ArevaEPRDCPEm Resource

From: Pederson Ronda M (AREVA NP INC) [Ronda.Pederson@areva.com]
Sent: Thursday, May 14, 2009 8:35 PM
To: Getachew Tesfaye
Cc: BENNETT Kathy A (OFR) (AREVA NP INC); DELANO Karen V (AREVA NP INC); DUNCAN Leslie E (AREVA NP INC); PORTER Thomas (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 144, FSAR Ch 14, Supplement 1
Attachments: RAI 144 Supplement 1 Response US EPR DC.pdf

Getachew,

AREVA NP Inc. (AREVA NP) provided responses to 4 of the 5 questions of RAI No. 144 on December 18, 2008. The attached file, "RAI 144 Supplement 1 Response US EPR DC.pdf," provides a technically correct and complete response to the remaining question, as committed.

The following table indicates the pages in the response document, "RAI 144 Supplement 1 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 144 — 14.02-72	2	3

This concludes the formal AREVA NP response to RAI 144, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Ronda Pederson
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From: WELLS Russell D (AREVA US)
Sent: Thursday, December 18, 2008 4:35 PM
To: 'Getachew Tesfaye'
Cc: 'John Rycyna'; Pederson Ronda M (AREVA US); BENNETT Kathy A (OFR) (AREVA US); DELANO Karen V (AREVA US); SLIVA Dana (EXT)
Subject: Response to U.S. EPR Design Certification Application RAI No. 144, FSAR Ch 14

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 144 Response US EPR DC.pdf" provides technically correct and complete responses to 4 of the 5 questions.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 144 Questions 14.02-73, 14.02-74, and 14.02-75.

The following table indicates the respective pages in the response document, "RAI 144 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 144 — 14.02-72	2	3
RAI 144 — 14.02-73	4	4
RAI 144 — 14.02-74	5	5
RAI 144 — 14.02-75	6	6
RAI 144 — 14.02-76	7	7

A complete answer is not provided for 1 of the 5 questions. The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI 144 — 14.02-72	May 14, 2009

Sincerely,

(Russ Wells on behalf of)
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From: Getachew Tesfaye [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Tuesday, November 18, 2008 4:02 PM
To: ZZ-DL-A-USEPR-DL
Cc: Dori Votolato; Juan Peralta; Michael Miernicki; Joseph Colaccino; John Rycyna
Subject: U.S. EPR Design Certification Application RAI No. 144 (1627), FSARCh. 14

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on November 16, 2008, and on November 18, 2008, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/NARP
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 467

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Response to

Request for Additional Information No. 144, Supplement 1 (1627), Revision 0

11/18/2008

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 14.02 - Initial Plant Test Program - Design Certification and New License Applicants
Application Section: Ch 14.2

QUESTIONS for Quality and Vendor Branch 1 (AP1000/EPR Projects) (CQVP)

Question 14.02-72:

RG 1.68, Appendix C, Preparation of Procedures, 1.b., “Test Objectives,” states that objectives of the test should be stated. Many systems tests will be intended to demonstrate that each of several initiation events will produce one or more expected responses. These initiating events and the corresponding responses should be identified. Also, RG 1.68 Appendix C.1.f., “Acceptance Criteria,” states that the test procedure should clearly identify the criteria against which the success or failure of the test will be judged, and should account for measurement errors and uncertainties. The staff requests that AREVA re-evaluate the U.S. EPR FSAR Sections 14.2.12.11 and 14.2.12.12 to ensure that initiating events and corresponding responses are identified and that descriptions clearly identify and state the criteria against which success or failure is measured, and revise the FSAR as appropriate. Examples of these issues are:

In Section 14.2.12.11.5, "Process Automation System (Test #128):"

> Item 5.1: What are the criteria for successful mitigation of ATWS?
>
> What are the criteria for successful mitigation of software common cause failure?
>
> What test method will simulate a common cause failure?
>
> What are “other risk significant” events?

Item 5.1.4: What are the manual control functions necessary to test to be considered a “successful” or “satisfactory” test”?

Item 5.2 & 5.3: Should there be acceptance criteria listed for auxiliary (or emergency) feedwater system and turbine trip initiation as well?

In Section 14.2.12.11.21,"Protection (Test #146):"

> Item 5.6: What are the acceptance criteria for successful (or unsuccessful) communication independence?
>
> What is the test method to test for protection system communication independence?

Item 5.11: What are the acceptance criteria for successful (or unsuccessful) safety to non-safety communication data path isolation? The description of the isolation device (electrical) is somewhat misleading in that one may consider it to be a conventional isolation device versus the Class 1E Maintenance Service Interfaces (MSI).

What is the test method and what are the acceptance criteria to verify that the Class 1E Maintenance Service Interfaces (MSI) provides adequate communication isolation between safety and non-safety systems?

In Section 14.2.12.12.8, "Safe Shutdown(Test #154):"

Item 3.2 & 3.5: Why are the locations of the manual trip not listed? What places are necessary to initiate a manual trip for the test to be considered successful? How does this determine that manual actuation is successfully accomplished from every possible means?

Response to Question 14.02-72:

Test abstracts in U.S. EPR FSAR Tier 2, Section 14.2 will be revised for clarification.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 14.2 and Table 1.1-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 1.1-1—U.S. EPR FSAR Acronyms and Descriptions
Sheet 2 of 19

Acronym	Description
ATWS	Anticipated Transient Without Scram
AU	Acquisition Unit
AVB	Anti-Vibration Bar
AVS	Annulus Ventilation System
AVT	All-Volatile Treatment
AWG	American Wire Gauge
B&W	Babcock & Wilcox
BACC	Boric Acid Corrosion Control
BAST	Boric Acid Storage Tank
BBC	Backup Bus Controller
BCMS	Boron Concentration Measurement System
BDBE	Beyond Design Basis Event
BISI	Bypassed and Inoperable Status Indication
BOC	Beginning of Cycle
BOP	Balance of Plant
BPV	Boiler and Pressure Vessel
BRL	Ballistic Research Laboratory
BTP	Branch Technical Position
BWR	Boiling Water Reactor
CAS	Compressed Air System
CAV	Cumulative Absolute Velocity
CBDTM	Cause-Based Decision Tree Method
CBV	Complete Breach of Vessel
CCF	Common-Cause Failure
CBVS	Containment Building Ventilation System
CCFL	Countercurrent Flow Limiting
CCFP	Conditional Containment Failure Probability
CCW	Component Cooling Water
CCWS	Component Cooling Water System
CDES	Core Damage End State
CDF	Core Damage Frequency
CDM	Certified Design Material
CDS	Coolant Degasification System

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Table 1.1-1—U.S. EPR FSAR Acronyms and Descriptions
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Acronym	Description
FFT	Fast Fourier Transform
FHS	Fuel Handling System
FIRS	Foundation Input Response Spectra
Fire-PRA	Probabilistic Fire Risk Assessment
FIV	Flow Induced Vibration
FL	Full Load
FLCV	Full Load Control Valve
FMEA	Failure Modes and Effects Analysis
FML	Fluid Momentum Loads
FPA	Fire Protection Analysis
FPCPS	Fuel Pool Cooling and Purification System
FPCS	Fuel Pool Cooling System
FPP	Fire Protection Program
FPPS	Fuel Pool Purification System
FPS	Fire Protection System
FR	Fuel Rack
FRA	Functional Requirements Analysis
FSAR	Final Safety Analysis Report
FTTF	Fuel Transfer Tube Facility
FUM	Function Modules
FV	Fussel-Vesely
FVW	Fussel-Vesely Worth
FWH	Feedwater Heater
FWIV	Feedwater Isolation Valve
FWLB	Feedwater Line Break
FWS	Feedwater System
GDC	General Design Criteria
GFES	Gaseous Fire Extinguishing System
GMRS	Ground Motion Response Spectra
GPS	Global Positioning System
GSI	Generic Safety Issue
GTAW	Gas Tungsten Arc Welding
GW	Gateway

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Table 1.1-1—U.S. EPR FSAR Acronyms and Descriptions
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Acronym	Description
NSM	Non-Self Monitored
NSS	Nuclear Sampling System
NSSS	Nuclear Steam Supply System
NUMARC	Nuclear Utilities Management and Resources Council
NUPS	Non-Class 1E UPS
OBE	Operating Basis Earthquake
OCWS	Operational Chilled Water System
OD	Outside Diameter
OER	Operating Experience Review
OH	Ordinary Hazard
OM	Operation & Maintenance
OPP	Overpressure Protection
ORE	Operator Reactor Experiments
OSC	Operational Support Center
OSSA	Operating Strategies for Severe Accidents
PA	Postulated Accident
PABX	Private Automatic Branch Exchange
PACS	Priority and Actuator Control
PAM	Post-Accident Monitoring
PAR	Passive Autocatalytic Recombiner
PAS	Process Automation System
PASS	Post Accident Sampling System
PC	Personal Computer
PCI	Pellet to Clad Interaction
PCD	Partial Cool Down
PDD	Power Density Detector
PDS	Pressurizer (or Primary) Depressurization System
PE	Phenomenological Evaluation
PFAS	Plant Fire Alarm System
PGA	Peak Ground Acceleration
PI	Panel Interface
PICS	Process Information and Control System
PIE	Post-Irradiation Examination

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2.6.2 Refueling cavity.

2.6.3 IRWST.

3.0 TEST METHOD

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3.1 Measure the head versus flow curves for pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach rated flow).

3.2 Operate each FPC train when aligned for one and two pump operation and measure flow to the SFP.

3.3 Observe the operation of each FPC train isolation valve during FPC pump start and stop.

3.4 Measure each FPC heat exchanger differential pressure at design flows.

3.5 Observe operation of instrument and controls (manual and automatic), including setpoints, actuations, instrument interlocks and alarms using actual or simulated inputs over the full range of the SFP instrumentation operation.

3.6 Check the functionality of the spent fuel pool gates and quantify gate leakage.

3.7 Check to determine if the anti-siphon pipes and holes on the FPCPS lines are free of obstructions.

3.8 Quantify leakage of the spent fuel pool by checking the spent fuel pool leak detection system.

3.9 Operate the Fuel Building purification pump and then the Reactor Building purification pump and measure flow when the system is aligned to the purification ion exchanger, filtering the following:

3.9.1 Spent fuel pool.

3.9.2 Refueling cavity.

3.9.3 IRWST.

3.10 Measure differential pressure across the FPP ion exchanger, pre-filter, and post filter.

3.11 Measure the performance characteristics of power-operated valves (e.g., thrust, stroke time, fail position upon loss of motive power) as designed.

3.12 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

5.1.6 Verify charging pump miniflow performance.

5.1.7 Verify various CVCS flow paths and flow rates.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.1.4 CVCS Letdown (Test #004)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the CVCS letdown subsystem for normal and emergency conditions.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CVCS letdown subsystem have been completed.

2.2 Letdown subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for the operation of the CVCS letdown subsystem control valves are functional.

2.4 The RCS is operated at HZP pressure and temperature.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication, and

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Record response of power-operated valves upon loss of motive power as designed (refer to Section 9.3.4).

3.3 Observe response of letdown system to simulated pressurizer level signals.

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3.4 Simulate a safety injection actuation signal (SIAS) and observe system response.

3.5 Simulate a containment isolation ~~actuation~~ signal (CI~~A~~S) and observe system response.

3.6 Simulate an inadvertent dilution event and observe system response.

3.7 Simulate a range of letdown temperatures and observe the response of control valves. Observe alarm and interlock operation.

3.8 Measure system pressure and temperature upstream and downstream of pressure control valves and verify sub-cooled conditions exist.

2.2 RCP and RCS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Component cooling water (CCW) to the RCP is available.

2.4 RCP motor initial operation preoperational test has been completed.

2.5 Pre-start RCP activities have been completed, including opening the standstill seal.

2.6 Support systems required for operation of the RCPs and RCS sample isolation valves are functional.

2.7 The humidity detection system has an installed test tube to route humid air to the detection system.

2.8 The humidity detection system humidity cell has been calibrated.

3.0 TEST METHOD

3.1 Simulate temperature, pressure, and flow signals from each RCP and verify alarm setpoints.

3.2 Simulate temperature signals from each RCS RTD and observe alarm operation.

3.3 Perform initial venting of RCPs, pressurizer, and reactor vessel.

3.4 Perform initial run of RCPs.

3.5 Vent the RCS after each run is complete.

3.6 Observe power-operated valves operation upon loss of motive power (refer to Section 5.1 for anticipated response).

3.7 Verify that the humidity detection system responds to a simulated high humidity.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

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3.9 Verify that the standstill seal can be engaged when the RCP is stopped.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms occur.

4.2 RCP cold performance data.

4.3 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 Verify performance and alarms of the RCS and RCPs as designed (refer to Sections 5.1, 5.2.5, and 5.4.1):

5.1.1 Verify valve performance per design requirements.

5.1.2 Verify alarm and interlocks function as designed.

3.3.1 MHSI pumps shall be aligned to discharge to the depressurized RCS (vessel level maintained below the vessel nozzles).

3.3.2 MHSI discharge valves throttled and calibrated instrumentation installed to compare safety injection (SI) pump flow and discharge pressure to the pump manufacturer head-flow curve.

3.3.3 Perform critical (full flow) sections of the test using normal and emergency power sources.

3.3.4 Collect valve data on valves that reposition to perform an accident mitigation function under maximum differential pressure conditions.

3.3.5 Measure suction supply (NPSH) to the MHSI pumps from the IRWST using the suction header under maximum flow conditions, minimum IRWST level, and minimum vessel level.

3.3.6 Compare the measured suction head to the MHSI pump manufacturer NPSH requirements when corrected for IRWST minimum level attainable during an SIAS and maximum IRWST fluid temperature. (Note: it is acceptable to correct available data if design conditions can not be duplicated).

3.3.7 Operate each MHSI pump available for cold leg safety injection (CLSI) through the CLSI header and collect pump operating data.

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3.4 Operate each MHSI pump to document the full flow capability.

3.4.1 Discharge head.

3.4.2 Flow corresponding to head at each point.

3.4.3 Starting time (motor start time and time to reach rated flow).

3.5 Collect fluid samples from each of the MHSI system sampling points.

3.6 Measure the MHSI pump minimum flow recirculation flow rate to the IRWST. Compare the measured flow rate to the required minimum flow rate provided by the pump supplier.

3.7 Record the static head of water in pump discharge lines relative to IRWST level with the valves in the MHSI lines between the IRWST and RCS in the open position.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify that the MHSI system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve position and position indication.

4.2 Position response of valves to loss of motive power.

4.3 Valve performance data, where required.

3.4 Observe operation of the protective devices, controls, interlocks, indications, and alarms using actual or simulated signals.

3.5 Observe operation, stroking speed, position indication, and response to interlock of control and isolation valves.

3.6 Determine if motor operated valve (MOV) isolation valves can be opened against design differential pressure.

3.7 Measure NPSH to the LHSI pumps from suction sources at maximum design flow rates.

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3.7.1 $NPSH_a \geq NPSH_R$.

3.7.2 Discharge head.

3.7.3 Flow corresponding to head at each point.

3.7.4 Starting time (motor start time and time to reach rated flow).

3.8 Measure flow capability of the RHR heat exchangers.

3.9 Measure flow through the flow limiting device, if applicable, in the LHSI discharge lines prevents runout flow when the LHSI system is at full flow.

3.10 Determine if each RHR train is capable of being powered by the electrically independent and redundant emergency power supplies.

3.11 Operate each LHSI pump available for hot and cold leg safety injection (SI) through the associated SI line and collect pump operating data.

3.12 Observe response of RHR and LHSI power-operated valves upon loss of motive power (refer to Section 6.3 for anticipated response).

3.13 Verify that the LHSI system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 LHSI pump head versus flow.

4.3 Valve performance data, where required.

4.4 Setpoints of alarms and interlocks.

4.5 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The RHR/LHSI systems meets design requirements (refer to Section 6.3):

5.1.1 Verify that LHSI pump miniflow is within minimum/ maximum flow limits.

5.1.2 Verify adequate LHSI pump NPSH from all available pump suction paths.

2.7 Temporary air hoses (minimum of two inch diameter) are installed between the temporary air compressor and the SAHRS header.

3.0 TEST METHOD

3.1 Record parameters associated with operation of the SAHRS pump with minimum flow established.

3.2 Record parameters associated with SAHRS pump performance including head and flow characteristics for design flow paths that can be tested by practical means.

3.3 Demonstrate valve performance data are within design limits.

3.4 Demonstrate by using the temporary air source that the SAHRS header and nozzles are free of obstructions.

3.5 Demonstrate adequate heat removal capability by the SAHRS heat exchangers, by flow measurement.

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3.6 Demonstrate response of power-operated valves upon loss of motive power (refer to Section 19.0 for anticipated response).

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 SAHRS pump head versus flow characteristics.

4.3 Valve performance data, where required.

4.4 Setpoints at which interlocks and alarms occur.

4.5 Position response of valves to loss of motive power.

4.6 Thermography record that spray nozzles are unobstructed. Thermography evidence shall be conclusive without need for supporting documentation.

5.0 ACCEPTANCE CRITERIA

5.1 The SAHRS meets design criteria (refer to Section 19.0):

5.1.1 Verify SAHRS pump performance is within minimum / maximum flow limits.

5.1.2 Verify that SAHRS pump performance on miniflow is within limits.

5.1.3 Verify that the SAHRS spray header nozzles are unobstructed.

5.1.4 Verify that the SAHRS heat exchangers meet flow requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

3.6 Measure performance, including head and flow characteristics, of the EBS pumps.

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3.6.1 $NPSH_a \geq NPSH_R$.

3.6.2 Discharge head.

3.6.3 Flow corresponding to head at each point.

3.6.4 Starting time (motor start time and time to reach rated flow).

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify that the EBS system meets full flow and shutoff head (by extrapolation) design requirements.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 EBS pump operating data.

4.5 Setpoints at which alarms and interlocks occur.

4.6 EBS pump head versus flow.

5.0 ACCEPTANCE CRITERIA

5.1 The EBS meets design requirements (refer to Section 6.8):

5.1.1 Verify that EBS pump relief valve discharges to the EBS storage tank to protect the EBS discharge piping.

5.1.2 Verify adequate EBS pump NPSH from all available pump suction paths.

5.1.3 Verify that the EBS can be aligned to take suction from the EBS Storage Tank and discharge to the reactor vessel cold leg within the minimum / maximum flow limits.

5.1.4 Verify that EBS pump flow and developed head are within minimum/maximum limits.

5.1.5 Verify alarm, interlock, and controls function as designed.

5.1.6 Verify that EBS valves function as designed.

5.1.7 Verify that the EBS maximum discharge pressure is greater than the maximum RCS design pressure.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.2.8 Emergency Feedwater System (Test #020)

1.0 OBJECTIVE

1.1 To perform the test described in this abstract on the emergency feedwater system (EFWS) in conditions that are representative of actual plant conditions or close enough to allow the data to be extrapolated to actual conditions.

1.2 To demonstrate that the EFWS is properly installed and is functional prior to fuel loading. This test shall demonstrate the ability of the EFWS to supply feedwater to the steam generators (SG) for design emergency conditions.

1.3 To record data that is used to validate design basis assumptions or provide a baseline record of system performance for non-safety-related attributes.

1.4 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have either been completed or exceptions have been recorded and the impact on system performance has been determined.

2.2 Permanently installed instrumentation is functional and calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated. A record of calibrated test instrumentation used with individual tracking number and calibration due date shall be recorded in the official test record.

2.4 Plant systems required to support testing are functional, or temporary systems are installed and functional.

3.0 TEST METHOD

3.1 Test the control logic and record response.

3.2 Measure the following head and flow characteristics of emergency feedwater (EFW) pumps:

3.2.1 Pump head versus flow.

3.2.2 Starting time (motor start time and time to reach rated flow).

14.02-72 → 3.2.3 $NPSH_a \geq NPSH_R$.

3.3 Align the EFW system to all possible design flow paths and record flow,

3.4 Determine if the operation in response to signals from the plant protection system is within design limits.

3.5 Measure EFW system operation in response to signals from the hardwired controls of the safety information and controls system.

3.6 Measure response of power operated valves (e.g., stroke time, developed thrust).

3.7 Record operation of the following using actual or simulated inputs:

3.7.1 Protective devices.

3.7.2 Controls.

3.7.3 Interlocks.

3.7.4 Instrumentation response.

3.7.5 Alarms.

3.8 Record pump performance during an endurance test.

3.9 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.9 for anticipated response).

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 EFWS valve position indications.

4.2 EFWS valve performance data, where required including valve stroke time under design basis differential pressure.

4.3 EFWS pump head versus flow curves.

4.4 Flow rates through venturi.

4.5 Response of EFW pumps to safety-related signals.

4.6 Pump start times.

4.7 Position response of EFWS valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The EFWS meets design criteria (refer to Section 10.4.9):

5.1.1 Verify that EFWS pump miniflow is within minimum/ maximum flow limits.

5.1.2 Verify adequate EFWS pump NPSH from all available pump suction paths.

5.1.3 Verify that the EFWS can be aligned to take suction from the EFW Storage Tank and discharge to the steam generator within the minimum / maximum flow limits ~~from the MCR~~.

14.02-72

- Table 14.3-1 Item 1-57.
- Table 14.3-1 Item 1-58.
- Table 14.3-1 Item 1-54.
- Table 14.3-1 Item 1-55.

14.2.12.3.5 Containment Isolation Valves Leakage Rate (Test #028)

1.0 OBJECTIVE

1.1 To verify that the measured leakage through each containment penetration isolation valve when summed with the total of other Type B and C LRTs is within the limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Temporary pressurization equipment is installed and instrumentation is calibrated.

3.0 TEST METHOD

3.1 Close the individual CIVs by the means provided for normal operation of each individual valve. The valves must be stroked to the closed position by the normal means to perform a valid leakage test.

3.2 Perform 10 CFR 50 Appendix J, Type C test, by local pressurization of each penetration.

4.0 DATA REQUIRED

4.1 Individual penetration leak data.

5.0 ACCEPTANCE CRITERIA

5.1 Verify leak rates, when summed with the total of other Type B and C LRTs, do not exceed the allowable limits as required by the Technical Specifications and 10 CFR 50, Appendix J.

5.2 The CIVs operate as designed (refer to Sections 3.1.5, 3.8.1, and 6.2.6).

14.2.12.3.6 Containment Integrated Leak Rate and Structural Integrity Tests (Test #029)

1.0 OBJECTIVE

1.1 To perform the structural integrity test (SIT) and integrated leak rate test (ILRT) for the containment.

1.2 To verify that the integrated leak rate from the containment does not exceed the maximum allowable leakage rate.

2.0 PREREQUISITES

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2.1 Containment ~~is functional and~~ penetration local leak rate testing has been completed ~~to the greatest extent possible~~.

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2.2 All systems inside containment which have CIVs identified are vented and drained as required by ~~Table 6.2.4-1—Containment Isolation Valve and Actuator Data~~Section 6.2.6.1.

2.3 Leakage rate determination instrumentation is available, calibrated, and is operating satisfactorily prior to performing the following test.

2.4 Containment inspection completed as required by the Technical Specifications and 10 CFR 50, Appendix J.

2.5 Systems required for the test are available, including station air and other miscellaneous systems.

2.6 Instrumentation to measure containment building movement is installed and calibrated and is operating satisfactorily prior to performing the following test.

2.7 Containment ventilation system fans are capable of running for air circulation. Note that it is necessary to create air circulation to eliminate local temperature variations that would bias the test results.

3.0 TEST METHOD

3.1 Close individual CIVs by the means provided for normal operation of the valves as required by 10 CFR 50, Appendix J.

3.2 Increase the internal pressure in the containment building from atmospheric pressure to a minimum of 115 percent of design pressure in at least four approximately equal increments and depressurized in the same increments.

3.3 Record data at each pressure level, during pressurization and depressurization, an evaluation of the deflections shall be made to determine if the response deviates significantly from the expected response.

3.4 Perform a visual inspection of the containment hatches, penetrations, and flanged joints.

3.5 Determine the containment leak rate at calculated peak accident pressure and at one-half calculated peak accident pressure.

3.6 Verify leakage by reference vessel method, absolute pressure method, or both.

3.7 Verify the test accuracy by supplementary means.

4.0 DATA REQUIRED

4.1 Structural integrity data.

4.1.1 The readings of instrumentation to measure containment building movement shall be recorded at selected pressure levels.

5.3 The fuel transfer tube closure hatch operates in accordance with manufacturer instructions.

5.4 The fuel transfer tube penetration and quick closure hatch perform as designed (refer to Sections 3.8.1 and 9.1.4).

5.5 The spent fuel penetration provides a leak tight seal in the floor of the loading pit.

14.2.12.4 Civil Components and Systems

14.2.12.4.1 Containment Polar Crane (Test #040)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the containment polar crane.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Containment polar crane instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist.

3.2 Check hoist and trolley speeds.

3.3 Check capability of crane to position over required containment building equipment.

3.4 Perform a functional test of the polar crane at 100 percent of rated load.

3.5 Perform 125 percent static load capacity test.

3.6 Verify the operation of protective and safety devices.

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3.7 Perform tests to demonstrate the following:

3.7.1 Redundant reeving.

3.7.2 Holding brakes.

3.7.3 Ability to handle load hang-ups.

3.7.4 Mis-spooling.

3.7.5 Two-block test or substitute test.

4.0 DATA REQUIRED

4.1 Hoist and trolley speeds.

4.2 Verification of that operation of interlocks is within design limits.

4.3 Load capacity data.

5.0 ACCEPTANCE CRITERIA

5.1 The containment polar crane meets design requirements (refer to Sections 3.8.3 and 9.1.5):

5.1.1 Trolley, bridge, and hoist function as designed.

5.1.2 Hoist and trolley speeds are within design limits.

5.1.3 Polar crane is capable of being positioned over required containment building equipment.

5.1.4 Polar crane protective and safety devices function as designed.

5.1.5 Polar crane load tests are completed satisfactorily.

14.02-72 5.1.6 Verify that the crane meets the test requirements of ASME NOG-1, 2004 and NUREG-0554.

14.2.12.4.2 Fuel Building Cranes (Test #041)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the fuel handling cranes.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Fuel building cranes instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist for each crane.

3.2 Check hoist and trolley speeds.

3.3 Check capability of cask handling and fuel handling crane to position over required fuel building equipment.

3.4 Perform a functional test of the cranes at 100 percent of rated load.

3.5 Perform 125 +/- 5 percent static load capacity test of the cask handling crane and the fuel handling crane.

14.02-72 3.6 Verify the operation of protective and safety devices.

3.7 Perform tests to demonstrate the following:

3.7.1 Redundant reeving.

3.7.2 Holding brakes.

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3.7.3 Ability to handle load hang-ups.

3.7.4 Mis-spooling

3.7.5 Two-block test or substitute test.

4.0 DATA REQUIRED

4.1 Hoist and trolley speeds.

4.2 Verification of that operation of interlocks is within design limits.

4.3 Load capacity data.

5.0 ACCEPTANCE CRITERIA

5.1 The fuel handling cranes perform as designed (refer to Section 9.1.5):

5.1.1 Trolley, bridge, and hoist function as designed.

5.1.2 Hoist and trolley speeds are within design limits.

5.1.3 Crane is capable of being positioned over required building equipment.

5.1.4 Crane protective and safety devices function as designed.

5.1.5 Crane load tests are completed satisfactorily.

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5.1.6 Verify that the crane meets the test requirements of ASME NOG-1, 2004 and NUREG-0554.

14.2.12.4.3 Turbine Building Crane (Test #042)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the turbine building crane.

2.0 PREREQUISITES

2.1 Electric power available.

2.2 Turbine building crane instrumentation has been calibrated and is functional for performance of the following test.

2.3 Construction activities on the crane and associated equipment have been completed.

3.0 TEST METHOD

3.1 Verify functionality of trolley, bridge, and hoist.

3.2 Check hoist and trolley speeds.

3.3 Check capability of crane to position over required turbine building equipment.

3.4 Perform 125 percent load capacity test.

14.2.12.5.4 Potable and Sanitary Water Systems (Test #225)

1.0 OBJECTIVE

1.1 To demonstrate the ability of potable water system to supply potable water under normal plant operations.

1.2 To demonstrate the ability of sanitary water system to supply sanitary water under normal plant operations.

2.0 PREREQUISITES

2.1 Construction activities on the potable and sanitary water systems have been completed.

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2.2 Potable and sanitary water systems instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system required for operation of the potable and sanitary water systems are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 The potable and sanitary water systems suction supplies are being maintained at the water level (pressure) specified in the design documents.

3.0 TEST METHOD

3.1 Verify potable and sanitary water systems measured pump and system flow meet design specifications.

3.2 Verify that potable and sanitary water systems interlocks and protective features perform as designed.

4.0 DATA REQUIRED

4.1 Pump operating data.

4.2 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The potable and sanitary water systems meets design requirements (refer to Section 9.2.4):

5.1.1 System flow is within design limits.

5.1.2 Supplied water meets design requirements.

14.2.12.5.5 Component Cooling Water System (Test #046)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the CCWS to provide treated cooling water under the following conditions:

1.1.1 Normal unit operation.

1.1.2 During unit cooldown.

1.1.3 During refueling.

1.1.4 During an emergency situation.

1.2 To demonstrate that system response to a simulated ESF actuation signal is as designed.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the CCWS have been completed.

2.2 CCWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support testing are functional, or temporary systems are installed and functional.

3.0 TEST METHOD

3.1 Demonstrate that operation of the surge tanks and their controls is within design limits.

3.2 Demonstrate that system and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

3.3 Perform a pump head versus flow verification for CCW pumps.

3.3.1 $NPSH_a \geq NPSH_R$.

3.3.2 Starting time (motor start time and time to reach rated flow).

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3.4 Verify the following responses to emergency signals:

a. Non-safety-related headers ~~and the spent fuel pool heat exchangers~~outside of the reactor building are isolated on an ~~SIAS~~SIS signal from the Protection System.

b. If the CCW surge tank level is less than MIN2, the non-safety piping is isolated if there is a difference between the measured flow rate at the inlet and outlet of each branch.

c. If the CCW surge tank level drops below MIN3, the leak may be located on the safety-related piping on the common header. The common headers are isolated by closing the switchover valves of the faulted train.

d. If the CCW surge tank level decreases below the MIN4 setpoint, the associated CCW pump is tripped.

3.5 Verify the ~~non-safety-related headers and RCP headers are isolated on a surge tank low-low level signal~~stroke closure time of the CCWS switchover valves.

3.6 Verify ~~a low CCW pump differential pressure signal starts the idle pump in each division~~that the start of a CCWS pump generates a starting of the corresponding ESWS train.

3.7 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

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3.8 Observe response of power-operated valves upon loss of motive power (refer to Section 9.2.2 for anticipated response).

3.9 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.10 Verify pump control from the ~~MCR~~PICS.

3.11 Demonstrate the ability of the CCWS in conjunction with the RHRS and essential service water system to perform a plant cooldown during HFT.

3.12 Verify that the RCP thermal barriers can be supplied by either the 1.b or 2.b common header. Demonstrate that the supply can be realigned with the RCPs operating during HFT.

3.13 Verify that the fire protection makeup to the CCW surge tank meets design flow rates.

3.14 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Record pump head versus flow and operating data for each pump.

4.2 Flow balancing data including flow to each component and throttle valve positions.

4.3 Setpoints of alarms interlocks and controls.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Temperature data during cooldown.

4.8 Response of CCW System to SIAS, ~~CSAS~~CIAS, ~~low-low~~ surge tank level signal, and CCW ~~pump high~~header differential ~~pressure~~flow signal.

5.0 ACCEPTANCE CRITERIA

5.1 The CCWS meets design requirements (refer to Section 9.2.2):

5.1.1 Operation of the surge tanks and their controls is within design limits.

5.1.2 System and component flow paths, flow rates, and pressure drops including head versus flow verification for the CCW pumps is within design limits.

5.1.3 Pump head versus flow verification for CCW pumps is within design limits.

5.1.4 Response to emergency signals meets design requirements.

5.1.5 Non-safety-related headers and RCP headers are isolated on simulated signals.

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5.1.6 CCW pump differential pressure signal starts the idle pump in each division.

5.1.7 System valves meet design requirements.

5.1.8 Alarms, interlocks, indicating instruments, and status lights meet design requirements.

5.1.9 Verify pump control from the ~~MCR~~PICS.

5.1.10 Verify the ability of the CCWS in conjunction with the RHRS and essential service water system (ESWS) to perform a plant cooldown during HFT.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.5.6 Reserved (Test #047)

14.2.12.5.7 Essential Service Water System (Test #048)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the ESWS to supply cooling water as designed under normal and emergency conditions, where the emergency includes postaccident system realignments, if applicable.

1.2 To demonstrate the ability of the ESWS to provide cooling water to the SAHRS in beyond design basis conditions.

1.3 To demonstrate the ability of the ESWS to provide cooling water to the essential service water pump building ventilation system (ESWPBVS).

1.4 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the ESWS are complete and the system is functional.

2.2 ESWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation available and calibrated per applicable procedures.

2.4 CCWS available to provide a heat load.

2.5 Appropriate AC and DC power sources are available.

2.6 Support systems required for operation of the ESWS are complete and functional.

2.7 The Ultimate Heat Sink (UHS) is available and functional.

2.8 The UHS basin is filled to normal level.

2.9 The UHS basin support systems required for operation of the ESWS and UHS are available, as required.

3.0 TEST METHOD

3.1 Demonstrate that the ESWS can be operated from the ~~MCR~~PICS.

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3.2 Demonstrate that the ESWS starts automatically in response to a~~n emergency~~Protection signal and applicable realignments are performed in a satisfactory manner.

3.3 Verify that the ESWS pumps supply cooling water at the rated flow and design conditions.

3.4 Verify ESWS water flow is supplied to components at required flow rates and developed head.

3.5 Verify alarms, interlocks, indicating instruments, and status lights are functional.

3.6 Verify head versus flow characteristics for the ESWS water pump.

3.6.1 $NPSH_a \geq NPSH_R$.

3.6.2 Discharge head.

3.6.3 Flow corresponding to head at each point.

3.6.4 Starting time (motor start time and time to reach rated flow.

3.7 Record valve performance data, where required.

3.8 Verify and ~~R~~record valve position indication.

3.9 Record position response of valves to loss of motive power.

3.10 Verify system baseline performance during HFT (with RHRS in service).

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.12 Verify filter backwash operation at simulated or actual high filter differential pressure.

3.13 Verify adequate $NPSH_a$ for the ESW pump ($NPSH_a > NPSH_R$.

3.14 Verify ESW/CCW response (simulated or actual) to inadvertant isolation of the operating ESW pump's discharge valve meets design requirements.

3.15 Verify operation of the CCWS switchover sequence meets design requirements.

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4.0 DATA REQUIRED

4.1 Record flows as required to components and throttle valve positions.

4.2 Record alarm, interlocks, and control setpoints.

4.3 Record pump head versus flow and operating data.

4.4 System operating parameters during HFT.

4.5 Verify flow to the CCW heat exchangers using the ESW pump in the normal system alignment.

4.6 Verify flow to the SAHRS using the dedicated ESW pump.

4.7 Valve position upon loss of motive power and valve position indication data.

4.8 Verify flow to the EDG heat exchangers using the ESW pump in the normal system alignment.

4.9 Verify flow to the ESW/PBVS room cooler using the ESW pump in the normal system alignment.

5.0 ACCEPTANCE CRITERIA

5.1 The ESWS meets design requirements (refer to Section 9.2.1):

5.1.1 Verify that each ESWS can be operated from the ~~MCR~~PICS.

5.1.2 Verify that each ESWS starts automatically in response to a~~n emergency~~Protection signal.

5.1.3 Verify that the ESWS pumps supply cooling water at the rated flow and design conditions.

5.1.4 Verify ESWS water flow supplied to components.

5.1.5 Verify alarms, interlocks, indicating instruments, and status lights perform as designed.

5.1.6 Verify head versus flow characteristics for the ESWS water pumps meets design requirements.

5.1.7 Verify that system valves meet design requirements.

5.1.8 Verify system baseline performance during HFT (with RHRS in service).

5.1.9 Verify filter backwash operation in response to high filter differential pressure.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.5.8 Ultimate Heat Sink (Test #049)

1.0 OBJECTIVE

1.1 To demonstrate that the UHS is maintained by its associated support systems.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 Demonstrate proper operation of the UHS, excluding heat removal capacity.

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2.0 PREREQUISITES

2.1 Construction activities on the UHS have been completed and the UHS is available and functional.

2.2 UHS makeup source available, as required.

2.3 UHS blowdown path available, as required.

2.4 The UHS system instrumentation has been calibrated and is functional for performance of the following test.

2.5 Test instrumentation available and calibrated per applicable procedures.

2.6 Appropriate AC and DC power sources are available.

2.7 UHS basin support systems required for operation of the UHS and ESWS are available, as required.

2.8 The UHS basin is filled to normal operating levels.

3.0 TEST METHOD

3.1 Demonstrate operation of the UHS tower over the design range of operation.

3.1.1 Simulate a UHS operating temperature that corresponds to the lower range of operation.

3.1.2 Demonstrate that fans operate in the reverse direction.

3.1.3 Demonstrate that tower bypass paths realign to mitigate ice formation.

3.1.4 Simulate a gradual increase in ambient UHS temperature and terminate the ambient temperature increase at the upper end of the design operation band.

3.1.5 Record changes to tower fans and critical component operation during temperature increase.

3.2 Perform valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time).

3.3 Demonstrate that UHS makeup flow rate meets design flow requirements.

3.3.1 During normal operation.

3.3.2 During emergency operation.

3.4 Demonstrate that UHS blowdown flow rate meets design flow requirements.

3.4.1 During normal operation.

3.4.2 During emergency operation.

3.5 Demonstrate the operation of UHS level and temperature instruments and alarms.

3.6 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.7 Demonstrate that the chemical treatment system functions as designed.

3.7.1 Injection flow rate to UHS.

3.7.2 Interlocks with UHS blowdown.

4.0 DATA REQUIRED

4.1 UHS makeup and blowdown flow rates.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Temperature and relative humidity trend data.

4.5 Setpoints at which alarms and interlocks occur.

14.02-72 4.6 Cooling fan air flow rates.

5.0 ACCEPTANCE CRITERIA

5.1 The UHS meets design requirements (refer to Section 9.2.5):

5.1.1 Verify that control logic starts forced draft fans and aligns critical components for UHS operation for the entire design range.

5.1.2 Verify that valve performance tests (e.g., valve position response of valves to loss of motive power, thrust, stroke time) meet design requirements.

5.1.3 Verify that UHS makeup flow rate meets design flow requirements.

5.1.4 Verify that UHS blowdown flow rate meets design flow requirements.

5.1.5 Verify that the operation of UHS level and temperature instruments and alarms meet design requirements.

5.1.6 Verify that the UHS tower bypass function meets design requirements.

5.1.7 Verify that the chemical treatment system meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.5.9 Reserved (Test #050)

14.2.12.6 General Supply Systems

14.2.12.6.1 Reserved (Test #051)

14.2.12.6.2 Safety Chilled Water System (Test #052)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the safety chilled water system (SCWS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the SCWS have been completed.

2.2 SCWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation available and calibrated per applicable procedures.

2.4 The CCWS is available for chiller operation, where necessary.

2.5 Appropriate AC and DC power sources are available.

2.6 Interfacing system loads are connected and available.

2.7 SCWS support systems (makeup, nitrogen) are available.

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2.8 SCWS has been filled and pressurized.

3.0 TEST METHOD

3.1 Verify pump performance characteristics (e.g., head versus flow, motor current) for the SCWS pumps.

3.1.1 $NPSH_a \geq NPSH_R$.

3.1.2 Discharge head.

3.1.3 Flow corresponding to head at each point.

3.1.4 Starting time (motor start time and time to reach flow).

14.2.12.6.3 Reserved (Test #053)

14.2.12.6.4 Fire Water Distribution System (Test #054)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the fire water distribution system (FWDS) to provide water at acceptable flows and pressures to protected areas.

2.0 PREREQUISITES

2.1 Construction activities on the FWDS have been completed.

2.2 FWDS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the FWDS are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that the fire water distribution system has two separate fresh water storage tanks that meet design requirements.

2.5.1 Table 14.3-3 Item 3-7.

3.0 TEST METHOD

3.1 Demonstrate the head and flow characteristics of the fire water pumps and the operation of auxiliaries.

3.2 Verify control logic.

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3.3 ~~Verify~~Measure developed head and flow rates in the various flow paths of the underground FWDS by measuring flow at appropriate discharge points.

3.3.1 $NPSH_a \geq NPSH_R$.

3.3.2 Discharge head.

3.3.3 Flow corresponding to head at each point.

3.3.4 Starting time (motor start time and time to reach flow).

3.4 Verify alarms, indicating instruments, and status lights are functional.

3.5 Verify that the ~~FWDS~~fire water pumps can be manually actuated, refer to Section 9.5.1.2.1.

3.6 Verify as-built FWDS drawings for above ground piping and equipment.

3.7 Verify that FWDS $NPSH_a$ is greater than the $NPSH_R$.

3.8 Verify the failed position of FWDS valves to loss of motive power.

4.0 DATA REQUIRED

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4.1 Setpoints under which alarms and interlocks occur.

4.2 Pump head versus flow and operating data.

4.3 As-built FWDS drawings.

5.0 ACCEPTANCE CRITERIA

5.1 The FWDS operates as designed (refer to Section 9.5.1, including manual features):

5.1.1 Verify the head and flow characteristics of the fire water pumps and the operation of auxiliaries.

5.1.2 Verify FWDS control logic meets design requirements.

5.1.3 Verify flow rates in the various flow paths of the FWDS are installed per design.

5.1.4 Verify alarms, indicating instruments, and status lights meet design requirements.

5.1.5 Verify that the FWDS can be manually actuated (refer to Section 9.5.1.2.1).

5.1.6 Verify that the fresh water storage tanks minimum level alarms meet design requirements.

14.2.12.6.5 Spray Deluge System (Test #055)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the spray deluge system ~~(SDS)~~ to provide effective spray pattern to protected areas.

2.0 PREREQUISITES

2.1 Construction activities on the ~~SDS~~ spray deluge system have been completed.

2.2 Support systems required for operation of the ~~SDS~~ spray deluge system are complete and functional.

2.3 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify sprinkler deluge spray patterns are not obstructed.

3.2 Verify as-built spray deluge system drawings.

4.0 DATA REQUIRED

4.1 Pictures of deluge spray patterns.

4.2 As-built spray deluge system drawings.

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5.0 ACCEPTANCE CRITERIA

5.1 The ~~SDS~~spray deluge system operates as designed (refer to Section 9.5.1):

5.1.1 Verify that spray patterns meet design requirements.

5.1.2 Activation devices (manual and automatic) meet design requirements.

5.1.3 Verify alarms and indicating instruments meet design requirements.

5.1.4 Piping and equipment are installed per as-built drawings.

14.2.12.6.6 Sprinkler System (Test #056)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the sprinkler system ~~(SPRS)~~ to provide coverage of designated areas.

2.0 PREREQUISITES

2.1 Construction activities on the ~~SPRS~~sprinkler system have been completed.

2.2 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify sprinkler system as-built drawings showing the location of installed sprinklers.

3.2 Verify sprinkler patterns are not obstructed.

3.3 Verify alarms and~~,~~ indicating instruments~~, and status lights~~ are functional.

3.4 Verify that the sprinkler systems ~~can be manually actuated~~are functional (refer to Section 9.5.1.2.1).

4.0 DATA REQUIRED

4.1 ~~Pictures of sprinkler spray nozzle patterns~~Spray nozzles meet NFPA 13 requirements for locating sprinkler heads.

4.2 As-built drawings of installed sprinklers~~, including manual features~~.

5.0 ACCEPTANCE CRITERIA

5.1 The ~~SPRS~~sprinkler system operates as designed (refer to Section 9.5.1):

5.1.1 Verify that ~~spray patterns~~piping and components meet sprinkler system design requirements.

5.1.2 Activation devices (manual and automatic) meet design requirements, where applicable.

14.2.12.6.7 Gaseous Fire Extinguishing System (Test #057)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the gaseous fire extinguishing system (GFES) to provide ~~non-combustible gas at acceptable to protected areas~~coverage of designated areas per design.

2.0 PREREQUISITES

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2.1 Construction activities on the GFES have been completed.

2.2 Support systems required for operation of the GFES are complete and functional.

2.3 Test instrumentation is available and calibrated.

2.4 Construction activities for the area being protected are complete and the structure is properly sealed.

3.0 TEST METHOD

3.1 Verify ~~markup~~as-built drawings showing the location of areas protected by the GFES ~~equipment~~.

3.2 Verify alarms, indicating instruments, and status lights are functional.

3.3 Verify that the gaseous fire extinguishing systems can be manually actuated (refer to Section 9.5.1.2.1).

3.4 Verify as-built GFES drawings.

4.0 DATA REQUIRED

4.1 As-built drawings showing the location of areas protected by GFES equipment.

4.2 As-built GFES drawings.

5.0 ACCEPTANCE CRITERIA

5.1 The GFES operates as designed (refer to Section 9.5.1, including manual features):

5.1.1 Verify that ~~discharge patterns meet design requirements.~~the GFES can provide coverage of designated areas to meet design requirements. System must achieve a design concentration in a specified time and hold that concentration for a specified time.

5.1.2 Manual a~~A~~ctivation devices ~~(manual and automatic)~~ meet design requirements.

5.1.3 Alarms and indicating instruments meet design requirements.

5.1.4 Piping and equipment installed per as-built system drawing meet design requirements.

14.2.12.6.8 Reserved (Test #058)

14.2.12.7 Power Conversion Systems

14.2.12.7.1 Feedwater System (Test #059)

1.0 OBJECTIVE

1.1 To demonstrate that the FWS, including startup feedwater pump, is capable of supplying feedwater to the SGs for normal operation.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the FWS have been completed.

2.2 FWS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the FWS are complete and functional.

2.4 Test instrumentation available and calibrated.

2.5 Condensate system functional.

2.6 Main condenser functional.

2.7 Appropriate AC and DC power available.

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3.0 TEST METHOD

3.1 Demonstrate design flow paths including economizer, downcomer, and cleanup recirculation (during HFT or ~~PAT~~power ascension tests).

3.2 Demonstrate that startup feedwater valve alignments and flow paths function as designed.

3.3 Verify the starting, head, and flow characteristics of the motor-driven startup feedwater pump.

3.4 Demonstrate minimum flow recirculation protection using simulated inputs.

3.5 Verify operation of protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs function as designed.

3.6 Verify the starting, head, and flow characteristics of motor-driven feedwater pumps.

3.7 Operate feedwater isolation valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, stroke times).

3.8 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.9 Observe response of the feedwater isolation valves upon loss of motive power (refer to Section 10.4.7 for anticipated response).

3.10 Verify the feedwater isolation valves close in response to protective signals.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.12 Demonstrate standby feedwater pumps response to loss of operating pumps.

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3.13 Depressurize the feedwater supply header and verify that the feedwater check valves prevent pressurization of the feedwater system at the feedwater pump discharge.

4.0 DATA REQUIRED

4.1 Motor-driven startup feedwater pump head versus flow data.

4.2 Motor-driven feedwater pump head versus flow data.

4.3 Valve performance data, where required.

4.4 Valve position indication.

4.5 Position response of valves to loss of motive power.

4.6 Setpoints at which alarms and interlocks occur.

4.7 Feedwater isolation valve data.

5.0 ACCEPTANCE CRITERIA

5.1 The FWS (including startup feedwater) operates as designed (refer to Section 10.4.7):

5.1.1 Verify design flow paths including economizer, downcomer, and cleanup recirculation meet design requirements.

5.1.2 Verify that startup feedwater valve alignments and flow paths function as designed.

5.1.3 Verify the starting, head, and flow characteristics of the motor-driven startup feedwater pump meet design requirements.

5.1.4 Verify that minimum flow recirculation protection meets design requirements.

5.1.5 Verify operation of protective devices, controls, interlocks, instrumentation, and alarms function as designed.

4.2 Pressure applied to the lifting device to lift the safety valve off its seat.

4.3 Popping pressure of each main steam safety valve.

5.0 ACCEPTANCE CRITERIA

5.1 The main steam safety valves perform as designed (refer to Section 10.3).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.5 Main Steam Isolation Valves and MSIV Bypass Valves (Test #063)

1.0 OBJECTIVE

1.1 To demonstrate the functional performance of the main steam isolation valves (MSIV) and MSIV bypass valve controls.

1.2 To demonstrate the proper operation of the MSIVs at normal operating temperatures, during HFT.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the MSIVs have been completed.

2.2 MSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the MSIVs are complete and functional.

2.4 Test equipment is available and test instrumentation is calibrated.

3.0 TEST METHOD

3.1 Operate MSIV and MSIV bypass valves remotely while:

a. Observing each valve operation and position indication.

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b. Measuring valve performance data (e.g., thrust, stroke times) at ambient and HFT conditions. Note that the MSIV has two operating scenarios, fast acting for MSIV and slow acting for open/close for normal operation. The intent is to measure response to normal operation.

3.2 Observe response of the MSIVs and MSIV bypass valves upon loss of motive power (refer to Section 10.3 for anticipated response).

3.3 Verify MSIV and MSIV bypass valve controls, alarms, and interlocks.

3.4 Verify MSIV and MSIV bypass valve response (e.g., thrust, stroke times) to ~~MSIS~~main steam isolation signal.

3.5 Verify MSIV and MSIV bypass valve seat leakage.

3.6 Perform MSIV drift test.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Verify that the MSIV and MSIV bypass valves meet design requirements.

4.0 DATA REQUIRED

4.1 MSIV and MSIV bypass valve performance data at ambient and HFT conditions.

4.2 Valve position indication.

4.3 Position response of valves to a loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 MSIV and MSIV bypass valve seat leakage.

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4.6 MSIV and MSIV bypass valve response to ~~MSIS~~main steam isolation signal.

4.7 MSIV drift data.

5.0 ACCEPTANCE CRITERIA

5.1 The MSIVs and MSIV bypass valves operate as designed (refer to Section 10.3):

5.1.1 Verify that valve meet design requirements (e.g., stroke time, thrust, seat leakage, loss of motive power).

- Table 14.3-1, Item 1-62.

5.1.2 Verify that system controls, alarms, and interlocks function as designed.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.6 Turbine Gland Sealing System (Test #064)

1.0 OBJECTIVE

1.1 To verify that the turbine gland sealing system (TGSS) provides adequate sealing to the turbine shaft against leakage of air to the turbine casings and escape of steam to the Turbine Building.

2.0 PREREQUISITES

2.1 Construction activities on the TGSS have been completed.

2.2 TGSS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Test instrumentation is available and calibrated.

2.4 Plant systems required to support the test including auxiliary steam, the condenser, and turbine cooling water system are functional.

2.5 Plant conditions for the following subsystems allow operation of the sealing steam system.

2.5.1 Main turbine.

2.5.2 Main feed pumps.

2.5.3 Turbine control valves.

14.02-72 2.5.4 Main condensate flow through the gland steam condenser.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.3 for anticipated response).

3.3 Place the TGSS in operation using auxiliary steam during turbine startup.

3.4 Verify that operation of the TGSS as turbine load is increased functions as designed.

3.5 Verify that performance of the sealing steam exhauster blowers and the sealing steam condenser function as designed.

3.6 Verify that operation of the high pressure turbine gland spillover valve for dumping excess gland seal leakage functions as designed.

3.7 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms function as designed.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The TGSS meets design requirements (refer to Section 10.4.3):

5.1.1 TGSS provides adequate sealing of the turbine shaft.

5.1.2 TGSS valves thrust, opening times, closing times, and controls (manual and automatic) meet design requirements.

5.1.3 TGSS alarms, interlocks, and system controls meet design requirements

14.2.12.7.7 Main Condenser and Main Condenser Evacuation System (Test #065)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the main condenser and main condenser evacuation system (CES) to provide a continuous heat sink for normal operation.

1.2 To demonstrate the ability of the main condenser and CES to provide a sink for the turbine bypass system.

2.0 PREREQUISITES

2.1 Construction activities on the main condenser and CES have been complete.

2.2 Main condenser and CES instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the main condenser and CES are complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Steam seals and lagging are available.

2.6 Turbine is on turning gear.

2.7 All electrical testing is complete on the vacuum pumps and condenser valves.

3.0 TEST METHOD

3.1 Verify the vacuum integrity of the condenser by performing the following tests:

3.1.1 Hydrostatic test of the condenser with the water boxes clean and dry.

3.1.2 Establish a vacuum and determine sources of in-leakage with helium, sulfur hexafluoride or equivalent tracer gas. (Look for leaks at each valve bonnet ~~and at the dog-bone seal between the turbine and the condenser with the seal clean and dry~~).

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3.2 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.3 Observe response of power-operated valves upon loss of motive power.

3.4 Demonstrate that operation of the vacuum pumps with design operating modes and flow paths function as designed.

5.1.2 The CS alarms, interlocks, protective devices, and controls (automatic and manual) function as designed.

5.1.3 CS valves perform as designed (e.g., thrust, seat leakage, opening time, closing time, bonnet air in-leakage, failure mode upon loss of motive power).

5.2 Vibration levels meet the requirements described in Section 3.9.2.4.

14.2.12.7.9 Steam Generator Blowdown System (Test #067)

1.0 OBJECTIVE

1.1 To verify the proper operation of the SG blowdown system (SGBS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the SGBS have been completed.

2.2 The SGBS instruments have been calibrated and are functional for performance of the following test.

2.3 Support systems required for operation of the SGBS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify the flow paths for generator blowdown and subsequent condensate recycle during HFT.

3.2 Verify blowdown flow path flow rates during HFT.

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3.3 ~~Operate control valves remotely~~Remotely operate power-operated valves while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.4 Observe response of power-operated valves upon loss of motive power (refer to Section 10.4.8 for anticipated response).

3.5 Verify that operation of the flash tank, valves, and heat exchanger in operational modes and flow paths function as designed.

3.6 Verify that the operation of protective devices, controls, interlocks, and alarms using actual or simulated inputs meet design requirements.

3.7 Verify system response to the following:

3.7.1 The ~~CIAS~~blowdown system meets design requirements in response to CIS.

3.7.2 ~~EFAS~~The blowdown system meets design requirements in response to signals described in Section 10.4.8.2.2.

3.7.3 The blowdown system meets design requirements in response to a main steam isolation signal caused by low SG pressure or high SG pressure drop.

3.7.4 The blowdown system meets design requirements in response to a partial cooldown signal coupled with either high secondary activity or high SG level.

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3.7.5 The blowdown system meets design requirements in response to a safety injection signal plus loss of offsite power.

3.8 Verify SG wet layup system operations.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Response of CIVs to ~~MSIS, CIAS~~CIS and ~~EFAS~~signals described in Section 10.4.8.2.2.

4.6 SG blowdown flow path flow rates.

5.0 ACCEPTANCE CRITERIA

5.1 The SGBS operates as designed (refer to Section 10.4.8):

5.1.1 SGBS alarms, interlocks, protective devices, and controls (manual and automatic) respond as required.

5.1.2 SGBS ~~flow~~ instrumentation performs as designed.

5.1.3 SGBS valves perform as designed (i.e., thrust, opening times, closing times, ability to initiate and terminate SGBS flow without introducing water hammers).

5.1.4 SGBS responds as designed to isolation signals.

5.1.5 SGBS flow rates meet design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.10 Steam Turbine (Test #068)

1.0 OBJECTIVE

1.1 To demonstrate functional performance of the steam turbine controls.

1.2 To demonstrate functional performance of the steam turbine support system.

1.3 To perform initial operation of the steam turbine system (HFT and ~~PAT~~power ascension tests). 14.02-72

1.4 To verify the steam turbine generator trips in response to the following:

1.4.1 Simulated reactor trip signal.

1.4.2 Simulated loss of condenser vacuum signal.

2.0 PREREQUISITES

2.1 Construction activities on the steam turbine system are complete.

2.2 Steam turbine system instrumentation has been calibrated and is functional for the performance of the following test.

2.3 Appropriate test equipment is available and has been calibrated.

2.4 Fluid levels throughout the system meet design limits. Personnel safety shall limit proximity to lubricating and hydraulic oils.

2.5 Schedule visual inspection of the secondary side of the SG following testing.

2.6 Appropriate AC and DC power sources are available and functional.

2.7 Support systems required for the steam turbine system are complete and functional.

2.8 MSS is available.

2.9 Main condenser is available.

3.0 TEST METHODS

3.1 Demonstrate the electro hydraulic control (EHC) system performs the following:

3.1.1 That turbine turning gear engages and disengages as designed.

3.1.2 That automatic control of turbine speed and acceleration functions through the entire speed range.

3.1.3 That automatic control of load and loading rate from auxiliary to full load, with continuous load adjustment and discrete loading rates.

3.1.4 Standby manual control of speed and load is functional when it becomes necessary to take the primary automatic control out of service.

3.1.5 Limiting of load in response to preset limits on operating parameters.

3.2 Verify that detection of dangerous or undesirable operating conditions, annunciation of detected conditions, and initiation of control response to such conditions meets design requirements, as follows:

3.2.1 Monitoring the status of the control systems including the power supplies and redundant control circuits.

3.2.2 Testing of valves and controls including response to a simulated reactor trip signal and simulated loss of condenser vacuum signal.

3.2.3 Pre-warming of valve chest and turbine rotor.

3.3 Perform steam turbine performance test per latest edition of ASME PTC-6 (Reference 3).

3.4 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Observe response of power-operated valves upon loss of motive power (refer to Section 10.2 ~~10.3~~ for anticipated response). 14.02-72

3.6 Demonstrate turbine lube oil system operation.

3.7 Demonstrate hydrogen oil-sealed cooling system for rotor cooling operation.

3.8 Demonstrate stator water cooling system operation.

3.9 Demonstrate moisture separators, reheaters, and extraction steam systems operation.

4.0 DATA REQUIRED

4.1 Setpoint at which alarms and interlocks occur.

4.2 Setpoints of automatic trips.

4.3 Conditions under which manual trips operate.

4.4 Verification of control logic combinations.

4.5 Valve logic verification of EHC system.

4.6 Valve performance data, where required.

4.7 Valve position indication.

4.8 Position response of valves to loss of motive power.

4.9 Operating data and function verification of associated turbine support systems.

5.0 ACCEPTANCE CRITERIA

5.1 The steam turbine system and support systems perform as designed (refer to Section 10.3):

5.1.1 Turbine turning gear engages and disengages as designed.

5.1.2 Turbine alarms, interlocks, protective devices, and controls (manual and automatic) meet design requirements.

a. Diversion valves to the condenser open at the established setpoint.

b. Modulation valves reposition to control feedwater heater and drain tank levels at established setpoints.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indication.

4.3 Position response of valves to loss of motive power.

4.4 Setpoints at which alarms and interlocks occur.

4.5 Level indication of various components.

5.0 ACCEPTANCE CRITERIA

5.1 The RHDS meets design requirements (refer to Section 10.4.7):

5.1.1 RHDS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 RHDS valves perform as designed (i.e., opening times, closing times, and ability to control feedwater heater levels).

5.1.3 RHDS pumps perform as designed.

5.1.4 RHDS feedwater levels control feedwater heater levels as designed.

14.2.12.7.13 Secondary Sampling System (Test #071)

1.0 OBJECTIVE

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1.1 To verify the ability of secondary sampling system (SECSS) to collect and deliver representative secondary samples ~~of liquids and gases in various process systems~~ to sample stations for chemical and radiological analysis during ~~operation~~power, cooldown, and standby operation.

1.2 To demonstrate electrical independence and redundancy of power supplies to steam generator blowdown sampling system containment isolation valves.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Systems being sampled are at or near normal operating pressure and temperature.

2.3 Calibrating gases and solutions are available.

2.4 Test instrumentation is available and calibrated.

2.5 SECSS instrumentation has been calibrated and is functional for performance of the following test.

3.0 TEST METHOD

3.1 Withdraw fluid at each sample point, verifying adequate sample flow.

3.2 Verify that operation of alarms and interlocks meets design requirements.

3.3 Verify that operation of pump and heat exchangers in normal operation using normal flow paths meets design requirements.

3.4 Verify the analytical instrumentation provides indication and response that meet the design requirements.

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~~3.5 Calculate the holdup times using the as-built piping lengths, piping volume and measured flow rate for the following:~~

~~3.5.1 SG samples.~~

~~3.5.2 Blowdown demineralizer samples.~~

3.5 ~~Operate control~~Activate power-operated valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.6 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.2).

3.7 Verify that ~~operation of~~ continuous monitors and sample ~~verify~~ flow rate meets design requirements.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Sampling flow rate from each sample point.

4.3 Analytical instrument data.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The SECSS meets design requirements (refer to Section 9.3.2):

5.1.1 SECSS alarms, interlocks, and controls (manual and automatic) function as designed.

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5.1.2 SECSS valves perform as designed (i.e., opening times, closing times, and pressure/temperature controls).

5.1.3 SECSS ~~holdup times~~ meet design requirements for representative samples.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.7.14 Steam Generator Blowdown Demineralizing System (Test #072)

1.0 OBJECTIVE

1.1 To verify the ability of ~~SG~~the steam generator blowdown (SGB) demineralizing system ~~(SGBDMS)~~ to clean the SG blowdown by a combination of filtration and ion exchange.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Systems being sampled are at or near normal operating pressure and temperature.

2.3 Calibrating gases and solutions are available.

2.4 Test instrumentation is available and calibrated.

2.5 Secondary sampling system instrumentation has been calibrated and is functional for performance of the following test.

3.0 TEST METHOD

3.1 Verify by physical inspection that the filter housing is constructed and assembled in a manner that doesn't permit bypass flow paths.

3.2 Verify that operation of alarms and interlocks meet design requirements.

3.3 Verify the analytical instrumentation provides indication and response that meets design requirements of ion exchanger outlet chemistry.

3.4 ~~Operate control~~Activate power-operated valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.5 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 10.4.8).

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

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5.1 The SGB~~DMS~~ demineralizing system meets design requirements (refer to Section 10.4.8):

5.1.1 ~~SGBDMS~~SGB demineralizing system alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 ~~SGBDMS~~SGB demineralizing system valves perform as designed (i.e., opening times, closing times~~, and ability to control feedwater heater levels~~).

14.2.12.8 Heating Ventilation and Air Conditioning (HVAC) Systems

14.2.12.8.1 Containment Building Cooling (Test #073)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the containment cooling and ventilation system to maintain acceptable temperature limits and air quality in the containment during normal operations and normal shutdown.

2.0 PREREQUISITES

2.1 Major construction activities inside the containment building have been completed.

2.2 Construction activities on the containment cooling and ventilation system have been completed.

2.3 Containment cooling and ventilation system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the containment cooling and ventilation systems are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 The RCS is at normal operating temperature and pressure during HFT.

3.0 TEST METHOD

3.1 Verify the operation of the containment recirculation cooling units.

3.2 Verify the operation of the reactor pit cooling fans.

3.3 Verify operation of the containment purge fans (both full flow and low flow).

3.4 Perform air balance as appropriate for each subsystem.

5.1.1 CBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 CBVS fan performance meets design requirements.

5.1.3 CBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.2 The CBVS meets design requirements to monitor radiation (refer to Section 7.3.1).

14.2.12.8.4 Containment Purge (Test #076)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the containment purge systems, both low-flow and full-flow, to maintain the containment air quality and cleanliness at the required value during normal operation (low-flow), inspection, testing, maintenance, and refueling operations.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities in the containment have been completed and acceptable levels of cleanliness established.

2.2 Construction activities on the containment purge systems have been completed.

2.3 Containment purge system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the containment purge systems are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate manual and automatic system controls.

3.2 Verify alarms, indicating instruments and status lights are functional.

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3.3 Verify design air flows for high purge, low purge ~~and two containment cleanup systems~~.

3.4 Perform HEPA filters and carbon ~~absorber~~adsorber efficiency tests.

3.5 Demonstrate system responses to a high radiation signal and high relative humidity signal.

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.4.7).

3.8 Simulate the following and observe isolation valve response:

3.8.1 CIAS.

3.8.2 High humidity actuation signal.

3.8.3 High radiation actuation signal.

3.9 Verify that operation of containment purge system radiation monitors meets design requirements.

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.11 Verify that the containment purge system functions as designed.

4.0 DATA REQUIRED

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4.1 Air balancing ~~verification~~report, including fan operating data for low purge and high purge fans.

4.2 HEPA filter and carbon ~~absorber~~adsorber data for exhaust filter trains.

4.3 Valve performance data, where required.

4.4 Valve position indication.

4.5 Position response of valves to loss of motive power.

4.6 Setpoints at which alarms and interlocks occur.

4.7 Temperature of air supply (outside) to high purge supply and discharge into containment.

4.8 Valves respond to the following simulated signals:

4.8.1 ~~CIAS~~CIS.

4.8.2 High humidity actuation signal.

4.8.3 High radiation actuation signal.

4.9 Containment purge system radiation monitors performance data.

5.0 ACCEPTANCE CRITERIA

5.1 The containment purge system meets design requirements (refer to Section 9.4.7):

5.1.1 The containment purge alarms, remote indications, interlocks, and controls (manual and automatic) respond as designed.

5.1.2 The containment purge valves meet the design requirements (i.e., thrust opening speed, closing speed, failure mode upon loss of motive power).

- Table 14.3-2 Item 2-10.

5.1.3 The containment purge flow rate meets design requirements.

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5.2 The containment purge system responds ~~as required~~ to the radiation monitors as designed (refer to Section 7.3.1):

5.2.1 The containment purge system isolates purge flow as designed.

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.5 Annulus Ventilation System (Test #077)

1.0 OBJECTIVE

1.1 To demonstrate the capability of the annulus ventilation system (AVS) to produce and maintain a negative pressure in the annulus following a loss of coolant accident (LOCA).

1.2 To minimize the release of radioisotopes following a LOCA by filtering ~~large volumes of~~ annulus air prior to discharge to the plant vent stack.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the containment wall and shield wall are complete with penetrations sealed in place.

2.2 Construction activities on the AVS have been completed.

2.3 AVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the AVS are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic, including response to ~~ESFAS~~Protection signals.

3.2 Verify that operation, failure mode, stroke speed and position indication of control valves and dampers meets design requirements.

3.3 Demonstrate that the AVS shall achieve a negative pressure in the Annulus within the design requirements:

3.3.1 Greater than or equal to the required inches water gauge.

3.3.2 Within the required elapsed time since actuation.

3.4 Verify that operation of protective devices, controls, interlocks, instrumentation and alarms meet design requirements.

3.5 Verify design air flow for normal and emergency operation.

3.6 Perform HEPA filter and carbon ~~absorber~~adsorber efficiency tests on the accident filtration train.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

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4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and controls occur.

4.2 Valve and damper operating data.

4.3 Air balancing ~~verification~~report, including fan operating data.

4.4 HEPA filter and carbon ~~absorber~~adsorber efficiency data.

4.5 Annulus negative pressurization data: Annulus pressure and drawdown time response curve.

5.0 ACCEPTANCE CRITERIA

5.1 The AVS operates as designed (refer to Section 6.2.3):

5.1.1 Verify that the response of alarms, interlocks, and control logic meets design requirements.

5.1.2 Verify that operation of valves and dampers meet design requirements.

5.1.3 Verify that system response to simulated accident signal meets design requirements.

- Table 14.3-2 Item 2-1.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.6 Electrical Division of Safeguard Building Ventilation System (Test #078)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the electrical division of safeguard building ventilation system (SBVSE):

1.1.1 Vital instrument and equipment room ventilation subsystems.

1.1.2 ~~Computer room ventilation subsystems~~Electrical and mechanical equipment room air handling units, recirculation fans, battery rooms/safety chilled water room exhaust fans.

1.1.3 ~~Operations support center ventilation subsystem~~Component cooling water/heat exchanger rooms fan coil units.

1.1.4 ~~Shift and assembly offices ventilation subsystem~~Emergency feedwater pump rooms fan coil units.

~~1.1.5 CAS and SEC group ventilation subsystem~~.

~~1.1.6 Personnel decontamination room ventilation subsystem~~.

~~1.1.7 The battery room ventilation subsystem~~.

~~1.1.8 Break room ventilation subsystem~~.

~~1.1.9 Electrical and mechanical equipment room HVAC units~~.

1.2 To demonstrate electrical independence and redundancy of power supplies.

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2.0 PREREQUISITES

2.1 Construction activities in the Safeguard Building controlled area are complete with penetrations sealed.

2.2 Construction activities on the SBVSE have been completed.

2.3 SBVSE instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the SBVSE are functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the ~~computer room air handling units or fans or both~~electrical and mechanical equipment room air handling units, recirculation fans, battery rooms/safety chilled water room exhaust fans.

3.3 Verify the operation of the ~~operations support center air handling units or fans or both~~component cooling water/heat exchanger rooms fan coil units.

3.4 Verify the operation of the ~~shift and assembly offices air handling units or fans or both~~emergency feedwater pump rooms fan coil units.

3.5 Verify ~~the operation of the CAS and SEC group air handling units or fans or both~~alarms, indicating lights, and status lights are functional.

3.6 ~~Verify the operation of the battery room air handling unit and fan~~Perform air flow balancing of the SBVSE.

3.7 Verify ~~the~~that operation of ~~the personnel decontamination room air handling units or fans or both~~dampers meet the requirements of ASME AG-1.

3.8 Verify ~~the operation of the break room air handling units or fans or both~~that operation of the vital instrument and equipment room HVAC units, fans, or both meet design requirements.

3.9 ~~Verify the operation of the electrical and mechanical equipment room air handling units or fans or both~~For separate HVAC units check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

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~~3.10 Verify operation of the smoke purge fans~~.

~~3.11 Verify alarms, indicating lights and status lights are functional~~.

~~3.12 Perform air flow balancing of the SBVSE~~.

~~3.13 Verify that operation of dampers meet design requirements~~.

~~3.14 Verify that operation of the vital instrument and equipment room HVAC units or fans or both meet design requirements~~.

~~3.15 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function~~.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms, center backs and control occur.

4.4 Temperature data for each of the SBVSE.

5.0 ACCEPTANCE CRITERIA

5.1 The SBVSE operates as designed (refer to Section 9.4.6):

5.1.1 Safeguard Building cooling alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 Safeguard Building cooling fan performance meets design requirements.

5.1.3 Safeguard Building cooling dampers/valve performance (thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 Safeguard Building cooling air balance meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.7 Nuclear Auxiliary Building Ventilation System (Test #079)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the nuclear auxiliary building ventilation system (NABVS).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities in the nuclear auxiliary building are complete with penetrations sealed.

2.2 Construction activities on the NABVS have been completed.

2.3 NABVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the NABVS are functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the air handling units or fans or both.

3.3 Verify alarms, indicating lights and status lights are functional.

3.4 Perform air flow balancing of the NABVS.

3.5 Verify that operation of dampers meets design requirements.

3.6 Perform HEPA filter and carbon ~~absorber~~adsorber efficiency tests.

14.02-72 3.7 Verify operation of the ventilation stack radioactivity monitors.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms and control occur.

4.4 Temperature data for each of the NABVS.

4.5 HEPA filter and carbon ~~absorber~~adsorber efficiency data.

5.0 ACCEPTANCE CRITERIA

5.1 The NABVS operates as designed (refer to Section 9.4.3):

5.1.1 NABVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 NABVS fan performance meets design requirements.

5.1.3 NABVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 NABVS air balance meets design requirements.

~~5.2 Verify that safety-related components meet electrical independence and redundancy requirements~~.

14.2.12.8.8 Radioactive Waste Building Ventilation System (Test #080)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the radioactive waste building ventilation system (RWBVS) to maintain design condition.

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2.0 PREREQUISITES

2.1 Construction activities on the RWBVS have been completed.

2.2 RWBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the RWBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroking speed and position indication of dampers meets design requirements.

3.3 Verify the capacity of the HVAC system to maintain the area temperature.

3.4 Verify the system maintains the Radioactive Waste Processing Building at a negative pressure.

3.5 Verify that operation of the general ventilation supply units and fans meets design requirements.

3.6 Verify that operation of the general ventilation exhaust units and fans meets design requirements.

3.7 Perform HEPA filter and carbon ~~absorber~~adsorber efficiency tests.

3.8 Verify the systems rated air flow and air balance.

3.9 Verify that operation of protective devices, controls, interlocks instrumentation and alarms using actual or simulated inputs meets design requirements.

3.10 Verify that operation of the RWBVS response to high radiation monitor signal meets design requirements.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data.

4.4 Setpoints of alarms interlocks and controls.

4.5 The Radioactive Waste Building negative pressure readings.

4.6 RWBVS performance data in response to radiation monitor signals.

14.02-72 4.7 HEPA filter and carbon ~~absorber~~ adsorber efficiency data.

5.0 ACCEPTANCE CRITERIA

5.1 The RWBVS operates as designed (refer to Section 9.4.8):

5.1.1 RWBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 RWBVS fan performance meets design requirements.

5.1.3 RWBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 RWBVS air balance meets design requirements.

5.2 The RWBVS responds as designed to radiation monitor signals designed (refer to Section 9.4.8).

14.2.12.8.9 Fuel Building Ventilation System (Test #081)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the fuel building ventilation system (FBVS) to maintain design conditions.

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the FBVS have been completed.

2.2 FBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the FBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroke speed and position indication of dampers meet design requirements.

3.3 Verify the system maintains the Fuel Building at a negative pressure.

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3.4 ~~Verify that operation of the ventilation supply units and fans meet design requirements~~Verify the NABVS supplies and exhausts air to the Fuel Building.

3.5 Verify that the operation of the fuel handling area ventilation exhaust units and fans meet design requirements.

3.6 Verify that operation of the heating and cooling units meet design requirements.

3.7 Verify HEPA filter efficiency, carbon ~~absorber~~adsorber efficiency, and air flow capacity.

3.8 Verify the systems rated air flow and air balance.

3.9 Verify that operation of protective devices, controls, interlocks instrumentation, and alarms using actual or simulated inputs.

3.10 Verify system response to a high radiation signal.

3.11 Verify that operation of the FBVS radiation monitor meets design requirements.

3.12 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data in the Fuel Building.

4.4 Setpoints at which alarms, interlocks, and controls occur.

4.5 Fuel Building negative pressurization data during normal and postulated emergency conditions.

4.6 Filter and carbon ~~absorber~~adsorber data.

4.7 FBVS performance data in response to radiation monitor signals.

5.0 ACCEPTANCE CRITERIA

14.02-72

5.1 The FBVS operates as designed (refer to Section 9.4.2):

5.1.1 FBVS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 FBVS valves and dampers function as design.

5.1.3 FBVS maintains the Fuel Building at the required negative pressure.

- Table 14.3-2 Item 2-9.

5.1.4 FBVS recirculation rate (e.g., through the HEPA filters, carbon ~~absorbers~~adsorber) meet design requirements.

5.1.5 FBVS normal operation heating and ventilation system performs as designed.

5.2 The FBVS responds to radiation monitor signals as designed (refer to Section 9.4.2).

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.10 Main Control Room Air Conditioning System (Test #082)

1.0 OBJECTIVE

1.1 To verify that operation of the main control air conditioning system (CRACS) establishes that a proper environment for personnel and equipment under postulated conditions in the following areas:

1.1.1 MCR.

1.1.2 Technical Support Center.

1.1.3 Other offices and equipment areas of the control room envelope (CRE).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities in the MCR complex have been completed and penetrations sealed.

2.2 Construction activities on the CRACS have been completed.

2.3 The CRACS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 Support systems required for operation of the CRACS are complete and functional.

2.5 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation, stroke speed and position indication of dampers meet design requirements.

3.3 Verify in manual operating mode that system rated air flow and air balance meet design requirements.

3.4 Demonstrate in automatic mode the transfer to emergency-operations as a result of the following:

3.4.1 ~~Radiation detection in MCR HVAC air supply~~Detection of radiation in one of the outside inlets places the CREFS filtration units in the filtered alignment.

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3.4.2 ~~Smoke detection~~Detection of toxic gas in one of the outside inlets places the CREFS filtration unit (at the location of the toxic gas inlet) in the filtered alignment.

~~3.4.3 Toxic chemical detection.~~

3.4.3 Safety injection actuation/primary containment isolation signal.

3.5 Verify the HEPA filter efficiency, carbon ~~absorber~~adsorber efficiency, and filter bank air flow capacity.

3.6 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms using actual or simulated inputs meets design requirements.

3.7 Verify that the system maintains the CRE at the required positive pressure relative to the outside atmosphere during system operation.

3.8 Verify the isolation capability of the CRE on detection of toxic gas at the intakes meets the requirements of RG 1.78.

3.9 Demonstrate the operation of the battery room exhaust fans.

3.10 Verify the CRE air in-leakage rate when aligned in the emergency mode.

3.11 Verify that operation of CRACS in response to radiation monitors meets design requirements.

3.12 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Air balancing verification.

4.2 Fan and damper operating data.

4.3 Temperature data in the CRE.

4.4 Response to radioactivity, toxic gas, and products of combustion.

4.5 Setpoints of alarms, interlocks, and controls.

4.6 Pressurization data for the CRE.

4.7 Filter and carbon ~~absorber~~adsorber data.

4.8 CRE in-leakage rate when aligned in the emergency mode.

4.9 The CRACS response to radiation monitors.

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5.0 ACCEPTANCE CRITERIA

5.1 The CRACS operates as designed (refer to Section 9.4.1).

5.1.1 CRACS alarms, interlocks, and controls (manual and automatic) function as designed.

5.1.2 CRACS valves and dampers function as design.

~~5.13 CRACS responds as designed to a simulated smoke signal.~~

5.1.3 CRACS responds as designed to a simulated toxic gas signal.

5.1.4 CRACS recirculation flow rate meets design requirements.

- Table 14.3-2 Item 2-7.

5.1.5 CRACS unfiltered air in-leakage rate while in recirculation mode meets design requirements.

- Table 14.3-2 Item 2-8.

5.1.6 CRACS is capable of generating a positive MCR pressure relative to adjacent areas, as designed.

- Table 14.3-2 Item 2-6.

5.1.7 CRACS responds as designed to a simulated SIS signal.

- Table 14.3-2 Item 2-5.

5.2 The CRACS radiation monitors perform as designed (refer to Section 9.4.1):

5.2.1 CRACS responds as designed to a simulated high radiation signal.

- Table 14.3-2 Item 2-5.

3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Damper operating data.

4.2 Air flow and balancing verification.

4.3 Setpoints at which alarms, center backs and control occur.

4.4 Temperature data for each of the SBVS.

5.0 ACCEPTANCE CRITERIA

5.1 The SBVS operates as designed (refer to Section 9.4.5):

5.1.1 SBVS air handlers/fans perform as designed.

5.1.2 The operation of the SBVS operational air exhaust mode in the mechanical area meets design requirements.

5.1.3 The operation of the SBVS accident air exhaust mode in the mechanical area meets design requirements.

5.1.4 The operation of the SBVS electric air convectors (area heaters) meets design requirements.

14.02-72 → 5.1.5 The operation of the SBVS filter air heaters, prefilters, HEPA filters, and ~~absorbers~~adsorber meets design requirements.

5.1.6 The operation of the SBVS recirculation cooling units meets design requirements.

5.1.7 SBVS alarms, indicating lights and status lights meet design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.12 Emergency Power Generating Building Ventilation System (Test #084)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the emergency power generating building ventilation system (EPGBVS).

1.2 To demonstrate proper operation of the EPGBVS.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the EPGBVS have been completed.

2.2 EPGBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the EPGBVS are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify design air flow with each EPGBVS in operation.

3.3 Verify design temperature can be maintained in each Emergency Power Generating Building.

3.4 Verify alarms, indicating instruments, and status lights are functional.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Air flow verification

4.3 Setpoint at which alarms, interlocks, and controls occur.

4.4 Temperature data of each Emergency Power Generating Building.

5.0 ACCEPTANCE CRITERIA

5.1 The EPGBVS operates as designed (refer to Section 9.4.9):

5.1.1 EPGBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 EPGBVS fan performance meets design requirements.

5.1.3 EPGBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 EPGBVS air balance meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.13 Smoke Confinement System (Test #085)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the smoke confinement system (SCS) for Nuclear Island.

14.02-72 ~~1.2 To demonstrate electrical independence and redundancy of power supplies.~~

2.0 PREREQUISITES

2.1 Construction activities in the SCS are complete with penetrations sealed.

~~2.2 Construction activities on the SCS have been completed.~~

2.2 SCS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

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2.3 Support systems required for operation of the SCS.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify the operation of the supply air ~~handling units or~~ fans ~~or both~~.

3.3 Verify operation of the smoke purge fans.

3.4 Verify alarms, indicating lights and status lights are functional.

3.5 Perform air flow balancing of the SCS.

3.6 Verify that operation of dampers meets design requirements.

~~3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.~~

4.0 DATA REQUIRED

4.1 ~~Fan~~Air balancing reports, including fan operating data for each of the air handling units and the smoke purge fans.

4.2 Damper operating data.

4.3 Air flow and balancing verification.

4.4 Setpoints at which alarms and control occur.

~~4.5 Temperature data for each of the SCS.~~

5.0 ACCEPTANCE CRITERIA

5.1 The SCS operates as designed (refer to Section 9.4.13):

5.1.1 SCS alarms, status lights, interlocks, and control logic meets design requirements.

5.1.2 The operation of the SCS smoke purge fans meet the design requirements.

5.1.3 The air balance of the SCS meets design requirements.

5.1.4 SCS dampers meet the design requirements.

~~5.2 Verify that safety-related components meet electrical independence and redundancy requirements.~~

5.1.3 SGBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 SGBVS air balance meets design requirements.

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~~5.2 Verify that safety-related components meet electrical independence and redundancy requirements.~~

14.2.12.8.15 Turbine Island Ventilation Systems (Test #087)

1.0 OBJECTIVE

1.1 To demonstrate that the turbine building ventilation system (TBVS) provides a suitable operating environment for equipment and personnel during normal operations.

1.2 To demonstrate that the main steam and feedwater valve room ventilation system (VRVS) provides a suitable operating environment for equipment and personnel during normal operations.

2.0 PREREQUISITES

2.1 Construction activities on the TBVS have been completed.

2.2 Construction activities on the VRVS have been completed.

2.3 TBVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.4 VRVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.5 Support systems required for operation of the TBVS are complete and functional.

2.6 Support systems required for operation of the VRVS are complete and functional.

3.0 TEST METHOD

3.1 Verify control logic.

3.2 Verify that operation of inlet air dampers and damper controls meets design requirements.

3.3 Verify that operation of the exhaust fan units and dampers meets design requirements.

3.4 Verify that operation of protective devices, controls, interlocks, instrumentation, and alarms meets design requirements.

4.0 DATA REQUIRED

4.1 Fan and damper operating data.

4.2 Setpoints at which alarms and interlocks occur.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Temperature data for the structure from each fan unit.

14.02-72 → 4.2 ~~Fan~~Air balancing report, including fan operating data.

4.3 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The ESWPBVS operates as designed (refer to Section 9.4.11):

5.1.1 ESWPBVS alarms, interlocks, protective devices, and controls (manual and automatic) function as designed.

5.1.2 ESWPBVS fan performance meets design requirements.

5.1.3 ESWPBVS dampers/valve performance (i.e., thrust, opening times, closing times, and ability to control flow) meets design requirements.

5.1.4 ESWPBVS air balance meets design requirements.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.8.17 Reserved (Test #089)

14.2.12.8.18 Reserved (Test #090)

14.2.12.8.19 Access Building Ventilation System (Test #224)

1.0 OBJECTIVE

1.1 To verify the access building ventilation system (ABVS) can maintain the space temperature as required.

1.2 To verify that radiological control features route the building exhaust to the plant stack.

2.0 PREREQUISITES

2.1 Construction activities on the ABVS have been completed.

2.2 ABVS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ABVS are complete and functional.

2.4 Test Instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify operation of the radiation monitor by utilizing the check source and external test equipment.

3.2 Check the self-testing feature of the monitor.

3.3 Verify control actuation by the monitor and record the response time meet design requirements.

3.4 Simulate a high radiation signal to the appropriate radiation monitors to verify that control actuations meet design requirements.

3.5 Verify that alarm actuation in the control room meet design requirements.

3.6 Simulate a high radiation signal to the radiation monitors to verify that alarm actuations ~~in the MCR or locally,~~function as designed.

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4.0 DATA REQUIRED

4.1 The monitor response to check source.

4.2 Technical data associated with the source.

4.3 Signal levels necessary to cause alarm actuation.

4.4 Response time of the monitor to perform control functions.

5.0 ACCEPTANCE CRITERIA

5.1 The SAMS operates as designed (refer to Section 11.5).

14.2.12.9.3 Solid Waste Storage System (Test #093)

1.0 OBJECTIVE

1.1 To demonstrate the functionality of the solid waste storage system to collect and package solid wastes for shipment.

2.0 PREREQUISITES

2.1 Construction activities on the solid waste management system have been completed.

2.2 Solid waste management system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the solid waste management system are completed and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

~~3.1 Verify the operation of the solid waste transfer system.~~

3.1 Verify the radioactive waste processing building crane can reach design points.

~~3.2 Verify expended resin beds from the LWPS can be sluiced to the solid waste storage system.~~

3.2 Verify that operation of alarms, controls and interlocks meets design requirements.

3.3 Verify system design flow paths.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

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4.2 Solid waste transfer system operating data.

4.3 Radioactive waste processing building crane data.

4.4 System flow path data.

5.0 ACCEPTANCE CRITERIA

5.1 The solid waste management system operates as designed (refer to Section 11.4).

14.2.12.9.4 Radioactive Concentrates Processing System - Solid Waste (Test #094)

1.0 OBJECTIVE

1.1 To verify the performance of the radioactive concentrates processing system.

2.0 PREREQUISITES

2.1 Construction activities have been completed on the radioactive concentrates processing system.

2.2 Support systems required for operation of the radioactive concentrates processing evaporator are complete and functional.

2.3 Radioactive concentrates processing system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

3.0 TEST METHOD

~~3.1 Operate radioactive concentrates processing evaporator control valves from appropriate control positions and observe valve operation and position indication.~~

3.1 Simulate interlock signals from interfacing equipment and observe radioactive concentrates processing system response, including observation of alarms.

3.2 Line up the radioactive concentrates processing system to interfacing systems and, using appropriate operating modes and indications, establish flow paths to these systems.

3.3 Verify that expended resin beds from the LWPS can be sluiced to the radioactive concentrates processing system.

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4.0 DATA REQUIRED

4.1 Valve position indication.

4.2 Radioactive concentrates processing system response to simulated interlocks.

4.3 Setpoints at which alarms interlock and automatic actuations occur.

4.4 Flow indications.

5.0 ACCEPTANCE CRITERIA

5.1 The radioactive concentrates processing system performs as described in Sections 11.2.2 and 11.4.

14.2.12.9.5 Liquid Waste Processing System (Test #095)

1.0 OBJECTIVE

1.1 To demonstrate the functionality of the liquid waste processing system (LWPS) for collection, processing and recycling of liquid wastes and for preparation of liquid waste for release to the environment.

2.0 PREREQUISITES

2.1 Construction activities on the liquid waste processing system have been completed.

2.2 Liquid waste processing system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the liquid waste processing system are completed and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 ~~Operate control valves remotely while~~Operate radioactive concentrates processing evaporator control valves from appropriate control positions:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g. thrust, opening and closing times).

3.2 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 11.2).

3.3 Verify that operation of the tank level alarms and interlocks meets design requirements.

3.4 Verify that operation of system pumps meet design requirements.

3.5 Verify that operation of high differential pressure alarms for the process vessel meet design requirements.

3.6 Verify that operation of the tank mixers meet design requirements.

3.7 Simulate a high radiation signal to the liquid waste processing system discharge radiation monitor and demonstrate that discharge isolation features and other system controls function as designed.

3.8 Verify alarms, indicating instruments, and status lights are functional.

3.9 Simulate a high radiation signal to the liquid waste processing system discharge radiation monitor and verify response.

4.0 DATA REQUIRED

4.1 Waste pump operating data.

4.2 Valve performance data, where required.

4.3 Valve position indication.

4.4 Position response of valves to loss of motive power.

4.5 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The LWPS operates as designed (refer to Section 11.2).

5.2 The LWPS discharge radiation monitor operates as designed (refer to Sections 7.3.1, 11.2, and 11.5).

14.2.12.9.6 Reactor Coolant Drain Tank (Test #096)

1.0 OBJECTIVE

1.1 To verify the proper performance of the reactor coolant drain tank (RCDT) subsystem.

2.0 PREREQUISITES

2.1 Construction activities on the RCDT subsystem have been completed.

2.2 The RCDT subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

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2.3 ~~EDT~~Process drain tank subsystem is ready to accept water from the RCDT.

~~2.4 The plant nitrogen system is functional.~~

2.4 Support systems required for operation of the RCDT subsystem are functional.

3.0 TEST METHOD

3.1 Operate control valves remotely while:

3.1.1 Observing each valve operation and position indication.

3.1.2 Measuring valve performance data (e.g., thrust, opening and closing times).

3.2 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.4).

3.3 Simulate a CIAS and observe isolation valve response.

3.4 Fill the RCDT from any convenient source and observe level and pressure indications and alarms.

3.5 Pressurize the RCDT, using ~~the nitrogen system~~simulated signals, to a full range of operating pressures and observe indications and alarms.

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3.6 Line up the RCDT to the EDT and drain the RCDT using each RCDT pump.

3.7 Observe level and pressure indicators, alarms and interlocks.

3.8 Simulate RCDT full range of operating temperatures and observe indications and alarms.

4.0 DATA REQUIRED

4.1 Valve performance data, where required.

4.2 Valve position indications.

4.3 Response of valves to simulated failed conditions.

4.4 Position response of valves to loss of motive power.

4.5 The RCDT level, pressure and temperature.

4.6 Setpoints of alarms and interlocks.

5.0 ACCEPTANCE CRITERIA

5.1 The reactor coolant drain tank subsystem meets design requirements (refer to Section 9.3.4).

14.2.12.9.7 ~~Equipment~~Process Drain Tank (Test #097)

1.0 OBJECTIVE

1.1 To verify the proper performance of the EDT subsystem.

2.0 PREREQUISITES

2.1 Construction activities on the EDT subsystem have been completed.

2.2 The EDT subsystem instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Verify ~~holdup tank, RCDT~~radwaste~~,~~ and reactor makeup water subsystems are functional.

3.0 TEST METHOD

3.1 Operate control valves from appropriate control positions and observe valve operation and position indication.

3.2 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.4).

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3.3 Fill the EDT from the reactor makeup water subsystem and observe indications, alarms, and interlocks.

3.4 Drain the EDT using an RCDT pump and observe indications, alarms, and interlocks.

3.5 Simulate a range of EDT temperatures while observing indications and alarms.

3.6 Simulate a range of EDT pressures while observing indications and alarms.

4.0 DATA REQUIRED

4.1 Valve position indications.

4.2 Position response of valves to loss of motive power.

4.3 The EDT level, pressure and temperature.

4.4 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The EDT subsystem meets design requirements (refer to Section 9.3.3).

14.2.12.9.8 Equipment and Floor Drainage System (Test #098)

1.0 OBJECTIVE

1.1 To demonstrate that the drain lines are correctly routed to their designated destination.

1.2 To demonstrate the sump pumps operate per design including alarms and interlocks.

1.3 To demonstrate the waste tanks operate per design including alarms and interlocks.

1.4 To demonstrate the sump level instrumentation operates per design including alarms and indications to demonstrate system segregation.

~~1.5 To demonstrate the turbine building floor drain sump operates per design.~~

2.0 PREREQUISITES

2.1 Construction activities on the equipment and floor drainage system have been completed.

2.2 Equipment and floor drainage system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the equipment and floor drainage system is complete and functional.

2.4 Water is available for flow paths to be checked.

2.5 Several colors of non-toxic dye are available for verifying source of water.

3.0 TEST METHOD

3.1 Verify the operation of alarms and interlocks.

3.2 Verify sump levels as required to demonstrate that operation of the sump pumps meet design requirements.

3.3 Flow water in each drain path to the equipment and floor drainage system.

3.4 Verify that the drains discharge to their designated destination and that system segregation is maintained.

4.0 DATA REQUIRED

4.1 Sump pump operating data is available for review.

4.2 Setpoints at which alarms and interlocks occur.

4.3 Discharge points of each drain.

5.0 ACCEPTANCE CRITERIA

5.1 The equipment and floor drainage system operates as designed (refer to Section 9.3.3).

14.2.12.9.9 Gaseous Waste Processing System (Test #099)

1.0 OBJECTIVE

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1.1 To demonstrate the ability of the gaseous waste ~~management~~processing system (GWPS) to collect and process radioactive and potentially flammable gases vented from plant equipment.

2.0 PREREQUISITES

2.1 Construction activities on the GWPS have been completed.

2.2 The GWPS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the GWPS are completed and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify flow paths.

3.2 Demonstrate that discharge isolation features and other system controls function as designed.

3.3 Simulate a high radiation signal to the GWPS discharge radiation monitor.

3.4 Verify alarms, indicating instruments and status lights are functional.

3.5 Simulate a high radioactivity signal to the GWPS discharge radiation monitor and verify alarm actuation ~~in the MCR~~as designed.

3.6 Demonstrate the operation of the gas drying equipment.

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3.7 Demonstrate that hold up time of gas through the charcoal ~~absorbers~~adsorber meet design requirements.

3.8 Demonstrate the operation of the gel dryer regeneration equipment (protects delay beds from moisture while operating in surge mode).

3.9 Demonstrate the operation of the system gas analyzers.

3.10 Demonstrate the operation of the recombiner.

3.11 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.12 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 11.3).

4.0 DATA REQUIRED

4.1 Setpoints of alarms, interlocks, and controls.

4.2 Gas dryer operating data.

4.3 Dryer regenerating equipment operating data.

4.4 Gas analyzer operating data.

4.5 Recombiner operating data.

4.6 Gas transport times.

4.7 Position response of valves to loss of motive power.

4.8 Valve performance data.

5.0 ACCEPTANCE CRITERIA

5.1 The GWPS operates as designed (refer to Section 11.3).

5.2 The GWPS discharge radiation monitor operates as designed (refer to Section 7.3.1).

14.2.12.9.10 Nuclear Sampling System (Test #100)

1.0 OBJECTIVE

1.1 To verify the ability of nuclear sampling system (NSS) to collect and deliver representative samples of liquids and gases in various process systems to sample stations for chemical and radiological analysis during operation cooldown.

1.2 To verify the ability of the severe accident sampling system (SASS) to collect and deliver gaseous and liquid samples from inside the containment following a severe accident for the purpose of confirming whether the containment atmosphere contains airborne activity.

1.3 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested have been completed.

2.2 Systems being sampled are at or near normal operating pressure and temperature.

2.3 Calibrating gases and solutions are available.

2.4 Test instrumentation is available and calibrated.

14.02-72 2.5 NSS and SASS instrumentation has been calibrated and is functional for performance of the following test.

3.0 TEST METHOD

3.1 Verify adequate flow from each sample location.

3.2 Verify that operation of alarms and interlocks meet design requirements.

3.3 Verify that operation of pump and heat exchangers in normal operating modes and flow paths meets design requirements.

3.4 Verify the analytical instrumentation provides indication and response as designed.

3.5 Calculate the holdup times using the as-built piping lengths, piping volume and measured flow rate for the following:

3.5.1 RCS samples.

3.5.2 Pressurizer samples.

3.5.3 Equipment rooms inside containment.

3.5.4 Annular rooms inside containment.

3.5.5 IRWST, via severe accident heat removal system (SAHRS).

3.6 Operate control valves remotely while:

a. Observing each valve operation and position indication.

b. Measuring valve performance data (e.g., thrust, opening and closing times).

3.7 Verify power-operated valves fail upon loss of motive power as designed (refer to Section 9.3.2).

3.8 Verify that operation of continuous monitors and verify adequate flow meet design requirements.

3.9 Check electrical independence and redundancy of power supplies for NSS and SASS safety-related functions by selectively removing power and determining loss of function.

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4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Sampling flow rate from each sample point.

4.3 Analytical instrument data.

4.4 Valve performance data, where required.

4.5 Valve position indication.

4.6 Position response of valves to loss of motive power.

4.7 Calculated holdup time for RCS and pressurizer samples.

5.0 ACCEPTANCE CRITERIA

5.1 The NSS meets design requirements (refer to Section 9.3.2.2.1.1).

5.2 The SASS performs as described in Section 9.3.2.2.1.3.

5.3 Verify that NSS and SASS safety-related components meet electrical independence and redundancy requirements.

14.2.12.9.11 Station Blackout Diesel Generator Set (Test #101)

1.0 OBJECTIVE

1.1 To demonstrate the station blackout diesel generator (SBODG) set system operates reliably.

2.0 PREREQUISITES

2.1 Construction activities on the SBODG system have been completed. This includes, but is not limited to the following:

2.1.1 SBODG fuel oil system.

2.1.2 SBODG engine lube oil system.

2.1.3 SBODG cooling system.

2.1.4 SBODG starting air system.

2.1.5 SBODG air intake and exhaust systems.

2.2 SBODG system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the SBODG system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 ~~Demonstrate that each SBODG can be started in automatic and manual from the MCR, the remote shutdown panel, and the local control station.~~Demonstrate that each SBODG can be started in automatic and manual using the PAS and the local control station.

3.2 Demonstrate that the following mechanical and electrical trips are functional (includes protective trips bypass tests).

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3.2.1 Engine over speed (electrical and mechanical).

3.2.2 Generator differential protection.

3.2.3 Low-low lube oil pressure.

3.2.4 Generator electrical protection.

3.2.5 Low level in the jacket water expansion tank.

3.2.6 Low-low lube oil sump tank level.

3.2.7 High pressure crankcase.

3.2.8 High-high temperature lube oil out.

3.2.9 High-high temperature jacket water.

3.2.10 Electronic governor failure.

3.2.11 Low fuel oil pressure.

3.3 Demonstrate that the following parameters are correctly monitored in the control room and at the SBODG local panel:

3.3.1 Lube oil temperature and pressures.

3.3.2 Bearing temperatures.

3.3.3 Cooling water temperatures and pressures.

3.3.4 Speed (rpm).

3.3.5 Starting air pressure.

3.4 Demonstrate the operation of the following status indications:

3.4.1 Cooling water expansion tank level.

3.4.2 SBODG output breaker ~~racked out~~position.

3.4.3 SBODG over speed.

3.4.4 Loss of control power.

3.4.5 Generator fault.

3.4.6 Low air and oil pressure.

3.4.7 Maintenance mode.

3.5 Demonstrate 25 consecutive starts capability.

3.6 Demonstrate full load capability.

3.7 Demonstrate SBODG speed control.

4.0 DATA REQUIRED

4.1 SBO engine operating parameters.

4.2 SBO engine consecutive starts data.

4.3 Setpoints of SBODG trips.

4.4 SBODG governor operating data.

4.5 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The SBODG mechanical system meets design requirements (refer to Section 8.4).

14.2.12.9.12 Station Blackout Diesel Generator Electrical (Test #102)

1.0 OBJECTIVE

1.1 To verify the SBODGs can supply power at the rated load, voltage and frequency under design conditions.

2.0 PREREQUISITES

2.1 Construction activities on the SBODG system have been completed.

2.2 SBODG mechanical system test is completed (Test #101).

2.3 SBODG system instrumentation has been calibrated and is functional for performance of the following test.

2.4 Support systems required for operation of the SBODG system are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 Electrical testing is complete as needed to allow the required buses to be energized.

2.7 The SBODG electrical voltage tests are complete.

14.02-72 ~~2.8 The SBODG loads are available to be loaded onto the bus.~~

2.8 ~~SBODG~~Switchgear Building ventilation system test is completed (Test #086).

3.0 TEST METHOD

~~3.1 Demonstrate control logic and controls and response to SBO actuation signals.~~

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3.1 Demonstrate 90 to 100 percent of the continuous rating of the SBODG, for an interval of not less than one hour and until temperature equilibrium has been attained.

3.2 Demonstrate that the SBODG unit starts from standby conditions and reaches required voltage and frequency within acceptable limits and time requirements.

3.3 Demonstrate by simulating a ~~loss of offsite power (LOOP)~~station blackout event that:

3.3.1 ~~The emergency buses are de-energized and the~~Non-essential loads are shed from the ~~emergency buses~~EPSS.

3.3.2 The SBODG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes the respective NPSS buses and ~~loads~~ can be manually connected with the respective EPSS buses within 10 minutes~~loaded, and operates while loaded with its shutdown loads for greater than or equal to five minutes~~.

~~3.4 Demonstrate that on an actuation signal, the SBODG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates for greater than or equal to five minutes.~~

3.4 Demonstrate the SBODGs capability to reject a loss of the largest single load while operating at power factor between 0.8 and 0.9, and verify that the voltage and frequency requirements are met and that the SBODG unit shall not trip on over speed.

3.5 Demonstrate the SBODGs capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor between 0.8 and 0.9, and verify that the voltage requirements are met and that the SBODG shall not trip on over speed.

3.6 Perform SBODG endurance and margin test to demonstrate:

3.6.1 Full-load carrying capability at a power factor between 0.8 and 0.9.

3.6.2 For an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the SBODG.

3.6.3 That 22 hours of the 24 hours are at a load equal to 90 to 100 percent of its continuous rating.

3.6.4 That voltage and frequency requirements are maintained.

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3.6.5 That mechanical systems such as fuel, lubrication, and cooling function within design limits.

3.6.6 Operation of the ~~air handling units or fans or both~~Switchgear Building ventilation system.

3.6.7 Area temperatures are maintained within design limits.

3.7 NOTE: Perform this testing within five minutes after operations at ≥ 90 percent capacity for ≥ two hours.

3.8 Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load).

~~3.8 Verify that the SBODG starts on a manual or automatic start signal.~~

~~3.9 NOTE: Perform this testing immediately after the full load carrying capability demonstration.~~

3.9 Demonstrate the ability to synchronize the SBODG unit with offsite power while loaded upon a simulated restoration of offsite power.

a. ~~Transfer load to the~~Parallel the SBO bus with offsite power, transfer SBODG and open SBODG output circuit breaker ~~while the unit is connected to the SBODG load~~.

b. ~~Isolate the diesel generator unit and r~~Restore ~~it~~the SBODG to standby status.

~~3.10 Demonstrate that with the SBODG operating in a test mode while connected to its bus, a simulated actuation signal overrides the test mode by returning the SBODG to standby operation.~~

3.10 Demonstrate that, by starting and running ~~redundant~~both SBODG units simultaneously, potential common failure modes that may be undetected in single SBODG unit tests do not occur.

4.0 DATA REQUIRED

~~4.1 Starting and loading sequence timing.~~

4.1 Test data traces for SBODG output voltage, frequency, and output circuit breaker closing data during start sequence~~starting, stopping and load shedding~~.

4.2 Running data for the parameters monitored during each of the required testing sequences.

4.3 Verification of field performance data versus shop data.

4.4 Periodic area temperatures, collected at least once per hour.

5.0 ACCEPTANCE CRITERIA

5.1 The SBODG electrical system meets design requirements (refer to Section 8.4).

5.2 The ~~SBODG~~Switchgear Building ventilation system meets design requirements (refer to Section 9.4.10).

14.2.12.9.14 Emergency Diesel Generator Set (Test #104)

1.0 OBJECTIVE

1.1 To demonstrate the emergency diesel generator (EDG) set system operates reliably.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that EDG diesel generator and auxiliary system alarms, interlocks, and control functions perform as designed.

2.0 PREREQUISITES

2.1 Construction activities on the EDG system have been completed. This includes, but is not limited to the following:

2.1.1 EDG fuel oil system (refer to Section 9.5.4).

2.1.2 EDG engine lube oil system (refer to Section 9.5.7).

2.1.3 EDG cooling system (refer to Section 9.5.5).

2.1.4 EDG starting air system (refer to Section 9.5.6).

2.1.5 EDG air intake system (refer to Section 9.5.8).

2.1.6 EDG exhaust system (refer to Section 9.5.8).

2.2 EDG system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the EDG system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

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3.1 Demonstrate that each EDG can be started in automatic and manual ~~from the MCR and the remote shutdown panel~~using the SICS and PICS control interfaces.

3.2 Demonstrate that the following mechanical and electrical trips are functional (includes protective trips bypass tests).

3.2.1 Engine over speed (electrical and mechanical).

3.2.2 Generator differential protection.

3.2.3 Low-low lube oil pressure.

3.2.4 Generator electrical protection.

3.2.5 Essential service water supply low pressure.

3.2.6 Low expansion tank level.

3.2.7 High pressure crankcase.

3.2.8 Fuel oil low pressure.

3.2.9 High-high temperature lube oil out.

3.2.10 High-high temperature jacket water.

3.2.11 Low-low lube oil sump tank level.

3.2.12 Stop button located near engine.

3.2.13 Electronic governor failure.

3.3 Demonstrate that the following parameters are correctly monitored in the control room and at the local panel:

3.3.1 Lube oil temperature and pressures.

3.3.2 Bearing temperatures.

3.3.3 Cooling water temperatures and pressures.

3.3.4 Speed (rpm).

3.3.5 Starting air pressure.

3.4 Demonstrate the operation of the following status indications:

3.4.1 Cooling water not available.

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3.4.2 EDG output breaker position~~racked out~~.

3.4.3 EDG over speed.

3.4.4 Loss of control power.

3.4.5 Generator fault.

3.4.6 Low air and oil pressure.

3.4.7 Maintenance mode.

3.5 Demonstrate 25 consecutive start~~s~~ and load tests~~ing capability~~.

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3.6 Demonstrate full load capability.

3.7 Demonstrate EDG speed control.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Demonstrate that EDG instrumentation operates over the design range using actual or simulated signals.

3.10 Demonstrate that EDG alarms and interlocks occur as designed.

3.11 Demonstrate that the EDG instrumentation responds as designed to actual or simulated limiting malfunctions or failures.

3.12 Demonstrate that the EDG instrumentation response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

4.0 DATA REQUIRED

4.1 EDG engine operating parameters.

4.2 EDG engine consecutive starts and loading data.

4.3 Setpoints of EDG trips.

4.4 EDG governor operating data.

4.5 Setpoints at which alarms and interlocks occur.

5.0 ACCEPTANCE CRITERIA

5.1 The EDG mechanical system meets design requirements (refer to Section 8.3.1):

5.1.1 Manual and automatic controls.

5.1.2 Trips, alarms, interlocks, status lights, and system controls.

5.1.3 System responds as required to actual or simulated signals.

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.9.15 Emergency Diesel Generator Electrical (Test #105)

1.0 OBJECTIVE

1.1 To verify the EDGs can supply power at the rated load, voltage, and frequency under design conditions.

1.2 To demonstrate electrical independence and redundancy of power supplies.

1.3 To verify that EDG alarms, interlocks, and control functions perform as designed.

2.0 PREREQUISITES

2.1 Construction activities on the EDG system have been completed.

2.2 EDG mechanical system test is completed (Test #104).

2.3 EDG system instrumentation has been calibrated and is functional for performance of the following test.

2.4 Support systems required for operation of the EDG system are complete and functional.

2.5 Test instrumentation is available and calibrated.

2.6 Electrical testing is complete as needed to allow the buses to be energized.

2.7 EDG electrical voltage tests are complete.

2.8 Engineered safety feature (ESF) loads are available to be loaded onto the bus.

2.9 ~~EDG~~Emergency Power Generating Building ventilation system test is completed. (Test #084).

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3.0 TEST METHOD

3.1 Demonstrate control logic and controls including the EDG load sequencer and response to ESF actuation signals.

3.2 Demonstrate EDG rated load capability by operating loaded for the indicated times without exceeding the manufacturer's design limits:~~Demonstrate 90 to 100 percent of the continuous rating of the emergency diesel generator, for an interval of not less than one hour and until temperature equilibrium has been attained.~~

a. Loaded at 90 to 100 percent of the continuous rating for the time required to reach engine temperature equilibrium plus one hour.

b. Following the load test described in item a), loaded at 105 to 110 percent for a period of two hours.

3.3 Demonstrate that the EDG starts from standby conditions, reaches required voltage and frequency within acceptable limits and time requirements.

3.4 Demonstrate by simulating a LOOP that:

3.4.1 The emergency buses are de-energized and the loads are shed from the emergency buses.

3.4.2 The EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer and operates while loaded with its shutdown loads for greater than or equal to five minutes.

3.5 Demonstrate that on an SIAS, the EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates for greater than or equal to five minutes.

3.6 Demonstrate that on a combined SIAS and a LOOP that:

3.6.1 The emergency buses are de-energized and the loads are shed from the emergency buses.

3.6.2 The EDG starts on the auto-start signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, energizes the auto-connected shutdown loads through the load sequencer, and operates while loaded with its shutdown loads for greater than or equal to five minutes.

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3.7 Demonstrate the EDGs capability to reject a loss of the largest single load while operating at power factor ~~between 0.8 and~~of ≤ 0.9, and verify that the voltage and frequency requirements are met and that the EDG ~~unit shall not trip on over speed~~output frequency is ≤ 63 Hz.

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3.8 Demonstrate the EDGs capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor ~~between 0.8 and~~of ≤ 0.9, and verify that the voltage requirements are met and that the EDG shall not trip on over speed.

3.9 Confirm EDG endurance and margin test as follows:

3.9.1 Full-load carrying capability at a power factor between 0.8 and 0.9.

3.9.2 For an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the EDG.

3.9.3 That 22 hours of the 24 hours are at a load equal to 90 to 100 percent of its continuous rating.

3.9.4 That voltage and frequency requirements are maintained.

3.9.5 That mechanical systems such as fuel, lubrication, and cooling function within design limits.

3.9.6 Operation of the ~~air handling units or fans or both~~Emergency Power Generating Building ventilation system.

3.9.7 Area temperatures are maintained within design limits.

3.10 NOTE: Perform this testing within five minutes after the full load carrying capability demonstration.

3.11 Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load).

a. Verify that the EDG starts on a manual or automatic start signal.

b. Verify that the EDG attains the required voltage and frequency within acceptable limits and time, and operates for longer than five minutes.

~~3.12 NOTE: Perform this testing immediately after the full load carrying capability demonstration.~~

3.12 Demonstrate the ability to synchronize the EDG unit with offsite power while loaded with emergency loads with a simulated restoration of offsite power.

a. ~~Transfer this load to the~~Parallel EPSS bus with offsite power while the ~~unit~~EDG is connected to the emergency load and transfer this load to offsite power.

b. ~~Isolate the EDG, and r~~Restore ~~it~~the EDG to standby status.

3.13 Demonstrate that with the EDG operating in a test mode while connected to its bus, a simulated SIAS overrides the test mode by returning the EDG to ~~standby~~ready-to-load operation, and automatically energizing the emergency loads from offsite power.

3.14 Demonstrate that, by starting and running redundant EDG units simultaneously, potential common failure modes that may be undetected in single EDG unit tests do not occur.

3.15 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.16 Verify that EDG instrumentation operates over the design range using actual or simulated signals.

3.17 Verify that EDG alarms and interlocks occur as designed.

3.18 Verify that the EDG instrumentation responds as designed to actual or simulated limiting malfunctions or failures.

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3.19 Verify that the EDG instrumentation response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.20 Demonstrate EDG load rejection capability by operating loaded at 105 to 110 percent, opening the EDG output circuit breaker, and verifying speeds and voltages that will cause tripping or component damage are not exceeded.

4.0 DATA REQUIRED

4.1 Starting and loading sequence timing.

4.2 Test data traces for starting, stopping and load shedding.

4.3 Running data for the parameters monitored during each of the required testing sequences.

4.4 Verification of field performance data versus shop data.

4.5 Periodic area temperatures, collected at least once per hour.

5.0 ACCEPTANCE CRITERIA

5.1 The EDG electrical system meets design requirements (refer to Section 8.3.1):

5.1.1 Verify the EDG provides power to essential safety equipment if there is a simulated loss of normal power.

- Table 14.3-1 Item 1-56.

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5.2 The EDG ventilation system meets design requirements (refer to Section 9.4.9).

5.3 ~~Verify that s~~Safety-related components meet electrical independence and redundancy requirements.

1.2 To verify the power generated by the turbine generator can be fed to grid through the switchyard~~ and preferred power system~~.

2.0 PREREQUISITES

2.1 Construction activities on the switchyard and preferred power system have been completed.

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2.2 Offsite power system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems are completed and functional for operation of the switchyard and preferred power system.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify operation of the switchyard protective relaying system.

3.2 Verify operation of switchyard power ~~current~~circuit breakers and motor-operated disconnects from the following, as applicable:

3.2.1 ~~The MCR~~PICS and SICS controls.

3.2.2 Switchyard relay house.

3.2.3 Switchyard local control cabinet.

~~3.3 Verify operation of interlock between the separate offsite power connections.~~

3.3 Verify operation of the switchyard 125 Vdc auxiliary supply system and its associated controls, alarms, and batteries.

3.4 Verify the operation of the switchyard 480 Vac auxiliary power system and its associated controls, alarms, and annunciators.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms and interlocks occur.

4.2 Setpoint of protective relays.

5.0 ACCEPTANCE CRITERIA

5.1 The switchyard and preferred power system operates as designed (refer to Section 8.2).

14.2.12.10.2 ~~Unit Main Power System~~Main Generator (Test #109)

1.0 OBJECTIVE

~~1.1 To demonstrate that the unit main power system is capable of supplying power to designated house loads.~~

1.1 To demonstrate that the ~~unit main power system~~turbine generator is capable of transmitting power ~~from the main generator~~ to the

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transmission system and designated house loads through the switchyard.

2.0 PREREQUISITES

2.1 Construction activities on the ~~unit main power system~~turbine generator and support systems have been completed.

2.2 The offsite power distribution system is available.

2.3 Buses and equipment have been voltage tested with acceptable results.

2.4 Equipment has been visually inspected.

2.5 Control power is available.

2.6 Plant conditions are such that the main generator can be operated.

3.0 TEST METHOD

~~3.1 Demonstrate the ability of the unit transformers to supply power to the unit auxiliary transformers from the offsite power source.~~

3.1 Demonstrate the ability of the ~~unit~~main step-up transformers to transmit power from the main generator to the offsite power transmission system at rated voltage and load.

3.2 Demonstrate the ability of the main generator to generate designed voltage and load.

3.3 Demonstrate the ability of the unit auxiliary transformers to supply station loads.

3.4 Verify the operation of the generator circuit breaker.

3.5 Verify the operation of interlocks, alarms and protective relays.

3.6 Verify the operation of the main generator auxiliary systems.

4.0 DATA REQUIRED

4.1 ~~Main generator~~Turbine generator operating data at load.

4.2 ~~Unit~~Main step-up transformer operating data.

~~4.3 Unit auxiliary transformer operating data.~~

4.3 ~~Setpoints of alarms interlocks and controls~~Alarm values, interlock actuation valves, and plant operating data.

5.0 ACCEPTANCE CRITERIA

5.1 The ~~unit main power system~~turbine generator, output breaker, and step-up transformer operates as designed (refer to Section 8.2.1).

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14.2.12.10.3 Class 1E Uninterruptible Power Supply (Test #110)

1.0 OBJECTIVE

1.1 To demonstrate the Class 1E ~~DC~~uninterruptible power supply (EUPS) systems supply power as designed in required operating modes.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the Class 1E ~~DC~~uninterruptible power supply (EUPS) system have been completed.

2.2 ~~Class 1E DC power~~ EUPS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ~~Class 1E DC power~~EUPS system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 ~~B~~EUPS batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables has been verified.

2.8 Ventilation systems are in operation, as needed.

2.9 Buses and associated equipment have been meggered with acceptable results.

2.10 EUPS components have been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate that the batteries and battery chargers meet design capacities by performing discharge and charging tests as follows:~~.~~

a. Perform battery modified performance discharge or service test per IEEE Standard 450-2002.

b. Perform battery charger capacity test to verify battery charger output meets design criteria.

3.2 Verify that EUPS battery minimum bank and individual cell limits are not exceeded during battery discharge test.

3.3 Verify that operation of the inverters, manual transfer switches~~,~~ and frequency synchronization~~, and blocking diodes~~ meet~~s~~ design requirements.

3.4 ~~Verify that the inverters automatically transfer input to the battery upon loss of preferred power while maintaining uninterrupted power output.~~Verity operation of the EUPS inverters as follows:

a. Verify operation of each EUPS inverter with the respective EUPS battery charger removed from service.

b. Verify each EUPS inverter bypass switch forward and reverse transfer operation.

3.5 ~~Place the battery chargers on equalize and verify that DC equalizing voltage shall not result in driving the inverter or relieving the rectifier from carrying the inverter load~~Place each battery charger in the equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

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3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meet design requirements.

3.7 Verify that operation of the vital instrumentation and control power status information subsystem meets design requirements.

~~3.8 Verify that operation of bus transfer devices meet design requirements.~~

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.9 Verify operation of the AC/DC and DC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power supplied to the I&C cabinet from the converter that remains in operation.

4.0 DATA REQUIRED

~~4.1 Battery voltage and load current without charger.~~

4.1 Record of the charger float voltage and current.

4.2 Test discharge recordings of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

~~4.3 Charger voltage and current as battery eliminator.~~

~~4.4 Inverter voltage, frequency, and current from preferred source.~~

4.3 Inverter voltage, frequency, and current from battery source.

4.4 ~~Setpoint~~Values at which alarms, interlocks, and controls occur.

4.5 System status information subsystem indications.

4.6 Capacity estimates of the EUPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The ~~Class 1E uninterruptible power~~EUPS system supplies the loads as designed (refer to Section 8.3.2).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.4 Non–Class 1E Uninterruptible Power Supply (Test #111)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the ~~following systems:~~non-Class 1E uninterruptible power supply (NUPS) system.

~~1.1.1 The 250 Vdc auxiliary power system.~~

2.0 PREREQUISITES

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2.1 Construction activities on the ~~non-Class 1E DC power~~NUPS system have been completed.

2.2 ~~Non-Class 1E DC power~~NUPS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ~~non-Class 1E power~~NUPS system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 NUPS ~~B~~batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables is verified.

2.8 Ventilation systems are in operation, as needed.

2.9 Buses and associated equipment have been meggered with acceptable results.

2.10 The NUPS equipment has been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate that the batteries and battery charges of the 250 Vdc auxiliary power system meet design capacities by performing discharge and charging tests as follows:~~.~~

a. Perform battery modified performance discharge test or service test per IEEE 450-2002.

b. Perform battery charger capacity test to verify battery charger output meets design criteria.

3.2 Verify that minimum bank and individual cell limits are not exceeded during battery discharge tests.

3.3 Verify that operation of the inverters, manual transfer switches, frequency synchronization and blocking diodes meets design requirements.

3.4 ~~Verify that the inverters automatically transfer the input to the battery upon loss of preferred power while maintaining uninterrupted power output.~~Verify operation of the NUPS inverters as follows:

a. Verify operation of each NUPS inverter with the respective NUPS battery charger removed from service.

b. Verify each NUPS inverter static bypass switch forward and reverse transfer operation.

3.5 ~~Place the battery chargers on equalize and verify the DC equalizing voltage shall not result in driving the inverter or relieving the rectifier from carrying the inverter load~~Place each battery charger in equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

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3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meets design requirements.

3.7 ~~Verify the operation of bus transfer devices~~Verify operation of the AC/DC and DC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power to the I&C cabinet from the converter remaining in operation.

4.0 DATA REQUIRED

~~4.1 Battery voltage and load current without charger.~~

4.1 Charger float voltage and current.

4.2 Test discharge recording of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

~~4.3 Charger voltage and current as battery eliminator.~~

~~4.4 Inverter voltage, frequency, and current from preferred source.~~

4.3 Inverter voltage, frequency, and current ~~from battery source~~.

4.4 ~~Setpoint~~Value at which alarms, interlocks, and controls occur.

4.5 Capacity estimates of the NUPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The ~~non-Class 1E uninterruptible power~~NUPS system supplies the loads as designed (refer to Section 8.3.2).

14.2.12.10.5 Control Rod Drive Power System (Test #112)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the control rod drive power system.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.3 Support systems required for operation of the normal lighting system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Equipment has been visually inspected.

2.6 Normal lighting system power is available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the source and feeder circuit breakers ~~locally and remotely~~.

~~3.2 Demonstrate the functionality of the bus interlocks alarms and protective relays.~~

~~3.3 Verify the operation of indication and automatic responses.~~

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3.2 Verify normal lighting levels for each system with other lighting systems de-energized.

4.0 DATA REQUIRED

4.1 ~~Setpoints at which alarms, interlocks, and protective relays occur~~Plant area illumination levels.

5.0 ACCEPTANCE CRITERIA

5.1 Normal lighting systems operate as designed (refer to Section 9.5.3).

14.2.12.10.7 Reserved (Test #114)

14.2.12.10.8 Emergency Lighting System (Test #115)

1.0 OBJECTIVE

1.1 To demonstrate that the emergency lighting system provides adequate illumination to operate equipment during emergency operations.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the emergency lighting system have been completed.

2.2 Test instruments are calibrated per applicable procedures and available.

3.0 TEST METHODS

3.1 Demonstrate that the emergency lighting system provides levels of illumination as required in designated control areas.

3.2 Demonstrate that the emergency lighting system provides levels of illumination in other designated areas of the plant.

3.3 Demonstrate that the emergency lighting system comes on upon loss of normal lighting.

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3.4 Demonstrate that the battery operated emergency lights provide adequate illumination at designated locations.

3.5 Demonstrate that the battery operated emergency lights are capable of providing lighting for the designated amount of time.

3.6 ~~Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function~~Demonstrate that the MCR emergency lighting is powered from redundant emergency power supply system buses by selectively removing power and verifying staggered lighting loss.~~.~~

4.0 DATA REQUIRED

4.1 Illumination levels in designated areas.

4.2 Battery powered lighting data.

5.0 ACCEPTANCE CRITERIA

5.1 The emergency lighting system operates as designed (refer to Section 9.5.3).

~~5.2 Verify that safety-related components meet electrical independence and redundancy requirements.~~

14.2.12.10.9 6.9 kV ~~Class 1E~~ Emergency Power Supply System (Test #116)

1.0 OBJECTIVE

1.1 To demonstrate the operation of 6.9 kV ~~Class lE~~ emergency power supply system (EPSS) equipment.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the 6.9 kV ~~Class lE emergency power system~~EPSS equipment have been completed.

2.2 The 6.9 kV ~~Class 1E emergency power system~~EPSS equipment instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 6.9 kV ~~Class 1E emergency power system~~EPSS are completed and functional.

2.4 Test Instrumentation is available and calibrated.

2.5 All 6.9 kV feeders and buses voltage tested with acceptable results.

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2.6 6.9 kV power is available from the normal and alternate ~~ESF transformer~~offsite power sources.

2.7 Switchgear assembly, breakers, control and protective equipment, and circuits have been inspected and tested and are capable of being placed into service.

2.8 The EDG and ~~emergency AC~~ SBODG sources are available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the switchgear and load center feeder and ~~cross-tie protective~~ circuit breakers locally and remotely.

3.2 Demonstrate the functionality of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Load the systems to the extent practical and verify full load voltage is within system design parameters.

3.4.1 Verify the capability of 6.9 kV and 480 V bus loads to start and operate as designed when connected to the respective Class 1E 6.9 kV BDA bus~~es~~ at ±10 percent nominal voltage.

3.5 Verify the 6.9 kV and 480 V safety-related systems load shed as designed on under-voltage.

3.6 Verify the applicable 6.9 kV Class 1E buses can be energized from the following power sources:

3.6.1 Respective emergency auxiliary transformer.

3.6.2 Respective EDG.

3.6.3 Respective ~~alternate AC source~~SBODG.

3.7 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.8 Demonstrate control logic and controls including the load sequencer and response to ESF actuation signals.

4.0 DATA REQUIRED

4.1 ~~Full load bus voltage data.~~Bus voltage data at maximum attainable load.

4.2 ~~Setpoints~~Values at which alarms, interlocks, and protective relays occur.

4.3 System response to ~~low~~ bus under voltage and degraded voltage condition.

5.0 ACCEPTANCE CRITERIA

5.1 The 6.9 kV Class 1E emergency power system operates as designed (refer to Section 8.3.1).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.10 480 V ~~Class 1E~~ Emergency Power Supply System (Test #117)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 480 V Class 1E ~~emergency power system~~EPSS.

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1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the 480 V ~~Class 1E emergency power system~~EPSS have been completed.

2.2 The 480 V ~~Class 1E emergency power system~~EPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 480 V ~~Class 1E emergency power systems~~EPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Buses and equipment meggered with acceptable results.

2.6 Applicable equipment has been visually inspected.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the 480 Vac source and feeder circuit breakers locally and remotely, as applicable.

3.2 Demonstrate the functionality of the bus interlocks alarms and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Perform energization of 480 V~~ac Class 1E emergency power system~~ EPSS.

3.5 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 480 V Class 1E emergency power system operates as designed (refer to Section 8.3.1).

5.2 Verify that safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.11 13.8 kV Normal Power Supply System (Test #118)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 13.8 kV normal power supply system (NPSS).

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2.0 PREREQUISITES

2.1 Construction activities on the 13.8 kV ~~normal power system~~NPSS have been completed.

2.2 13.8 kV ~~normal power system~~NPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 13.8 kV ~~normal power system~~NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Normal auxiliary transformers available.

2.6 All 13.8 kV feeders and buses have been voltage tested with acceptable results.

2.7 Switchgear assembly, breaker, control and protective equipment, and circuits have been inspected and tested and are capable of being placed into service.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the switchgear and load center 13.8 kV feeder circuit breakers locally and remotely.

3.2 Demonstrate the functionality of the bus interlocks, alarms, and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Demonstrate the functionality of the feeder circuit breakers from the normal transformers to the NPSS locally and remotely.

4.0 DATA REQUIRED

4.1 Setpoints at which alarms, interlocks, and protective relays occur.

5.0 ACCEPTANCE CRITERIA

5.1 The 13.8 kV normal power system operates as designed (refer to Sections 8.2 and 8.3.1).

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5.2 Safety-related components meet electrical independence and redundancy requirements.

14.2.12.10.12 6.9 kV Normal Power Supply System (Test #119)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 6.9 kV normal power supply system (NPSS).

2.0 PREREQUISITE

2.1 Construction activities on the 6.9 kV ~~normal power system~~NPSS have been completed.

2.2 The 6.9 kV ~~normal power system~~NPSS instrumentation are calibrated and are operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 6.9 kV ~~normal power system~~NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 All 6.9 kV feeders and buses have been voltage tested with acceptable results.

2.6 The 6.9 kV power is available from the following:

2.6.1 Normal auxiliary transformer.

2.6.2 Respective ~~alternate AC source~~SBODG.

2.7 Switch gear assembly, breakers, and control and protective equipment and circuits have been inspected and tested and are capable of being placed into service.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the feeder ~~protective~~ circuit breakers from the ~~permanent non-safety~~ buses to the ~~safety loads buses~~EPSS.

~~3.2 Demonstrate the functionality of the feeder protective circuit breakers from the unit auxiliary transformer to the non-safety loads locally and remotely.~~

3.2 Demonstrate the functionality of the switchgear and load center feeder ~~and cross-tie protective~~ circuit breakers ~~for the permanent non-safety loads~~ locally and remotely.

3.3 Demonstrate the functionality of the bus~~es'~~ interlocks, alarms and protective relays.

3.4 Verify the operation of indication and automatic responses.

3.5 Verify the permanent non-safety buses can be energized from the normal auxiliary transformer, and the respective ~~alternate AC source~~SBODG.

~~3.6 Demonstrate the operation of the bus transfer for the permanent non-safety buses – preferred 1 (normal) supply power to preferred 2 (alternate) supply power.~~

4.0 DATA REQUIRED

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4.1 ~~Setpoints~~Values at which alarms, interlocks, and protective relays occur.

~~4.2 System response to transfer of preferred 1 (normal) supply power to preferred 2 (alternate) supply power.~~

5.0 ACCEPTANCE CRITERIA

5.1 The 6.9 kV ~~normal power supply system~~NPSS supplies the loads as described in Section 8.3.1.

14.2.12.10.13 480 V Normal Power Supply System (Test #120)

1.0 OBJECTIVE

1.1 To demonstrate the operation of the 480 V normal power supply system (NPSS).

2.0 PREREQUISITES

2.1 Construction activities on the 480 V ~~normal power systems~~NPSS have been completed.

2.2 480 V ~~normal power system~~NPSS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the 480 V ~~normal power systems~~NPSS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Buses and equipment have been meggered with acceptable results.

2.6 Equipment has been visually inspected.

2.7 The 13.8 kV and 6.9 kV ~~normal auxiliary power supply~~NPSS is available.

3.0 TEST METHOD

3.1 Demonstrate the functionality of the 480 Vac source and feeder circuit breakers locally and remotely, as applicable.

3.2 Demonstrate the functionality of the bus interlocks alarms and protective relays.

3.3 Verify the operation of indication and automatic responses.

3.4 Perform energization of 480 V~~ac normal power system~~NPSS.

4.0 DATA REQUIRED

4.1 ~~Setpoints~~Values at which alarms, interlocks, and protective relays occur.

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5.0 ACCEPTANCE CRITERIA

5.1 The 480 V ~~normal power system~~NPSS operates as designed (refer to Section 8.3.1).

14.2.12.10.14 ~~Class 1E DC Power System~~Reserved (Test #121)

1.0 ~~OBJECTIVE~~

1.1 ~~To demonstrate the operation of the Class 1E DC power system.~~

1.2 ~~To demonstrate electrical independence and redundancy of safety-related power supplies.~~

2.0 ~~PREREQUISITES~~

2.1 ~~Construction activities on the Class 1E DC power systems have been completed.~~

2.2 ~~Class 1E DC power system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.~~

2.3 ~~Support systems required for operation of the Class 1E DC power systems are completed and functional.~~

2.4 ~~Test instrumentation is available and calibrated.~~

2.5 ~~Buses and equipment have been meggered with acceptable results.~~

2.6 ~~Equipment has been visually inspected.~~

3.0 ~~TEST METHOD~~

3.1 ~~Demonstrate the functionality of the Class 1E DC source and feeder circuit breakers locally and remotely.~~

3.2 ~~Demonstrate the functionality of the bus interlocks alarms and protective relays.~~

3.3 ~~Verify the operation of indication and automatic responses.~~

3.4 ~~Perform energization of Class 1E DC power system.~~

4.0 ~~DATA REQUIRED~~

4.1 ~~Setpoints at which alarms, interlocks and protective relays occur.~~

4.2 ~~Capacity estimates of the batteries.~~

5.0 ~~ACCEPTANCE CRITERIA~~

5.1 ~~The Class 1E DC power system operates as designed (refer to Section 8.3.2.1).~~

14.2.12.10.15 ~~Non-Class 1E DC Power System~~Reserved (Test #122)

1.0 ~~OBJECTIVE~~

1.1 ~~To demonstrate the operation of the severe accident non-Class 1E DC power system.~~

1.2 ~~To demonstrate the operation of the TI non-Class 1E DC power system.~~

2.0 ~~PREREQUISITES~~

2.1 ~~Construction activities on both non-Class 1E DC power systems have been completed.~~

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2.2 ~~Non-Class 1E DC power system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.~~

2.3 ~~Support systems required for operation of the non-Class 1E DC power systems are completed and functional.~~

2.4 ~~Test instrumentation is available and calibrated.~~

2.5 ~~Buses and equipment have been meggered with acceptable results.~~

2.6 ~~Equipment has been visually inspected.~~

3.0 ~~TEST METHOD~~

3.1 ~~Demonstrate the functionality of the non-Class 1E DC source and feeder circuit breakers locally and remotely.~~

3.2 ~~Demonstrate the functionality of the bus interlocks alarms and protective relays.~~

3.3 ~~Verify the operation of indication and automatic responses.~~

3.4 ~~Perform energization of both non-Class 1E DC power system.~~

4.0 ~~DATA REQUIRED~~

4.1 ~~Setpoints at which alarms, interlocks, and protective relays occur.~~

4.2 ~~Estimated capacity of the batteries.~~

5.0 ~~ACCEPTANCE CRITERIA~~

5.1 ~~The non-Class 1E DC power system operates as designed (refer to Section 8.3.2.1).~~

14.2.12.10.16 ~~Severe~~12-Hour Accident Uninterruptible Power Supply (Test #123)

1.0 OBJECTIVE

1.1 To demonstrate the ~~severe accident DC power systems~~12-hour uninterruptible power supply ~~power~~system (12 UPS) supply power as designed in required operating modes.

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2.0 PREREQUISITES

2.1 Construction activities on the ~~severe accident DC power system~~12 UPS have been completed.

2.2 ~~Severe accident DC power system~~12 UPS instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the ~~severe accident DC power system~~12 UPS are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 ~~B~~12 UPS batteries are fully charged.

2.6 Load banks are available for discharge test.

2.7 Operation of breakers and cables has been verified.

2.8 Ventilation systems are in operation, as needed.

3.0 TEST METHOD

3.1 Demonstrate that the 12 UPS batteries and battery chargers meet design capacities by performing discharge and charging tests.

3.2 Verify that minimum bank and individual cell limits are not exceeded during battery discharge test.

3.3 Verify that operation of the inverters, manual transfer switches, and frequency synchronization~~, and blocking diodes~~ meets design requirements.

3.4 ~~Verify that the inverters automatically transfer input to the battery upon loss of preferred power while maintaining uninterrupted power output.~~Verify operation of the 12 UPS inverters as follows:

a. Verify operation of each 12 UPS inverter with the respective UPS battery charger removed from service.

b. Verify each 12 UPS inverter static bypass switch forward and reverse transfer operation.

3.5 ~~Place the battery chargers on equalize and verify DC equalizing voltage shall not result in driving the inverter, relieving the rectifier from carrying the inverter load.~~Place each battery charger in equalize mode and verify battery charger, battery, and inverter performance meets design requirements.

3.6 Verify that operation of protective devices, controls, interlocks, alarms, computer inputs, and ground detection meet design requirements.

3.7 Verify that operation of the vital instrumentation and control power status information subsystem meets design requirements.

3.8 ~~Verify proper operation of bus transfer devices.~~Verify operation of the AC/DC converter output to the I&C cabinets by alternately removing power and verifying continued power to the I&C cabinet from the converter remaining in operation.

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4.0 DATA REQUIRED

~~4.1 Battery voltage and load current without charger.~~

4.1 Charger float voltage and current.

4.2 Test discharge recordings of battery terminal voltage, current, temperature, capacity in ampere hours, and individual cell voltages.

~~4.3 Charger voltage and current as battery eliminator.~~

~~4.4 Inverter voltage, frequency, and current from preferred source.~~

4.3 Inverter voltage, frequency, and current ~~from battery source~~.

4.4 ~~Setpoint~~Values at which alarms, interlocks, and controls occur.

4.5 System status information subsystem indications.

4.6 Capacity estimates of the 12 UPS batteries.

5.0 ACCEPTANCE CRITERIA

5.1 The ~~severe accident uninterruptible power system~~12 UPS supplies the loads as designed (refer to Sections 8.3.1 and 8.3.2).

14.2.12.11 I&C Systems

14.2.12.11.1 ~~Reserved~~Safety Information and Control System (Test #124)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the safety-related monitoring and control functions of the safety information and control system (SICS), including the requirements of Regulatory Guide 1.97 type A, B, and C variable. (This test should be performed in coordination with safe shutdown, the safety automation system, and the protection system, where applicable.)

2.0 PREREQUISITES

2.1 The instrumentation used to operate the SICS has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 Programming and diagnostic testing is complete.

2.3 Support systems required for testing SICS are installed and have successfully completed initial testing.

3.0 TEST METHOD

3.1 Energize power supplies and verify operation.

3.2 Activate manual trips and monitor operation.

3.3 Activate ESF actuations and monitor operation.

3.4 Simulate safe shutdown scenarios and observe appropriate alarms and indications.

3.5 Exercise the transfer of control functions to SICS from PICS.

3.6 Exercise manual control of individual components required in the Chapter 15 analysis.

3.7 Verify the SICS control signals override lower priority signals where appropriate.

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3.8 Verify permissive and interlocks can be manually controlled.

3.9 Verify monitoring and control of safety-related auxiliary support systems required to mitigate Chapter 15 events and recovery.

3.10 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power conditions) SICS divisions and determining which functions are lost on the energized PS division and which overall SICS functions are lost. Repeat test for all SICS divisions.

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operation.

4.3 Safety parameter trends during testing.

4.4 Response time for manually initiated actions.

4.5 Reactor trip and actuation path response.

5.0 ACCEPTANCE CRITERIA

5.1 The SICS has been verified to be capable of control and monitoring of critical plant functions automatically and in response to manual signals.

5.2 The SICS operates properly once control has been transferred from PICS.

5.3 The response times meet those assumed in the safety analysis.

14.2.12.11.2 Seismic Monitoring System (Test #125)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the non-safety-related seismic monitoring system (SMS).

2.0 PREREQUISITES

2.1 Construction activities on the SMS have been completed.

2.2 Seismic instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Verify functionality of internal calibration devices by recording calibration records on applicable sensors.

3.2 Verify system response to simulated seismic events by actuating the appropriate trigger units, recording accelerograph outputs, and playing back records for analysis.

3.3 Verify and calibrate systems alarms and indicators.

3.4 Verify that operation and installation of peak recording accelerographs meet design requirements.

3.5 Verify that factory acceptance testing has been completed.

3.6 Verify proper operation of alarm, control and indication functions.

3.7 Verify that the SMS system operates over the design range using actual or simulated signals.

3.8 Verify that the SMS system responds as designed to actual or simulated limiting malfunctions or failures.

3.9 Verify that the SMS system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.10 ~~Verify redundancy and electrical independence of the SMS design~~ (internal and external battery power supplies).

4.0 DATA REQUIRED

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4.1 Record sensor response to simulated seismic inputs.

5.0 ACCEPTANCE CRITERIA

5.1 The as-built location of the SMS equipment is as shown on the plant layout drawings.

5.2 The SMS system can compute the cumulative absolute velocity (CAV) and provide indication of the CAV. ~~in the main control room (MCR).~~

5.3 The SMS has sufficient dynamic range.

5.4 The SMS has a sufficient bandwidth.

5.5 The SMS has a sufficient sampling rate.

5.6 The SMS has a sufficient trigger level.

5.7 The SMS backup battery has sufficient capacity to power its instruments for continuous operation as described in the equipment specification.

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5.8 The SMS functions as described in Section 3.7.4.

14.2.12.11.3 Boron Concentration Measurement System (Test #126)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the safety-related boron concentration measurement system (BCMS). The system measures the nuclear cross-section of CVCS fluid and ~~calculates a corresponding boron concentration~~provides this information to the PS for calculation of the corresponding boron concentration.

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 The BCMS has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 Support systems required for BCMS operation are complete and functional.

2.3 Verify that factory acceptance testing has been completed.

2.4 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Observe boron cross-section measurement indications using the built-in test features.

3.2 Formulate sample concentrations of 500 ppmB, 1000 ppmB, 1500 ppmB and 2000 ppmB using naturally occurring boron-10 isotopic enrichments.

3.3 Flush test samples through the ~~boron instrumentation system~~associated BCMS piping while observing system response.

3.4 Formulate sample concentrations of 500 ppmB, 1000 ppmB, 1500 ppmB and 2000 ppmB using 37 percent enriched boron-10.

3.5 Flush the samples through the charging pump suction pipe while observing system response.

3.6 Verify that the BCMS system operates over the design range using actual or simulated signals.

3.7 Verify that the BCMS system responds as designed to actual or simulated limiting malfunctions or failures.

3.8 Verify that the BCMS system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence and redundancy of the BCMS design.

4.0 DATA REQUIRED

4.1 Pulse rates and boron cross-section measurement output (boron concentration).

4.2 Alarm setpoints and actuation levels.

5.0 ACCEPTANCE CRITERIA

5.1 The BCMS equipment is installed in the locations shown on the plant layout drawings.

5.2 The BCMS provides input signals for the engineered safety feature function described in the equipment specification.

5.3 The Class 1E BCMS equipment receives power from its respective Class 1E division.

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5.4 The BCMS functions as described in Sections 9.3.4.2.3.4~~9.3.4~~ and ~~7.1.1~~7.1.1.5.4.

14.2.12.11.5 Aeroball Measurement System (Test #127)

1.0 OBJECTIVE

1.1 To measure cable insulation resistance.

1.2 To verify proper amplifier operation.

1.3 To demonstrate proper operation of the non-safety-related counting table and the signal processing equipment.

2.0 PERQUISITES

2.1 Construction activities on the Aeroball measurement system (AMS), i.e. movable incore nuclear instrumentation system, are complete (Aeroball lances and vanadium balls do not need to be installed at this time).

2.2 AMS incore nuclear signal channel instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test equipment has been checked and calibrated.

2.4 Support systems required for operation of the AMS are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Simulate AMS detector signals into the signal conditioning circuits using external test instrumentation.

3.3 Test each amplifier for as designed operation in accordance with the manufacturer instruction manual using internal test circuits.

3.4 Simulate variable inputs to the amplifier and record displayed values~~ displayed by the data processing system (DPS)~~.

3.5 Verify that the AMS operates over the design range using actual or simulated signals.

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4.0 DATA REQUIRED

4.1 Cabling insulation resistance readings.

4.2 Status and performance of the internal test circuits.

4.3 Values of simulated input and derived output signals for correlation purposes.

4.4 Satisfactory operation of AMS detectors.

5.0 ACCEPTANCE CRITERIA

5.1 The cable insulation resistance for the cables associated with the AMS are within specification.

5.2 Amplifiers associated with the AMS are operating properly.

5.3 The non-safety-related counting table and the signal processing equipment respond as designed to a test source.

5.4 The AMS nuclear signal channel cables and instrumentation function as described in Section 7.1.1.4.6~~Section 7.1.1~~.

14.2.12.11.6 Process Automation System (Test #128)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related process automation system (PAS) to monitor and control non-safety processes.

1.1.1 Automatic risk reduction functions, including:

- Mitigation of ATWS,
- Mitigation of SBO,
- Mitigation of other risk significant events.

1.1.2 Automatic primary plant limitation functions.

1.1.3 Automatic operational functions, including:

- Equipment protection,
- Closed loop controls.

1.1.4 Manual control functions.

1.1.5 Processing of information for display, including:

- Type A-E post-accident monitoring (PAM) variables.
- Process system instrumentation,
- Alarms.

1.2 DAS, which is a subsystem of PAS.

1.3 DAS generated reactor trip signals.

1.4 Risk mitigation DAS functions.

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2.0 PREREQUISITES

2.1 Construction activities on the PAS have been completed.

2.2 PAS instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support system(s) required for operation of the PAS is complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PAS meets design requirements.

3.2 Verify that PAS operates over the design range using actual or simulated signals.

3.3 Verify that PAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the PAS design.

3.5 Verify that PAS meets design requirements for ~~adverse~~diverse reactor trip system (without Protection system inputs or outputs).

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 PAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 The PAS provides the following operational I&C functions.

5.1.1 Automatic risk reduction functions, including:

- Mitigation of ATWS and software common cause failure, as described in Section 7.1.2.6.27 and 7.8.2.1.3.
- Mitigation of SBO, as described in Section 7.4.1.4.
- Mitigation of other risk significant events, as described in Sections 7.1.1.6.1 and 7.4.2.2.1.

5.1.2 Automatic primary plant limitation functions.

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5.1.3 Automatic operational functions, including:

- Equipment protection.
- Closed loop controls.

5.1.4 Manual control functions, as described in Section 7.1.1.3.1 and 7.1.2.6.29.

5.1.5 Processing of information for display, including:

- Type A-E post-accident monitoring (PAM) variables.
- Process system instrumentation.
- Alarms.

5.2 The Diverse Actuation System (DAS), which is a subsystem of PAS, generates signals for automatic actuation of the functions described in the software design specification.

5.3 The DAS generates independent reactor trip signals in response to simulated inputs.

5.4 DAS provides EFW system actuation as described in Section 7.8.1.2.12.

5.5 The DAS functions as described in Section 7.1.1.

14.2.12.11.7 Process Information and Control System (Test #129)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related process information and control system (PICS) to monitor and control ~~non-safety~~plant processes.

2.0 PREREQUISITES

2.1 Construction activities on the PICS have been completed.

2.2 Support system(s) required for operation of the PICS is complete and functional.

2.3 Test instrumentation is available and calibrated.

2.4 Verify that factory acceptance testing has been completed

2.5 Verify proper operation of alarm, control, and indication functions

3.0 TEST METHOD

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3.1 ~~Demonstrate operation of the PICS, as designed, by verifying that each operator interface that is permitted to make control and monitoring changes is enabled, and conversely verify that operator interfaces that are only allowed monitoring privileges do not have control permissions~~Demonstrate that operation of the PICS meets design requirements.

3.2 Verify that the PICS operates over the design range using actual or simulated signals.

3.3 Verify that the PICS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the PICS design.

3.5 Verify full capability and independence of PICS operation at the MCR and RSS.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 PICS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Each PICS operator interface that provides monitoring and control capabilities is enabled

5.2 Each PICS operator interface that provides monitoring only capabilities is enabled and does not allow control capabilities.

5.3 The PICS provides monitoring and control of process systems.

5.4 The PICS provides the status of the automatic reactor trip and engineered safety features.

5.5 The PICS provides the manual reset of automatic reactor trip and engineered safety features.

5.6 The PICS provides manual component control of safety-related process systems via the PAS and the PACS.

5.7 The PICS provides safety parameter display system (SPDS) functions.

5.8 The PICS displays the Type A-E post-accident monitoring (PAM) variables.

5.9 The PICS provides monitoring and control of systems required to mitigate severe accidents.

5.10 The PICS displays bypassed and inoperable status of safety systems.

5.11 The PICS provides alarm management capability.

5.12 The PICS provides the capability to archive plant and other selected data.

5.13 The PICS provides the interface to external I&C computers.

5.14 The PICS provides an interface to external computers via a unidirectional firewall.

5.15 The PICS functions as described in Section 7.1.1.3.2~~Section 7.1.1~~.

14.2.12.11.8 Communication System (Test #130)

1.0 OBJECTIVE

1.1 To demonstrate the adequacy of the intra-plant communication system to provide communications between vital plant areas.

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1.2 To demonstrate the offsite communication system to provide communications with exterior entities.

1.3 Verify that non-safety-related ~~portions of the~~ communication system functions as designed to malfunctions or failures.

1.4 ~~To demonstrate electrical independence and redundancy of safety-related power supplies~~To demonstrate that COMS meets design requirements.

2.0 PREREQUISITES

2.1 Construction activities on the intraplant communication system have been completed.

2.2 Support systems required for operation of the intraplant communication system are complete and functional.

2.3 Plant equipment that contributes to the ambient noise level shall be in operation.

3.0 TEST METHOD

3.1 Verify the intraplant portable wireless communication system functions as designed.

3.2 Verify that the intraplant (PABX) telephone system functions as designed.

3.3 Verify the intraplant sound powered telephone system functions as designed.

3.4 Verify the intraplant public address system functions as designed.

~~3.5 Verify that the intraplant cell telephone system functions as designed.~~

3.5 Verify the security radio system functions as designed at locations throughout the plant.

3.6 Verify the normal offsite telephone system functions as designed.

3.7 Verify the emergency telephone system (emergency notification system, health physics network ~~and ring down phone system~~) function as designed.

3.8 Verify that the communication system responds as designed to actual or simulated limiting malfunctions or failures.

~~3.9 Verify redundancy and electrical independence of the communication system.~~

~~3.10 Verify that the communication system's response meets the accident analysis assumptions.~~

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~~3.11 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.~~

3.9 Verify that the communications equipment will perform under anticipated maximum plant noise levels.

3.10 Verify the effectiveness of the exclusion zones established for protecting the safety-related I&C equipment from mis-operation due to EMI/RFI effects from the portable phones and radios of the communication system.

4.0 DATA REQUIRED

4.1 Record the results of communication attempts from each system and its locations.

5.0 ACCEPTANCE CRITERIA

5.1 The portable wireless communication system provides radio coverage throughout the plant, except in areas restricted due to potential EMI/ RFI considerations.

5.2 The portable wireless communication system provides an interconnection to the public switched telephone network (PSTN) to allow offsite communications.

5.3 The digital telephone system provides plant-wide intercom capability.

5.4 The digital telephone system provides an interconnection to the public switched telephone network (PSTN) to allow offsite communications.

5.5 The public address and alarm system operates as described in the design specification.

5.6 The sound powered system operates as described in the design specification.

5.7 The security communication system operates as described in the design specification.

5.8 The communication system provides communication with the emergency notification system and the health physics network.

5.9 The communication equipment is capable of operating under maximum noise conditions.

~~5.10 Verify that safety-related components meet electrical independence and redundancy requirements.~~

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5.10 Safety-related I&C equipment is not adversely impacted by the portable phones and radios of the communication system.

5.11 The intraplant and offsite communication systems functions as described in Sections 9.5.2.

14.2.12.11.9 Vibration Monitoring System (Test #131)

1.0 OBJECTIVE

1.1 To verify that the operation of the non-safety-related vibration monitoring system meets the design requirements.

1.2 To verify that the vibration monitoring setpoints are suitable for initial power operation.

2.0 PREREQUISITES

2.1 Construction activities on the vibration monitoring system are completed.

2.2 Sensors, cables, and conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the response of the vibration monitoring channels by simultaneously monitoring equipment operation with calibrated portable instrumentation.

3.2 Verify alarm functions.

3.3 Establish baseline data for a cold subcritical plant.

3.4 Establish alarm levels in a cold subcritical plant.

4.0 DATA REQUIRED

4.1 Baseline vibration data.

4.2 Alarm levels applicable to protect plant equipment.

5.0 ACCEPTANCE CRITERIA

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5.1 The ~~accelerometers~~sensors of the vibration monitoring system are functioning properly.

- accelerometers.
- absolute displacement transducers.
- relative displacement transducers.
- pressure fluctuation transducers.
- relative shaft displacement transducers.
- absolute velocity transducer.

5.2 The signal conditioning equipment is operating properly.

5.3 The portions of the vibration monitoring system that provide data recording, data analysis, and alarm functions are operating satisfactorily.

5.4 The vibration monitoring system functions as described in Section 7.1.1.5.10.

14.2.12.11.10 Plant Fire Alarm System (Test #132)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related plant fire alarm system (PFAS) to detect the presence of fire, alert plant personnel, and perform designed function in protected areas.

2.0 PREREQUISITES

2.1 Construction activities associated with the portion of the PFAS have been completed.

2.2 PFAS instrumentation has been calibrated and is functional for performing the applicable tests.

2.3 Support system(s) required for operation of the PFAS.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Demonstrate that operation of the PFAS is in accordance with the requirements of Chapter 10 of NFPA 72.

3.2 Verify input devices and circuits annunciate and the corresponding output and control logic properly occurs as designed.

3.3 Verify circuit integrity and device operability under required circuit conditions.

3.4 Verify the input and output functions operability under loss of primary power source event.

3.5 Verify that notification circuits and appliances deliver the required audible and visual signaling levels required for the area.

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3.6 Verify that the PFAS operates over the design range using ~~actual or~~ simulated signals.

3.7 Verify that the PFAS responds as designed to ~~actual or~~ simulated limiting malfunctions or failures.

3.8 Verify that the PFAS response meets the ~~accident~~ analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence of the PFAS design.

3.10 Verify that the plant fire alarm system can be manually actuated.

4.0 DATA REQUIRED

4.1 Set points under which alarms are activated and control outputs occur.

4.2 Fire alarm system circuit and device integrity meets design requirements.

4.3 Fire alarm system output functions occur as designed for each corresponding alarm input received.

4.4 All initiating, notification appliance, releasing, and control circuits and devices function as designed during loss of primary power source.

4.5 Notification devices meet design requirements for the given area.

5.0 ACCEPTANCE CRITERIA

5.1 The PFAS provides control and monitoring capability of the plant fire suppression and detection system.

5.2 The PFAS provides the ~~Main Control Room (MCR)~~plant operators with information displays and supports automatic and manual control of fire protection equipment where applicable.

5.3 The PFAS is provided with both an electrically supervised primary and secondary power source that will transfer automatically to the secondary power source upon loss of the primary power source. A trouble signal is provided ~~in the MCR~~ upon loss of either power source to any local fire control panel or workstation.

5.4 The PFAS operates as designed (refer to Sections 9.5.1.2.1).

14.2.12.11.11 Loose Parts Monitoring System (Test #133)

1.0 OBJECTIVE

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1.1 To verify that operation of the non-safety-related loose parts monitoring system (LPMS) meets design requirements.

1.2 To verify that the loose parts setpoints are suitable for initial power operation.

2.0 PREREQUISITES

2.1 Construction activities on the loose parts monitoring system are completed.

2.2 Sensors, cables, and signal conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the response of the loose parts monitoring channels with a mechanical impulse type device.

3.2 Verify alarm functions using simulated signals.

3.3 Establish baseline monitoring data for a cold subcritical plant.

3.4 Establish the alarm level for loose parts monitoring channels in a cold subcritical plant.

3.5 Verify that the LPMS operates over the design range using actual or simulated signals.

3.0 TEST METHOD

3.1 Verify input data and control paths from systems associated with the turbine-generator instrumentation and control system.

3.2 Simulate inputs and verify system responses and demand settings.

3.3 Verify the functions of the turbine-generator instrumentation and control system. Using simulated signals, verify that the operator interface allows turbine control, as designed.

4.0 DATA REQUIRED

4.1 Input signals from associated systems.

4.2 Turbine-generator instrumentation and control system demand outputs in response to inputs.

4.3 Alarm and trip values.

5.0 ACCEPTANCE CRITERIA

5.1 The turbine-generator instrumentation and control system ~~(TG I&C)~~ trip logic operates properly.

5.2 The ~~TG~~turbine-generator I&C system provides grid synchronization capability.

5.3 The ~~TG~~turbine-generator I&C system startup and shutdown controls operate properly.

5.4 The controls for startup and shutdown of the turbine~~-~~-generator auxiliaries operate properly.

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5.5 The automatic and manual controls to preheat the turbines, to ~~start~~close the main output breaker and load the generator, to adjust generator load, to perform all normal test functions, and to unload the generator are operating properly.

5.6 The ~~TG~~turbine-generator speed control is operating properly.

5.7 The ~~TG~~turbine-generator load control is operating properly.

5.8 The primary and backup turbine~~-~~-generator overspeed trip devices are operating properly.

5.9 The ~~TG~~turbine-generator I&C system provides monitoring of thermal, hydraulic, and electrical parameters associated with the turbine generator and initiates a turbine trip for the conditions listed in Section 10.2.2.10.

5.10 The ~~TG~~turbine-generator I&C system functions as described in Section 10.2.

14.2.12.11.13 Reactor Pressure Vessel Level Measurement System (Test #135)

1.0 OBJECTIVE

1.1 To verify the non-safety-related reactor pressure vessel level (RPVL) measurement system is capable of indicating vessel level.

2.0 PREREQUISITES

2.1 Construction activities on the RPVL measurement system have been completed.

2.2 The RPVL measurement system instrumentation has been calibrated and is functional for performance of the following test.

2.3 Support systems required for operation of the RPVL measurement system are complete and functional.

2.4 Test instrumentation is available and calibrated.

3.0 TEST METHOD

3.1 Demonstrate control logic and controls and response to reactor pressure vessel level changes.

3.2 Verify that the RPVL system operates over the design range using actual or simulated signals.

3.3 Verify that the RPVL system responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify that the RPVL system response meets the design assumptions, such as time response, accuracy, and control stability.

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3.5 Verify redundancy and electrical independence of the RPVL system design.

4.0 DATA REQUIRED

4.1 RPVL measurement system indication.

5.0 ACCEPTANCE CRITERIA

5.1 The RPVL measurement system provides reactor vessel water level measurement.

5.2 The RPVL measurement system conditioning cabinets receive power from their respective Class 1E division.

5.3 The RPVL measurement system response to simulated malfunctions and failures is as designed.

5.4 The RPVL measurement system functions as described in Section 7.1.1.5.7.

14.2.12.11.14 Fatigue Monitoring System (Test #136)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the non-safety-related fatigue monitoring system (FAMOS) to continuously collect and store temperatures and pressure readings of previously identified sensitive zones.

1.2 To verify recorded data consists of parameters such as ~~mass flow, reactor power, and valve positions~~temperature and pressure that are clearly identified.

2.0 PREREQUISITES

2.1 Construction activities on the FAMOS have been completed.

2.2 Support system(s) required for operation of the FAMOS is complete and functional.

2.3 FAMOS instrumentation is available and functional.

2.4 Special test instrumentation is available and calibrated, as required.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Demonstrate ~~that~~the operation of the FAMOS by verifying that the system is monitoring previously identified sensitive zones as designed.

3.2 Verify that FAMOS alarms occur when sensitive zone data triggers are initiated (may be necessary to simulate data to meet trigger values).

3.3 Verify that FAMOS alarms, indicating instruments, and status lights are functional.

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3.4 ~~Verify that FAMOS communicate with other I&C computer platforms.~~

4.0 DATA REQUIRED

4.1 FAMOS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 The FAMOS equipment is capable of measuring loading conditions on monitored plant equipment.

5.2 The FAMOS functions as described in Section 7.1.1.5.11.

14.2.12.11.15 Leak Detection System~~s~~ (Test #137)

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the non-safety-related leak detection system~~s (LDS)~~.

1.2 To adjust the alarm setpoints under functional conditions.

1.3 To demonstrate automated calibration features.

2.0 PREREQUISITES

2.1 Construction activities on the LDS are complete.

2.2 Sensors, cables, and signal conditioning electronics are installed and functional.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is functional.

2.5 Data analysis, storage, and trending software are functional for humidity methods.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify the calibration and alarm setpoints using simulated signals to the ~~acoustic~~humidity monitoring channels.

3.2 Verify alarm functions.

3.3 Establish baseline monitoring data under operating conditions for a cold, subcritical plant.

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3.4 Verify the automated electronics calibration functions.

3.5 Verify the ability to detect leakage with design basis limits.

4.0 DATA REQUIRED

4.1 Baseline ~~acoustic~~humidity data.

4.2 Alarm levels applicable to detection of coolant leaks.

5.0 ACCEPTANCE CRITERIA

5.1 The LDS provides condensate flow measurement capability.

5.2 The LDS provides temperature and humidity measurement capability of the containment environment.

5.3 The LDS provides local humidity detection for the main steam piping.

5.4 The alarm setpoints have been established.

5.5 The LDS functions as designed (refer to Sections 5.2.5 and 7.1.1.5.12).

5.6 Verify that the LDS meets the regulatory requirements for leakage detection, refer to Regulatory Guide 1.45.

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~~11.16~~ ~~Reserved~~Safety Automation System (Test #139)

1.0 OBJECTIVE

1.1 To demonstrate the ability of the safety-related Safety Automation System (SAS) to perform automatic and selected manual control functions on safety-related processes during normal operations, abnormal operational occurrences, postulated accidents, and post accidents.

2.0 PREREQUISITES

2.1 Construction activities on the SAS have been completed.

2.2 SAS instrumentation has been calibrated and is functional for performance of this test.

2.3 Support system(s) required for operation of the SAS is complete and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Demonstrate the operation of the SAS meets design requirements.

3.2 Verify that SAS operates over the design range using actual or simulated signals.

3.3 Verify that SAS responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify redundancy and electrical independence of the SAS design.

4.0 DATA REQUIRED

4.1 Setpoints under which alarms and interlocks occur.

4.2 SAS functional data (input data and corresponding output).

5.0 ACCEPTANCE CRITERIA

5.1 Monitoring and control of safety related automatic and manual functions after initiation through the Protection System.

5.2 Monitoring and control of essential auxiliary support systems.

5.3 Processing Type A-C PAM variables for display on the SICS.

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5.4 Certain interlock functions.

14.2.12.11.17 Remote Shutdown Station (Test #140)

1.0 OBJECTIVE

1.1 To verify proper operation of the remote shutdown station (RSS).

1.2 To determine transfer of control occurs and that the plant can be controlled and cooled down from the RSS.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 All construction activities on the RSS have been completed.

2.2 The RSS instrumentation has been calibrated and is functional for performing the following test.

2.3 The communication systems between the MCR and RSS location have been demonstrated to be functional.

2.4 Verify that factory acceptance testing has been completed.

2.5 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Simulate signals to verify that operation of RSS instrumentation meets design requirements.

3.2 Perform a full transfer of control from the MCR during the performance of the HFT.

3.3 Perform a controlled cooldown from the remote shutdown panel during the performance of the HFT.

3.4 Verify that the RSS operates over the design range using actual or simulated signals.

3.5 Verify that the RSS responds as designed to actual or simulated limiting malfunctions or failures.

3.6 Verify that the RSS response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.7 Verify redundancy and electrical independence of the RSS.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 RCS temperatures and pressures.

5.0 ACCEPTANCE CRITERIA

5.1 The ability to cooldown using remote shutdown instrumentation and controls has been demonstrated.

5.2 The RSS transfer switches provide the capability to transfer control from the Main Control Room (MCR) to the RSS.

5.3 Electrical isolation is provided between ~~the~~ MCR and ~~the~~ RSS controls.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The RSS functions as described in Sections 6.4.2, 7.4.1, and 7.4.2~~7.4.3~~.

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14.2.12.11.18 Incore Instrumentation System (Test #141)

1.0 OBJECTIVE

1.1 To measure fixed incore cable insulation resistance.

1.2 To verify proper amplifier operation.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the incore instrumentation system are complete. However, detectors (instrument lances) do not need to be installed.

2.2 Fixed incore nuclear signal channel instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Special test instrumentation has been calibrated, as applicable.

2.4 Incore instrumentation system support systems are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Simulate incore signals into the signal conditioning circuits using external test instrumentation.

3.3 Test each amplifier for as designed operation in accordance with the manufacturer instruction manual using the internal test circuits.

3.4 Simulate variable inputs to the amplifier and record its output values displayed by the DPS.

3.5 Verify that the incore instrumentation system operates over the design range using actual or simulated signals.

3.6 Verify that the incore instrumentation system responds as designed to actual or simulated limiting malfunctions or failures.

3.7 Verify that the incore instrumentation system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.8 Verify redundancy and electrical independence of the incore design.

3.9 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Cabling insulation resistance readings.

4.2 Status and performance of the internal test circuits.

4.3 Values of simulated input and derived output signals for correlation purposes.

5.0 ACCEPTANCE CRITERIA

5.1 The incore instrumentation is arranged as shown on the plant layout drawings. Reference Figure 4.4-8 for additional information.

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5.2 The self-powered neutron detectors generate neutron flux measurement signals as input to the protection system using simulated signals.

5.3 The core outlet thermocouples generate core outlet temperature measurement signals as input to the safety automation system using simulated signals.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The incore instrumentation cables and instrumentation function as described in Section 7.1.1.5.2.

14.2.12.11.19 Excore Instrumentation System (Test #142)

1.0 OBJECTIVE

1.1 To verify the proper functional performance of the safety-related excore instrumentation system.

1.2 To verify the proper performance of audio and visual indicators.

1.3 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the excore instrumentation system have been completed.

2.2 Excore instrumentation system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for operation of the excore instrumentation system are functional.

2.5 Verify that factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate and vary input signals to the startup, safety, and control channels of the excore instrumentation system using appropriate test instrumentation.

3.2 Monitor and record output signals as a function of variable inputs provided by test instrumentation.

3.3 Record the performance of audio and visual indicators in response to changing input signals.

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3.4 Verify that the excore instrumentation system operates over the design range using actual or simulated signals.

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3.5 Verify that the excore system responds as designed to actual or simulated limiting malfunctions or failures.

3.6 Verify that the excore system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.7 Verify redundancy and electrical independence of the excore design.

3.8 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

4.0 DATA REQUIRED

4.1 Values of input and output signals for correlation purposes, as required.

4.2 Values of output signals triggering audio and visual alarms.

5.0 ACCEPTANCE CRITERIA

5.1 The excore instrumentation is arranged as illustrated on the plant layout drawings. Reference Figure 7.1-15 for additional information.

5.2 The intermediate range and power range detectors generate neutron flux measurement signals as inputs to the protection system using simulated signals.

5.3 The excore instrumentation receives power from its respective Class 1E division.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The excore instrumentation system functions as described in Section 7.1.1.5.3.

14.2.12.11.20 Radiation Monitoring System (Test #143)

1.0 OBJECTIVE

1.1 To verify the functional performance of the airborne radiation monitoring system.

1.2 To verify the functional performance of the area radiation monitoring system.

2.0 PREREQUISITES

2.1 Construction activities on the safety-related radiation monitoring system have been completed.

2.2 Radiation monitoring system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the radiation monitoring system are completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check source is available, as required.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

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3.0 TEST METHOD

3.1 Verify the operation of the radiation monitor using a check source and external test equipment, as applicable.

3.2 Check the self-testing feature of the radiation monitor, as applicable.

3.3 Compare local and remote indications.

3.4 Verify as--designed local and remote alarm actuations, as applicable.

3.5 Simulate automatic initiation signals and record control actuations.

3.6 Verify that the radiation monitoring system operates over the design range using actual or simulated signals.

3.7 Verify that the radiation monitoring system responds as designed to actual or simulated limiting malfunctions or failures.

3.8 Verify that the radiation monitoring system response meets the accident analysis assumptions, such as time response, accuracy, and control stability.

3.9 Verify redundancy and electrical independence of the radiation monitoring system design.

4.0 DATA REQUIRED

4.1 Radiation monitor response to a check source, as applicable.

4.2 Technical data associated with the source.

4.3 Local and remote responses to test signals, as applicable.

4.4 Signals levels necessary to cause alarm actuation.

5.0 ACCEPTANCE CRITERIA

5.1 The radiation monitoring system generates a Main Control Room air intake activity measurement signal as input to the protection system

5.2 The airborne and area radiation monitors function as described in Section 7.1.1.5.5~~Sections 7.1.1~~, 7.3.1, 7.5.1, and 12.3.4.

14.2.12.11.21 Process and Effluent Radiological Monitoring System (Test #144)

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1.0 OBJECTIVE

1.1 To verify that the process and effluent radiological monitoring system can detect and record specific radiation levels, and to verify alarms and interlocks.

2.0 PREREQUISITES

2.1 Construction activities on the process and effluent radiological monitoring system have been completed.

2.2 Process and effluent radiological monitoring system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of the process and effluent radiological monitoring system is completed and functional.

2.4 Test instrumentation is available and calibrated.

2.5 Calibration check source is available, as necessary.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control, and indication functions.

3.0 TEST METHOD

3.1 Verify calibration and operation of the monitor using a check source and external test equipment, as necessary.

3.2 Check the self-testing feature of the monitor.

3.3 Record the response time ~~and control actuation signals produced by~~of the monitor.

3.4 Simulate a high radiation signal to the appropriate radiation monitors to verify as designed control actuations.

3.5 ~~Verify as designed alarm actuation in the MCR.~~

3.6 ~~Simulate a high radiation signal to the radiation monitors.~~

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3.5 Record alarm actuations ~~in the MCR or local control room~~at local and remote locations, as appropriate.

4.0 DATA REQUIRED

4.1 The monitor response to check source, as necessary.

4.2 Technical data associated with the source.

4.3 Signal levels necessary to cause alarm actuation.

4.4 Response time of the monitor ~~to perform control functions~~.

5.0 ACCEPTANCE CRITERIA

5.1 Verify that the process and effluent radiological monitoring system operates as follows:

5.1.1 Radiation monitors are installed on ~~all~~ effluent paths as shown on plant layout drawings.

5.1.2 The radiation monitors have been source checked to verify response.

5.1.3 Preliminary alarm setpoints have been established and calibrated in the equipment.

5.1.4 Upon activating the alarm setpoint, automatic actions (valve closure, pumps stopping, etc.) occur as designed.

5.1.5 Radiation monitors function as described in Section 11.5.1.

14.2.12.11.22 Hydrogen Monitoring System (Test #145)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the safety-related hydrogen monitoring system (HMS).

1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the hydrogen monitoring system have been completed.

2.2 Hydrogen monitoring instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Electrical power systems required for the hydrogen monitoring system are available.

2.0 PREREQUISITES

2.1 Construction activities on the ~~trip circuit breaker~~reactor trip breakers, reactor trip contactors, and PS have been completed.

2.2 PS system instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test instrumentation is available and calibrated.

2.4 ~~Verify that f~~Factory acceptance testing has been completed.

2.5 Support systems required for PS operation are functional and the plant is configured so that equipment damage or personnel injury will not occur. For example, pump breakers racked to test to prevent inadvertent pump start, or pump motors uncoupled.:

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2.5.1 Reactor trip breakers.

2.5.2 Reactor trip contactors.

~~2.5.3 Transistors of CRDM operating coils.~~

~~2.5.4 Safety injection system (SIS) components are energized and positioned in a manner to respond to an actuation.~~

~~2.5.5 Emergency feedwater system (EFWS) components are energized and positioned in a manner to respond to an actuation.~~

2.5.3 Manual reactor trip (RT) ~~signals from~~controls on SICS.

2.5.4 Engineered Safety Features systems components are energized and positioned in a manner to respond to a PS actuation.

3.0 TEST METHOD

3.1 Energize power supplies and verify power supply output voltage.

~~3.2 Simulate ground faults and observe operation of the ground fault detectors.~~

~~3.3 Activate manual trips and monitor PS response.~~

3.2 Simulate combinations of the ~~two-out-of-four~~actuation voting trip logic for each of the actuation signals and observe actuation and associated alarms.

3.3 Simulate PS inputs that would generate a reactor trip signal and trip each reactor trip breaker. Observe reactor trip breaker operation.

3.4 Simulate PS inputs that would generate a reactor trip signal and trip each reactor trip contactor. Observe reactor trip contactor operation.

3.5 ~~Exercise the bi-stable comparators using internal and external test circuitry and observe the setpoints and operation of the appropriate logic. Simulate PS inputs that would generate a reactor trip signal and trip each CRDM operating coil transistor. Observe CRDM operating coil transistor discharge.~~

3.5 Simulate PS inputs that would generate a SIS actuation signal and observe SIS response.

3.6 Simulate PS inputs that would generate an EFWS actuation signal and observe EFWS response.

3.7 Initiate a manual reactor trip from SICS and observe the following:

3.7.1 Reactor trip breaker operation.

3.7.2 Reactor trip contactor operation.

3.7.3 CRDM operating coil transistor discharge.

3.8 Initiate each manual ESF actuation from SICS while observing ESF system response.

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3.9 Check the operation of bypass features including, where applicable, observation ~~of the setpoints at which the trip~~that operating bypasses are cancelled automatically.

3.10 Inject signals into appropriate sensors or sensor terminals and measure the elapsed time to achieve actuation of the field device (e.g., breaker, contactor). Trip or actuation paths may be tested in several segments.

3.11 Observe protection system operation over the design range using actual or simulated input signals.

3.12 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing from service (i.e., loss of power condition) ~~three of four~~ PS divisions and determining which functions are lost on the energized PS division and which overall PS functions are lost. Repeat test for all PS divisions.

4.0 DATA REQUIRED

4.1 Power supply voltages.

~~4.2 Resistance for ground fault detector operation.~~

4.2 Circuit breaker and indicator operational data.

4.3 PS functional logic diagrams.

4.4 ~~Point of actuation of bi-stable comparators~~PS activation values.

4.5 Reset margin and rate of setpoint change of variable setpoints.

4.6 Maximum and minimum values of variable setpoints.

4.7 PS ~~and trip and actuation path~~ response times described in the safety analyses.

4.8 ~~Local coincidence logic operation~~ESF system actuator operational data.

4.9 ~~List of functional components when only one PS division is available.~~

5.0 ACCEPTANCE CRITERIA

~~5.1 Physical separation exists between the four divisions of the protection system (PS).~~

5.1 The PS generates automatic RT signals.

5.2 The PS generates automatically actuated engineered safety feature signals.

5.3 The PS provides the correct operating bypasses for reactor trip functions.

5.4 The PS provides the correct operating bypasses for the engineered safety features.

5.5 ~~Communication independence is provided in the inter-division communication paths within the PS~~Operating bypasses are automatically removed when required.

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5.6 ~~Bypassed or inoperable PS channels status information is retrievable in the MCR~~Manual actuation of reactor trip and engineering safety features occurs when initiated.

~~5.7~~ ~~Setpoints associated with the automatic reactor trips and engineered safety features are determined using a methodology that addresses the determination of applicable contributors to instrumentation loop errors, the method in which the errors are combined, and how the errors are applied to the design analytical limits.~~

~~5.8~~ ~~The PS receives input signals as described in the equipment specification.~~

5.7 The PS provides ~~signals~~status information to the non-safety-related control systems ~~through electrical isolation devices~~.

~~5.8~~ ~~Electrical isolation devices exist in the data communication paths between the PS and the non-safety-related displays and controls.~~

~~5.9~~ ~~Controls exist in the MCR to allow manual actuation of reactor trip and engineered safety features.~~

~~5.10~~ ~~Controls exist in the MCR and RSS to allow validation or inhibition of manual permissives.~~

~~5.11~~ ~~The PS provides interlocks as described in the equipment specification.~~

5.8 The total response time of each PS trip or actuation path is verified to be conservative with respect to the times used in the safety analysis.

5.9 ~~Verify that safety-related components meet e~~Electrical independence and redundancy requirements are met.

5.10 The PS functions as described in Section 7.1.1.4.1.

14.2.12.11.24 Reactor Control, Surveillance and~~&~~ Limitation System (Test #147)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the non-safety-related reactor control, surveillance and limitation system (RCSL).

1.2 To demonstrate electrical independence and redundancy of power supplies.

2.0 PREREQUISITES

2.1 Construction activities on the RCSL have been completed.

2.2 RCSL software is installed and instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for operation of the RCSL are functional.

2.5 Cabling has been completed between the RCSL and interface equipment.

2.6 Verify that factory acceptance testing has been completed.

2.7 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate inputs to the RCSL; observe receipt of these signals at the RCSL and system response.

3.2 Verify that the RCSL operates over the design range using actual or simulated signals.

3.3 Verify that the RCSL responds as designed to actual or simulated limiting malfunctions or failures.

3.4 Verify that the RCSL response meets design bases assumptions.

3.5 Verify redundancy and electrical independence of the non-safety RCSL design.

4.0 DATA REQUIRED

14.02-72

4.1 Input signal values.

4.2 RCSL output ~~response~~.

5.0 ACCEPTANCE CRITERIA

5.1 Verify that preliminary control setpoints have been established for the following:

5.1.1 RCCA withdrawal limits.

5.1.2 Full power target axial offset (AO).

5.1.3 Positive and negative AO bands about the target AO.

5.1.4 Power ramp rate limits.

5.1.5 Limits with respect to approaching heat flux control limits.

5.2 The RCSL responds as designed to simulated inputs (AO, SPNDs, reactor power, etc.).

5.3 Verify that safety-related components meet electrical independence and redundancy requirements.

5.4 The MSRT functions as described in Sections 7.3 and 10.3.

14.2.12.12.3 Steam Generator Level Control System (Test #149)

Note: The steam generator level control is performed by the PAS and is separated from other PAS functions in this test ~~for clarity~~to describe a function that should be verified during HFT.

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the SG level control system.

~~1.2 To demonstrate electrical independence and redundancy of safety-related power supplies.~~

2.0 PREREQUISITES

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2.1 Construction activities on the SG level control system and interfacing equipment have been completed.

2.2 The SG level control system instrumentation has been calibrated and is functional for performance of the following test.

2.3 External test equipment has been calibrated and is functional.

2.4 Support systems required for the operation of the SG level control system are functional.

~~2.5 Verify that factory acceptance testing has been completed.~~

2.5 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

3.1 Simulate inputs to the SG level control system and observe receipt of these signals at the non-safety control system.

3.2 Simulate varying input signals to the SG level control system and observe output responses at the non-safety control system.

3.3 Monitor the system during initial operation and verify as-designed operation, including control stability.

3.4 Verify that the steam generator level controls respond as designed to ~~actual or~~ simulated ~~limiting malfunctions or failures~~steam generator level transmitter failures.

~~3.5 Verify the redundancy and electrical independence of the I&C design.~~

3.5 Verify that the steam generator level control function operates over the design range using actual or simulated signals.

~~3.6~~ ~~Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.~~

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 The SG level control system response.

5.0 ACCEPTANCE CRITERIA

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5.1 The steam generator level control setpoints have been installed in the PAS computer.

5.2 The steam generator controls respond as designed to simulated high and low signals by opening and closing the feedwater regulating valves.

5.3 The steam generator level controls start the startup and shutdown feedwater pump and EFW pumps, as designed.

5.4 Verify that safety-related components meet electrical independence and redundancy requirements.

5.5 The steam generator level control system functions as described in Sections 7.7.2 and 10.4.7.

14.2.12.12.4 ~~Reactor~~ Partial Trip (Test #150)

Note: The partial trip function is performed by the RCSL system and is separated from other RCSL functions in this test for clarity.

1.0 OBJECTIVE

1.1 To demonstrate proper operation of the ~~reactor~~ partial trip ~~(RPT~~function.

~~1.2~~ ~~To demonstrate electrical independence and redundancy of safety-related power supplies.~~

2.0 PREREQUISITES

2.1 ~~Construction activities on the RPT have been completed~~The partial trip RCCAs have been installed in actual or dummy assembles and are available to be tripped.

~~2.2~~ ~~RPT instrumentation has been calibrated and is functional for performance of the following test.~~

~~2.3~~ ~~External test equipment has been checked and calibrated.~~

2.2 Support systems required for the operation of the ~~RPT~~partial trip are functional.

2.3 Verify that factory acceptance testing has been completed.

2.4 Verify proper operation of alarm, control and indication functions.

2.5 The reactor trip breakers and associate support systems required to position the partial trip RCCAs are functional.

2.6 Partial trip setpoints have been installed in the RCSL software.

3.0 TEST METHOD

3.1 Simulate signals to plant control system that are equivalent to hot full power.

3.2 Simulate loss of single RCP input to the ~~RPT~~partial trip; observe response.

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3.3 Simulate loss of feedwater pump without startup of standby feedwater pump input to the ~~RPT~~partial trip; observe response.

3.4 ~~Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function~~Observe response of turbine controls to partial trip signal.

4.0 DATA REQUIRED

4.1 Input signal values.

4.2 ~~RPCS output response~~Response time from injection of signal to partial trip RCCAs on bottom.

5.0 ACCEPTANCE CRITERIA

~~5.1~~ ~~The reactor partial trip setpoints have been properly configured in the RCSL software.~~

5.1 The ~~reactor~~ partial trip function sends the signal to drop the designated RCCAs upon receiving the appropriate simulated signal.

5.2 The ~~reactor~~ partial trip function sends the signal to runback the turbine load upon receiving the appropriate simulated signal.

~~5.3~~ ~~Verify that safety-related components meet electrical independence and redundancy requirements.~~

5.3 The ~~reactor~~ partial trip functions as described in ~~Sections 7.1.1 and 7.7.2~~Section 7.7.2.3.1.

14.2.12.12.5 Primary Depressurization System (Test #151)

1.0 OBJECTIVE

1.1 To verify the flow paths of the primary depressurization system.

1.2 To verify that pressurizer safety valves and associated piping perform as designed.

3.0 TEST METHOD

3.1 Verify the performance of the MSRT by simulating a safety injection signal and verifying that the MSRT setpoint is reduced.

3.2 Verify power-operated valves fail upon loss of motive power as designed.

3.3 Check electrical independence and redundancy of power supplies for safety-related functions by selectively removing power and determining loss of function.

3.4 Verify that the MSRCV positions to 40 percent open based on a thermal power level of 0 percent.

4.0 DATA REQUIRED

4.1 Valve position indication as a function of time.

4.2 RCS temperature and pressure as a function of time.

4.3 RCS depressurization rate as a function of time.

4.4 SG pressure and level as a function of time.

4.5 Position response of MSRT valves to loss of motive power.

5.0 ACCEPTANCE CRITERIA

5.1 The main steam system provides a depressurization path through the MSRT valves and associated silencers to atmosphere, as designed (refer to Section 10.3.2.2).

5.2 The MSRT setpoint is reduced upon receipt of a safety injection signal, as designed (refer to Sections 6.3.3.1, 10.3.2.2, and 16 B3.3.1).

5.3 Verify that safety-related components meet electrical power supply independence and redundancy requirements, as designed (refer to Section 8.1.4.2).

5.4 The MSRCV positions to 40 percent based on a thermal power of 0 percent, as designed (refer to Section 10.3.2.2).

5.5 The MSRIV positions as required to control the rate of steam pressure reduction with minimal overshoot.

5.6 Verify the response of the partial cooldown function to a SIS signal.

5.6.1 Table 14.3-1 Item 1-44.

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14.2.12.12.7 Reserved (Test #153)

14.2.12.12.8 Remote Safe Shutdown (Test #154)

1.0 OBJECTIVE

1.1 To demonstrate the proper operation of the remote safe shutdown function.

2.0 PREREQUISITES

2.1 The instrumentation used during safe shutdown has been calibrated and is operating satisfactorily prior to performing the following test.

2.2 External test instrumentation is available and calibrated.

2.3 Support systems required for testing safe shutdown are functional.

3.0 TEST METHOD

3.1 Verify that safe shutdown control signals override lower priority signals.

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3.2 ~~Activate manual trips and monitor operation~~Verify functionality of hard-wired functions at the RSS.

3.2.1 RSS transfer switches are repositioned to allow RSS control.

3.2.2 Manual reactor trip is available at the RSS.

3.3 Simulate safe shutdown scenarios and observe actuation of the appropriate trip circuit and associated alarms.

3.4 Exercise the control functions to the safety depressurization and shutdown cooling system to verify as designed operations.

~~3.5 Activate manual trips and observe relay operation.~~

4.0 DATA REQUIRED

4.1 Power supply voltages.

4.2 Circuit breaker and indicator operation.

4.3 Safety parameter trends during testing.

4.4 Reactor trip and actuation path response.

5.0 ACCEPTANCE CRITERIA

5.1 The plant remote safe shutdown function has been verified to be capable of controlling critical plant functions when activated.

5.2 The plant safe shutdown function overrides all other commands and controls.

5.3 The ability to reach a safe shutdown using systems described in Section 7.4 has been verified.

14.2.12.12.9 Post-Accident Monitoring Instrumentation (Test #155)

1.0 OBJECTIVE

1.1 To verify that the post accident monitor instrumentation (PAM) is installed properly, responds correctly to external inputs and provides proper outputs to the distributed display and recording equipment.

2.0 PREREQUISITES

2.1 Construction activities on the PPC and PLC have been completed.

2.2 PPC and PLC software is installed; local instrumentation has been calibrated and is operating satisfactorily prior to performing the following test.

2.3 Support systems required for operation of components in the PPC and PLC are functional.

2.4 The RCS including the pressurizer is filled sufficiently to cover the pressurizer heaters.

2.5 Verify that the PAS factory acceptance testing has been completed.

2.6 Verify proper operation of alarm, control and indication functions.

3.0 TEST METHOD

14.02-72

3.1 Operate ~~backup~~ heater breakers from ~~the MCR~~PICS. Observe breaker operation and indicating light response.

3.2 Simulate a decreasing pressurizer pressure and verify as designed outputs to the heater control circuits. Verify alarm ~~setpoints~~values.

3.3 Simulate an increasing pressurizer pressure and verify as designed outputs to the heater and spray valves control valve circuits. Verify alarm ~~setpoints~~values.

3.4 Simulate a low level error in the pressurizer and verify as designed outputs to the CVCS letdown control valve circuit. Verify alarm ~~setpoints~~values.

3.5 Simulate a high level error in the pressurizer and verify as designed outputs to the pressurizer backup heater and the CVCS letdown control valve circuits. Verify alarm ~~setpoints~~values.

3.6 Simulate signals to pressurizer pressure and level controllers and verify as designed outputs.

3.7 Simulate a low-low pressurizer level and verify as-designed outputs.

3.8 Simulate a low pressurizer level and verify as designed output signals to the CVCS letdown control valve circuits.

4.0 DATA REQUIRED

4.1 Pressurizer level, pressure signals, and outputs to pressurizer heaters control circuits.

4.2 Pressurizer pressure signals and outputs to spray valve control circuits.

4.3 Pressurizer level signals and outputs to CVCS letdown control valve circuits.

4.4 Pressurizer level to letdown valve control circuits.

4.5 Setpoints at which alarm, indications, and interlocks occur.

5.0 ACCEPTANCE CRITERIA

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5.1 The pressurizer level and pressure control setpoints have been configured in the PAS software.

5.2 The pressurizer level controls respond as designed to simulated high and low signals by repositioning the letdown regulating valves.

5.3 The pressurizer ~~level~~pressure controls ~~actuate protective actions~~respond as designed to simulated low and high pressurizer ~~levels~~pressure.

5.4 The pressurizer pressure and level control systems function as described in Section 5.4.10.

14.2.12.13 Hot Functional Tests

14.2.12.13.1 Hot Functional Sequencing Document (Test #161)

1.0 OBJECTIVE

1.1 To demonstrate the proper integrated operation of plant systems when in simulated or actual operating configurations.

1.2 To demonstration that RCS temperature and pressure can be lowered to permit operation of the RHRS, and the RHRS can be used to achieve cold shutdown.

1.3 The residual heat removal (RHR) cooldown rate shall not exceed Technical Specification limits.

1.4 Demonstrations of the operation of the steam bypass valves.

1.5 To verify electrical distribution system voltages per BTP 8-6.

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are completed.

2.2 Permanently installed instrumentation on systems to be tested has been calibrated and is functional.

2.3 Necessary test instrumentation is available and calibrated.

2.4 Hydrostatic testing of the primary and secondary systems has been completed.

2.5 SGs are in wet lay-up in accordance with the secondary water chemistry program.

2.6 Reactor internals, as appropriate for pre-core HFT, have been installed.

2.7 Full flow debris filters, dummy fuel assemblies, or equivalents have been installed in the internals to simulate the flow resistance of the fuel assemblies.

3.0 TEST METHOD

3.1 Specify plant conditions and coordinate the execution of the related pre-core HFT test abstracts.

4.0 DATA REQUIRED

4.1 As specified by the individual pre-core HFT appendices.

5.0 ACCEPTANCE CRITERIA

5.1 Integrated operation of the RCS, secondary, and related auxiliary systems perform in accordance with design criteria.

5.2 RCS temperature and pressure can be lowered in a controlled manner to permit operation of the RHRS.

5.3 The RHRS is used to achieve cold shutdown at a cooldown rate not in excess of Technical Specification limits.

5.4 The turbine bypass valves can be operated to control RCS temperature.

5.5 The RCPs can be secured one at a time at HZP conditions and the standstill seal can be verified to limit RCS leakage within design limits.

5.6 As specified by the individual pre-core HFT procedures.

14.2.12.13.2 Pre–Core Instrument Correlation (Test #162)

1.0 OBJECTIVE

1.1 To demonstrate that the inputs and appropriate outputs between the following safety-related digital systems are in agreement:

1.1.1 Plant P~~p~~rotection system.

1.1.2 Process instrumentation.

1.1.3 Discrete indication and alarm system.

1.1.4 DPS.

1.2 To verify ~~NR~~safety-related temperature and pressure instrumentation accuracy and operation by comparing similar channels of instrumentation.

2.0 PREREQUISITES

14.02-72

2.1 Instrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Record ~~wide range process~~safety-related wide range instrumentation readings as directed by the pre-core HFT.

3.2 Record ~~NR process~~safety-related narrow range instrumentation readings as directed by the pre-core HFT.

4.0 DATA REQUIRED

4.1 ~~MCR panel instrument reading~~PICS and SICS readings.

4.2 DAS readings.

4.3 DPS readings.

5.0 ACCEPTANCE CRITERIA

5.1 ~~NR~~Safety-related instrument readings shall agree within the accuracy of the instrumentation as designed (refer to Sections 7.1.2 and 7.5.1).

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5.2 Wide range instrument readings shall agree within the accuracy of the instrumentation as designed (refer to Sections 7.1.2 and 7.5.1).

14.2.12.13.3 Pre-Core Test Data Record (Test #163)

1.0 OBJECTIVE

1.1 To monitor non-safety-related instrumentation during integrated plant operation.

1.2 To verify, by cross checking channels, the satisfactory tracking of process instrumentation.

1.3 To provide a permanent record of plant pre-core loading parameter indication.

2.0 PREREQUISITES

2.1 Non-safety-related i~~I~~nstrumentation has been calibrated and is functional.

3.0 TEST METHOD

3.1 Record ~~MCR~~non-safety-related instrumentation steady-state readings as directed by the pre-core HFT controlling document.

4.0 DATA REQUIRED

4.1 Plant conditions at the time instrument readings are recorded.

4.2 Instrument readings.

5.0 ACCEPTANCE CRITERIA

5.1 ~~Similar~~Non-safety-related instrumentation readings shall agree within the accuracy limits of the instrumentation as designed (refer to Section 7.1.2).

4.1.5 Fail downscale.

4.1.6 Fail to perform other required functions.

5.0 ACCEPTANCE CRITERIA

5.1 Valves fail to their designated fail position upon loss of air and remain in the design position upon restoration.

5.2 Verify that the air-operated or air-powered loads that are a part of (or support the operation of) portions of the facility respond as designed to a loss of air pressure.

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5.3 The instrument air system meets the design requirements described in Section 9.3.1.

14.2.12.13.19 Pre-Core Electrical Distribution System Voltage Verification (Test #226)

1.0 OBJECTIVE

1.1 To demonstrate the analytical techniques and assumptions used in the electrical transient analyzer program (ETAP) model for distribution system voltage analyses are valid.

2.0 PREREQUISITES

2.1 ETAP analyses completed in accordance with BTP 8-6.

2.2 The station distribution buses, including Class 1E buses down to the 120/208 V level, are loaded to at least 30 percent.

3.0 TEST METHOD

3.1 Record the existing grid and Class 1E bus voltages and bus loading down to the 120/208 V level at steady-state conditions and during the start of both a large Class 1E and non-Class 1E motor (not concurrently). The location of the voltage readings is to be determined in accordance with guidance provided in BTP 8-6.

4.0 DATA REQUIRED

4.1 Class 1E bus voltage readings in accordance with BTP 8-6.

5.0 ACCEPTANCE CRITERIA

5.1 Measured bus voltages are not more than 3 percent lower than the analytical results.

5.2 The difference between the measured values and the analytical results, when subtracted from the original analyses, are not less than the Class 1E equipment-rated voltages.

2.0 PREREQUISITES

2.1 The plant is operating at the desired power level with equilibrium xenon conditions.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

3.1 Monitor the trend data for parameters listed in the previous step. Determine if parameters are within design tolerances.

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3.2 Collect data from transmitters in the field and compare the local parameters with indications ~~in the MCR~~displayed on PICS and SICS. The intent is not to verify each transmitter, but rather sample various types and applications.

3.3 Verify that plant indications meet design predictions or that discrepancies are investigated and dispositioned.

4.0 DATA REQUIRED

4.1 Time stamped data with a short scan rate:

4.1.1 Power measurements (e.g., including thermal power, AO, DNB, LPD).

4.1.2 Boron concentration.

4.1.3 RCS parameters (e.g., temperature, flow).

4.1.4 Pressurizer pressure and level.

4.1.5 SG pressures and levels.

4.1.6 RCP speeds and differential pressures.

4.1.7 Turbine-generator output.

4.1.8 Secondary performance data.

5.0 ACCEPTANCE CRITERIA

5.1 The measured plant parameters are within established tolerances of the design model.

5.2 If the measured parameter is outside of the established tolerances a condition report has been generated to investigate the difference. Reactor power will not be increased until the issue has been evaluated and plant management concurs that power may be increased.

1.2.3 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level.

2.2 The following systems are in automatic operation:

2.2.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.2.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.2.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.2.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

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3.1 Secure one train of feedwater heaters ~~(Reheater Stage 2 Drain Cooler, High Pressure Feedwater #7, and High Pressure Feedwater #6)~~ by bypassing the feedwater heaters.

3.2 Verify that loss of feedwater heating design limits are met.

4.0 DATA REQUIRED

4.1 Secondary temperature, pressure, and flow data.

4.2 Primary flow, temperature, pressurizer, and reactor power data.

5.0 ACCEPTANCE CRITERIA

5.1 The feedwater temperature remains above the temperature in ~~Section 10.4.7, Table 10.1-1, and~~ Table 15.0-5 (Note 2~~1~~).

14.2.12.20 Power Ascension Plateau, 75 Percent Power Ascension Plateau

Some of the following tests are performed in more than one plateau. In those instances the test is listed in the first plateau that it is recommended to be performed.

14.2.12.20.1 Liquid Waste Storage and Processing Systems (Test #215)

1.0 OBJECTIVE

1.1 To demonstrate that the operation of the liquid waste storage and processing systems (LWSPS) for collection, processing, recycling, and preparation of liquid waste for release to the environment is satisfactory.

1.2 To determine the ability of plant systems to process radioactive effluents. This procedure shall be performed at the following plateaus:

1.2.1 75 percent reactor power in accordance with RG 1.68.

1.2.2 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The liquid waste processing equipment is functional.

3.0 TEST METHOD

3.1 Monitor the performance of the LWSPS.

3.2 Verify isotopic concentrations in the liquid stream.

3.3 Verify that the LWSPS is capable of collecting and processing liquid waste per design.

4.0 DATA REQUIRED

4.1 Conditions of Measurement.

4.1.1 Reactor power history and RCS radioactivity level.

4.1.2 Liquid waste processing system tank levels.

4.1.3 Liquid waste processing system demineralizer data.

4.1.4 Liquid waste processing system evaporator data.

4.1.5 Liquid waste processing system centrifuge data.

5.0 ACCEPTANCE CRITERIA

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5.1 The LWSPS processes radioactive effluents as designed (refer to Section 11.2).

14.2.12.20.2 Gaseous Waste Processing System (Test #216)

1.0 OBJECTIVE

1.1 To demonstrate that the operation of the gaseous waste processing system (GWPS) for collection and processing of radioactive ~~gases~~and potentially flammable gases vented from plant equipment is ~~performing satisfactorily~~.

1.2 To determine the ability of plant systems to process radioactive effluents. This procedure shall be performed at the following plateaus:

1.2.1 75 percent reactor power in accordance with RG 1.68.

1.2.2 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The gaseous waste processing equipment is functional.

3.0 TEST METHOD

3.1 Verify that the gaseous waste processing simultaneously collects and processes gaseous waste per design.

4.0 DATA REQUIRED

4.1 Conditions of Measurement:

4.1.1 Reactor power history and RCS radioactivity level.

4.1.2 Containment temperature and humidity.

4.1.3 Condenser operating data.

4.1.4 Effluent control monitor operating data.

4.1.5 Gas analyzer operating data.

4.1.6 Gas transport times.

4.1.7 Recombiner operating data

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5.0 ACCEPTANCE CRITERIA

5.1 The GWPS processes radioactive and potentially flammable gases effluent as designed (refer to Section 11.3).

14.2.12.20.3 Loss of Feedwater Pump (Test #217)

1.0 OBJECTIVE

1.1 To evaluate system response to a loss of one of three operating feedwater pumps.

1.2 To demonstrate system effectiveness of instrumentation in detecting a dropped rod and verification of automatic actions in accordance with RG 1.68.

1.3 To demonstrate that rapid load changes can be accomplished in a manner that maintains plant safety.

1.4 This procedure shall be performed at the following plateau:

1.4.1 75 percent reactor power.

2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level.

2.2 Establish a band of operation in which there are no restrictions on the rate of load increase or decrease based on AREVA Fuel Preconditioning Guidelines.

2.3 The following systems are in automatic operation:

2.3.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.3.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.3.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.3.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

14.2.12.21.2 Trip of Generator Main Breaker (Test #219)

1.0 OBJECTIVE

1.1 To demonstrate that the plant responds and is controlled as designed following a full-power turbine trip.

1.2 This procedure shall be performed at the following plateau:

1.2.1 ≥98 percent reactor power in accordance with RG 1.68.

2.0 PREREQUISITES

2.1 The following systems are in automatic operation:

2.1.1 Primary and secondary level controls (e.g., pressurizer, feedwater heaters, VCT, deaerator, SG).

2.1.2 Primary and secondary pressure controls (e.g., pressurizer, VCT, condensate).

2.1.3 Primary and secondary flow controls (e.g., CVCS letdown, feedwater).

2.1.4 Primary and secondary temperature controls (e.g., RCS T_{avg}).

3.0 TEST METHOD

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3.1 The turbine is tripped from t~~he MCR~~PICS simultaneous with trip of each RCP.

3.2 Verify that RCPs cease to operate.

3.3 The plant behavior is monitored to establish that the control systems maintain the NSSS within operating limits.

3.4 Verify that the following feedwater systems are capable of removing decay heat, residual heat from the metal mass, and RCP heat following shutdown:

3.4.1 Startup and shutdown feedwater.

3.4.2 Emergency feedwater.

3.5 After verifying that the startup and shutdown feedwater system is capable of controlling the plant cooldown, secure the startup and shutdown feedwater pump and verify that the emergency feedwater pump can control the cooldown.

3.6 The plant responds as designed to a reactor trip generated by opening of the main breaker.

4.0 DATA REQUIRED

4.1 Plant condition prior to trip.

4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:

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Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
001	Fuel Pool Cooling and Purification System	FSAR	Appendix A, 1.m.(1)		
002	CVCS Volume Control Tank	FSAR	Appendix A,1.b.(2)		
003	CVCS Charging and Seal Injection	FSAR	Appendix A,1.b.(2)		
004	CVCS Letdown	FSAR	Appendix A,1.b.(2)		
005	CVCS Chemical Addition	FSAR	Appendix A,1.b.(2)		
006	Coolant Supply and Storage System	FSAR	Appendix A,1.b.(2)		
007	Reactor Boron and Water Makeup System	FSAR	Appendix A,1.b.(2)		
008	Boric Acid Mixing Tank	FSAR	Appendix A,1.b.(2)		
009	Boric Acid Storage Tank	FSAR	Appendix A,1.b.(2)		
010	Coolant Degasification System	FSAR	Appendix A, 1.n.(10)		
011	Coolant Purification System	FSAR	Appendix A, 1.n.(10)		
012	Reactor Coolant System	FSAR	Appendix A, 1.a.(2)	RG 1.20	
013	Combustible Gas Control System	FSAR	Appendix A,1.h.(4)		
014	Medium Head Safety Injection System	FSAR	Appendix A, 1.h.(1) & 5.k	RG 1.79	
015	Safety Injection Accumulator System	FSAR	Appendix A, 1.h.(1)	RG 1.79	
016	Residual Heat Removal System	FSAR	Appendix A, 1.d.(5) & 5.k	RG 1.79, ~~RG 1.139~~	
017	Mid-loop Operations Verification	FSAR	Appendix A, 1.d.(5)	~~RG 1.139~~	
018	Severe Accident Heat Removal System	FSAR	Appendix A, 1.d.(5)		

Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
037	Pressurizer Safety Relief Valves	FSAR	Appendix A, 1.a.(2)(d)		
038	Fuel Handling System	FSAR	Appendix A, 1.m.(2)		
039	Fuel Transfer System Operation and Leak Test	FSAR	Appendix A, 1.m.(3) & (5)	14.02-72	
040	Containment Polar Crane	FSAR	Appendix A, 1.o.(1), (2), & (3)	NUREG-0554 NUREG-0612 ASME NOG-1	
041	Fuel Building Cranes	FSAR	Appendix A, 1.m.(2)	NURGE-0554 NUREG-0612 ASME-NOG1	
042	Turbine Building Crane	FSAR	Appendix A, 1.n		
043	Raw Water Supply System	COLA	Appendix A, 1.n		
044	Reserved				
045	Seal Water Supply System	FSAR	Appendix A, 1.n.(8)		
046	Component Cooling Water System	FSAR	Appendix A, 1.d.(11) & 1.n.(3)		
047	Reserved				
048	Essential Service Water System	FSAR	Appendix A, 1.d.(11) & 1.n.(1)		
049	Ultimate Heat Sink	FSAR	Appendix A, 1.d.(10) & 1.h.(10)		
050	Reserved				
051	Reserved				

Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
086	Switchgear Building Ventilation System	FSAR	Appendix A, 1.n.(14)		
087	Turbine Island Ventilation Systems	FSAR	Appendix A, 1.n.(14)		
088	Essential Service Water Pump Building Ventilation System	FSAR	Appendix A, 1.n.(14)		
089	Reserved				
090	Reserved				
091	Leak-off System	FSAR	Appendix A, 1.n		
092	Sampling Activity Monitoring System	FSAR	Appendix A, 1.k.(1)		
093	Solid Waste Storage System	FSAR	Appendix A, 1.l.(3)		
094	Radioactive Concentrates Processing System – Solid Waste	FSAR	Appendix A, 1.l.(3)		
095	Liquid Waste Processing System	FSAR	Appendix A, 1.l.(1)		
096	Reactor Coolant Drain Tank	FSAR	Appendix A, 1.l.(7)		
097	~~Equipment~~Process Drain Tank	FSAR	Appendix A, 1.l.(7)		
098	Equipment and Floor Drainage System	FSAR	Appendix A, 1.l.(7)		
099	Gaseous Waste Processing System	FSAR	Appendix A, 1.l.(2)		
100	Nuclear Sampling System	FSAR	Appendix A, 1.l.(8)		
101	Station Blackout Diesel Generator Set	FSAR	Appendix A, 1.g.(1)		
102	Station Blackout Diesel Generator Electrical	FSAR	Appendix A, 1.g.(1)		
103	Station Blackout Diesel Generator Auxiliaries	FSAR	Appendix A, 1.g.(1)		

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Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
104	Emergency Diesel Generator Set	FSAR	Appendix A, 1.g.(3)	RG 1.9	
105	Emergency Diesel Generator Electrical	FSAR	Appendix A, 1.g.(3)	RG 1.9	
106	Emergency Diesel Generator Auxiliaries	FSAR	Appendix A, 1.g.(3)	RG 1.9	
107	Auxiliary Steam Generating System	FSAR	Appendix A, 1.n.		
108	Switchyard and Preferred Power System	FSAR	Appendix A, 1.g.(1)		
109	~~Unit Main Power System~~Main Generator	FSAR	Appendix A, 1.g.(1)		
110	Class 1E Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(3)		
111	Non-Class 1E Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(1)		
112	Control Rod Drive Power System	FSAR	Appendix A, 1.g.(1)		
113	Normal Lighting System	FSAR	Appendix A, 1.g.(1)		
114	Reserved				
115	Emergency Lighting System	FSAR	Appendix A, 1.g.(1)		
116	6.9 Kv ~~Class 1E~~ Emergency Power ~~System~~Supply	FSAR	Appendix A, 1.g.(2)		
117	480 V ~~Class 1E~~ Emergency Power ~~System~~Supply	FSAR	Appendix A, 1.g.(2)		
118	13.8 Kv Normal Power ~~System~~Supply	FSAR	Appendix A, 1.g.(1)		
119	6.9 Kv Normal Power ~~System~~Supply	FSAR	Appendix A, 1.g.(1)		
120	480 V Normal Power ~~System~~Supply	FSAR	Appendix A, 1.g.(1)		
121	~~Class 1E DC Power System~~Reserved	FSAR	Appendix A, 1.g.(4)		

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Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test # 14.02-72	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
122	~~Non-class 1e DC Power System~~Reserved	FSAR	Appendix A, 1.g.(4)		
123	~~Severe Accident~~12-Hour Uninterruptible Power Supply	FSAR	Appendix A, 1.g.(1)		
124	~~Reserved~~Safety Information and Control System	FSAR	Appendix A, 1.c.		
125	Seismic Monitoring System	FSAR	Appendix A, 1.j.(10)		
126	Boron Concentration Measurement System	FSAR	Appendix A, 1.n.(6)		
127	Aeroball Measurement System	FSAR	Appendix A, 1.j.(11)		
128	Process Automation System	FSAR	Appendix A, 1.j.(8) & 5.gg		
129	Process Information and Control System	FSAR	Appendix A, 1.j.(8)		
130	Communication System	FSAR	Appendix A, 1.n.(13)		
131	Vibration Monitoring System	FSAR	Appendix A, 1.j.(2)		
132	Plant Fire Alarm System	FSAR	Appendix A, 1.n.(7)		
133	Loose Parts Monitoring System	FSAR	Appendix A, 1.j.(6)		
134	Turbine-generator Instrumentation and Control System	FSAR	Appendix A, 1.j.(8) & (15)		
135	Reactor Pressure Vessel Level Measurement System	FSAR	Appendix A, 1.j.(22) & 5.y		
136	Fatigue Monitoring System	FSAR	Appendix A, 1.j.(8)		
137	Leak Detection Systems	FSAR	Appendix A, 1.j.(20) & 5.o		
138	Accident Monitoring	FSAR	Appendix A, 1.j.(22)		
139	~~Reserved~~Safety Automation System	FSAR	Appendix A, 1.c.		

Table 14.2-1—List of Initial Tests for the U.S. EPR
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Test #	Test Name	FSAR or COLA Test	Applicable Section of RG 1.68, Revision 3	Other RG	ITAAC
140	Remote Shutdown Station	FSAR	Appendix A, 1.j.(19)	RG 1.68.2	
141	Incore Instrumentation System	FSAR	Appendix A, 1.j.(13)		
142	Excore Instrumentation System	FSAR	Appendix A, 1.j.(13)		
143	Radiation Monitoring System	FSAR	Appendix A, 1.k.(1)		
144	Process and Effluent Radiological Monitoring System	FSAR	Appendix A, 1.k.(1)		
145	Hydrogen Monitoring System	FSAR	Appendix A, 1.j.(23)		
146	Protection System	FSAR	Appendix A, 1.c.		
147	Reactor Control, Surveillance ~~&~~and Limitation System	FSAR	Appendix A, 1.j.(8)		
148	Main Steam Relief Trains	FSAR	Appendix A, 1.d.(3) & 1.e.(4)		
149	Steam Generator Level Control	FSAR	Appendix A, 1.j.(2)		
150	~~Reactor~~ Partial Trip	FSAR	Appendix A, 1.c.		
151	Primary Depressurization	FSAR	Appendix A, 1.a.(2)(d) & 1.h.(2)		
152	Partial Cooldown	FSAR	Appendix A, 1.a.(2)(d) & 1.h.(2)		
153	Reserved				
154	Remote Safe Shutdown	FSAR	Appendix A, 1.c		
155	Post-accident Monitoring Instrumentation	FSAR	Appendix A, 1.j.(22)		
156	Pressurizer Pressure and Level Control	FSAR	Appendix A, 1.j.(1)		
157	Reserved				

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