) from the WBN Unit 2 Annulus, the NRC staff concludes that this is acceptable because of the physical configuration as described above, the installed fire protection systems, and the administrative controls. Therefore, the NRC staff concludes that there is reasonable assurance that the lack of fire dampers would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7 Exception – Openings in Fire Barriers

Section D.1.j of Appendix A to BTP (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Plants Docketed Prior to July 1, 1976," specifies that penetrations in walls, floors, and ceiling forming part of a fire barrier be protected with self-closure devices having a fire-resistive rating equivalent to that of the barrier.

6.2.7.1 Ventilation and Purge Air Room Ventilation Penetrations

In FPR Part VII, Section 2.6.1, TVA stated that the ventilation and purge air (VPA) rooms (Rooms 737.0-A5 and 737.0-A9), the post-accident sampling system (PASS) rooms (Rooms 729.0-A8 and 729.0-A9), and the nitrogen storage room (Room 729.0-A6) are separated by 2-hour fire-rated barriers. The walls and floor of the VPA rooms are penetrated by HVAC ducts that pass from the PASS rooms, enter the VPA rooms, and then exit into the PASS and nitrogen storage rooms. TVA stated that the ducts have no fire dampers, but they also have no openings into the VPA rooms. Additionally, one duct enters each VPA room from the nitrogen storage room and terminates at a normally closed isolation damper. The ducts are constructed from Schedule 40 carbon steel pipe. Pipe sleeves are provided where the ducts penetrate the barriers between the VPA rooms and the PASS rooms and nitrogen storage rooms. Further, the annular space between the sleeves and the ducts is sealed with a fire-rated seal.

TVA stated that each of these rooms contains safe shutdown equipment. TVA further stated that the VPA and PASS rooms have fire detection and automatic fire suppression systems installed, and the nitrogen storage room has ionization smoke detection. Standpipe and hose systems are available in adjacent rooms and portable extinguishers are also available for manual firefighting in these rooms.

TVA stated that the significant fire exposure to the ducts from the VPA rooms consists of charcoal filter units in each VPA room. TVA also stated that closed-head water-spray suppression systems are provided for the charcoal filters and are actuated by duct-mounted ionization smoke detectors.

TVA stated that the effect of a fire in the PASS rooms or the nitrogen storage room would be experienced in the VPA rooms in the form of radiant heat from hot gases passing through the ducts. In the VPA rooms, TVA stated that no fixed combustibles are located in the immediate vicinity of these ducts, and the ducts are separated from the nearest safe shutdown circuit by more than 20 feet.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations for ventilation systems should be protected by a standard "fire door damper" where required. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing that no fire dampers be installed in the HVAC ducts that pass from the PASS rooms, enter the VPA rooms, and then exit into the PASS and nitrogen rooms, the NRC staff concludes that this is acceptable because of the installed fire detection and automatic fire suppression systems, the special hazard protection for the charcoal filters, and the construction of the ducts. Therefore, the NRC staff concludes that there is reasonable assurance that the lack of fire dampers would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.2 Scuppers

6.2.7.2.1 ERCW Pump Room

TVA committed to the guidance in Position D.1.j of Appendix A to BTP (APCSB) 9.5-1, which states that penetrations in fire barriers, including conduits and piping, be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself.

In FPR Part VII, Section 2.6.2.1, TVA stated that, contrary to Position D.1.j, on elevation 741.0 feet of the IPS, there are four scupper openings penetrating the fire wall between the ERCW pump rooms and traveling screen room.

The wall separating the redundant ERCW pumps and the wall separating the ERCW pumps from the traveling screen pumps are 3-hour fire-rated barriers with the exception of the four scupper openings. These scupper openings are located at the floor and provide drainage of rainwater from the ERCW pump rooms to the traveling screen wells. The floor slopes away from the ERCW pumps toward the scuppers so that a fire in one ERCW pump room will not propagate through the scuppers and jeopardize a redundant train of ERCW pumps.

The wall separating the ERCW pump rooms and traveling screen room is intended to protect the rooms from the radiant heat of an exposure fire. The roof is designed as a missile shield and has beams that will allow free air flow from a fire to dissipate heat to the outside environment.

ERCW Pump Rooms A and B have heat detectors installed over the ERCW pumps, and standpipe and hose stations are accessible for manual firefighting activities. TVA stated that even though these rooms are not provided with suppression and full area detection, the fire area barrier ratings are sufficient given the combustible loadings in the area.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations in 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 and that the fire hazard in each area should be evaluated to determine barrier requirements. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to shutdown the plant safety is maintained. Although TVA is proposing four unrated scupper openings penetrating the fire wall between the ERCW pump rooms and traveling screen room, the NRC staff concludes that this is acceptable because of the location of the scupper openings, the floor slope away from the ERCW pumps, the installed heat detectors over the ERCW pumps, and the availability of standpipe and hose systems for manual firefighting activities. Therefore, the NRC staff concludes that there is reasonable assurance that the unrated penetrations would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.2.2 Yard Duct Bank

TVA committed to the guidance in Position D.1.j of Appendix A to BTP (APCSB) 9.5-1, which states that penetrations in fire barriers, including conduits and piping, be sealed or closed to provide a fire resistance rating at least equal to that of the fire barrier itself.

In FPR Part VII, Section 2.6.2.1, TVA stated that contrary to Position D.1.j, there are scupper openings in the Train A and Train B yard duct banks that run from the auxiliary building to the IPS where they share a common wall in three manholes.

Manholes 1A and 1B, 2A and 2B, and 3A and 3B are used to access the Train A and Train B duct banks that connect the auxiliary building to the IPS. The Train A and Train B duct banks are separated by a 12-inch thick reinforced concrete wall at each pair of manholes. One manhole in each pair contains a sump pump and is connected to the other manhole by a 2-inch diameter scupper opening. There are no other openings in the common wall separating the Train A and Train B manholes.

Cable insulation is the only combustible material in the yard duct banks where they share a common wall. The sump pumps are the only equipment in the yard duct banks where they share a common wall.

TVA stated that a postulated fire in the cable insulation of one duct bank or in the sump pump will not propagate through the scupper openings to the adjacent duct bank due to the lack of continuity of combustible materials between duct banks.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations in 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 and that the fire hazard in each area should be evaluated to determine barrier requirements. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to shutdown the plant safety is maintained. Although TVA is proposing four unrated scupper openings in the Train A and Train B yard duct banks that run from the auxiliary building to the IPS where they share a common wall in three manholes, the NRC staff concludes that this is acceptable because of the lack of combustibles, the lack of ignition sources, and the inability of a fire to propagate from one duct bank to the other. Therefore, the NRC staff concludes that there is reasonable assurance that the unrated penetrations would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.3 Auxiliary Building Penetrations

In FPR Part VII, Section 2.6.3, TVA described the following unprotected openings in the auxiliary building:

- *Open Stairs and Hatches.* TVA stated that water curtains designed in accordance with NFPA 13-1974, Section 4-4.8.2, have been installed to protect the openings listed in FPR Part VII, Section 2.6.3.1.

- *Sheet Metal Ducts That Are Not Provided with Fire Dampers.* TVA stated that these ducts are constructed of minimum 22 gauge sheet metal, are securely fastened to the fire barrier with angle steel, and that automatic suppression and detection is provided on at least one side of the opening. Finally, TVA stated that the safe shutdown analysis considered these openings as unprotected and ensured that a fire on either side of the opening would not impact both paths of redundant safe shutdown components, cables, or equipment.

- *Round HVAC Ducts Constructed of Spiral Welded Pipe or Schedule 10 Piping*. TVA stated that these ducts are treated as normal mechanical penetrations with appropriate fire rated mechanical penetration seals.

- *Spare Conduit Sleeves.* As described in FPR Part VII, Section 2.6.3.3, TVA stated that spare conduit sleeves which penetrate fire barriers are provided with approved sealant material, capped on each end with metal caps or plugs, or a combination of the two.

- *Unrated Steel Hatches into Monolithic Concrete Enclosures*. As described in FPR Part VII, Section 2.6.3.4, TVA stated that the monolithic enclosures in which the steel hatches are located are not open to other rooms on other elevations. Further, TVA stated that there are no safe shutdown cables or components within the monolithic enclosures.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations in 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 and that the fire hazard in each area should be evaluated to determine barrier requirements. Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations for ventilation systems should be protected by a standard "fire door damper" where required. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to shutdown the plant safety is maintained. Although TVA is proposing open stairs and hatches, sheet metal ducts without fire dampers, round HVAC ducts constructed of spiral welded pipe or schedule 10 piping, spare conduit sleeves, and unrated steel hatches into monolithic concrete enclosures, in the Auxiliary building, the NRC staff concludes that these configurations are acceptable because of either the installed water curtains, the physical configuration of the ducts, the installed automatic detection and suppression systems, the installed sealant material and/or caps and plugs, or the lack of safe shutdown cables or components. Therefore, the NRC staff concludes that there is reasonable assurance that these configurations would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.4 Control Building Equipment Hatches to the Turbine Building

In FPR Part VII, Section 2.6.4, TVA stated that the mechanical equipment rooms in the control building (Rooms 692.0-C1 and 692.0-C10) are provided with equipment hatches in the ceiling separating them from the turbine building. The equipment hatches have flush fitting steel covers which are not fire rated. TVA stated that the covers are vital area boundaries with access control and security features attached to the undersides, to prevent inadvertent removal.

TVA stated that the covers do not form a watertight seal, but will limit any flammable and combustible liquid spills through the hatch openings into the control building mechanical equipment rooms. Seepage could occur around the perimeter where the covers are mounted to the floor and through the small diameter holes in the covers that are provided to facilitate their removal.

TVA stated that there are no safe shutdown components in the turbine building within 20 feet of the equipment hatches, so that a fire that spreads up into the turbine building will not impact FSSD capability. Further, TVA stated that the mechanical equipment rooms are provided with automatic detection and preaction sprinkler systems, including sidewall heads in the vicinity of the hatches. TVA stated that the installed detection and suppression systems would control or extinguish postulated fires passing through the hatch covers prior to arrival of the fire brigade.

Appendix A to BTP (APCSB) 9.5 1, Position D.1.j states that penetrations in 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 and that the fire hazard in each area should be evaluated to determine barrier requirements. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to shutdown the plant safety is maintained. Although TVA is proposing unrated equipment hatches between the mechanical equipment rooms of the control building and the turbine building, the NRC staff concludes that these hatches are acceptable because of the hatch configuration, the separation between FSSD equipment, and the installed fire protection systems. Therefore, the NRC staff concludes that there is reasonable assurance that these configurations would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.5 1-½ Hour Rated Fire Dampers

6.2.7.5.1 Fire Damper 0-ISD-30-620

In FPR Part VII, Section 4.7, TVA stated that fire damper 0-ISD-30-620 located in the 3-hour fire-rated floor separating the DG building corridor (Room 742.0-D9A) from the Unit 1 A-A DG exhaust room (Room 760.5-D3) is a 1-1/2-hour fire resistance rated damper. TVA also stated that there is detection installed in both rooms and an automatic preaction sprinkler system in the corridor and that manual suppression capability is available from hose stations and hydrants at the DG building.

TVA stated that the DG building corridor has a low in situ combustible loading (less than 1 hour) and the DG exhaust room has a moderate in situ combustible loading (less than 2 hours). In accordance with NFPA Standard 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems,” a fire damper with a 1-1/2-hour fire resistance rating is appropriate for installation in barriers with a fire resistance rating of 2 hours.

TVA determined that a fire in the DG building will not result in a loss of offsite power. TVA also stated that there is no equipment in the DG building required to achieve post-FSSD for a fire in the DG building. The only time these rooms would be needed for post-FSSD is for fires in other buildings and areas of the plant.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations for ventilation systems should be protected by a standard "fire door damper" where required. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of 1-1/2 hour fire resistance rated dampers in the 3-hour rated barrier between the DG building corridor and the Unit 1 A-A DG exhaust room, the NRC staff concludes that this is acceptable because of the installed fire protection features, the hazards present in the rooms, and the lack of equipment needed for post-FSSD. Therefore, the NRC staff concludes that there is reasonable assurance that the installed 1-1/2 hour fire resistance rated dampers would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.7.5.2 Fire Dampers 0-ISD-31-2427 and 0-ISD-31-2429

In FPR Part VII, Section 4.7, TVA stated that fire dampers 0-ISD-31-2427 and 0-ISD-31-2429 located in the 3-hour fire-rated wall separating the waste packaging room (Room 729.0-A4) from the condensate demineralizer waste evaporator (CDWE) building are 1-1/2-hour fire resistance rated dampers. TVA also stated that there is detection and an automatic preaction sprinkler system installed in the waste packaging room, and that manual suppression capability is available from hose stations in the CDWE and the auxiliary building railroad bay (an adjoining room to the waste packaging room).

TVA stated that the waste packaging room has a moderate (less than 2 hours) in situ combustible loading and the CDWE has a low (less than 1 hour) in situ combustible loading. In accordance with NFPA Standard 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems,” a fire damper with a 1-1/2-hour fire resistance rating is appropriate for installation in barriers with a fire resistance rating of 2 hours.

TVA stated that a fire in either room does not adversely impact post-FSSD of the plant since there is no equipment in either the CDWE or the waste packaging room that is needed for post-FSSD for a fire in any plant area.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j states that penetrations for ventilation systems should be protected by a standard "fire door damper" where required. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of 1-1/2 hour fire resistance rated dampers in the 3-hour rated barrier between the waste packaging room and the CDWE building, the NRC staff concludes that this is acceptable because of the installed fire protection features, the hazards present in the rooms, and the lack of equipment needed for post-FSSD. Therefore, the NRC staff concludes that there is reasonable assurance that the installed 1-1/2 hour fire resistance rated dampers would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.8 Evaluation – Large Fire Dampers

TVA committed to the guidance in Position D.1.j of Appendix A to BTP (APCSB) 9.5-1, which states that fire dampers should be tested and approved by a nationally recognized laboratory and the tests shall bound the installed configurations. In FPR Part VII, Section 3.4, TVA stated that in a December 12, 1984, report, UL stated that the maximum sizes of dampers covered by its classification and followup service program are 90 inches wide by 72 inches high in multiple assemblies (maximum sections being 30 inches wide by 36 inches high) and that dampers exceeding this are not eligible to be labeled. Contrary to this, fire dampers 1-ISD-31-3807 and 2-ISD-31-3882 consist of four 24-inch-wide and 24-1/2-inch-high damper sections resulting in an opening 98-5/8 inches wide by 24-1/2 inches high. This exceeds the UL-rated damper width by 8-5/8 inches.

TVA further stated that fire tests reports dated June 15 and July 19, 1984, document the results of tests conducted by UL for Ruskin (the damper manufacturer) on large-size damper installations. The large damper configurations in the two tests (100 inches by 91 inches and 100 inches by 72 inches) both passed the 3-hour fire endurance acceptance criteria by remaining in place and not having an opening in the damper configuration. Both configurations, however, failed the hose stream test at the end of the 3-hour fire exposure. The report dated December 12, 1984, documented UL’s evaluation of WBN’s installation of the large dampers.

The large fire damper installations at WBN are constructed from individual damper sections which are smaller than the maximum allowed by UL. The UL-listed assembly is three sections wide by two sections high, but the WBN configuration is one section high and four sections wide, thus making the assembly more rigid and less susceptible to buckling and twisting under actual fire conditions. Also, the individual damper sections are 24 inches wide by 24-1/2 inches high, which are less than the UL-allowable 30 inches wide by 36 inches high. The overall damper height is 24-1/2 inches high, and the UL-allowable height is 72 inches, when two 36-inch dampers are stacked.

In the December 12, 1984, report, UL indicated that the WBN dampers (98-5/8 inches wide by 24-1/2 inches high) should have significantly less buckling and twisting of the vertical mullions than the tested damper (91 inches wide and 72 inches high) noted in the June 15, 1984, report. UL also concluded that the large damper installations at WBN provide adequate protection for their HVAC penetration.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j, states that fire dampers should be tested and approved by a nationally recognized laboratory and the tests shall bound the installed configurations. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of large fire dampers that are not tested and approved by a nationally recognized laboratory, the NRC staff concludes that this is acceptable because of the physical configuration of the dampers, and because of the UL conclusion that the large damper installations provide adequate protection for the HVAC penetrations. Therefore, the NRC staff concludes that there is reasonable assurance that the large fire dampers would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.9 Evaluation – Emergency Diesel Generators 7 Day Storage Tanks

TVA committed to the guidance in Position F.10 of Appendix A to BTP (APCSB) 9.5-1, which states that diesel fuel oil tanks with a capacity of over 1,100 gallons should not be located inside buildings containing safety-related equipment. If located inside such buildings, the tanks should be separated by 3-hour fire barriers. Buried tanks are considered to meet the 3-hour fire resistance rating.

In FPR Part VII, Section 4.4, TVA stated that there are four 7-day (70,248-gallon) storage tank assemblies, one per DG, that are almost entirely buried below the floor of the DG building. The fuel oil storage assembly for each DG consists of four interconnected tanks, each with its own manway access openings, one at either end of the tank. There are a total of 16 manway access openings to the tanks from the corridor and four in each DG room. The manway access openings are the only portion of the tanks that are not buried underneath the floor of the DG building.

Each manway access opening is in a pit covered by a removable plate cover sitting over the top of the pit flush with the floor. The cover is 1/4-inch-thick steel plate, secured to the top of the tank by eighteen (18) 1/2-inch bolts. There are three normally closed openings in the cover plates in the corridor. Two of the openings are provided for fuel oil circulation, and the other is for taking fuel oil samples.

The Pipe Gallery and Corridor (Room 742.0-D9) and DG Units 1A-A, 2A-A, 1B-B, and 2B-B (Rooms 742.0-D4, D5, D6 and D7) are provided with full area detection and automatic suppression systems. The DG units each have heat detectors and a total flooding CO_2 suppression system. Standpipe and hose stations are provided within the DG building on both elevations, and there are also fire hydrants available in the yard. The Pipe Gallery and Corridor has smoke detectors and an automatic preaction sprinkler system. A standpipe and hose station is provided in the Pipe Gallery and Corridor.

Fire effects on the emergency diesel generators and associated cables in the DG building will not have an adverse effect on safe shutdown. The DGs are not credited for any fire in the DG building. The DG building is located remotely from other buildings containing equipment or cables needed for safe shutdown. This is because offsite power capabilities have been evaluated and determined not to be affected or required for a fire in the DG building, including the corridor.

Appendix A to BTP (APCSB) 9.5-1, Position F.10, states that diesel fuel oil tanks with a capacity of over 1,100 gallons should not be located inside buildings containing safety-related equipment, that if located inside such buildings, the tanks should be separated by 3-hour fire barriers, and that buried tanks are considered to meet the 3-hour fire resistance requirements. The proper placement of diesel fuel oil tanks is a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of four partially buried tanks in the DG building, the NRC staff concludes that this configuration is acceptable because of the physical construction of the manway access openings, the manway access openings being the only portion of the tanks that are not buried, the installed detection and suppression systems, the DGs not being required for any fire in the DG building, location of the DG building, and the offsite power capabilities not being affected by a DG building fire. Therefore, the NRC staff concludes that there is reasonable assurance that the partially buried tanks in the DG building would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.10 Evaluation – Fire Dampers in the VCT Room Doors

In FPR Part VII, Section 3.5, TVA stated that a fire damper in the door connecting each of the two volume control tank (VCT) rooms with the associated pipe gallery has been changed from a blade-type to a curtain-type configuration. The new dampers are damper/sleeve assemblies, installed with the damper inside the doors. The sleeve extends a short distance on each side of the opening. The door was tested with the original damper, but not with the new damper.

TVA provided the following details regarding these configurations:

- The combustible loading in the immediate vicinity of the doors is insignificant.
- The new dampers are listed dampers.
- The rooms on both sides of the doors are provided with automatic fire detection and suppression, with the exception of the VCT rooms' entrance labyrinths.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.j, states that door openings should be protected with equivalent rated doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory and that such doors should be normally closed and locked or alarmed with alarm and annunciation in the control room. Penetrations in fire barriers are required to be rated as they are a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of untested doors connecting each of the two VCT rooms with the associated pipe gallery, the NRC staff concludes that these doors are acceptable because of the physical configuration, the installed fire protection systems, and the limited combustibles in the area. Therefore, the NRC staff concludes that there is reasonable assurance that use of these doors would not impact fire damage limits or the capability to safely shutdown the plant.

6.2.11 Evaluation – Plexiglas Windows in the Radiation Protection Control Point Building on the Refueling Floor

TVA committed to the guidance in Position D.1.d in Appendix A to BTP (APCSB) 9.5-1, which states, in part, that interior finishes should be noncombustible or have a flame spread rating of 25 or less.

In FPR Part VIII, TVA stated that, contrary to the guidance, the windows in the radiation protection control point building (on the 757.0 foot elevation on the Refueling Floor) was built with Plexiglas windows, which do not meet the flame spread criteria. TVA stated the following concerning the Plexiglas windows:

- Based on operating experience at Sequoyah Nuclear Plant (i.e., a near-miss incident), glass windows pose a safety concern.
- Available alternatives either do not meet the flame spread criteria, or are not sufficiently transparent.
- The Plexiglas windows add an insignificant amount of combustibles to a large room.
- The Plexiglas windows have no effect on the safe shutdown analysis.
- The building is not used for safe shutdown.

Appendix A to BTP (APCSB) 9.5-1, Position D.1.d states, in part, that interior finishes should be noncombustible or have a flame spread rating of 25 or less. Use of non-combustible interior finishes or interior finishes with a flame spread rating of 25 or less is required in order to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing the use of Plexiglas windows that do not meet the flame spread criteria in the radiation protection control point building, the NRC staff concludes that this is acceptable because the use of Plexiglas windows only adds an insignificant amount of combustibles to a large room, the use of Plexiglas windows has no effect on the safe shutdown analysis, and because the building is not used for safe shutdown. Therefore, the NRC staff concludes that there is reasonable assurance that use of Plexiglas would not impact fire damage limits or the capability to safely shutdown the plant.

6.3 Additional Engineering Evaluations

6.3.1 Evaluations Related to the Reactor Buildings' Equipment Hatches

6.3.1.1 Relaxation of FPR Surveillance Frequencies for the Reactor Buildings' Equipment Hatches

FPR Part VII, Section 6.1, summarizes TVA's evaluation of relaxing the surveillance frequencies for fire protection features (smoke detectors, sprinklers, Thermo-Lag, penetration seals) from their regular schedules elsewhere in the plant for the equipment hatches (Rooms 757.0-A11 and -A15). TVA stated that these actions will be performed during outages, because these areas are inaccessible high-radiation areas while the associated unit is operating.

These rooms connect the refueling floor and the reactor buildings and provide equipment access. TVA stated that the rooms are constructed of reinforced concrete and are provided with smoke detectors and automatic preaction sprinkler systems. The rooms are inaccessible during plant operations by the closure of the equipment hatch doors and placement of concrete shield blocks. FPR Part VI states that the rooms' barriers are 3-hour fire-rated, with the exception of the blast door into the reactor building. TVA stated that these doors are of heavy metal construction that would prevent a fire from propagating from either the reactor building into the room or from the room into the reactor building. TVA further stated that combustible loading in the rooms is comprised of cable insulation, light covers, and Thermo-Lag (Room 757.0-A11 only), and that there are no ignition sources in the rooms during power operation.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing to only conduct fire protection systems and equipment surveillances for the equipment hatches (Rooms 757.0-A11 and -A15) during outages, the NRC staff concludes that this is acceptable because the rooms are not accessible during normal plant operations, the rooms are equipped with 3-hour fire rated barriers, the limited amount of combustible loading in the rooms, and the lack of ignition sources. Therefore, the NRC staff concludes that there is reasonable assurance that the reduced fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.1.2 Elimination of Certain Compensatory Measures for the Reactor Buildings' Equipment Hatches

FPR Part VII, Section 6.1, also summarizes TVA's evaluation of not performing certain compensatory measures for out of service fire protection features (smoke detectors, sprinklers) for the equipment hatches (Rooms 757.0-A11 and -A15). TVA stated that compensatory measures performed inside these rooms are impractical when these rooms are inaccessible high radiation areas, that is, while the associated unit is operating.

These rooms connect the refueling floor and the reactor buildings, and provide equipment access. TVA stated that the rooms are constructed of reinforced concrete and are provided with smoke detectors and automatic preaction sprinkler systems. The rooms are inaccessible during plant operations by the closure of the equipment hatch doors and placement of concrete shield blocks. FPR Part VI states that the rooms' barriers are 3-hour fire-rated, with the exception of the blast door into the reactor building. TVA stated that these doors are of heavy metal construction that would prevent a fire from propagating from either the reactor building into the room or from the room into the reactor building. TVA further stated that combustible loading in the rooms is comprised of cable insulation, light covers, and Thermo-Lag (Room 757.0-A11 only), and that there are no ignition sources in the rooms during power operation.

The performance of compensatory measures for out of service fire protection features are required in order to maintain some level of fire protection to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing to not perform compensatory measures for out of service fire protection features (smoke detectors, sprinklers) for the equipment hatches (Rooms 757.0-A11 and -A15) during plant operation, the NRC staff concludes that this is acceptable because the rooms are not accessible during normal plant operations, the rooms are equipped with 3-hour fire rated barriers, the limited amount of combustible loading in the rooms, and the lack of ignition sources. Therefore, the NRC staff concludes that there is reasonable assurance that not performing certain compensatory measures during plant operations would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.2 Relaxation of FPR Surveillance Period for Fire Dampers in High Radiation and Contaminated Areas

In FPR Part VII, Section 6.2, TVA evaluated the need to perform surveillance for fire dampers in high radiation or contaminated areas. TVA evaluated the consequences of the failure of the following fire dampers to close during a fire event: 0-ISD-31-3846, 0-ISD-31-3847, and 0-ISD-31-3848. TVA stated that these fire dampers are located in contaminated areas and are considered to be inaccessible.

6.3.2.1 Fire Damper 0-ISD-31-3846

TVA stated that fire damper 0-ISD-31-3846 is located in a 24-inch-diameter embedded duct that starts at an embedded collector box located in the Fuel Transfer Canal wall and runs for 40 feet where it exits the concrete wall of the VPA room (Room 737.0-A5) and then enters a large (64-inch by 54-inch) duct.

TVA also stated that there is no combustible hazard in the fuel transfer canal, and negligible quantities of combustibles in the vicinity of the duct in the VPA room. TVA further stated that the room is provided with smoke detection and automatic suppression. Finally, TVA stated that should a fire breach the walls of the duct in the VPA room, the fire would have to travel a distance of 40 feet to reach the fuel transfer canal.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of fire dampers in high radiation or contaminated areas, the NRC staff concludes that this is acceptable because of the limited combustibles in each room, the distance the fire would have to travel to reach the other room, the automatic suppression installed in the VPA room, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of this fire damper is consistent with Interpretation 4, “Fire Area Boundaries,” of GL 86-10 and, therefore, is acceptable. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.2.2 Fire Dampers 0-ISD-31-3847 and 0-ISD-31-3848

TVA stated that one of the fire dampers is located in a 24-inch-diameter embedded duct that starts at an embedded collector box located in the spent fuel pit wall, runs for approximately 5 feet where it exits the concrete wall, traverses a corridor, and penetrates the concrete wall of the VPA room, and then enters a large (58-inch by 54-inch) duct. TVA stated that the other fire damper is located in a 30-inch-diameter embedded duct that starts at an embedded collector box located in the opposite wall of the spent fuel pit, runs for approximately 80 feet where it exits the spent fuel pit wall (near the 24-inch duct), traverses the corridor, and penetrates the wall of the VPA room and enters the large duct.

TVA stated that both ducts are coated with 2 inches of fire protective material (Pyrocrete) where they traverse the corridor. Further, TVA stated that there are no combustible hazards in the spent fuel pit and negligible quantities of combustibles in the vicinity of the ducts in the corridor and near the ducts in the VPA room. In addition, the corridor and the VPA room are provided with smoke detection, and the VPA room is also provided with automatic suppression. Finally, TVA indicated that, should a fire breach the walls of the ducts in the VPA room, the fire would have to travel the width of the corridor plus a distance of 5 feet (24-inch duct) or 80 feet (30-inch duct) to reach the spent fuel pit, which is filled with water.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of fire dampers in high radiation or contaminated areas, the NRC staff concludes that this is acceptable because of the limited combustibles in each room, the distance the fire would have to travel to reach the other room, the automatic suppression installed in the VPA room, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of this fire damper is consistent with Interpretation 4, “Fire Area Boundaries,” of GL 86-10 and, therefore, is acceptable. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.3 Gap between Door and Frame for Fire Door W9

In FPR Part VII, Section 6.3, TVA stated that a portion of the gap between the door and frame of fire door W9 exceeds the maximum 3/16-inch clearance. TVA further stated that the fire door is located in the wall that separates the raw cooling water (RCW) pump deck from the Train A ERCW pump room. TVA stated the following concerning the environment of door W9:

- The RCW pump deck is open to the atmosphere on three sides and does not have a roof.
- The ERCW pump room does not have a roof.
- The nearest RCW pump is located 17 feet horizontally from the door and the bottom of the door is 13.5 feet above the RCW pump deck.
- The in situ combustible load of the RCW pump deck consists primarily of lube oil associated with the RCW pumps.

- There are no in situ combustibles located directly under the door and the stairs and landings prevent any appreciable quantities of transient combustibles from being stored under the door.

- The door opens into a labyrinth that does not contain any in situ combustibles, nor are transient combustibles stored in the labyrinth.

Gaps between fire doors and frames are required to be limited in size as a means to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is proposing a larger than required door gap between the door and frame for fire door W9, the NRC staff concludes that this is acceptable because of the physical configuration that would prevent the formation of a hot gas layer, the distance to the nearest source of combustibles, and the limited amount of combustibles in this area. The NRC staff also concludes that this is consistent with Interpretation 4, "Fire Area Boundaries," of GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that the excessive door gap would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.4 Relaxation of FPR Surveillance Period for Penetration Seals in High Radiation and Contaminated Areas

In FPR Part VII, Section 6.4, TVA evaluated the need to perform surveillance for penetration seals in high radiation areas by evaluating the consequences of the failure of the penetration seals for each of the rooms. TVA stated that its evaluations considered the locations not inspected, the proximity of combustibles, and the construction features of the rooms on either side of the seals.

6.3.4.1 Spent Resin Tank Room (Room 692.0-A15)

TVA stated that the penetration seals of interest in Room 692.0-A15 are installed in the wall separating it from the pipe gallery and chase room (Room 692.0-A24), which is a 2-hour rated fire barrier of reinforced concrete construction. TVA stated that the penetration seals are accessible for surveillance inspection from Room 692.0-A24, however, they are not accessible for inspection from the spent resin tank room due to the radiation posting of the room.

TVA stated that there is no safe shutdown equipment in the spent resin tank room. FPR Part VI stated that the combustible loading in both rooms is insignificant. TVA also stated that there is smoke detection installed in Room 692.0-A24.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of penetration seals in high radiation areas, the NRC staff concludes that this is acceptable because of the minimal amount of combustibles in each room, the lack of safe shutdown equipment or cables in the spent resin tank room, the automatic smoke detection installed in the pipe gallery and chase room, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of this penetration seal is consistent with Interpretation 4, "Fire Area Boundaries," of GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.4.2 Tritiated Drain Collector Tank Room (Room 674.0-A1)

TVA stated that the penetration seals of interest in Room 674.0-A1 are installed in the wall separating it from the RHR Pump Room 1A-A (Room 676.0-A11) which is a 2-hour fire rated barrier of reinforced concrete construction. TVA stated that the penetration seals are accessible for surveillance inspection from Room 676.0-A11; however, they are not accessible for inspection from Room 674.0-A1 due to the radiation posting of the room.

TVA stated that there is no safe shutdown equipment installed in the tritiated drain collector tank room which is required for a fire in the auxiliary building. FPR Part VI stated that the combustible loading in both rooms is insignificant. TVA also stated that there is smoke detection installed in Room 676.0-A11.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of penetration seals in high radiation areas, the NRC staff concludes that this is acceptable because of the limited amount of combustibles in each room, the lack of safe shutdown equipment or cables in the tritiated drain collector tank room, the automatic smoke detection installed in the RHR Pump Room 1A-A, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of these penetration seals is consistent with Interpretation 4, “Fire Area Boundaries,” of GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.4.3 Hold Up Tank Rooms A and B (Rooms 676.0-A2 and 676.0-A3)

TVA stated that Rooms 676.0-A2 and 676.0-A3 are separated from adjacent non-high-radiation area rooms by 2- and 3-hour fire-rated barriers of reinforced concrete construction. TVA stated that the penetration seals are accessible for surveillance inspection from these adjacent rooms. The penetrations are not accessible from inside the holdup tank rooms for surveillance inspection due to the radiation posting of the rooms.

TVA stated that there is no safe shutdown equipment installed in the holdup tank rooms, nor any equipment that could initiate a plant trip. FPR Part VI stated that the combustible loading in both rooms is insignificant. Additionally, TVA stated that all the adjacent rooms which contain cables or equipment needed for FSSD have installed smoke detection, with the exception of Room 692.0, which contains one cable related to FSSD. TVA further stated that fire damage to this cable will not cause spurious operation or otherwise prevent safe shutdown.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of penetration seals in high radiation areas, the NRC staff concludes that this is acceptable because of the limited amount of combustibles in these rooms, the lack of safe shutdown equipment or cables in the holdup tank room, the automatic smoke detection installed in the adjacent rooms which contain FSSD equipment or cables, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of these penetration seals is consistent with Interpretation 4, “Fire Area Boundaries,” of GL 86-10.

Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.4.4 Gas Decay Tank Rooms (Rooms 692.0-A3 and 692.0-A5)

TVA stated that Rooms 692.0-A3 and 692.0-A5 are separated from adjacent non-high radiation area rooms by 2- and 3-hour fire rated barriers of reinforced concrete construction. TVA stated that the penetration seals are accessible for surveillance inspection from these adjacent rooms. The penetration seals are not accessible for inspection from the gas decay tank rooms due to the radiation posting of the rooms.

TVA stated that there is no safe shutdown equipment installed in the gas decay tank rooms, nor any equipment that could initiate a plant trip. TVA also stated that Room 692.0 contains one cable related to FSSD, but that fire damage to this cable will not cause spurious operation or otherwise prevent safe shutdown. FPR Part VI stated that the combustible loading in both rooms is insignificant. Additionally, TVA stated that all the adjacent rooms that contain cables or equipment needed for FSSD have installed automatic smoke detection.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of penetration seals in high radiation areas, the NRC staff concludes that this is acceptable because of the limited amount of combustibles in these rooms, the lack of safe shutdown equipment or cables in the gas decay tank rooms, the automatic smoke detection installed in the adjacent rooms that contain FSSD equipment or cables, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of these penetration seals is consistent with Interpretation 4, "Fire Area Boundaries," of GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.4.5 Barriers between High Radiation Area Rooms (Rooms 676.0-A2, 676.0-A3, 692.0-A3 and 692.0-A5)

TVA stated that the barriers between Rooms 676.0-A2 and 676.0-A3, Rooms 676.0-A2 and 692.0-A3, and Rooms 692.0-A3 and 692.0-A5 are not accessible because of the high levels of radiation present in these rooms.

TVA stated that there is no safe shutdown equipment installed in any of these rooms, nor any equipment that could initiate a plant trip. TVA also stated that Room 692.0 contains one cable related to FSSD, but that fire damage to this cable will not cause spurious operation or otherwise prevent safe shutdown. FPR Part VI stated that the combustible loading in all the rooms is insignificant. Additionally, TVA stated that all the adjacent rooms that contain cables or equipment needed for FSSD have installed automatic smoke detection.

Periodic surveillances of fire protection system and equipment are required in order to ensure that the installed fire protection features are available to limit fire damage so that the capability to safely shutdown the plant is maintained. Although TVA is not proposing to conduct periodic surveillance of penetration seals in high radiation areas, the NRC staff concludes that this is acceptable because of the limited amount of combustibles in these rooms, the lack of safe shutdown equipment or cables in Rooms 676.0-A2, 676.0-A3, 692.0-A3 and 692.0-A5, the automatic smoke detection installed in the adjacent rooms that contain FSSD equipment or cables, and the ALARA concern identified by TVA. The NRC staff also concludes that not performing surveillance of these penetration seals is consistent with Interpretation 4, "Fire Area Boundaries," of GL 86-10. Therefore, the NRC staff concludes that there is reasonable assurance that not conducting these fire protection surveillances would not impact fire damage limits or the capability to safely shutdown the plant.

6.3.5 Diesel Generator Building Lube Oil Storage Room Fire Door

In FPR Part VII, Section 5.2, TVA stated that the lube oil storage room (Room 742.0-D2) has a 3-hour fire-rated barrier separating it from the adjacent Rooms 742.0-D4 (DG 1A-A) and 742.0-D9 (pipe gallery/corridor). There is an opening between Rooms 742.0-D9 and 742.0-D2 that is protected with a swinging hollow metal door in the opening and a sliding fire door. There is a preaction sprinkler system installed in Room 742.0-D9 and a total flooding CO_2 suppression system installed in the lube oil storage room.

The 3-hour fire-rated self-closing sliding door is held in the open position and closes only when a thermal link above the door melts or the CO_2 suppression system for the lube oil storage room discharges. In addition to the sliding door, TVA installed a hollow metal side-hinged door in the opening, which is normally closed. TVA stated that this door is similar to rated fire doors and is expected to prevent smoke and hot gases from a fire from passing through the opening until the fusible links melt or the fire suppression system in the lube oil storage room actuates, and the sliding door closes.

NFPA 80 requires fusible links on both sides of a sliding fire door, but the installed configuration only has these links on the lube oil storage room side. The NRC staff concludes that the installed configuration provides an equivalent level of safety because of the presence of automatic suppression systems on both sides of the opening, the addition of a CO_2 system actuation release for the sliding door, the presence of the normally closed swinging door, and the relatively higher fire loading in the lube oil storage room.

Based on its review of the information submitted by TVA, the NRC staff concludes that the fire door configuration in the lube oil storage room complies with Position D.1.j of Appendix A to BTP (APCSB) 9.5-1 and, therefore, is acceptable.

7.0 CONCLUSION

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed Tennessee Valley Authority's (TVA's) as-constructed Fire Protection Report (FPR) and TVA's supplemental information as referenced by this evaluation. Based on its review, the NRC staff concludes, with the exception of WBN, Unit 1, specific operator manual actions (OMAs) which the NRC staff documented its approval of in SSER 18, that the fire protection program for WBN:

- meets Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.48(a),
- meets General Design Criterion 3 of Appendix A to 10 CFR Part 50,
- is consistent with Sections III.G, III.J, III.L, and III.O of Appendix R to 10 CFR Part 50, and
- is consistent with Appendix A to Branch Technical Position (Auxiliary Power Conversion Systems Branch) 9.5-1, May 1976.

All alternatives and exceptions have been properly justified. Therefore, the NRC staff concludes that the as-constructed FPR is acceptable.

APPENDIX GG FINAL MEMORANDUM ON FACILITY COMPLETION IN ACCORDANCE WITH INSPECTION MANUAL CHAPTER 94302

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

October 15, 2015

MEMORANDUM TO: William M. Dean, Director
Office of Nuclear Reactor Regulation

FROM: Leonard D. Wert, Jr. **/RA/**
Acting Regional Administrator

SUBJECT: READINESS OF WATTS BAR UNIT 2 TO RECEIVE AN OPERATING LICENSE

Region II has completed the inspections needed to support issuing an operating license for Watts Bar Unit 2. NRC Inspection Procedure 94302, "Status of Watts Bar Unit 2 Readiness for an Operating License," lists the NRC findings necessary before an operating license can be issued. Those findings as described in Title 10 of the Code of Federal Regulations (10 CFR) Part 50.57 are: "(a)(1) Construction of the facility has been substantially completed, in conformity with the construction permit and the application as amended…;" "(a)(2) the facility will operate in conformity with the application as amended…;" and (a)(3)(ii) there is reasonable assurance that facility will be operated in accordance with the regulations…."

The NRC staff developed a plant-specific construction inspection program for Watts Bar Nuclear Plant (WBN) Unit 2, and specific inspection items were listed in the Inspection Planning and Scheduling (IP&S) data base. Items in IP&S include construction inspection procedures, corrective action programs and special programs Tennessee Valley Authority (TVA) developed to address historical quality assurance problems, generic communications, inspection open items, allegations and refurbishment activities. There were 560 items identified for WBN Unit 2. The NRC staff verified that the items needed for this readiness determination have been sufficiently addressed. Review and closure of the items are documented in 64 inspection reports issued during the past eight years. Those inspection reports are available on the WBN Unit 2 Reactivation website (http://www.nrc.gov/info-finder/reactor/wb/watts-bar.html). The twenty-one (21) IP&S items that have not been fully closed are listed in Enclosure 2, Open Items List, along with a description of why the items do not impact the readiness decision.

An overview of the WBN Unit 2 construction inspection program is provided in Enclosure 1. In addition to the IP&S items, the NRC staff has completed all pre-operational test procedure reviews and witnessed mandatory and safety-related system tests needed for the 10 CFR 50.57 findings. The NRC staff will perform additional inspections as TVA's pre-operational testing program is completed. Those testing activities are included in Enclosure 2.

CONTACT: William B. Jones, RII/DCP
404-997-4200

Region II operational preparedness inspections also verified that TVA has adequate management controls and procedures, including quality assurance programs, security, operations, and radiological controls necessary for an operating reactor.

In 2009, the NRC established the WBN Unit 2 Reactivation Assessment Group (WRAG), led by division level management from the Office of Nuclear Reactor Regulation (NRR) and Region II. The WRAG responsibilities include informing the Region II Regional Administrator when the activities in Inspection Manual Chapter (IMC) 2517, Watts Bar 2 Inspection Program, needed to support an operating license, have been completed.

On August 12, 2015, TVA submitted their substantially complete letter (ADAMS Accession No. ML15224B482) and requested that the NRC issue an operating license for WBN Unit 2. The staff reviewed that letter and briefed the WRAG on the results of the reviews. The staff's review of the letter was also factored into the three 10 CFR 50.57 findings.

Region II inspection activities support that the construction of the WBN Unit 2 facility has been substantially completed in conformity with the construction permit and the application as amended. This conclusion is based on completion of the construction inspections necessary to support this finding.

Region II inspection activities support that WBN Unit 2 facility will operate in conformity with the application as amended. This is based on completion of the pre-operational testing inspections identified in IMC 2513, Appendix A, Light Water Reactor - Preoperational Testing Phase, that are necessary to support this finding. The NRC staff will continue to implement IMC 2517, through WBN Unit 2 commercial operations. This will include completion of IMC 2513, Light Water Reactor Inspection Program - Preoperational Testing and Operational Preparedness Phase, IMC 2514, Light Water Reactor Inspection Program -- Startup Testing Phase, and the implementation of the reactor oversight program including IMC 2515, Light-Water Reactor Inspection Program-Operations Phase, at the issuance of the operating license.

Finally, Region II inspection activities support that there is reasonable assurance that activities authorized by the license will be conducted according to applicable regulations. This is based on completion of operational preparedness inspections items that were necessary to support this finding and conclusions from the Operational Readiness Assessment Team inspection (ORAT). The ORAT inspection (ADAMS Accession No. ML 15226A212) concluded TVA adequately demonstrated the readiness of the facility and staff to safely begin operating the WBN Unit 2 facility.

Inspections that have not been completed are listed in Enclosure 2 along with justification that the open items do not impact the determination that construction of the facility has been substantially completed, that the facility will operate in conformity with the application and that activities authorized by the license will be conducted according to the applicable regulations. For those items listed in Enclosure 2, a sufficient amount of inspection has been completed to provide reasonable assurance that associated systems, structures, components, or operational programs will perform as described in the application or applicable regulations.

In addition, Region II found no pending or open enforcement issues or open allegations that would affect a determination of reasonable assurance of the three 10 CFR 50.57 inspection findings. Integrated inspection report (IIR) 05000391/2015607 (ADAMS Accession No. ML15273A452) that was issued on September 29, 2015, contained a Severity Level IV Notice of Violation (NOV), involving deliberate misconduct by a contract employee. The staff conducted an initial assessment of TVA's corrective actions while determining the appropriate enforcement actions for this matter. Based on this review, Region II determined this issue does not impact the 94302 recommendation. The NRC staff will continue review of the enforcement action in accordance with NRC procedures. Region II has reviewed the one currently open allegation for WBN Unit 2, including technical aspects and corrective actions. Region II determined the allegation does not impact the 94302 recommendation. The NRC staff will continue actions to address the allegation in accordance with our established process.

The NRC staff has assessed the safety culture for WBN Unit 2 with a variety of activities. On a routine bases, the resident inspectors monitored TVA's employee concerns program to review concerns and trends. During the annual problem identification and resolution inspections, the safety conscious work environment was assessed while interviewing the construction staff and reviewing related documents. Allegations for WBN Unit 2 also provided insight on safety culture. Overall, the NRC staff determined that TVA had established an adequate safety culture for WBN Unit 2.

The WRAG has reviewed the inspections completed, the items listed in Enclosure 2, and supports the Region II assessment that the necessary inspections and reviews have been completed to support the 10 CFR 50.57 (a)(1), (a)(2), and (a)(3)(ii) findings.

Enclosures:
As Stated

October 15, 2015

MEMORANDUM TO: William M. Dean, Director
Office of Nuclear Reactor Regulation

FROM: Leonard D. Wert, Jr. **/RA/**
Acting Regional Administrator

SUBJECT: READINESS OF WATTS BAR UNIT 2 TO RECEIVE AN OPERATING LICENSE

Region II has completed the inspections needed to support issuing an operating license for Watts Bar Unit 2. NRC Inspection Procedure 94302, "Status of Watts Bar Unit 2 Readiness for an Operating License," lists the NRC findings necessary before an operating license can be issued. Those findings as described in Title 10 of the Code of Federal Regulations (10 CFR) Part 50.57 are: "(a)(1) Construction of the facility has been substantially completed, in conformity with the construction permit and the application as amended…;" "(a)(2) the facility will operate in conformity with the application as amended…;" and (a)(3)(ii) there is reasonable assurance that facility will be operated in accordance with the regulations…."

The NRC staff developed a plant-specific construction inspection program for Watts Bar Nuclear Plant (WBN) Unit 2, and specific inspection items were listed in the Inspection Planning and Scheduling (IP&S) data base. Items in IP&S include construction inspection procedures, corrective action programs and special programs Tennessee Valley Authority (TVA) developed to address historical quality assurance problems, generic communications, inspection open items, allegations and refurbishment activities. There were 560 items identified for WBN Unit 2. The NRC staff verified that the items needed for this readiness determination have been sufficiently addressed. Review and closure of the items are documented in 64 inspection reports issued during the past eight years. Those inspection reports are available on the WBN Unit 2 Reactivation website (http://www.nrc.gov/info-finder/reactor/wb/watts-bar.html). The twenty-one (21) IP&S items that have not been fully closed are listed in Enclosure 2, Open Items List, along with a description of why the items do not impact the readiness decision.

An overview of the WBN Unit 2 construction inspection program is provided in Enclosure 1. In addition to the IP&S items, the NRC staff has completed all pre-operational test procedure reviews and witnessed mandatory and safety-related system tests needed for the 10 CFR 50.57 findings. The NRC staff will perform additional inspections as TVA's pre-operational testing program is completed. Those testing activities are included in Enclosure 2.

CONTACT: William B. Jones, RII/DCP
404-997-4200

☒ PUBLICLY AVAILABLE ☐ NON-PUBLICLY AVAILABLE ☐ SENSITIVE ☒ NON-SENSITIVE

ADAMS: ☒ Yes ACCESSION NUMBER: ML15288A305 ☒ SUNSI REVIEW COMPLETE ☐ FORM 665 ATTACHED

OFFICE	RII:DCP	RII:DCP	RII:DCP	NRR	NRR	NRR	RII:ORA	RII:ORA
SIGNATURE	\RA via Email	RCH	WJ	\RA via Email	\RA via Email	\RA via Email	LAD	LW
NAME	E. Patterson	R. Haag	W. Jones	J. Poole	J. Quichocho	J. Trapp	L. Dudes	L. Wert
DATE	10/09/15	10/08/15	10/09/15	10/08/15	10/08/;15	10/08/15	10/09/15	10/15/15
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY

Overview of the Watts Bar Unit 2 Construction and Testing Inspection Programs

Inspection Manual Chapter (IMC) 2517 was issued to establish policy for implementing the WBN Unit 2 construction, preoperational testing, and startup testing inspection programs that are covered under IMCs 2512, 2513, and 2514. The construction inspection program was expanded to include items specific to WBN Unit 2 such as the refurbishment program and TVA-specific Corrective Action Programs (CAPs) and Special Programs (SPs). Since many of the WBN Unit 2 components had been installed during initial construction, the refurbishment program was implemented to assure the components meet or exceed their original specifications. The CAPs and SPs were implemented to correct historical problems encountered during initial construction. The construction inspection program also factored in both historical and current industry initiatives. Examples include motor operated valve testing and surveillance, potential impact of pressurized water reactor containment sump blockage, Fukushima response actions, and Design Vulnerability in Electrical Power System (Open Phase Condition).

A. Construction Phase Inspections

IMC 2512

IMC 2512 prescribes all the required NRC construction inspection procedures (IPs). Many of these inspections were completed or partially completed prior to suspension of WBN Unit 2 construction in the mid-1980s. To understand the amount of previously completed WBN Unit 2 construction inspections, the staff performed a reconstitution of the 2512 inspection program. The reconstitution effort involved a computer assisted search of historical inspection reports to identify portions/ samples of 2512 IPs that had already been completed. Unfinished items in the IPs were noted, with the understanding that these items would be inspected following resumption of construction, such that all aspects of the 2512 IPs would be accomplished at the completion of WBN Unit 2 construction. New work (activities performed following resumption of construction in 2008) would also be inspected under the 2512 IPs, even if reconstitution had determined that the applicable section(s) of an IP had been completed.

Additional items were considered when developing a comprehensive construction inspection program for WBN Unit 2. The following items were added to the WBN Unit 2 construction inspection program:

- Old allegations – closed allegations were screened to identify possible WBN Unit 2 unresolved items.
- Generic Issues – The staff reviewed TVA's responses for all applicable issued generic communications including generic letters, bulletins, and Three Mile Island action items. Generic communications that were issued after construction on WBN Unit 2 resumed in 2008 were reviewed on a routine basis and added to the inspection program as applicable. Inspection was performed to address the resolution of each of the issues. Additionally, applicable Temporary Instructions were re-issued and utilized to perform the required inspections of outstanding design, licensing, and regulatory issues for WBN Unit 2.
- Construction Deficiency Reports (CDRs) – CDRs issued during initial construction that were not previously closed were reviewed to determine the current applicability on WBN Unit 2 construction and inspected as required.

- Inspection items identified during the licensing review process – Items identified for inspection follow-up in Appendix HH to NUREG-0847 "Safety Evaluation Report [SER] Related to the Operation of Watts Bar Nuclear Plant Units 1 and 2," and its supplements (SSER).
- Inspection Open Items – Unresolved items and violations identified in inspection reports were tracked and inspected for closure.

Construction Refurbishment Program

Because plant construction was inactive for a long time and the scope of equipment layup activities was limited, TVA developed and submitted its Construction Refurbishment Program to ensure that the design and licensing basis, including original equipment design specifications, would be met. The Construction Refurbishment Program was intended to refurbish or replace most active components and instruments. For other equipment, the program determines the potential degradation mechanism for each category of components, taking into account the environmental conditions, the acceptance criteria, and the refurbishment or inspection activities necessary to demonstrate compliance with applicable vendor and design specifications or requirements. The NRC staff reviewed TVA's program and on July 2, 2010, issued its evaluation, which concluded that, upon proper implementation, the Construction Refurbishment Program would provide reasonable assurance that the equipment would meet its design criteria and perform its intended functions. A new IP 37002, "Construction Refurbishment Process—Watts Bar Unit 2," was developed to provide guidance for inspection of the refurbishment program. RII conducted several refurbishment inspections throughout the project. The IP was closed in inspection report 05000391/2014605 (ADAMS Accession No. ML14226A049).

Inspection of Nuclear Performance Plan (NPP) Implementation

To address historical construction quality issues that were identified in 1985, TVA implemented its NPP which included Corrective Action Programs (CAPs) and Special Programs (SPs) to correct the deficient areas. At that time, TVA's NPP efforts were focused on WBN Unit 1. The NRC staff reviewed components of the NPP for WBN Unit 1 and recognized the general approaches of various corrective actions. From 1985 to 1993, the NRC focused on inspecting the CAPs and SPs as they applied to WBN Unit 1 and no conclusions were stated for WBN Unit 2.

To address the quality issue for WBN Unit 2, TVA developed CAPs and SPs that contained many of the same corrective actions performed at WBN Unit 1. TVA submitted its plans in 2008 detailing specific actions for the CAPs and SPs to resolve historical quality issues for WBN Unit 2. The staff reviewed these plans and determined that when implemented thoroughly, the proposed corrective actions should address the identified deficiencies for WBN Unit 2. Region II has inspected all of the CAPs and SPs and has concluded that the programs were adequate. Additional inspections are necessary for one CAP and two SPs to verify the implementation of the programs. These inspection items are listed in Enclosure 2.

TVA Implementation of Fukushima Actions at WBN, Unit 2

Of the three Orders issued by the NRC related to the implementation of Fukushima actions, two were applicable to WBN based on plant design (spent fuel pool instrumentation and mitigating strategies).

The Orders state that prior to issuance of an operating license, the holder of a construction permit must state that they fully comply with the Order via letter to the NRC. TVA submitted a final Compliance Letter for the Spent Fuel Pool Order on December 19, 2014 (ADAMS Accession No. ML 15002A202). A Full Compliance Letter for the Mitigating Strategies Order was submitted on March 12, 2015 (ADAMS Accession No. ML15072A116). Since that time, TVA has implemented several of the actions, made modifications to the plant, and acquired new equipment. The NRC inspected a sample of these modifications focused on critical design and structural attributes using Temporary Instruction 2515/191. Additionally, inspections were performed of as-built and completed modifications to verify that specifications, drawings, requirements, and standards were met. The results of this inspection were issued on June 22, 2015, in inspection report 05000391/2015616 (ADAMS Accession No. ML15173A317).

Inspection of Design Vulnerability in Electrical Power System (Open Phase Condition)

An inspection was performed to verify actions to address the concerns identified in NRC Bulletin 2012-01, Design Vulnerability in Electrical Power System. The inspectors confirmed the interim actions taken by WBN Unit 2 in response to Bulletin 2012-001 were consistent with SSER 27, their September 3, 2014 and February 3, 2014, RAI responses and the TVA Response to Bulletin 2012-001, dated October 25, 2012.

B. **Preoperational Testing Inspections**

IMC 2513 Appendix A

Region II implemented the preoperational testing inspections specified in Appendix A of IMC 2513. Appendix A contains the procedures applicable to verifying that systems and components important to safety of the plant are fully tested to demonstrate that they satisfy their design requirements. Region II has completed all of the selected IMC 2513 Appendix A procedure review inspections and the majority of the test witnessing inspections. The groupings of preoperational testing inspections are listed as follows:

Mandatory Tests

- Reactor Coolant System Hydrostatic Test
- Reactor Protection System Test
- Engineered Safety Features Test
- Loss of Offsite Power Test
- Containment Integrated Leak Rate Test
- Integrated Hot Functional Test

Primal System Testing

A minimum selection of five safety-related systems was required to complete the primal system testing inspection requirement. Region II developed an inspection sample based primarily on the risk-significance of systems at WBN Unit 2. The following systems were selected for review: auxiliary feedwater (AFW), chemical and volume control (CVCS), safety injection (SI), essential raw cooling water (ERCW), component cooling water (CCS), containment spray (CS), residual heat removal (RHR), main steam isolation valve (MSIV), main feedwater (MFW), ice condenser, and containment hydrogen mitigation.

Other Inspections Areas Covered Under IMC 2513, Appendix A

IMC 2513 lists several other IPs that involve inspection of the testing program infrastructure and inspections of related areas that assess the quality of the plant as construction is near completion. Example IPs include "Quality Assurance for Preoperational Testing", "Comparison of As-Built Plant to FSAR Description", and "Testing of Pipe Support and Restraint Systems".

C. <u>Operational Preparedness Inspections</u>

<u>IMC 2513 Appendix B</u>

Operational preparedness inspections are specified in Appendix B of IMC 2513 and address functional areas such as operations, maintenance, radiological controls, security, etc. Many of these programs and procedures for WBN Unit 2 will be the same or nearly identical to those already established and in use for WBN Unit 1. The NRC staff reviewed each of the IPs in Appendix B and developed revised requirements for performing these IPs, focusing on aspects of these programs and procedures that are unique to WBN Unit 2 or required substantive changes to address WBN Unit 2. The inspection plan for the Appendix B inspections was issued to TVA by letter dated November 8, 2013 (ADAMS Accession No. ML13312A082.

<u>Operational Readiness Assessment Team (ORAT) Inspection</u>

The ORAT inspection was completed at WBN Unit 2 on June 26, 2015. The ORAT team performed an independent assessment of TVA's readiness to operate and integrate WBN Unit 2 into a currently operating facility, WBN Unit 1. The ORAT inspection team looked at five broad areas: management oversight, control of safety-significant activities, operations training and experience, corrective action program, and maintenance support activities. The ORAT determined that TVA has programs and processes to effectively turnover systems from construction, to testing, and then to operations. Based on this determination and a review of other dual unit transition activities, the ORAT concluded that TVA has demonstrated their readiness to safety startup and conduct power operations on WBN Unit 2. The final inspection report was issued on August 14, 2015 (ADAMS Accession No. ML15226A212).

OPEN INSPECTION ITEMS

Inspection Item	Basis to Remain Open After IP 94302 Issuance
IMC 2512 - Construction Inspection (IP&S Items)	
Fire Protection Corrective Action Program (CAP)	NRC verified TVA's CAP has adequate corrective actions for the fire protection deficiencies. NRC verified a sample of fire protection deficiencies were adequately resolved. Additional NRC inspections of TVA's implementation of the fire protection program corrective actions will be conducted to close this item.
Mechanical Equipment Qualification Special Program (SP)	NRC inspection activities verified that applicable equipment is included in the mechanical equipment qualification SP. This was documented in inspection report 05000391/2012603. NRC also inspected implementation of the program for the containment spray system, including specific preventive maintenance plans for this system. This was documented in inspection report 05000391/2015605. The NRC will inspect additional samples to complete this item.
Radiation Monitoring System SP	NRC inspection verified that formal design criteria had been adequately established for the Unit 2 radiation monitoring system. Previous inspections of this SP were documented in inspection reports 05000391/2010603, 05000391/2010605, and 05000391/2011607. Further inspection will evaluate the implementation of this SP by verifying the installed equipment and its design.
Inspection Procedure (IP) 63050, Containment Structural Integrity Test	This IP consists of the procedure review, test witness, and results review for the containment structural integrity test. NRC reviewed the test procedure and determined that it was adequate and that the acceptance criteria met the design requirements. NRC also witnessed the successful completion of the test. NRC will review the results of the test to complete the inspection procedure.
Bulletin 80-06, Emergency safety feature reset controls	This item has been inspected as part of the emergency safety features (ESF) preoperational test. NRC verified by inspection that the reset feature meets its design requirements. The ESF test consists of three preoperational test instructions (PTIs), two of which have been witnessed by NRC inspectors and were determined to be adequate. NRC will inspect the remaining portion of the ESF test to complete this item.

Inspection Item	Basis to Remain Open After IP 94302 Issuance
Three Mile Island (TMI) II.D.1, relief and safety valve test requirements	During hot functional testing (HFT), NRC witnessed the power operated relief valve (PORV) stroke time test. TVA is addressing PORV test deficiencies that were identified during the HFT. This includes testing the valve at a testing facility at normal operating conditions. NRC determined that the test plan is adequate and will review PORV stroke testing following re-installation.
Generic Letter (GL) 88-14, Instrument air supply system problems affecting safety-related equipment	Previous NRC inspection of this item verified that implementation of design changes and installation of equipment were consistent with TVA's approach documented in the NRC regulatory framework letter (ADAMS Accession No. ML 080320443). This was documented in inspection report 05000391/2013605. Additional inspection will be performed to verify that the test results meet the design requirements of the system.
GL 89-04, Guidelines on developing acceptable in-service testing (IST) programs	NRC verified through inspection that WBN Unit 2's IST program is the same as WBN Unit 1's program. Unit 1's program is in compliance with regulatory requirements. This initial IST program inspection for Unit 2 was completed and documented in inspection report 05000391/2014614. NRC will review additional IST baseline testing to complete the inspection of GL 89-04.
GL 04-02, Potential impact of debris blockage on emergency recirculation during design basis accidents at pressurized water reactors (PWRs)	Previous NRC inspection of the emergency recirculation system verified the adequacy of work associated with the containment sump and coatings inside containment that could impact containment sump performance. This inspection was documented in inspection report 05000391/2015604. NRC will review the final results of the containment latent debris walkdown to complete inspection of this generic letter.
Temporary Instruction (TI) 2500/19, USI A-26: Licensee's actions taken to implement USI A-26: Transient protection	NRC inspected WBN Unit 2's mitigation system for low-temperature overpressure transient conditions, and concluded that it was adequate. Inspections of the system implementation verified the design, administrative controls, procedures, modifications, training, and surveillances. The inspection results were documented in inspection reports 05000391/2013607 and 2015605. NRC will review the remaining PORV stroke time testing to complete this item.
TI 2500/20, ATWS Rule, GL 83-28 & 85-06	Previous NRC inspections verified that the current design and sampled installation were in accordance with the approved design. These inspections were documented in inspection reports 05000391/2011603, 2014602, and 2014615. Additional inspections will review system testing to complete this item.

Inspection Item	Basis to Remain Open After IP 94302 Issuance
TI 2515/110, Performance of Safety-Related Check Valves,	NRC has verified through inspection that WBN Unit 2's IST program which covers check valves is the same as WBN Unit 1's program. Unit 1's program is in compliance with regulatory requirements. An initial IST program inspection for Unit 2 was completed and documented in inspection report 05000391/2014614. NRC will review additional IST baseline testing to complete the inspection of this item.
TI 2515/114, In-Service Testing, GL 89-04	NRC has verified through inspection that WBN Unit 2's IST program is the same as Unit 1's program. Unit 1's program is in compliance with regulatory requirements. An initial IST program inspection for Unit 2 was completed and documented in inspection report 05000391/2014614. NRC will review additional IST baseline testing to complete the inspection requirements of this item.
TI 2515/166, Containment sump blockage	A previous NRC inspection of the emergency recirculation system verified the adequacy of work associated with the containment sump and coatings inside containment that could impact containment sump performance. This inspection was documented in inspection report 05000391/2015604. NRC will inspect the final results of the containment latent debris walkdown to complete inspection of this item.
Inspector Follow-up Item 86-10-03, U2 Instrument Air Preoperational Test	Previous NRC inspection of this item verified that implementation of design changes and installation of equipment were consistent with TVA's approach documented in the NRC regulatory framework letter (ADAMS Accession No. ML 080320443), and was documented in inspection report 05000391/2013605. Additional inspection will verify that the system test results meet the design requirements.
Construction Deficiency Report (CDR) 83-61, Failure to provide self-contained lights as committed to NRC	NRC verified through inspection that TVA's emergency lighting system modification methodology is adequate. The NRC will review additional samples when they are available to verify that the implementation of the program meets applicable regulatory requirements.
CDR 86-11, Lack of thermal qualification for Systems 43 & 90 piping	This item required inspection of two systems, the radiation sampling system (system 43) and the radiation monitoring system (system 90). Previous NRC inspections of the radiation sampling system determined that the design, analysis, and implementation were adequate. This was documented in inspection report 05000391/2015607. Additional inspections of the radiation monitoring system implementation will be performed to complete this item.

Inspection Item	**Basis to Remain Open After IP 94302 Issuance**
CDR 89-09, Significant trend associated with damaged, loose, or missing hardware	NRC verified through inspection that the damaged, loose, and missing hardware program and associated procedures were adequate. This was documented in inspection report 05000391/2013605. NRC has performed several subsequent inspections of safety systems and determined that the program is being implemented appropriately. These inspections included hand-over-hand walkdowns of the systems as well as area walkdowns. NRC will walkdown additional systems and areas of the plant to complete this item.
CDR 93-02, Loose flexible conduit fittings	NRC has reviewed TVA's corrective actions and concluded that the program was adequate. This was documented in inspection report 05000391/2014604. NRC has performed several subsequent inspections of safety systems and determined that the program is being implemented appropriately. These inspections included system and area walkdowns. NRC will walkdown additional systems and areas of the plant to complete this item.
Final CAP/SP Inspection - This item is to satisfy Section 03.02 of CAP/SP related TI's	The TI for each CAP/SP requires a final inspection be performed after TVA certifies that the CAP/SP has been completed. All CAP/SPs have been inspected for technical adequacy to verify that the corrective actions that TVA developed to address the issues were acceptable. A sample of 20 certified CAP/SPs were inspected and documented in inspection report 05000391/2015607. NRC will perform additional inspection once TVA has certified the remaining CAPs/SPs are completed.
Enforcement Action, EA-15-112; inspection report 05000391/2015607	This severity level (SL) IV notice of violation (NOV) was the result of the enforcement process for NRC Office of Investigations Report 2-2013-017. The staff reviewed the initial corrective actions as part of the enforcement process and verified that the anchor bolt in question was acceptable and will not affect the ability of the reactor coolant drain tank pump 6 to perform its function. Further inspection of this issue will be performed after receipt of TVA's written response to the NOV.

	Inspection Item	Basis to Remain Open After IP 94302 Issuance
	IMC 2513 Appendix A – Pre-Operational Testing Inspection	
	IP 70329, Preoperational Test Results Evaluation	Previous NRC inspections of preoperational test results have included the inspection requirements and guidance of IP 70329 into the scope of those reviews. These inspections concluded that the test results were adequate. Additional inspections of final test result evaluations will be performed to complete this inspection procedure.
	IP 71302, Preoperational Test Program Implementation Verification	Previous NRC inspections concluded that TVA's implementation of the preoperational test program was adequate. These inspections were documented in integrated inspection report 05000391/2014607. Additional inspections of the preoperational test program implementation will be conducted to complete this inspection procedure.
	IP 70370, Testing Piping Support and Restraint Systems	NRC has completed all aspects of the inspection procedure that were required during preoperational testing (IMC 2513). Additional inspections during plant operations will be conducted to complete this inspection procedure.
ESF	**IP 70315, Engineering Safety Features Test Witnessing**	This mandatory test consists of three PTIs. NRC has determined the PTIs were adequate and that the acceptance criteria met the design requirements. Also, NRC witnessed the acceptability of two of the PTIs. TVA stated in their substantially complete letter that this mandatory test would be completed prior to fuel load. NRC will witness the remaining PTI to complete the inspection procedure.
ESF	**IP 70322, Engineering Safety Features Test Results Evaluation**	Previous NRC inspections verified that the test procedures' acceptance criteria met the design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final test results to complete the inspection procedure.
RPS	**IP 70317, Reactor Protection System (RPS) Test Witnessing**	This mandatory test consists of seven PTIs. NRC has determined the PTIs were adequate and that the acceptance criteria met the design requirements. Also, NRC witnessed the acceptability of five of the PTIs. TVA stated in their substantially complete letter that this mandatory test would be completed prior to fuel load. NRC will witness the remaining two PTIs to complete the inspection procedure.
RPS	**IP 70325, Reactor Protection System Test Results Evaluation**	Previous NRC inspections verified that the test procedures' acceptance criteria met the design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final test results to complete the inspection procedure.

	Inspection Item	Basis to Remain Open After IP 94302 Issuance
		IMC 2513 Appendix A – Pre-Operational Testing Inspection
LOOP	**IP 70326, Loss of Offsite Power Test Results Evaluation**	Previous NRC inspections for the Loss of Offsite Power (LOOP) pre-operational tests verified that the test procedures' acceptance criteria met the design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the results of the LOOP tests to complete the inspection procedure.
CILRT	**IP 70323, Containment System: Integrated Leak Rate Test Results Evaluation**	Previous inspections of this mandatory test verified that the acceptance criteria in the test procedures met design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final results of the test to complete the inspection procedure.
MFW	**IP 70400, Preoperational Test Results Evaluation**	NRC inspections for the primal preoperational test of the main feedwater (MFW) system verified that the acceptance criteria in the test procedure met design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final results of the test to complete the inspection procedure.
AFW	**IP 70438, Auxiliary Feedwater System (AFW) Test Witnessing**	This primal test consists of three PTIs. NRC has verified through inspection that the acceptance criteria in the test procedures met the design requirements, and witnessed the acceptability of the test for two of these PTIs. NRC will witness the remaining PTI to complete the inspection procedure.
AFW	**IP 70400, Preoperational Test Results Evaluation**	NRC conducted previous inspections of the AFW preoperational tests by verifying that the acceptance criteria in the test procedures met design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final results of the tests to complete the inspection procedure.
CVCS	**IP 70400, Preoperational Test Results Evaluation**	This primal test consisted of three PTIs. NRC conducted previous inspections of the chemical and volume control system (CVCS) preoperational tests, including verification that the acceptance criteria in the test procedures met design requirements, that during the test the acceptance criteria was met, and that test deficiencies were properly identified for correction in accordance with TVA procedures. NRC will review the final results of the tests to complete the inspection procedure.

	Inspection Item	Basis to Remain Open After IP 94302 Issuance
ERCW	**IP 70400, Preoperational Test Results Evaluation**	This primal test consisted of four PTIs. NRC conducted previous inspections for the essential raw cooling system (ERCW) preoperational tests, including verification that the acceptance criteria in the test procedures met design requirements, that during the test the acceptance criteria was met, that test deficiencies were properly identified for correction in accordance with TVA procedures, and that the final results of three of the PTIs were adequate. NRC will review the final results for the remaining PTI to complete the inspection procedure.
RHR	**IP 70400 Preoperational Test Results Evaluation**	This primal test consisted of three PTIs. NRC conducted previous inspections for the residual heat removal (RHR) system preoperational tests, including verification that the acceptance criteria in the test procedures met design requirements, that during the test the acceptance criteria was met, that test deficiencies were properly identified for correction in accordance with TVA procedures, and that the final results of two of the PTIs were adequate. NRC will review the final results for the remaining PTI to complete the inspection procedure.
H2	**IP 70442, Containment Combustible Gas (H2) Control System Test Witnessing**	This primal test consists of one PTI. NRC has reviewed the acceptance criteria in the test procedure to ensure that they met design requirements, and documented this in inspection report 05000391/2015605. Other NRC inspections have determined the design and constructability of the system were adequate. These inspections were documented in inspection reports 05000391/2011602, 2011604, 2011605, 2012603, 2013605, 2014604, and 2015602. NRC will witness the test to complete this inspection procedure.
H2	**IP 70400, Preoperational Test Results Evaluation**	NRC has reviewed the acceptance criteria in the hydrogen mitigation test procedure to ensure that they met design requirements, and documented this in inspection report 05000391/2015605. Other NRC inspections have determined the design and constructability of the system were adequate. These inspections were documented in inspection reports 05000391/2011602, 2011604, 2011605, 2012603, 2013605, 2014604, and 2015602. NRC will review the final test results to complete this inspection procedure.

Inspection Item	Basis to Remain Open After IP 94302 Issuance
IMC 2513 Appendix B – Operational Preparedness Inspections	
IP 35744, Quality Assurance (QA) Program - Design Changes and Modifications	An inspection of the design change and modification program has been performed and documented in inspection report 05000391/2013607. This inspection concluded that the program was in compliance with applicable regulatory requirements. Further NRC inspection is planned if temporary modifications are initiated during the first six months of operation.
IP 35749, QA Program – Tests and Experiments	An inspection of the 10 CFR 50.59 program procedures was performed and documented in inspection report 05000391/2014607. This inspection concluded that the program was in compliance with applicable regulatory requirements. The 50.59 program would not apply to Unit 2 until an operating license is issued. NRC will review TVA's implementation of this program to complete the inspection procedure.
IP 64704, Fire Protection Program	NRC has verified through inspection that the TVA's new dual unit fire protection program is in compliance with the as-constructed fire protection report. SSER 29 will document the final fire protection report and licensing basis. NRC will review additional samples of TVA's ongoing implementation of in-plant modifications that are credited in the fire protection program.
IP 83526, Control of Radioactive Materials and Contamination, Surveys, and Monitoring	A previous inspection of the radiation protection survey and monitoring program concluded that WBN Unit 1 capabilities currently in place for portable surveys, protective clothing, contamination control, and exit-point monitoring are adequate to support dual-unit operation. For the in-place radiation monitoring components unique to WBN Unit 2, the components have been installed. Additional inspections will review the results of the preoperational testing for these components.
IP 84523, Liquids and Liquid Wastes	A previous inspection reviewed the liquid radwaste system and liquid effluent monitors and determined that the processing, sampling, and discharge protocols and methodologies used for the liquid radwaste system in Unit 2 were the same as those used in WBN Unit 1. The inspection also determined that the installation and testing of the liquid effluent monitor was adequate. NRC will review additional testing results of the liquid radwaste system to complete this inspection procedure.
IP 84524, Gaseous Waste System	A previous inspection of the gaseous radwaste system and gaseous effluent monitors determined that the components unique to WBN Unit 2 had been adequately installed. NRC will review additional testing results of the gaseous radwaste system and gaseous effluent monitors to complete this inspection procedure.

APPENDIX HH WATTS BAR, UNIT 2, ACTION ITEMS TABLE

This table provides a status of required action items associated of all open items, confirmatory issues (Cis), and proposed license conditions that the U.S. Nuclear Regulatory Commission (NRC) staff has identified. Unless otherwise noted, the item references are to sections of this Supplemental SER (SSER). Items that are still open are listed first, and items that have been closed are listed second. Some numbers were not used in the sequential list. There are no open and **139 items** that have been closed.

Closed Items				
Item	**Type**	**Action Required**	**Lead**	**Status**
(1)	Confirmatory Issue (CI)	Review evaluations and corrective actions associated with a power assisted cable pull. (NRC safety evaluation, dated August 31, 2009, Agencywide Documents Access and Management System (ADAMS) Accession No. ML092151155). Closed. Inspection Report 0500391/2015607 dated September 29, 2015 (ADAMS Accession No. ML15273A452) stated that based on the results of this inspection and past inspections on this activity, adequate controls were in place during the reviewed cable pulling activities. The NRC staff's evaluation of the corrective actions program (CAP) plans for cable and electrical issues was documented in a letter dated August 31, 2009 (ADAMS Accession No. ML092151154) which stated that the NRC has completed its review of the CAP plans for the cable and electrical issues. Based on its review, the NRC staff concluded that these CAP plans provide acceptable guidelines for identification, resolution, implementation, and inspection of the various issues addressed in the program plans. Based on the inspection and NRC staff review, the staff considers this item closed.	RII	Closed
(2)	CI	Conduct appropriate inspection activities to verify cable lengths used in calculations and analysis match as-installed configuration. (NRC safety evaluation, dated August 31, 2009, ADAMS Accession No. ML092151155). Closed in Inspection Report 05000391/2013604, dated June 27, 2013, ADAMS Accession No. ML13179A079.	RII	Closed

(3)	CI	Confirm TVA submitted update to FSAR section 8.3.1.4.1. (NRC safety evaluation (SE) dated August 31, 2009, ADAMS Accession No. ML092151155) Closed in SSER 24, Section 8.1.	NRR	Closed
(4)	CI	Conduct appropriate inspection activities to verify that TVA's maximum SWBP criteria for signal level and coaxial cables do not exceed the cable manufacturer's maximum SWBP criteria. (NRC safety evaluation, dated August 31, 2009, ADAMS Accession No. ML092151155) Closed in Inspection Report 0500391/2012602, dated March 27, 2012, ADAMS Accession No. ML12087A324.	RII	Closed
(5)	CI	Verify timely submittal of pre-startup core map and perform technical review. (TVA letter, dated September 7, 2007, ADAMS Accession No. ML072570676). By letter dated July 30, 2012, TVA provided the pre-startup core map. The staff has verified the information and has closed Appendix HH Open Items 5 and 8, which came from the review of BL 1996-01.	NRR	Closed
(6)	CI	Verify implementation of TSTF-449. (TVA letter dated September 7, 2007, ADAMS Accession No. ML072570676). Staff has reviewed Revision I to the proposed TSs and found that TSTF 449 has been incorporated.	NRR	Closed
(7)	CI	Verify commitment completion and review electrical design calculations. (TVA letter dated October 9, 1990, ADAMS Accession No. ML073551056). Closed in Inspection Report 05000391/2013610, dated February 14, 2014, ADAMS Accession No. ML14049A158.	RII	Closed
(8)	CI	TVA should provide a pre-startup map to the NRC staff indicating the rodded fuel assemblies and a projected end of cycle burnup of each rodded assembly for the initial fuel cycle 6-months prior to fuel load. (NRC safety evaluation, dated May 3, 2010, ADAMS Accession No. ML101200035). By letter dated July 30, 2012, TVA provided the pre-startup core map. The staff has verified the information and has closed Appendix HH Open Items 5 and 8, which came from the review of BL 1996-01.	NRR	Closed

(9)	CI	Confirm that education and experience of management and principal supervisory positions down through the shift supervisory level conform to Regulatory Guide 1.8. (SSER 22, Section 13.1.3). Closed in Inspection Report 0500391/2014603, dated May 9, 2014, ADAMS Accession No. ML14129A381.	RII	Closed
(10)	CI	Confirm that TVA has an adequate number of licensed and non-licensed operators in the training pipeline to support the preoperational test program, fuel loading, and dual unit operation. (SSER 22, Section 13.1.3). Closed in Inspection Report 0500391/2014603, dated May 9, 2014, ADAMS Accession No. ML14129A381.	RII	Closed
(11)	CI	The plant administrative procedures should clearly state that, when the Assistant Shift Engineer assumes his duties as Fire Brigade Leader, his control room duties are temporarily assumed by the Shift Supervisor (Shift Engineer), or by another senior reactor operator, if one is available. The plant administrative procedures should clearly describe this transfer of control room duties. (SSER 22, Section 13.1.3) Closed in SSER 25, Section 13.1.3.	NRR	Closed
(12)		TVA's implementation of New Generation Development and Construction PP-20 and Engineering Document Construction Release Appendix J is subject to future NRC audit and inspection. (SSER 22, Section 25.9). Closed in SSER 27, Section 25.9.	NRR	Closed
(13)		TVA is expected to submit an inservice testing program and specific relief requests for WBN, Unit 2, 9 months before the projected date of OL issuance. (SSER 22, Section 3.9.6). Closed in SSER 27, Section 3.9.6.	NRR	Closed
(14)		TVA stated that the Unit 2, Pressure and Temperature Limits Report (PTLR) is included in the Unit 2, System Description for the Reactor Coolant System (WBN2-68-4001), which will be revised to reflect required revisions to the PTLR by September 17, 2010. (SSER 22, Section 5.3.1) Closed in SSER 25, Section 5.3.1.	NRR	Closed

(15)		TVA should confirm to the NRC staff the completion of Primary Stress Corrosion Cracking (PWSCC) mitigation activities on the Alloy 600 dissimilar metal butt welds (DMBWs) in the primary loop piping. (SSER 22, Section 3.6.3) Closed in SSER 24, Section 3.6.3.	NRR	Closed
(16)		Based on the uniqueness of environmental qualification (EQ), the NRC staff must perform a detailed inspection and evaluation prior to fuel load to determine how the WBN, Unit 2, EQ program complies with the requirements of 10 CFR 50.49. (SSER 22, Section 3.11.2) Closed in Inspection Report 05000391/2015605, dated August 14, 2015, ADAMS Accession No. ML15226A345.	RII/NRR	Closed
(17)		The NRC staff should verify the accuracy of the WBN, Unit 2, EQ list prior to fuel load. (SSER 22, Section 3.11.2.1) Closed in Inspection Report 05000391/2014615, dated February 13, 2014, ADAMS Accession No. ML15044A424.	RII/NRR	Closed
(18)		Based on the extensive layup period of equipment within WBN, Unit 2, the NRC staff must review, prior to fuel load, the assumptions used by TVA to re-establish a baseline for the qualified life of equipment. The purpose of the staff's review is to ensure that TVA has addressed the effects of environmental conditions on equipment during the layup period. (SSER 22, Section 3.11.2.2) Closed in Inspection Report 0500391/2011604, dated June 29, 2011, ADAMS Accession No. ML111810890.	RII/NRR	Closed
(19)		The NRC staff should complete its review of TVA's EQ Program procedures for WBN, Unit 2, prior to fuel load. (SSER 22, Section 3.11.2.2.1) Closed in Inspection Report 0500391/2011604, dated June 29, 2011, ADAMS Accession No. ML111810890.	RII/NRR	Closed
(20)	CI	Resolve whether or not routine maintenance activities should result in increasing the EQ of the 6.9 kV motors to Category I status in accordance with 10 CFR 50.49. (SSER 22, Section 3.11.2.2.1; SSER 24, Section 8.1) Closed in Inspection Report 0500391/2011605, dated August 5, 2011, ADAMS Accession No. ML112201418.	RII/NRR	Closed

(21)		The NRC staff should confirm that the electrical penetration assemblies (EPAs) are installed in the tested configuration, and that the feedthrough module is manufactured by the same company and is consistent with the EQ test report for the EPA. (SSER 22, Section 3.11.2.2.1) Closed in Inspection Report 05000391/2011607, dated September 30, 2011, ADAMS Accession No. ML112730197.	RII/NRR	Closed
(22)		TVA must clarify its use of the term “equivalent” (e.g., identical, similar) regarding the replacement terminal blocks to the NRC staff. If the blocks are similar, then a similarity analysis should be completed and presented to the NRC for review. (SSER 22, Section 3.11.2.2.1) Closed in SSER 24, Section 8.1.	NRR	Closed
(23)		Resolve whether or not TVA’s reasoning for not upgrading the main steam isolation valve solenoid valves to Category I is a sound reason to the contrary, as specified in 10 CFR 50.49(l). (SSER 22, Section 3.11.2.2.1; SSER 24, Section 8.1). Closed in SSER 27, Section 3.11.2.2.1.	NRR	Closed
(24)		The NRC staff requires supporting documentation from TVA to justify its establishment of a mild environment threshold for total integrated dose of less than $1x10^3$ rads for electronic components such as semiconductors or electronic components containing organic material. (SSER 22, Section 3.11.2.2.1) Closed in SSER 24, Section 8.1.	NRR	Closed
(25)		Prior to the issuance of an OL, TVA is required to provide satisfactory documentation that it has obtained the maximum secondary liability insurance coverage pursuant to 10 CFR 140.11(a)(4), and not less than the amount required by 10 CFR 50.54(w), with respect to property insurance, and the NRC staff has reviewed and approved the documentation. (SSER 22, Section 22.3) Closed in SSER 29, Section 22.3.	NRR	Closed

(26)		For the scenario with an accident in one unit and concurrent shutdown of the second unit without offsite power, TVA stated that Unit 2, pre-operational testing will validate the diesel response to sequencing of loads on the Unit 2, emergency diesel generators (EDGs). The NRC staff will evaluate the status of this issue and will update the status of the EDG load response in a future SSER. (SSER 22, Section 8.1). Closed in SSER 27, Section 8.1.	NRR	Closed
(27)		TVA should provide a summary of margin studies based on scenarios described in Section 8.1 for CSSTs A, B, C, and D. (SSER 22, Section 8.2.2) Closed in SSER 24, Section 8.1.	NRR	Closed
(28)		TVA should provide to the NRC staff a detailed discussion showing that the load tap changer is able to maintain the 6.9 kV bus voltage control band, given the normal and post-contingency transmission operating voltage band, bounding voltage drop on the grid, and plant conditions. (SSER 22, Section 8.2.2) Closed in SSER 24, Section 8.1.	NRR	Closed
(29)		TVA should provide information about the operating characteristics of the offsite power supply at the Watts Bar Hydro Plant (for dual-unit operation), including the operating voltage range, post contingency voltage drops (including bounding values and post-unit trip values), and operating frequency range. (SSER 22, Section 8.2.2) (corrected version of Open Item 29 from SSER 22 Appendix HH) Closed in SSER 24, Section 8.1.	NRR	Closed
(30)		TVA should confirm that all other safety-related equipment (in addition to the Class 1E motors) will have adequate starting and running voltage at the most limiting safety-related components (such as motor-operated valves (MOVs), contactors, solenoid valves or relays) at the degraded voltage relay setpoint dropout setting. TVA should also confirm that the final Technical Specifications are properly derived from these analytical values for the degraded voltage settings. (SSER 22, Section 8.3.1.2) Closed in SSER 28, Section 8.3.1.2.	RII/NRR	Closed

(31)		TVA should clarify the loading sequence as explained in its letter dated December 6, 2010, to the staff. TVA should clarify whether the existing statements in FSAR regarding automatic sequencing logic are correct. If the FSAR description is correct, TVA should explain how the EDG and logic sequencing circuitry will respond to a LOCA followed by a loss-of-offsite power (LOOP) scenario. (SSER 22, Section 8.3.1.11) (corrected version of Open Item 31 from SSER 22 Appendix HH) Closed in SSER 24, Section 8.1	NRR	Closed
(32)		TVA should provide to the NRC staff the details of the administrative limits of EDG voltage and speed range, and the basis for its conclusion that the impact is negligible, and describe how it accounts for the administrative limits in the Technical Specification surveillance requirements for EDG voltage and frequency. (SSER 22, Section 8.3.1.14). Closed in SSER 27, Section 8.3.	NRR	Closed
(33)	CI	TVA stated in Attachment 9 of its letter dated July 31, 2010, that certain design change notices (DCNs) are required or anticipated for completion of WBN, Unit 2, and that these DCNs were unverified assumptions used in its analysis of the 125 volt direct current (VDC) vital battery system. Verification of completion of these DCNs to the NRC staff is necessary prior to issuance of the OL. (SSER 22, Section 8.3.2.3; SSER 24, Section 8.1) Closed in Inspection Report 05000391/2015602, dated March 24, 2015, ADAMS Accession No. ML15083A276.	RII/NRR	Closed
(34)	CI	TVA stated that the method of compliance with Phase I guidelines would be substantially similar to the current Unit 1,program and that a new Section 3.12 will be added to the Unit 2, FSAR that will be materially equivalent to Section 3.12 of the current Unit 1, FSAR. (SSER 22, Section 9.1.4) Closed in SSER 24, Section 9.1.4.	NRR	Closed
(35)		TVA should provide information to the NRC staff that the CCS will produce feedwater purity in accordance with BTP Materials Engineering Branch 5-3 or, alternatively, provide justification for producing feedwater purity to another acceptable standard. (SSER 22, Section 10.4.6). Closed in SSER 27, Section 10.4.6.	NRR	Closed

(36)		TVA should provide information to the NRC staff to enable verification that the SGBS meets the requirements and guidance specified in the SER or provide justification that the SGBS meets other standards that demonstrate conformance to GDC 1 and GDC 14. (SSER 22, Section 10.4.8) Closed in SSER 24, Section 10.4.8.	NRR	Closed
(37)	CI	The NRC staff will review the combined WBN, Unit 1, and 2 Appendix C prior to issuance of the Unit 2, OL to confirm (1) that the proposed Unit 2, changes were incorporated into Appendix C, and (2) that changes made to Appendix C for Unit 1, since Revision 92 and the changes made to the Nuclear Power Radiological Emergency Plan (REP) since Revision 92 do not affect the bases of the staff's findings in this SER supplement. (SSER 22, Section 13.3.2) Closed in SSER 28, Section 13.3.2.	NSIR	Closed
(38)	CI	The NRC staff will confirm the availability and operability of the ERDS for Unit 2, prior to issuance of the Unit 2 OL. (SSER 22, Section 13.3.2.6) Closed in Inspection Report 05000391/2014614, dated December 29, 2014, ADAMS Accession No. ML14363A315.	RII/NSIR	Closed
(39)	CI	The NRC staff will confirm the adequacy of the communications capability to support dual unit operations prior to issuance of the Unit 2 OL. (SSER 22, Section 13.3.2.6) Closed in Inspection Report 0500391/2011609, dated December 16, 2011, ADAMS Accession No. ML11350A229.	RII/NSIR	Closed
(40)	CI	The NRC staff will confirm the adequacy of the emergency facilities and equipment to support dual unit operations prior to issuance of the Unit 2, OL. (SSER 22, Section 13.3.2.8) Closed in Inspection Report 05000391/2014614, dated December 29, 2014, ADAMS Accession No. ML14363A315.	RII/NSIR	Closed
(41)	CI	TVA committed to (1) update plant data displays as necessary to include Unit 2, and (2) to update dose assessment models to provide capabilities for assessing releases from both WBN Units. The NRC staff will confirm the adequacy of these items prior to issuance of the Unit 2 OL. (SSER 22, Section 13.3.2.9) Closed in Inspection Report 05000391/2015603, dated May 1, 2015, ADAMS Accession No. ML15124A921.	RII/NSIR	Closed

(42)	CI	The NRC staff will confirm the adequacy of the accident assessment capabilities to support dual unit operations prior to issuance of the Unit 2 OL. (SSER 22, Section 13.3.2.9) Closed in Inspection Report 0500391/2011609, dated December 16, 2011, ADAMS Accession No. ML11350A229.	RII/NSIR	Closed
(43)	CI	Section V of Appendix E to 10 CFR Part 50 requires TVA to submit its detailed implementing procedures for its emergency plan no less than 180 days before the scheduled issuance of an OL. Completion of this requirement will be confirmed by the NRC staff prior to the issuance of an OL. (SSER 22, Section 13.3.2.18) Closed in SSER 28, Section 13.3.2.18	NSIR	Closed
(44)		TVA should provide additional information to clarify how the initial and irradiated RT_{NDT} was determined. (SSER 22, Section 5.3.1) Closed in SSER 25, Section 5.3.1.	NRR	Closed
(45)	CI	TVA stated in its response to RAI 5.3.2-2, dated July 31, 2010, that the PTLR would be revised to incorporate the cold overpressure mitigation system arming temperature. (SSER 22, Section 5.3.2) Closed in SSER 25, Section 5.3.2.	NRR	Closed
(46)	CI	The LTOP lift settings were not included in the PTLR, but were provided in TVA's response to RAI 5.3.2-2 in its letter dated July 31, 2010. TVA stated in its RAI response that the PTLR would be revised to incorporate the LTOP lift settings into the PTLR. (SSER 22, Section 5.3.2) Closed in SSER 25, Section 5.3.2.	NRR	Closed

(47)	CI	The NRC staff noted that TVA's changes to Section 6.2.6 in FSAR Amendment No. 97, regarding the implementation of Option B of Appendix J, were incomplete, because several statements remained regarding performing water-sealed valve leakage tests "as specified in 10 CFR [Part] 50, Appendix J." With the adoption of Option B, the specified testing requirements are no longer applicable; Option A to Appendix J retains these requirements. The NRC discussed this discrepancy with TVA in a telephone conference on September 28, 2010. TVA stated that it would remove the inaccurate reference to Appendix J for specific water testing requirements in a future FSAR amendment. (SSER 22, Section 6.2.6) Closed in SSER 26, Section 6.2.6.	NRR	Closed
(48)	CI	The NRC staff should verify that its conclusions in the review of FSAR Section 15.4.1 do not affect the conclusions of the staff regarding the acceptability of Section 6.5.3. (SSER 22, Section 6.5.3) Closed in SSER 26, Section 6.5.3.	NRR	Closed
(49)	CI	The NRC staff was unable to determine how TVA linked the training qualification requirements of ANSI N45.2-1971 to TVA Procedure Technical Instruction (TI)-119. Therefore, the implementation of training and qualification for inspectors will be the subject of future NRC staff inspections. (NRC letter dated July 2, 2010, ADAMS Accession No. ML101720050). Closed in Inspection Report 0500391/2014602, dated March 27, 2014, ADAMS Accession No. ML14086A063.	RII	Closed
(50)	CI	TVA stated that about 5 percent of the anchor bolts for safety-related pipe supports do not have quality control documentation, because the pull tests have not yet been performed. Since the documentation is still under development, the NRC staff will conduct inspections to follow-up on the adequate implementation of this construction refurbishment program requirement. (NRC letter dated July 2, 2010, ADAMS Accession No. ML101720050) Closed in Inspection Report 0500391/2013612, dated March 28, 2013, ADAMS Accession No. ML13088A066.	RII	Closed

(51)	CI	The implementation of TVA Procedure TI-119 will be the subject of NRC follow-up inspection to determine if the construction refurbishment program requirements are being adequately implemented. (NRC letter dated July 2, 2010, ADAMS Accession No. ML101720050). Closed in Inspection Report 0500391/2014602, dated March 27, 2014, ADAMS Accession No. ML14086A063.	RII	Closed
(52) through (58)		Not used.		
(59)		The staff's evaluation of the compatibility of the ESF system materials with containment sprays and core cooling water in the event of a LOCA is incomplete pending resolution of Generic Safety Issue-191 for WBN, Unit 2. (SSER 23, Section 6.1.1.4). Closed in SSER 27, Section 6.1.	NRR	Closed
(60)	CI	TVA should amend the FSAR description of the design and operation of the spent fuel pool cooling and cleanup system in FSAR Section 9.1.3 as proposed in its December 21, 2010, letter to the NRC. (SSER 23, Section 9.1.3) Closed in SSER 26, Section 9.1.3.	NRR	Closed
(61)		TVA should provide information to the NRC staff to demonstrate that Performance Analysis and Design (PAD) 4.0 can conservatively calculate the fuel temperature and other impacted variables, such as stored energy, given the lack of a fuel thermal conductivity degradation model. (SSER 23, Section 4.2.2). Closed in SSER 27, Section 4.2.	NRR	Closed
(62)	CI	Confirm TVA's change to FSAR Section 10.4.9 to reflect its intention to operate with each condensate storage tank isolated from the other. (SSER 23, Section 10.4.9) Closed in SSER 24, Section 10.4.9.	NRR	Closed
(63)	CI	TVA should confirm to the NRC staff that testing prior to Unit 2 fuel load has demonstrated that two-way communications is impossible with the Eagle 21 communications interface. (SSER 23, Section 7.2.1.1). Closed in SSER 27, Section 7.2.	RII	Closed

(64)	CI	TVA stated that, "Post modification testing will be performed to verify that the design change corrects the Eagle 21, Rack 2 resistance temperature detector accuracy issue prior to WBN, Unit 2 fuel load." This issue is open pending NRC staff review of the testing results. (SSER 23, Section 7.2.1.1). Closed in Inspection Report 05000391/2014602, dated March 27, 2014, ADAMS Accession No. ML14086A063.	RII	Closed
(65)		TVA should provide justification to the staff regarding why different revisions of Westinghouse Commercial Atomic Power-13869 are referenced in WBN, Units 1 and 2. (SSER 23, Section 7.2.1.1) Closed in SSER 26, Section 7.2.1.1.	NRR	Closed
(66)	CI	TVA should clarify FSAR Section 9.2.5 to add the capability of the ultimate heat sink to bring the nonaccident unit to cold shutdown within 72 hours. (SSER 23, Section 9.2.5). Closed in SSER 27, Section 9.2.5.	NRR	Closed
(67)	CI	TVA should confirm, and the NRC staff should verify, that the component cooling booster pumps for Unit 2 are above probable maximum flood level. (SSER 23, Section 9.2.2). Closed in SSER 27, Section 9.2.2 and Inspection Report 05000391/2014615, dated February 13, 2014, ADAMS Accession No. ML15044A424.	NRR	Closed
(68)		Not used.		
(69)	CI	The WBN, Unit 2, reactor coolant system (RCS) vent system is acceptable, pending verification that the RCS vent system is installed. (SSER 23, Section 5.4.5) Closed in Inspection Report 05000391/2014614, dated December 29, 2014, ADAMS Accession No. ML14363A315.	RII	Closed
(70)		TVA should provide the revised WBN, Unit 2, preservice inspection program ASME Class 1, 2, and 3 Supports "Summary Tables," to include numbers of components so that the NRC staff can verify that the numbers meet the reference ASME Code. (Section 3.2.3 of Appendix Z of SSER 23). Closed in SSER 27, Section 3.2.3 of Appendix Z.	NRR	Closed

(71)		By letter dated April 21, 2011 (ADAMS Accession No. ML111110513), TVA withdrew its commitment to replace the Unit 2 clevis insert bolts. TVA should provide further justification for the decision to not replace the bolts to the NRC staff. (SSER 23, Section 3.9.5) Closed in SSER 26, Section 3.9.5.	NRR	Closed
(72)		The NRC staff should complete its review and evaluation of the additional information provided by TVA regarding the inadequate core cooling instrumentation. (SSER 23, Section 4.4.8) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(73)	CI	The NRC staff will inspect to confirm that TVA has completed the WBN, Unit 2, emergency operating procedures (EOPs) prior to fuel load. (SSER 23, Section 7.5.3). Closed in Inspection Report 05000391/2014604, dated June 25, 2014, ADAMS Accession No. ML14177A214.	RII	Closed
(74)	CI	The NRC staff will verify installation of the acoustic-monitoring system for the power-operated relief valve (PORV) position indication in WBN, Unit 2, before fuel load. (SSER 23, Section 7.8.1) Closed in Inspection Report 05000391/2015604, dated June 29, 2015, ADAMS Accession No. ML15181A446.	RII	Closed
(75)	CI	The NRC staff will verify that the test procedures and qualification testing for auxiliary feedwater initiation and control and flow indication are completed in WBN, Unit 2, before fuel load. (SSER 23, Section 7.8.2) Closed in Inspection Report 05000391/2015608, dated October 21, 2015, ADAMS Accession No. ML15287A166.	RII	Closed
(76)	CI	The NRC staff will verify that the derivative time constant is set to zero in WBN, Unit 2, before fuel load. (SSER 23, Section 7.8.3) Closed in Inspection Report 05000391/2011607, dated September 30, 2011, ADAMS Accession No. ML112730197.	RII	Closed
(77)		It is unclear to the NRC staff which software verification and validation (V&V) documents are applicable to the HRCAR monitors. TVA should clarify which software V&V documents are applicable, in order for the staff to complete its evaluation. (SSER 23, Section 7.5.2.3) Closed in SSER 26, Section 7.5.2.3.4	NRR	Closed

(78)		TVA intends to issue a revised calculation reflecting that the total integrated dose in the control room is less than 1×10^3 rads, which will be evaluated by the NRC staff. (SSER 23, Section 7.5.2.3) Closed in SSER 25, Section 7.5.2.3.	NRR	Closed
(79)		TVA should perform a radiated susceptibility survey, after the installation of the hardware but prior to the RM-1000 being placed in service, to establish the need for exclusion distance for the high range containment air radiation (HRCAR) monitors while using handheld portable devices (e.g., walkie-talkie) in the control room, as documented in Attachment 23 to TVA's letter, dated February 25, 2011, and item number 355 of TVA's letter, dated April 15, 2011. (SSER 23, Section 7.5.2.3) Closed in SSER 29, Section 7.5.2.3.	NRR	Closed
(80)		TVA should provide clarification to the staff on how TVA Standard Specification SS-E18-14.1 meets the guidance of Regulatory Guide (RG) 1.180, and should address any deviations from the guidance of the RG. (SSER 23, Section 7.5.2.3). Closed in SSER 27, Section 7.5.2.3.	NRR	Closed
(81)		The extent to which TVA's supplier, General Atomics (GA), complies with Electric Power Research Institute TR-106439 and the methods that General Atomics used for its commercial dedication process should be provided by TVA to the NRC staff for review. (SSER 23, Section 7.5.2.3) Closed in SSER 26, Section 7.5.2.3.4.	NRR	Closed
(82)		The staff concluded that the information provided by TVA pertaining to the in-containment loose part monitoring system equipment qualification for vibration was incomplete. TVA should provide (item number 362 of ADAMS Accession No. ML111050009), documentation that demonstrates the loose part monitoring system in-containment equipment has been qualified to remain functional in its normal operating vibration environment, per RG 1.133, Revision 1. (SSER 23, Section 7.6.1) Closed in SSER 24, Section 7.6.1.4.5.	NRR	Closed

(83)	CI	TVA should confirm to the NRC staff the completion of the data storm test on the distribution control system. (SSER 23, Section 7.7.1.4) Closed in SSER 29, Section 7.7.1.4.	NRR	Closed
(84) through (89)		Not used.		
(90)	CI	The NRC staff should verify that the essential raw cooling water (ERCW) dual unit flow balance confirms that the ERCW pumps meet all specified performance requirements and have sufficient capability to supply all required ERCW normal and accident flows for dual-unit operation and accident response, in order to verify that the ERCW pumps meet GDC 5 for two-unit operation. (SSER 23, Section 9.2.1) Closed in Inspection Report 05000391/2015608, dated October 21, 2015, ADAMS Accession No. ML15287A166.	RII/NRR	Closed
(91)		TVA should update the FSAR with information describing how WBN, Unit 2, meets GDC 5, assuming the worst case single failure and a LOOP, as provided in TVA's letter dated April 13, 2011. (SSER 23, Section 9.2.1). Closed in SSER 27, Section 9.2.1.	NRR	Closed
(92)		Not used.		
(93)		TVA should confirm to the staff that testing of the Eagle 21 system has sufficiently demonstrated that two-way communication to the ICS is precluded with the described configurations. (SSER 23, Section 7.9.3.2). Closed in SSER 27, Section 7.9.	RII	Closed
(94)		TVA should provide to the staff either information that demonstrates that the WBN, Unit 2, Common Q post-accident monitoring system (PAMS) meets the applicable requirements in Institute of Electrical and Electronics Engineers (IEEE) Std. 603-1991, or justification for why the Common Q PAMS should not meet those requirements. (SSER 23, Section 7.5.2.2.3) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed
(95)		TVA should update FSAR Table 7.1-1, "Watts Bar Nuclear Plant NRC Regulatory Guide Conformance," to reference IEEE Std. 603-1991 for the WBN, Unit 2, Common Q PAMS. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed

(96)		TVA should (1) update FSAR Table 7.1-1 to include RG 1.100, Revision 3, for the Common Q PAMS, or (2) demonstrate that the Common Q PAMS is in conformance with RG 1.100, Revision 1, or provide justification for not conforming. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(97)		TVA should demonstrate that the WBN, Unit 2, Common Q PAMS is in conformance with RG 1.153, Revision 1, or provide justification for not conforming. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(98)		TVA should demonstrate that the WBN, Unit 2, Common Q PAMS is in conformance with RG 1.152, Revision 2, or provide justification for not conforming. (SSER 23, Section 7.5.2.2.3) Closed in SSER 26, Section 7.5.2.2.3.	NRR	Closed
(99)		TVA should update FSAR Table 7.1-1 to reference IEEE 7-4.3.2-2003 as being applicable to the WBN, Unit 2, Common Q PAMS. (SSER 23, Section 7.5.2.2.3; SSER 25, Section 7.5.2.2) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(100)		TVA should update FSAR Table 7.1-1 to reference RG 1.168, Revision 1; IEEE 1012-1998; and IEEE 1028-1997 as being applicable to the WBN, Unit 2, Common Q PAMS. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(101)		TVA should demonstrate that the WBN, Unit 2, Common Q PAMS application software is in conformance with RG 1.168, Revision 1, or provide justification for not conforming. (SSER 23, Section 7.5.2.2.3) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed
(102)		TVA should update FSAR Table 7.1-1 to reference RG 1.209 and IEEE Std. 323-2003 as being applicable to the WBN, Unit 2, Common Q PAMS. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(103)		TVA should demonstrate that the WBN, Unit 2, Common Q PAMS conforms to RG 1.209 and IEEE Std. 323-2003, or provide justification for not conforming. (SSER 23, Section 7.5.2.2.3) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed

(104)	CI	The NRC staff will review the Westinghouse Electric Corporation self-assessment to verify that it the WBN, Unit 2, PAMS is compliant to the V&V requirements in the software program manual or that deviations from the requirements are adequately justified. (SSER 23, Section 7.5.2.2.3.4.2) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(105)		TVA should produce an acceptable description of how the WBN, Unit 2, Common Q PAMS System Requirements Specification and software requirements specification (SRS) implement the design-basis requirements of IEEE Std. 603-1991 Clause 4. (SSER 23, Section 7.5.2.2.3.4.3.1) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed
(106)		TVA should produce a final WBN, Unit 2, Common Q PAMS SRS that is independently reviewed. (SSER 23, Section 7.5.2.2.3.4.3.1) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(107)	CI	TVA should provide to the NRC staff documentation to confirm that the final WBN, Unit 2, Common Q PAMS software design descriptions that are independently reviewed. (SSER 23, Section 7.5.2.2.3.4.3.2) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(108)		TVA should demonstrate to the NRC staff that there are no synergistic effects between temperature and humidity for the Common Q PAMS equipment. (SSER 23, Section 7.5.2.2.3.5.2) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed
(109)		TVA should demonstrate to the NRC staff acceptable data storm testing of the Common Q PAMS. (SSER 23, Section 7.5.2.2.3.7.1.8) Closed in SSER 25, Section 7.5.2.2.	NRR	Closed
(110)		TVA should provide information to the NRC staff describing how the WBN, Unit 2, Common Q PAMS design supports periodic testing of the RVLIS function. (SSER 23, Section 7.5.2.2.3.9.2.6) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed
(111)		TVA should confirm to the staff that there are no changes required to the TSs as a result of the modification installing the Common Q PAMS. If any changes to the TSs are required, TVA should provide the changes to the NRC staff for review. (SSER 23, Section 7.5.2.2.3.11) Closed in SSER 26, Section 7.5.2.2.	NRR	Closed

(112)	CI	TVA should provide an update to the FSAR reflecting the radiation protection design features descriptive information provided in its letter dated October 4, 2010. (SSER 24, Section 12.4) Closed in SSER 26, Section 12.4.	NRR	Closed
(113)	CI	TVA should provide an update to the FSAR reflecting the justification for the periodicity of the channel operability test frequency for WBN non-safety-related area radiation monitors. (SSER 24, Section 12.4) Closed in SSER 26, Section 12.4.	NRR	Closed
(114)	CI	TVA should update the FSAR to reflect that WBN meets the radiation monitoring requirements of 10 CFR 50.68. (SSER 24, Section 12.4) Closed in SSER 26, Section 12.4.	NRR	Closed
(115)	CI	TVA should update the FSAR to reflect the information regarding design changes to be implemented to lower radiation levels as provided in its letter to the NRC dated June 3, 2010. (SSER 24, Section 12.5). Closed in SSER 27, Section 12.5	NRR	Closed
(116)	CI	TVA should update the FSAR to reflect the qualification standards of the radiation protection manager as provided in its letter to the NRC dated October 4, 2010. (SSER 24, Section 12.6) Closed in SSER 26, Section 12.6.	NRR	Closed
(117)	CI	TVA should update the FSAR to reflect the calculational basis for access to vital areas as provided in its letter dated February 25, 2011. (SSER 24, Section 12.7.1). Closed in SSER 27, Section 12.7.1	NRR	Closed
(118)		TVA should provide to the NRC staff a description of how the other vanadium detectors within the in-core instrumentation thimble assembly (IITA) would be operable following the failure of a self-powered neutron detector (SPND). (SSER 24, Section 7.7.1.9.2) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(119)		TVA should submit WNA-CN-00157-WBT, Revision 0, to the NRC by letter. The NRC staff should confirm by review of WNA-CN-00157-WBT, Revision 0, that no credible source of faulting can negatively impact the CETs or PAMS train. (SSER 24, Section 7.7.1.9.5) Closed in SSER 25, Section 7.7.1.9.	NRR	Closed

(120)		TVA must confirm to the NRC staff that the maximum over-voltage or surge voltage that could affect the system is 264 VAC, assuming that the power supply cable to the signal processing system (SPS) cabinet is not routed with other cables greater than 264 VAC. (SSER 24, Section 7.7.1.9.5; SSER 25, Section 7.7.1.9) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(121)		TVA should submit the results to the NRC staff of a 600 VDC dielectric strength test performed on the IITA assembly. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(122)		TVA should confirm to the NRC staff that different divisions of safety power are supplied to the in-core instrumentation system SPS cabinets, with the power cables routed in separate shielded conduits. (SSER 24, Section 7.7.1.9.5) Closed in SSER 25, Section 7.7.1.9.	NRR	Closed
(123)		TVA should provide an explanation to the NRC staff of how the system will assign a data quality value to notify the power distribution calculation software to disregard data from a failed SPND. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(124)		While the BEACON datalink on the Application server can connect to either BEACON machine, only BEACON A is used for communication. TVA should clarify to the NRC staff whether automatic switchover to the other server is not permitted. (SSER 24, Section 7.7.1.9.5) Closed in SSER 25, Section 7.7.1.9.	NRR	Closed
(125)		TVA should provide clarification to the NRC staff of the type of connector used with the MI cable in Unit 2, and which EQ test is applicable. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(126)		To enable the NRC staff to evaluate and review the IITA EQ, TVA should provide the summary report of the EQ for the IITA. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed

(127)		TVA should provide a summary to the NRC staff of the electro-magnetic interference/radio-frequency interference testing for the MI cable electro-magnetic compatibility (EMC) qualification test results. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(128)		TVA should submit the seismic qualification test report procedures and results for the SPS cabinets to the NRC staff for review. (SSER 24, Section 7.7.1.9.5) Closed in SSER 25, Section 7.7.1.9.	NRR	Closed
(129)		TVA should verify to the NRC staff resolution of the open item in WNA-CN-00157-WBT for the Quint power supply (to be installed in the SPS cabinet) to undergo EMC testing of 4 kV to validate the assumptions made in the Westinghouse analysis. (SSER 24, Section 7.7.1.9.5) Closed in SSER 26, Section 7.7.1.9.	NRR	Closed
(130)		TVA should provide a summary to the NRC staff of the EMC qualification test results of the SPS cabinets. (SSER 24, Section 7.7.1.9.5) Closed in SSER 25, Section 7.7.1.9.	NRR	Closed
(131)		TVA should review the EOP action level setpoint to account for the difference between core exit temperature readings for Units 1 and 2, and confirm the EOP action level setpoint to the NRC staff. (SSER 24, Section 7.7.1.9.5). Closed in SSER 27, Section 7.7.	NRR	Closed
(132)		TVA must provide the NRC staff with analyses of the boron dilution event that meet the criteria of Standard Review Plan (SRP) Section 15.4.6, including a description of the methods and procedures used by the operators to identify the dilution path(s) and terminate the dilution, in order for the staff to determine that the analyses comply with GDC 10. (SSER 24, Section 15.2.4.4) Closed in SSER 26, Section 15.2.4.4.	NRR	Closed

(133)		In order to confirm the stability analysis of the sand baskets used by TVA in the WBN, Unit 2, licensing basis, TVA will perform either a hydrology analysis without crediting the use of the sand baskets at the Fort Loudoun Dam for the seismic dam failure and flood combination, or TVA will perform a seismic test of the sand baskets, as stated in TVA's letter dated April 20, 2011. TVA will report the results of this analysis or test to the NRC by October 31, 2011. (SSER 24, Section 2.4.10). Closed in SSER 27, Section 2.4.10.	NRR	Closed
(134)		TVA should provide to the NRC staff supporting technical justification for the statements in Amendment No. 104 of FSAR Section 2.4.4.1, "Dam Failure Permutations," page 2.4-32 (in the section "Multiple Failures") that, "Fort Loudoun, Tellico, and Watts Bar have previously been judged not to fail for the operating basis earthquake (OBE) (0.09 g). Postulation of Tellico failure in this combination has not been evaluated but is bounded by the SSE [safe shutdown earthquake] failure of Norris, Cherokee, Douglas and Tellico." (SSER 24, Section 2.4.10) Closed in SSER 28, Section 2.4.10	NRR	Closed
(135)		TVA has not provided the analysis required by 10 CFR Part 50, Appendix I, subsection II.D. TVA must demonstrate with a cost-benefit analysis that a sufficient reduction in the collective dose to the public within a 50-mile radius would not be achieved by reasonable changes to the design of the WBN gaseous effluent processing systems. (SSER 24, Section 11.3) Closed in SSER 25, Section 11.3.	NRR	Closed
(136)	CI	The joint frequency distribution summary for the data from 1991 through 2010 provided by letter dated November 7, 2011, and a discussion of the long-term representativeness of these data should be provided in the WBN, Unit 2, FSAR. Upon receipt of the UFSAR, the NRC staff will confirm that these updates have been made by TVA. (SSER 25, Section 2.3.3) Closed in SSER 26, Section 2.3.3.	NRR	Closed

(137)	CI	The NRC staff will confirm, upon receipt, that TVA integrated the updated control room atmospheric diversion estimate (χ/Q) values from its letter dated September 15, 2011, into a future amendment of the FSAR. (SSER 25, Section 2.3.4) Closed in SSER 26, Section 2.3.4.	NRR	Closed
(138)	CI	Upon receipt of the updated Offsite Dose Calculation Manual (ODCM), the NRC staff will confirm that corresponding revisions related to the updated annual average χ/Q and deposition factor values have been made to the ODCM. (SSER 25, Section 2.3.5) Closed in SSER 26, Section 2.3.5.	NRR	Closed
(139)	CI	The results of the cost-benefit analysis required by 10 CFR Part 50, Appendix I, subsection II.D, should be provided in the WBN, Unit 2, FSAR. Upon receipt of the UFSAR, the NRC staff will confirm that the update has been made by TVA. (SSER 25, Section 11.3). Closed in SSER 27, Section 11.3	NRR	Closed
(140)	CI	TVA to confirm to the staff the completion of the Unit 2, OMA feasibility walkdowns. (SSER 26, Appendix FF, Section 8.0). Closed in SSER 29, Section 9.5	NRR	Closed
(141)	CI	TVA to confirm to the staff the completion of the multiple spurious operation scenario resolution actions for scenarios that only affect Unit 2. (SSER 26, Appendix FF, Section 8.0). Closed in SSER 29, Section 9.5	NRR	Closed
(142)	CI	TVA to confirm to the staff the completion of the electrical coordination modifications. (SSER 26, Appendix FF, Section 8.0). Closed in SSER 29, Section 9.5)	NRR	Closed
(143)	CI	TVA to confirm the as-built fire protection report aligns with as-designed fire protection report. Gaps to be submitted to the NRC for approval. (SSER 26, Appendix FF, Section 8.0). Closed in SSER 29, Section 9.5	NRR	Closed

NRC FORM 335
(12-2010)
NRCMD 3.7

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

(See instructions on the reverse)

1. REPORT NUMBER
(Assigned by NRC, Add Vol., Supp., Rev., and Addendum Numbers, if any.)

NUREG-0847
Supplement No. 29

2. TITLE AND SUBTITLE
Safety Evaluation Report
Related to the Operation of
Watts Bar Nuclear Plant Unit 2
Docket No. 50-391

3. DATE REPORT PUBLISHED

MONTH	YEAR
October	2015

4. FIN OR GRANT NUMBER

5. AUTHOR(S)
J. Poole, et al.

6. TYPE OF REPORT
Technical

7. PERIOD COVERED (Inclusive Dates)

8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address)
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

9. SPONSORING ORGANIZATION - NAME AND ADDRESS (If NRC, type "Same as above", if contractor, provide NRC Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address.)
Same as above.

10. SUPPLEMENTARY NOTES
Docket No. 50-391

11. ABSTRACT (200 words or less)
This SSER documents the NRC staff's completion of its review of open items in support of TVA's application for an OL for WBN, Unit 2. In addition to closure of remaining open items, this SSER discusses a revision to the motor operated valve testing program, the fire protection program, the technical specifications, and final safety evaluation report modifications made by the applicant.

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 No. 50-391

13 AVAILABILITY STATEMENT
unlimited

14 SECURITY CLASSIFICATION
(This Page)
unclassified
(This Report)
unclassified

15. NUMBER OF PAGES

16. PRICE

NRC FORM 335 (12-2010)

Printed on recycled paper

Federal Recycling Program

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, DC 20555-0001

OFFICIAL BUSINESS

@NRCgov

NUREG-0847
Supplement 29

Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2

October 2015