H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

OPERATOR TRAINING SIMULATOR

SIMULATOR CERTIFICATION

QUADRENNIAL REPORT

MARCH 1999

CAROLINA POWER & LIGHT COMPANY

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NRC FORM 474 **U.S. NUCLEAR REGULATORY COMMISSION**
(8-1998)

SIMULATION FACILITY CERTIFICATION

APPROVED BY OMB: NO. 3150-0138EXPIRES: 08/31/2001

Estimated burden per response to comply with this mandatory information collection request: 120 hours. This information is used to certify a simulation facility. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0138), Office of Management and Budget, Washington, DC 20503. If an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

INSTRUCTIONS: This form is to be filed for initial certification, recertification (if required), and for any change to a simulation facility performance testing plan made after initial submittal of such a plan. Provide the following information and check the appropriate box to indicate reason for submittal.

FACILITY	DOCKET NUMBER
Robinson Steam Electric Plant, Unit No. 2	50–261
LICENSEE	**DATE**
Carolina Power and Light Company	3/15/99

This is to certify that:

1. The above named facility licensee is using a simulation facility consisting solely of a plant-referenced simulator that meets the requirements of 10 CFR 55.45.
2. Documentation is available for NRC review in accordance with 10 CFR 55.45(b).
3. This simulation facility meets the guidance contained in ANSI/ANS 3.5-1985 or ANSI/ANS 3.5-1993, as endorsed by NRC Regulatory Guide 1.149.

   If there are any **EXCEPTIONS** to the certification of this item, **CHECK HERE [X]** and describe fully on additional pages as necessary.

NAME *(or other identification)* AND LOCATION OF SIMULATION FACILITY.

Robinson Simulator - H. B. Robinson Steam Electric Plant, Unit No. 2
3581 West Entrance Road
Hartsville, South Carolina 29550

[X] SIMULATION FACILITY PERFORMANCE TEST ABSTRACTS ATTACHED. *(For performance tests conducted in the period ending with the date of this certification.)*

DESCRIPTION OF PERFORMANCE TESTING COMPLETED. *(Attach additional pages as necessary and identify the item description being continued.)*

See Section 4.0, "Performance Tests," and Appendix B, " Description of Performance Tests Run (1995 - 1998)" and Appendix E, "Abstracts Of Performance Tests".

[X] SIMULATION FACILITY PERFORMANCE TESTING SCHEDULE ATTACHED. *(For the conduct of approximately 25 percent of performance tests per year for the four-year period commencing with the date of this certification.)*

DESCRIPTION OF PERFORMANCE TESTING TO BE CONDUCTED. *(Attach additional pages as necessary and identify the item description being continued.)*

See Section 4.0, "Performance Tests"; Appendix C, "Schedule of Annual Operability Tests (1999-2002)"; and Appendix D, "Schedule of Malfunction Tests (1999-2002)."

[X] PERFORMANCE TESTING PLAN CHANGE. *(For any modification to a performance testing plan submitted on a previous certification.)*

DESCRIPTION OF PERFORMANCE TESTING PLAN CHANGE *(Attach additional pages as necessary and identify the item description being continued.)*

A complete, revised test plan is attached. See Section 4.0, " Performance Tests"; Appendix C, "Schedule for Annual Operability Tests (1999-2002)"; and Appendix D, "Schedule of Malfunction Tests (1999-2002)".

[ ] RECERTIFICATION *(Describe corrective actions taken, attach results of completed performance testing in accordance with 10 CFR 55.45(b)(5)(v). (Attach additional pages as necessary and identify the item description being continued.)*

Any false statement or omission in this document, including attachments, may be subject to civil and criminal sanctions. I certify under penalty of perjury that the information in this document and attachments is true and correct.

SIGNATURE – AUTHORIZED REPRESENTATIVE	TITLE	DATE
R. L. Warden	Manager, Regulatory Affairs	3/19/99

In accordance with 10 CFR 55.5, Communications, this form shall be submitted to the NRC as follows:

BY MAIL ADDRESSED TO: **DIRECTOR, OFFICE OF NUCLEAR REACTOR REGULATION, U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001**

BY DELIVERY IN PERSON TO THE NRC OFFICE AT: **ONE WHITE FLINT NORTH, 11555 ROCKVILLE PIKE, ROCKVILLE, MD**

NRC FORM 474 (8-1998)

INTRODUCTION

General Information

The H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2 Simulator Certification Quadrennial Report is provided to demonstrate compliance with the requirements of 10CFR55.45(b) including compliance with ANSI/ANS-3.5-1985 as implemented by NRC Regulatory Guide 1.149 Rev 1. The subject simulation facility consists solely of a plant reference full-scope simulator, which is the primary vehicle for providing positive, practical license training and examination. The documentation contained herein is intended to constitute sufficient basis for retention of the certification of the HBRSEP, Unit No. 2 Simulator.

Simulator Configuration Control

A Simulator Review Group (SRG) is tasked with oversight of changes, potential enhancements, identified discrepancies, and proposed upgrades for implementation or resolution on the Simulator.

The SRG is comprised of the Simulator - Lead, Supervisor of License Operator Continuing Training, Lead Instructor for Operator Initial Training (OIT) and Operations Group representative. Other training and plant operations personnel may also participate in SRG meetings as a function of the topics to be addressed.

Plant modifications are reviewed by the Simulator - Lead. Those with clear impact to the scope of simulation, require no further review and are implemented. Those changes with questionable impact are presented to the SRG to determine if the changes need to be implemented. This SRG review ensures that differences between the plant and the simulator do not detract from training. The SRG also reviews outstanding deficiencies for impact on training to ensure high priority items are properly scheduled for resolution. The SRG provides guidance for scheduling discrepancy resolutions and modification implementations.

Exceptions to ANSI/ANS-3.5-1985 Standard

The exceptions taken are listed in Appendix A by ANSI-3.5 reference and subject, along with the justification for each exception.

1.0 SIMULATOR INFORMATION

1.1 Simulator General

1.1.1	Owner:	Carolina Power & Light Company
1.1.2	Reference Plant/Unit:	H. B. Robinson Steam Electric Plant, Unit No. 2, Westinghouse 3-Loop PWR
1.1.3	Simulator Supplier:	Westinghouse Electric Corporation with major upgrades by S3 Technologies (currently GSES)
1.1.4	Ready-for-Training Date:	Initial: June 26, 1987 Upgrade: February 3, 1995
1.1.5	Type of Report:	Quadrennial (4-Year) Report

1.2 Simulator Control Room

The Simulator Control Room is compared annually to the Reference Plant's Control Room via performance Test 6.7, Physical Fidelity Comparison Test. The Simulator Control Room arrangement is virtually the same as the Reference Plant Control Room. The Simulator panels are also virtually the same as the Reference Plant's.

Systems accessible from the reference plant control room are simulated. This includes communication systems that a control room operator would use to communicate with an auxiliary operator or other support activities to the extent that the simulator instructor, when performing these remote activities, is able to communicate over the appropriate communication system.

Some differences exist between the Simulator Control Room and the Reference Plant's Control Room, such as the wall separating the Simulator Control Room and the Instructors booth. However these differences are not major in nature and none of them impact training in a negative manner. These differences have been documented in Performance Test 6.7.

1.3 Simulator Instructor Interface

1.3.1 General Instructor System

The HBRSEP, Unit No. Simulator has an instructor booth (or station) that is separated from the simulator control room and out of sight (one way mirrored glass) from the operator's view. The instructor is able to observe the actions of the operators in the simulator control room from the booth. A multiple camera audio/video system is provided in the simulator facility to allow better analysis of operator activity.

The instructor controls the functions of the simulator from the Instructor Stations in the instructor booth. Using the control boards and Instructor Station, the instructor establishes simulator initial conditions, inputs malfunctions, simulates local operator actions, and inserts panel and transmitter overrides. The instructor is also able to interact with students using special features of the simulator including monitoring and plotting plant parameters. The features of the Instructor Station exceed the requirements of ANSI 3.5 - 1985.

The instructor has the capability of operating the simulator from the instructor's booth or from the simulator control room using a hand held remote device.

1.3.2 Initial Conditions

The simulator has the capability to store up to 255 Initial Condition sets. A controlled set of ICs are stabilized and re-snapped after each major simulator modification/upgrade period, or as required.

1.3.3 Malfunction Selection

The simulation contains capability to insert discrete malfunctions individually or in combination. The selection of malfunctions may be accomplished through command line entry, menu selection or available simulation dynamic Piping & Instrumentation Diagrams (P&ID).

Malfunction severity, time of activation, and time to reach selected severity may be entered through the instructor system and modified as

training objectives dictate. Several malfunctions may be active at the same time. Malfunctions may also be initiated based on specific plant conditions. Deactivation and time delayed deactivation of malfunctions are also facilitated. The current status of selected malfunctions is readily available to the instructor.

1.3.4 Overrides

1.3.4.1 Panel Overrides

The instructor has the ability to override any simulated device on the control room panels. For example, a meter may be driven to any value, a light may be turned off or on, or a switch may be failed closed. The override may be inserted with a time delay, and analog values may be ramped in over a specified time band.

1.3.4.2 Transmitter Overrides

Most transmitters that have meters on the main control board or others, may be overridden or failed to any value in it's range so that corresponding bistable trips and automatic actions will occur. The bistables may also be overridden directly. As with malfunctions, the override may be ramped in over a specified time period.

1.3.4.3 Relay Overrides

Selected relays may be overridden or failed to a specified state. This capability was added since initial simulator certification.

1.3.4.4 Selection of Overrides

The selection of overrides may be accomplished through command line entry, through a menu of available overrides or from dynamic system P&IDs.

1.3.5 Local Operator Actions (LOAs)

Local operator actions needed to provide training are available through the

same selection methods as malfunctions and overrides. Additional LOAs identified by training within the scope of simulation are added as needed.

1.3.6 Parameter and Equipment Monitoring

The graphical capabilities of the instructor system facilitate visual monitoring of the simulation through dynamic P&IDs and panel mimic displays. Plot capabilities for up to 400 parameters simultaneously is available through the instructor system. The standard parameter versus time and X-Y plots are available along with the capability to trend against previously recorded trends.

1.3.7 Simulator Special Features

Industry standard capabilities are available in the areas of switch check status/override, run, freeze, backtrack, replay, snapshot, fast time for certain parameters, slow time, Computer Aided Exercises, and simulation limit exceeded warnings.

Backtrack capabilities allow for four hours of storage at 2 minute intervals. The time between snaps of backtracks can be changed to lengthen or shorten this time.

In accordance with ANSI/ANS-3.5 Section 4.3, the simulator alerts the instructor by way of a pop-up message displayed on the Instructor Station, if certain operating limits are exceeded which could lead to negative operator training.

1.4 Operating Procedures for the Reference Plant

The Simulator Control Room utilizes a selected set of controlled procedures identical to those used in the HBRSEP, Unit No. 2 control room.

1.5 Changes Since Last Report

1.5.1 Plant Modifications

Plant modifications continue to be reviewed for simulator and training

impact. Applicable and operable plant modifications have been implemented on the simulator.

1.5.2 Simulator Upgrades

Since the last quadrennial report, the following models have been upgraded using the latest model building tools (TOPMERET and ELEGANT):

- Main Steam
- Turbine
- Electrical Distribution System

2.0 SIMULATOR DESIGN DATABASE

The Simulator Design Data Base consists of reference plant drawings (logics, CWDs, P&IDs, etc.), reference plant operating manuals and procedures, reference plant technical manuals, reference plant system descriptions, reference and similar plant transient data, engineering best estimate transient data, Updated Final Safety Analysis Report (UFSAR), and other appropriate material.

Plant modification/change data have continued to be collected and analyzed for simulator applicability through formally controlled distribution of Engineering Service Requests (ESRs) and plant procedure changes.

3.0 SIMULATOR DISCREPANCY AND UPGRADE PROGRAMS

3.1 Simulator Service Request Program

Discrepancies noted in the simulator during testing or training sessions are documented by a Simulator Service Request (SSR). The SSR is used by the simulator staff to evaluate the problem and to identify and implement corrective actions.

3.2 Engineering Service Request Implementation

Engineering Service Requests (ESRs) are reviewed and documented through the Configuration Management System. ESRs which are applicable to the scope of simulation are used to generate a Simulator Modification Request (SMR).

Plant modifications are scheduled to be completed in the simulator within twelve months of their operability in the plant. If requested by the plant operations staff, the modification may be performed in the simulator prior to its completion in the plant in order that the operators may be trained prior to plant modification completion. This is particularly true for many modifications performed during a scheduled plant outage so as to be available for training operators prior to plant start-up.

3.3 Simulator Configuration Management System

The simulator Configuration Management System (CMS) is a PC-based management and control system which is used to document and track the Simulator Service Requests and Simulator Modification Requests.

4.0 PERFORMANCE TESTS

During the last quadrennial period, the simulator performance testing was carried out in accordance with the Simulator Performance test schedule. Appendix B gives the description of the performance tests that were run. The operability tests were run annually and the malfunction tests were run such that approximately 25 percent of the required malfunctions were tested each year. Discrepancies identified during the performance testing process have been resolved. The abstracts of the tests are listed in Appendix E. The number of performance tests to be run in the current quadrennial period is different from the prior period and will be as described below.

4.1 Performance Test Schedule (1999 - 2002)

4.1.1 Annual Operability Tests

The annual operability tests include the simulator Real Time Test, the Steady State Stability and Accuracy Tests, and the Transient tests. These tests are listed in Appendix C.

4.1.2 Malfunction Tests

Malfunctions available on the simulator and incorporated in the operator training program have been tested typically at the time of inclusion. In addition malfunctions included in the simulation to meet the requirements of ANS/ANSI 3.5 -1985 Section 3.1.2 are tested on a periodic basis. These tests are scheduled such that approximately 25 percent of these required malfunctions are tested each year. Appendix D lists the malfunctions which meet this requirement and are scheduled for testing during the next four years.

APPENDIX A

SIMULATOR SUMMARY OF EXCEPTIONS

ANSI Specification: 3.1.1(7)

Title: Startup, Shutdown and Power Operations With Less Than Full Reactor Coolant Flow

Exception: HBRSEP, Unit No. 2 takes exception to this requirement. There is no simulator performance test which will be performed as part of the HBRSEP, Unit No. 2 simulator certification process.

Justification: HBRSEP, Unit No. 2 does not have procedures, nor is it permitted by Technical Specifications, for plant operations with less than full reactor coolant flow.

ANSI Specification: 3.1.1(9)

Title: Core Performance Testing Such as Plant Heat Balance, Determination of Shutdown Margin, and Measurement of Reactivity Coefficients and Control Rod Worth Using Permanently Installed Instrumentation.

Exception: HBRSEP, Unit No. 2 takes exception to the reactivity coefficient and control rod worth measurement portion of this requirement.

Justification: HBRSEP, Unit No. 2, by design, does not have permanently installed instrumentation for core reactivity tests.

ANSI Specification: 3.1.2(12)

Title: Control Rod Failure Including Stuck Rods, Uncoupled Rods, Drifting Rods, Rod Drops, and Misaligned Rods

Exception: HBRSEP, Unit No. 2 takes exception to the Drifting Rods portion of this

requirement.

Justification: Drifting Rod Malfunctions are not applicable to the Westinghouse design control rod drive system.

ANSI Specification: 3.1.2(25)

Title: Reactor Pressure Control System Failure Including Turbine Bypass Failure(BWR)

Exception: HBRSEP, Unit No. 2 takes exception to this requirement. There is no simulator performance test which will be performed as part of the HBRSEP, Unit No. 2 certification process.

Justification: HBRSEP, Unit No. 2 is a Westinghouse Pressurized Water Reactor (PWR). This requirement is not applicable to the H.B. Robinson simulator.

ANSI Specification: 4.3(3)&(5)

Title: Fuel Temperature Histories Indicative of Gross Fuel Failure and BWR Suppression Pool Temperature Greater Than the Highest Value at Which Condensation Instability is Known Not to Occur.

Exception: HBRSEP, Unit No. 2 takes exception to these requirements. These parameters are not monitored to alert the instructor of exceeding operating limits.

Justification: The HBRSEP, Unit No. 2 simulator does not monitor fuel temperature histories, but it does monitor current fuel temperatures and warns the instructor if fuel temperatures exceed 1550 degrees F. BWR suppression pool temperature monitoring is not applicable to HBRSEP, Unit No. 2 since the plant is a PWR design.

ANSI Specification: Appendix B.1

Title: BWR Simulator Operability Test

Exception: HBRSEP, Unit No. 2 takes exception to this requirement. There is no simulator performance test which will be performed as part of the HBRSEP, Unit No. 2 certification process.

Justification: This part of Appendix B applies to BWR plants only and HBRSEP, Unit No. 2 is a PWR plant.

APPENDIX B

DESCRIPTION OF PERFORMANCE TESTS RUN (1995 - 1998)

TEST #	DESCRIPTION
1.0	REAL TIME SIMULATION VERIFICATION
2.0.1	FULL POWER SIMULATOR STABILITY TEST
2.0.2	FULL POWER - STEADY STATE COMPARISON TEST
2.0.3	INTERIM POWER - STEADY STATE COMPARISON TEST
2.1	PLANT STARTUP TEST - COLD SHUTDOWN TO HOT STANDBY
2.10.001	COMPOSITE NUCLEAR INSTRUMENTATION SYSTEM TEST
2.10.006	SOURCE/INTERMEDIATE RANGE NUCLEAR INSTRUMENTATION SYSTEM TEST
2.10.007	NUCLEAR INSTRUMENTATION COMPARATOR CHANNEL TEST
2.10.008	NUCLEAR INSTRUMENTATION STARTUP RATE CHANNEL TEST
2.10.009	NUCLEAR INSTRUMENTATION AUDIO COUNT RATE CHANNEL TEST
2.10.011	ROD CLUSTER CONTROL EXERCISE & ROD POSITION INDICATION TEST
2.10.051	RCS DAILY LEAKAGE EVALUATION TEST
2.10.054	CORE COOLING MONITOR CHANNEL TEST
2.10.055	REACTOR VESSEL LEVEL INSTRUMENTATION SYSTEM TEST
2.10.107	BORIC ACID BLENDER TEST
2.10.109	VOLUME CONTROL TANK OUTLET CHECK VALVE BACK LEAKAGE TEST
2.10.161	ACCUMULATOR ISOLATION AND CHECK VALVE OPERABILITY TEST
2.10.255	RHR AND SI SYSTEM CHECK VALVE TEST
2.10.401	EMERGENCY DIESELS TEST
2.10.501	MAIN STEAM ISOLATION VALVE TEST
2.10.551	TURBINE VALVE TEST
2.10.553	TURBINE MECHANICAL OVERSPEED TRIP TEST
2.10.905	RADIATION MONITORING SYSTEM TEST
2.2	REACTOR STARTUP TEST
2.3.1	UNIT STARTUP AND SYNCHRONIZATION TEST
2.3.2	POWER ASCENT TO FULL POWER TEST
2.4	REACTOR TRIP FOLLOWED BY RECOVERY TEST
2.5	HOT SHUTDOWN OPERATIONS TESTS

TEST #	DESCRIPTION
2.8	UNIT SHUTDOWN FROM RATED POWER TEST
2.9.1	HEAT BALANCE TEST
2.9.2	DETERMINATION OF SHUTDOWN MARGIN BORON CONCENTRATION TEST
4.1	MANUAL REACTOR TRIP TRANSIENT TEST
4.10	PZR PORV STUCK OPEN WITHOUT SI TRANSIENT TEST
4.2	SIMULTANEOUS TRIP OF MFW PUMPS TRANSIENT TEST
4.3	SIMULTANEOUS CLOSURE OF MSIVS TRANSIENT TEST
4.4	SIMULTANEOUS TRIP OF ALL RCPS TRANSIENT TEST
4.5	SINGLE RCP TRIP TRANSIENT TEST
4.6	TURBINE TRIP FROM 9% POWER TRANSIENT TEST
4.7	MAXIMUM RATE POWER RAMP TRANSIENT TEST
4.8	DBA LOCA WITH LOSS OF OFFSITE POWER TRANSIENT TEST
4.9	DBA MAIN STEAM LINE BREAK TRANSIENT TEST
5.1.1	COMPLETE LOSS OF INSTRUMENT AIR TEST
5.1.2	INSTRUMENT AIR COMPRESSOR TRIP TEST
5.10.13	LOSS OF START-UP TRANSFORMER TEST
5.10.2	LOSS OF INSTRUMENT BUSES TEST
5.10.3	LOSS OF 125VDC BUSES TEST
5.10.4	LOSS OF 4160v BUSES TEST
5.10.5	E-1 AND E-2 FEEDER BREAKER TRIP TEST
5.10.7	AUXILIARY TRANSFORMER FAILURE TEST
5.10.8	LOSS OF 480V BUSES TEST
5.10.9	DEGRADED GRID VOLTAGE TEST
5.12.2	TURBINE TRIP ON GENERATOR TRIP FAILURE TEST
5.12.3	GENERATOR OUTPUT BREAKER FAILURES TEST
5.12.5	LOAD REJECTION TEST
5.12.6	GENERATOR TRIPS TEST
5.13.1	CONTAINMENT FAN COOLER TRIP TEST
5.14.1	REFUELING WATER STORAGE TANK LEAK TEST
5.14.4	PHASE A ISOLATION SIGNAL FAILURE TEST
5.14.5	PHASE B ISOLATION SIGNAL FAILURE TEST
5.15.2.1	DBA STEAM BREAK OUTSIDE CV TEST
5.15.3	MSIV FAILS OPEN TEST
5.15.4	STEAM GENERATOR PORV FAILURE TEST
5.15.5	STEAM DUMP CONTROLLER MODULATION FAILURE TEST
5.15.6	STEAM DUMP FAILURE TEST

TEST #	DESCRIPTION
5.15.7	STEAM DUMP PERMISSIVE FAILURE TEST
5.15.9	MAIN STEAM HEADER LEAK TEST
5.16.10	SR NI FUSE FAILURES TEST
5.16.11	IR NI FUSE FAILURES TEST
5.16.12	PR NI FUSE FAILURE TEST
5.16.13	NOISY SR NI CHANNEL TEST
5.16.14	FAILURE OF SR NI BLOCK TEST
5.16.15	FAILURE OF SR NI TO REENERGIZE TEST
5.16.16	NI51/NI52 LOSS OF HIGH VOLTAGE POWER SUPPLY TEST
5.16.2	SR NI PULSE HEIGHT DISCRIMINATOR FAILURE TEST
5.16.3	SR NI HIGH VOLTS CUTOFF FAILURE TEST
5.16.4	SR NI HIGH VOLTS FAILURE TEST
5.16.6	IR NI GAMMA COMPENSATION FAILURE TEST
5.16.7	PR NI DETECTOR FAILURE TEST
5.16.9	INCORE DETECTOR FAILURE TEST
5.17.1	PRESSURIZER STEAM SPACE LEAK TEST
5.17.2	PRESSURIZER SPRAY VALVE FAILURE TEST
5.17.3	PRESSURIZER PORV FAILURE TEST
5.17.4	PRESSURIZER SAFETY VALVE FAILURE TEST
5.17.5	PRESSURIZER BACKUP HEATER GROUP FAILURES TEST
5.17.6	PRESSURIZER PRESSURE CONTROL BAND SHIFT TEST
5.17.7	PRESSURIZER LEVEL CONTROL BAND SHIFT TEST
5.18.1	DBA RCS HOT LEG LOCA TEST
5.18.12	REACTOR COOLANT PUMP THERMAL BARRIER LEAK TEST
5.18.13	REACTOR COOLANT PUMP #1 SEAL FAILURE TEST
5.18.14	REACTOR COOLANT PUMP A #2 SEAL FAILURE TEST
5.18.15	REACTOR COOLANT PUMP #3 SEAL FAILURE TEST
5.18.16	REACTOR COOLANT PUMP VIBRATION TEST
5.18.17	RCP SEAL PACKAGE FAILURE TEST
5.18.3	RCP LOCKED ROTOR TEST
5.18.5	VARIABLE BORON CONCENTRATION FUNCTION TEST
5.18.9.1	RCS SMALL LEAK TEST
5.18.9.2	RCS SMALL LOCA TEST
5.19.1	RHR PUMP TRIP TEST
5.19.2	RESIDUAL HEAT REMOVAL, HCV-758 FAILURE TEST
5.19.3	RESIDUAL HEAT REMOVAL, FCV-605, FAILURE TEST
5.19.4	HAND CONTROL VALVE 142 FAILURE TEST

TEST #	DESCRIPTION
5.19.5	RESIDUAL HEAT REMOVAL LEAK TEST
5.19.6	RESIDUAL HEAT REMOVAL SUMP VALVE FAILURE TEST
5.19.7	RESIDUAL HEAT REMOVAL HEAT EXCHANGER TUBE LEAK TEST
5.19.8	RESIDUAL HEAT REMOVAL RELIEF VALVE FAILURE TEST
5.2.1	CCW PUMP TRIP TEST
5.2.2	LOSS OF COMPONENT COOLING WATER TO RHR HEAT EXCHANGER TEST
5.2.3	COMPONENT COOLING WATER TO SERVICE WATER LEAK THROUGH HEAT EXCHANGERS
5.2.4	TOTAL LOSS OF COMPONENT COOLING WATER TO REACTOR COOLANT PUMP
5.2.6	COMPONENT COOLING WATER LINE BREAK INSIDE CONTAINMENT VESSEL
5.2.7	REACTOR COOLANT PUMP BEARING OIL COOLER CCW LEAK TEST
5.2.8	TCV-144 CONTROLLER FAILURE TEST
5.21.1.1	REACTOR TRIP BREAKER FAILURE TEST
5.21.1.2	ATWS TEST
5.21.2	AMSAC FAILURES TEST
5.23.1	STEAM GENERATOR SAFETY VALVE FAILURE TEST
5.23.2.1	SG TUBE LEAK TEST
5.23.2.2	STEAM GENERATOR TUBE RUPTURE TEST
5.23.3	STEAM GENERATOR LEVEL PROGRAM FAILURE TEST
5.24.1	SI INITIATION FAILURE TEST
5.24.2	ACCUMULATOR LIQUID LEAK TEST
5.24.3	ACCUMULATOR NITROGEN LEAK TEST
5.24.4	SAFETY INJECTION PUMP FAILURE TEST
5.24.6	FAILURE OF SI TRAINS TO RESET TEST
5.25.1	SERVICE WATER PUMP TRIP TEST
5.25.2	SW LEAK ON CONTAINMENT VESSEL FAN COOLER TEST
5.25.4	SERVICE WATER HEADER LEAK TEST
5.25.6	SW BOOSTER PUMP SUCTION LINE LEAK TEST
5.25.8	SW TO EDG TCV FAILURE TEST
5.26.11	TURBINE LUBE OIL PUMPS TRIP TEST
5.26.12	LOSS OF EH OIL PUMPS TEST
5.26.13	TURBINE TURNING GEAR FAILURE TEST

TEST #	DESCRIPTION
5.26.14	TURBINE MAIN LUBE OIL LEAK TEST
5.26.16	LOSS OF GLAND SEAL STEAM TEST
5.26.18	EH RESERVOIR LEAK TEST
5.26.19	TURBINE BEARING LIFT OIL PUMP TRIP TEST
5.26.2	TURBINE TRIP FAILURES TEST
5.26.20	ROD DROP RUNBACK TIME DELAY FAILURE TEST
5.26.21	TURBINE RUNBACK FAILURES TEST
5.26.22	EH HIGH PRESSURE FLUID LEAK TEST
5.26.4	TURBINE BEARING FAILURE TEST
5.26.5	TURBINE GOVERNOR VALVE FAILURE TEST
5.28.1	HIGH RCS ACTIVITY TEST
5.29.1	FEEDWATER FLOW TRANSMITTER FAILURE TEST
5.29.3	PT-145 FAILURE TEST
5.29.4	LT:459A FAILURE TEST
5.29.5	PT-444 FAILURE TEST
5.29.6	CONTROLLING STEAM GENERATOR PRESSURE TRANSMITTER FAILURE TEST
5.29.7	STEAM GENERATOR PRESSURE TRANSMITTER TO PORV FAILURE TEST
5.3.1	AFW PUMPS TRIP TEST
5.3.10	FW ISOLATION VALVE FAILURE TEST
5.3.12	HEATER DRAIN PUMP TRIP TEST
5.3.13	HIGH PRESSURE FEEDWATER HEATER 6 TUBE LEAK TEST
5.3.14.1	LOW PRESSURE FEEDWATER HEATER 1A TUBE RUPTURE TESTS
5.3.14.2	LOW PRESSURE FEEDWATER HEATER 3A TUBE RUPTURE TEST
5.3.16	MAIN FEEDWATER PUMP RECIRCULATION VALVE FAILURE TEST
5.3.17	FEEDWATER CONTROL VALVE FAILURE TEST
5.3.18	FEEDWATER BREAK INSIDE CONTAINMENT TEST
5.3.19	TOTAL LOSS OF FEEDWATER TEST
5.3.20	INADVERTENT FW ISOLATION TEST
5.3.21	SG HIGH LEVEL TRIP FAILURE TEST
5.3.24	FEEDWATER BREAK IN MAIN FEEDWATER HEADER TEST
5.3.26	FEED LINE BREAK IN DISCHARGE OF MAIN FEEDWATER PUMP TEST

TEST #	DESCRIPTION
5.3.28	LOSS OF MFW PUMP LUBE OIL TEST
5.3.29	CONDENSATE STORAGE TANK LEAK TEST
5.3.3	TURBINE DRIVEN AFW PUMP STEAM SUPPLY BREAK TEST
5.3.4	AFW LINE RUPTURE OUTSIDE CV TEST
5.3.5	AFW LINE RUPTURE INSIDE CV TEST
5.3.6	MOTOR-DRIVEN AFW PUMP ISOLATION VALVES FAILURE TEST
5.3.7	FW BYPASS VALVE FAILURE TEST
5.3.8	TURBINE DRIVEN AFW FLOW CONTROL VALVE FAILURE TEST
5.3.9	CONDENSATE PUMP TRIP TEST
5.30.1	ESF PASSIVE FAILURES TEST
5.4.2	CONDENSER AIR IN LEAKAGE TEST
5.4.3	CONDENSER VACUUM PUMP TRIP TEST
5.4.4	VACUUM PUMP SHAFT BREAK TEST
5.4.5	HOTWELL LEVEL CONTROLLER FAILURE TEST
5.5.1	FALSE CV SPRAY ACTUATION TEST
5.5.2	CV SPRAY PUMP FAILURE TEST
5.5.3	CV SPRAY HEADER LEAK TEST
5.6.1	POWER CABINET URGENT FAILURE TEST
5.6.10	IRPI COIL FAILURES TEST
5.6.11	CONTROL BANK OVERLAP FAILURE TESTS
5.6.12	STEP COUNTER FAILURE TEST
5.6.13	ROD SPEED DEAD BAND CONTROLLER FAILURE TEST
5.6.16	DRIVE MG SETS TEST
5.6.17	LOSS OF POWER TO POWER CABINETS TEST
5.6.18	BENT CONTROL ROD SHAFT TEST
5.6.2	FAILURE OF CONTROL RODS TO MOVE TEST
5.6.3	DROPPED CONTROL ROD TEST
5.6.4	STUCK CONTROL ROD TEST
5.6.5	EJECTED CONTROL ROD TEST
5.6.6	UNCONTROLLED ROD MOTION TESTS
5.6.7	AUTO ROD SPEED CONTROLLER FAILURE TEST
5.6.8	ROD CONTROL TREF FAILURE TEST
5.7.1	LETDOWN ISOLATION VALVES FAILURES TEST
5.7.11	NON-REGEN. HX TUBE LEAK TEST
5.7.12	SEAL WATER EXCHANGER TUBE LEAK TEST

TEST #	DESCRIPTION
5.7.13	PLUGGED BORIC ACID FILTER TEST
5.7.14	PLUGGED RCS FILTER TEST
5.7.15	CHARGING PUMP SPEED CONTROLLER FAILURE TEST
5.7.16	ORIFICE ISOLATION VALVE FAILURE TEST
5.7.17	LETDOWN LEAK BEFORE ORIFICE ISO. VALVES TEST
5.7.18	AUXILIARY SPRAY VALVE FAILURE TEST
5.7.19	NORMAL AND ALTERNATE CHARGING VALVES FAILURES TEST
5.7.2	CVC-LCV-115C FAILURES TEST
5.7.21	CVC-LCV-115B FAILURE TEST
5.7.22	BORIC ACID PUMP TRIP TEST
5.7.23	PLUGGED SEAL WATER RETURN FILTER TEST
5.7.24	CHARGING LEAK TEST
5.7.25	MAKEUP SELECTOR SWITCH FAILURE TEST
5.7.3	LETDOWN LINE LEAK INSIDE CV TEST
5.7.4	LETDOWN LINE LEAK OUTSIDE CV TEST
5.7.5	CHARGING PUMP TRIP TEST
5.7.6	PRIMARY WATER PUMP TRIP TEST
5.7.7	PCV-145 CONTROLLER FAILURE TEST
5.7.8	INADVERTENT LOW PZR LEVEL BISTABLE ACTUATION TEST
5.7.9	LC-112 FAILURE TEST
5.8.1.1	CIRCULATING WATER PUMP TRIP TEST
5.8.1.2	LOSS OF CIRCULATING WATER PUMP TRIP TEST
5.9.1	DIESEL GENERATOR FAILURES TEST
5.9.4	EMERGENCY DIESEL GENERATOR LOAD SEQUENCER TEST
6.1	CLOSURE OF ONE MSIV AT FULL POWER TEST
6.6	VALVE STROKE-TIME TEST
6.7	PHYSICAL FIDELITY COMPARISON TEST

APPENDIX C

SCHEDULE OF ANNUAL OPERABILITY TESTS (1999-2002)

The following tests are performed on an annual basis.

Real Time Test

1.0	REAL TIME SIMULATION VERIFICATION

Steady State Tests

2.0.1	FULL POWER SIMULATOR STABILITY TEST
2.0.2	FULL POWER STEADY STATE COMPARISON TEST
2.0.3	INTERIM POWER STEADY STATE COMPARISON TEST

Transient Tests

4.1	MANUAL REACTOR TRIP TRANSIENT TEST
4.2	SIMULTANEOUS TRIP OF MFW PUMPS TRANSIENT TEST
4.3	SIMULTANEOUS CLOSURE OF MSIVS TRANSIENT TEST
4.4	SIMULTANEOUS TRIP OF ALL RCPS TRANSIENT TEST
4.5	SINGLE RCP TRIP TRANSIENT TEST
4.6	TURBINE TRIP FROM 9% POWER TRANSIENT TEST
4.7	MAXIMUM RATE POWER RAMP TRANSIENT TEST
4.8	DBA LOCA WITH LOSS OF OFFSITE POWER TRANSIENT TEST
4.9	DBA MAIN STEAM LINE BREAK TRANSIENT TEST
4.10	PZR PORV STUCK OPEN WITHOUT SI TRANSIENT TEST

6.7	PHYSICAL FIDELITY COMPARISON TEST

APPENDIX D

SCHEDULE OF MALFUNCTION TESTS (1999-2002)

MALFUNCTION TESTS FIRST YEAR

5.21.1.1	REACTOR TRIP BREAKER FAILURE TEST
5.17.1	PRESSURIZER STEAM SPACE LEAK TEST
5.25.1	SERVICE WATER PUMP TRIP TEST
5.23.2.2	STEAM GENERATOR TUBE RUPTURE TEST
5.19.5	RESIDUAL HEAT REMOVAL LEAK TEST
5.6.1	POWER CABINET URGENT FAILURE TEST
5.6.4	STUCK CONTROL ROD TEST
5.7.16	ORIFICE ISOLATION VALVE FAILURE TEST
5.10.2	LOSS OF INSTRUMENT BUSES TEST
5.3.9	CONDENSATE PUMP TRIP TEST
5.3.24	FEEDWATER BREAK IN MAIN FEEDWATER HEADER TEST
5.15.4	STEAM GENERATOR PORV FAILURE TEST
5.16.7	PR NI DETECTOR FAILURE TEST
5.18.9.2	RCS SMALL LOCA TEST
5.10.9	DEGRADED GRID VOLTAGE TEST
5.2.3	COMPONENT COOLING WATER TO SERVICE WATER LEAK THROUGH HEAT EXCHANGERS
5.28.1	HIGH RCS ACTIVITY TEST
5.29.4	LT:459A FAILURE TEST
5.3.19	TOTAL LOSS OF FEEDWATER TEST
5.6.18	BENT CONTROL ROD SHAFT TEST

MALFUNCTION TESTS SECOND YEAR

5.24.1	SI INITIATION FAILURE TEST
5.1.1	COMPLETE LOSS OF INSTRUMENT AIR TEST
5.17.3	PRESSURIZER PORV FAILURE TEST
5.17.4	PRESSURIZER SAFETY VALVE FAILURE TEST
5.18.9.1	RCS SMALL LEAK TEST
5.26.2	TURBINE TRIP FAILURES TEST
5.6.5	EJECTED CONTROL ROD TEST
5.7.7	PCV-145 CONTROLLER FAILURE TEST
5.10.4	LOSS OF 4160V BUSES TEST
5.9.1	DIESEL GENERATOR FAILURES TEST
5.3.3	TURBINE DRIVEN AFW PUMP STEAM SUPPLY BREAK TEST
5.3.28	LOSS OF MFW PUMP LUBE OIL TEST
5.3.18	FEEDWATER BREAK INSIDE CONTAINMENT TEST
5.15.2.1	DBA STEAM BREAK OUTSIDE CV TEST
5.12.6	GENERATOR TRIPS TEST
5.18.12	REACTOR COOLANT PUMP THERMAL BARRIER LEAK TEST
5.2.8	TCV-144 CONTROLLER FAILURE TEST
5.21.2	AMSAC FAILURES TEST
5.6.7	AUTO ROD SPEED CONTROLLER FAILURE TEST
5.7.24	CHARGING LEAK TEST

MALFUNCTION TESTS THIRD YEAR

5.26.21	TURBINE RUNBACK FAILURES TEST
5.17.6	PRESSURIZER PRESSURE CONTROL BAND SHIFT TEST
5.1.2	INSTRUMENT AIR COMPRESSOR TRIP TEST
5.6.6	UNCONTROLLED ROD MOTION TESTS
5.18.1	DBA RCS HOT LEG LOCA TEST
5.23.2.1	SG TUBE LEAK TEST
5.19.6	RESIDUAL HEAT REMOVAL SUMP VALVE FAILURE TEST
5.4.5	HOTWELL LEVEL CONTROLLER FAILURE TEST
5.4.2	CONDENSER AIR IN LEAKAGE TEST
5.12.3	GENERATOR OUTPUT BREAKER FAILURES TEST
5.3.1	AFW PUMPS TRIP TEST
5.3.8	TURBINE DRIVEN AFW FLOW CONTROL VALVE FAILURE TEST
5.15.9	MAIN STEAM HEADER LEAK TEST
5.16.10	SR NI FUSE FAILURES TEST
5.10.8	LOSS OF 480V BUSES TEST
5.25.8	SW TO EDG TCV FAILURE TEST
5.26.12	LOSS OF EH OIL PUMPS TEST
5.6.8	ROD CONTROL TREF FAILURE TEST
5.7.9	LC-112 FAILURE TEST
5.4.3	CONDENSER VACUUM PUMP TRIP TEST

MALFUNCTION TESTS FOURTH YEAR

5.9.4	EMERGENCY DIESEL GENERATOR LOAD SEQUENCER TEST
5.17.2	PRESSURIZER SPRAY VALVE FAILURE TEST
5.24.2	ACCUMULATOR LIQUID LEAK TEST
5.2.1	CCW PUMP TRIP TEST
5.2.2	LOSS OF COMPONENT COOLING WATER TO RHR HEAT EXCHANGER TEST
5.2.4	TOTAL LOSS OF COMPONENT COOLING WATER TO REACTOR COOLANT PUMP
5.6.3	DROPPED CONTROL ROD TEST
5.18.13	REACTOR COOLANT PUMP #1 SEAL FAILURE TEST
5.16.11	IR NI FUSE FAILURES TEST
5.21.1.2	ATWS TEST
5.7.15	CHARGING PUMP SPEED CONTROLLER FAILURE TEST
5.14.4	PHASE A ISOLATION SIGNAL FAILURE TEST
5.14.5	PHASE B ISOLATION SIGNAL FAILURE TEST
5.25.4	SERVICE WATER HEADER LEAK TEST
5.24.4	SAFETY INJECTION PUMP FAILURE TEST
5.10.3	LOSS OF 125VDC BUSES TEST
5.19.3	RESIDUAL HEAT REMOVAL, FCV-605, FAILURE TEST
5.23.3	STEAM GENERATOR LEVEL PROGRAM FAILURE TEST
5.3.20	INADVERTENT FW ISOLATION TEST
5.3.4	AFW LINE RUPTURE OUTSIDE CV TEST

APPENDIX E

ABSTRACTS OF PERFORMANCE TESTS

1.0 Real Time Simulation Verification

This simulator performance test verifies that the simulator's simulation of dynamic performance is in the same time base relationships, sequences, duration's, rates and accelerations as the reference plant. This test verifies real time simulation during steady state operation, and multiple malfunction entry including reactor coolant system LOCA, steam generator tube rupture, main steam line break, and loss of off site power. This test utilizes SGI sar - system activity reporter command to measure spare time on the simulator, along with UNIX OSVIEW utility to observe individual CPU spare time averages. This test also checks for overtime and simulation failures.

2.0.1 Full Power Simulator Stability Test

This simulator performance test verifies the simulator is capable of operating at 100% power for a period of one hour while maintaining within a +/-2% deviation on certain critical and noncritical parameters.

2.0.2 Full Power - Steady State Comparison Test

This simulator performance test verifies the simulator's accuracy related to full power values for which valid reference plant information is available. Simulator computed value accuracy is verified to be within +/- 2% for critical parameters and +/- 10% for noncritical parameters of the reference plant, with an additional 2% (of full scale) tolerance to account for reference plant instrument error. Also, the simulator indicated values are verified to be within +/- 2% for critical parameters and noncritical parameters of the simulator computed values.

2.0.3 Interim Power - Steady State Comparison Test

This simulator performance test verifies the simulator's accuracy related to interim power levels of approximately 25% and 75% of full power for which valid reference plant information is available. Simulator computed value accuracy is verified to be within +/- 2% for critical parameters and +/- 10% for noncritical parameters of the reference plant, with an additional

2% (of full scale) tolerance to account for reference plant instrument error. Also, the simulator indicated values are verified to be within +/- 2% for critical parameters and noncritical parameters of the simulator computed values.

2.1 Plant Startup Test - Cold Shutdown to Hot Standby

This simulator performance test verifies the ability of simulating continuously, and in real time a plant heat up from cold shutdown (<200 Deg F) with the pressurizer solid to hot standby (hot, subcritical at no load Tavg). The simulator's ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation, and providing proper alarm or protective system action, or both, are verified.

2.2 Reactor Startup Test

This simulator performance test verifies the ability of simulating continuously, and in real time, a reactor startup from hot subcritical at no load Tavg (547 deg. F) to 10^{-8} amps reactor power. The ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation, and providing alarms or protective system action, or both, are verified.

2.3.1 Unit Startup and Synchronization Test

A plant startup is performed per General Plant Procedure from reactor critical at 10^{-8} amps to closure of the Main Generator Output Breakers and the ability to simulate continuously and in real time during the performance of this evolution is verified. The ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation and providing alarms and appropriate protective system action is verified.

2.3.2 Power Ascent to Full Power Test

A plant startup is performed per General Plant Procedure from Generator Breaker Closure to 100% power. The ability to simulate continuously and in real time during the performance of this evolution is verified. The ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation, and providing proper alarm and appropriate protective action is verified.

2.4 Reactor Trip Followed By Recovery Test

The Reactor is manually tripped from 100% power. Appropriate Emergency Plant Procedures are completed and when the plant is stable, General Plant Procedures are used to return the plant to 100% power. The simulator's ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation and providing proper alarm and appropriate protective action is verified.

2.5 Hot Shutdown Operations Tests

The response of the Pressurizer Pressure Control System, Level Control System, and the alarms, stability, and control of these systems is verified. Pressurizer Spray and Heater effectiveness is also verified. The simulator's ability to calculate plant parameters corresponding to these evolutions, displaying these parameters corresponding to these evolutions, displaying these parameters on the appropriate instrumentation, and providing proper alarm is verified.

2.8 Unit Shutdown From Rated Power Test

A shutdown from 100% power to Hot Shutdown is performed utilizing General Plant Procedure. The shutdown is then continued to Cold Shutdown utilizing another General Plant Procedure. The ability of simulating continuously and in real time a unit shutdown from rated power to Cold Shutdown is verified. The simulator's ability to calculate plant system parameters corresponding to this evolution, displaying these parameters on the appropriate instrumentation, and providing proper alarm and appropriate protective action is verified.

2.9.1 Heat Balance Test

The current revision of Operations Surveillance Test Procedure (OST-10), Power Range Calorimetric During Power Operation, is completed. This test verifies the simulator's ability to calculate and display the parameters required to perform a Power Range Calorimetric.

2.9.2 Determination of Shutdown Margin Boron Concentration Test

This test verifies the simulator's ability to calculate

and display the parameters required to perform a manual determination of Shutdown Margin Boron Concentration.

2.10.001 Composite Nuclear Instrumentation System Test

The current revisions of Operations Surveillance Test (OST-001), Nuclear Instrumentation Source Range, Intermediate Range, and Power Range Weekly, is completed. This test verifies the simulator's ability to calculate and display the parameters required to perform appropriate Operations Surveillance Tests.

2.10.006 Source/Intermediate Range Nuclear Instrumentation System Test

The current revision of Operations Surveillance Test Procedure (OST-006), Nuclear Instrumentation Source Range and Intermediate Range Bi-weekly (Power above P-6) Prior to Scheduled Shutdown Interval, is completed. This test verifies the simulator's ability to calculate and display the parameters required to perform OST-006.

2.10.007 Nuclear Instrumentation Comparator Channel Test

The current revision of Operations Surveillance Test (OST-007), Nuclear Instrumentation Comparator, is completed. This test verifies the simulator's ability to calculate and display the parameters required to perform OST-007.

2.10.008 Nuclear Instrumentation Startup Rate Channel Test

The current revision of Operations Surveillance Test (OST-008), Nuclear Instrumentation Startup Rate Channel, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-008.

2.10.009 Nuclear Instrumentation Audio Count Rate Channel Test

The current revision of Operations Surveillance Test (OST-009), Nuclear Instrumentation Audio Count Rate Channel, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-009.

2.10.011 Rod Cluster Control Exercise and Rod Position Indication Test

The current revision of Operations Surveillance Test (OST-011), Rod Cluster Control and Rod Position Indication Bi-Weekly Interval, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-011.

2.10.051 RCS Daily Leakage Evaluation Test

The current revision of Operations Surveillance Test (OST-051), Reactor Coolant System Leakage Evaluation, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-051.

2.10.054 Core Cooling Monitor Channel Test

The current revision of Operations Surveillance Test (OST-054), Core Cooling Monitor Channel Check, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-054.

2.10.055 Reactor Vessel Level Instrumentation System Test

The current revision of Operations Surveillance Test (OST-055), Reactor Vessel Level Instrumentation System, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-055.

2.10.107 Boric Acid Blender Test

The current revision of Operations Surveillance Test (OST-107), Boric Acid Blender Control, Valve and Pump Operation, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-107.

2.10.109 Volume Control Tank Outlet Check Valve Back Leakage Test

The current revision of Operations Surveillance Test (OST-109), Chemical and Volume Control System Check Valve CVC-266 Back Leakage Test, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-109.

2.10.161 Accumulator Isolation and Check Valve Operability Test

The current revision of Operations Surveillance Test, (OST-161), Accumulator Isolation and Check Valve Operability Test, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-161.

2.10.255 RHR and SI System Check Valve Test

The current revision of Operations Surveillance Test (OST-255), RHR and SI System Check Valve Test, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-255.

2.10.401 Emergency Diesels Test

The ability of simulating continuously, and in real time, a test of the Emergency Diesel Generators is verified. This test is based on OST-401 and OST-409 Emergency Diesels Operation Surveillance Test. Some steps have been removed due to Local Operator Actions not vital to Control Room indication, and additional steps were added to provide qualitative check of simulator responses. The "A" Diesel Generator is started, synchronized, loaded, unloaded, and shutdown using LOAs for actions outside the Control Room and normal controls in the RTGB. The test is repeated for "B" Emergency Diesel.

2.10.501 Main Steam Isolation Valve Test

The current revision of Operations Surveillance Test (OST-501) Main Steam Isolation Valves (Refueling), is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-501.

2.10.551 Turbine Valve Test

The current revision of Operations Surveillance Test (OST-551), Turbine Valve and Trip Functional Test, is completed. This test verifies the simulator's ability to calculate and display the parameters required to perform Turbine Valve Test. The test does not include Local Turbine Trip Tests.

2.10.553 Turbine Mechanical Overspeed Trip Test

The current revision of Operations Surveillance Test

(OST-553), Turbine Mechanical Overspeed Trip Test, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-553.

2.10.905 Radiation Monitoring System Test

The current revision of Operations Surveillance Test (OST-905), Radiation Monitoring Systems, is completed. This test verifies the simulator's ability to calculate and display the parameters required to complete OST-905.

4.1 Manual Reactor Trip Transient Test

The manual reactor trip malfunction is entered with the simulator at a stable 100% power. The transient test is allowed to run for a minimum of 30 minutes. The appropriate parameter response per the ANSI guidelines are verified. The following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.2 Simultaneous Trip of MFW Pumps

The malfunction to trip both MFW Pumps simultaneously is entered with the reactor stable at 100% power. The transient test is allowed to continue for a minimum of 30 minutes. The appropriate parameter responses per the ANSI guideline were verified. The following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did not occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.3 Simultaneous Closure of MSIVs

The malfunction to simultaneously close all MSIVs are entered with the reactor stable at 100% Power. The transient test is allowed to continue for a minimum of 30 minutes. The appropriate parameter response per the ANSI guideline were verified. The following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.4 Simultaneous Trip of All RCPs Transient Test

The malfunctions for Simultaneous Trip of the RCPs are entered with the reactor stable at 100% power. The transient test is allowed to continue until the natural circulation criteria for Emergency Plant Procedure is verified. The following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.5 Single Reactor Coolant Pump Trip Transient Test

With the simulator at a stable 100% power condition, the "A" Reactor Coolant Pump was tripped. This transient test was allowed to run for a minimum of 30 minutes. The appropriate parameter responses, per the ANSI guidelines, are verified. Additionally, the

following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.6 Turbine Trip From 9% Power Transient Test

With the Simulator at stable 9% power condition, the Turbine was tripped. This is the maximum power level (< 10%) at which a turbine trip does not result in a direct reactor trip. This transient test was allowed to run for a minimum of 30 minutes. The appropriate parameter responses, per the ANSI Guidelines are verified. Additionally, the following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.7 Maximum Rate Power Ramp Transient Test

With the simulator at a stable 100% power condition, power was reduced to 75% and then returned to 100% at a 5%/min. rate. Once the simulator was returned to 100% power, the appropriate parameters are verified, per the ANSI guidelines. Additionally, the following conditions are verified.

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.8 DBA LOCA With Loss of Off site Power Transient Test

With the simulator at a stable 100% power condition, the DBA LOCA in coincidence with a loss of offsite power was inserted. This transient test was allowed to run for a minimum of 30 minutes. The appropriate parameter responses, per the ANSI guidelines are verified. Additionally, the following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.9 DBA Main Steam Line Break Transient Test

With the simulator at a stable 100% power condition, the malfunction to cause a DBA Main Steam Line Break was entered. This transient test was allowed to run for a minimum of 30 minutes. The appropriate parameter response per the ANSI Guidelines, are verified. Additionally, the following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

4.10 Pressurizer PORV Stuck Open Without SI Transient Test

With the simulator at a stable 100% power condition, the Pressurizer PORV was failed open. This transient test was allowed to run for a minimum of 60 minutes. The appropriate parameter responses, per the ANSI Guidelines, are verified. Additionally, the following conditions are verified:

a. Parameter changes were in the proper direction.

b. Physical laws of nature were not violated.

c. Alarms and automatic actions which should have occurred did occur.

d. Alarms and automatic actions which should not have occurred did not occur.

e. System interactions provided a total system integrated response.

5.1.1 Complete Loss of Instrument Air Test

The three Air Headers are failed simultaneously in three sections of the test (different status of plant) to permit testing of components/parameters response under conditions most favorable to verify the loss of air response. Proper response of components/parameters is verified either during the reduction in instrument air pressure or following the complete loss of pressure. When possible, attempts are made to change the status of components to verify failed status.

5.1.2 Instrument Air Compressor Trip Test

Proper parameter response of the simulator is verified for normal operation and abnormal operation (trip) of each air compressor which supplies the Instrument and Station Air Headers. Cross connect capability between the Instrument Air System and Station Air System is also verified. Local Operator Action (LOAs) are used to align the Compressors and Air Header Cross Connect Valves for the various evolutions in this test.

5.2.1 Component Cooling Water (CCW) Pump Trip Test

Each CCW pump is placed in service as the only running pump with the other pumps in standby. The appropriate malfunction is inserted to trip the running pump. Automatic start of the standby pumps and correct response of the plant is verified.

Plant response to a total loss of CCW flow is tested

with the plant at 100% power and with the plant in cold shutdown on RHR.

Proper alarms, indicating lights and flow indications are verified for the pump trips. After total loss of CCW at power, a CCW pump is restarted to verify alarms will clear.

5.2.2 Loss of Component Cooling Water (CCW) to Residual Heat Exchanger Test

With the primary system in Cooldown, both malfunctions are entered with a ramp time of 10 seconds, isolating Component Cooling Water to both RHR Heat Exchangers. Integrated plant response is verified.

The malfunctions are cleared and "A" CCW Outlet Valve is opened to reestablish Cooldown. The "B" Outlet Valve is then opened and "A" Outlet Valve is closed to verify the malfunctions have cleared and Cooldown of the primary system continues.

5.2.3 Component Cooling Water (CCW) to Service Water Leak through Heat Exchanger Test

The malfunction is first inserted for "A" CCW Heat Exchanger and allowed to continue until 0% level is reached in the CCW Surge Tank, at which time the pumps are stopped. The pumps remain off until complete integrated plant response is verified. The initial conditions are then reestablished and the entire test is repeated for "B" CCW Heat Exchanger.

5.2.4 Total Loss of Component Cooling Water (CCW) to Reactor Coolant Pumps Test

Component Cooling Water to the Reactor Coolant Pumps is isolated by entering Malfunction CCW-4A. The flows, temperatures, and alarms associated with CCW and Reactor Coolant Pumps are verified to be correct. CCW is then reestablished and it is verified that flows, temperature, and alarms return to normal.

Malfunction CCW-4B is entered and the same verifications are repeated. Initial Conditions are reestablished and Malfunction CCW-4B is entered a second time until Reactor Coolant Pump bearing temperatures increase and the pumps are tripped. It is then verified that the Reactor Coolant Pumps upper and lower motor bearings trend toward Containment Vessel Ambient Air Temperature.

5.2.6 Component Cooling Water (CCW) Line Break Inside Containment Vessel Test

A 2000 gpm leak is introduced inside the Containment Vessel and allowed to continue until the CCW Surge Tank Level reaches 0% and the CCW Pumps are stopped.

Integrated plant response is verified to be correct including alarms, flows, temperatures, levels, and valves repositioning.

The malfunction is removed and makeup is established to restore the CCW Surge Tank Level. A CCW Pump is restarted and integrated plant response is verified to be correct as CCW flow is reestablished.

5.2.7 Reactor Coolant Pump Bearing Oil Cooler Component Cooling Water Leak Test

This test verifies that Malfunction CCW-7 produces the integrated plant response indicative of a Component Cooling Water leak into the Reactor Coolant Pump Bearing Oil Coolers. In addition LOAs are entered to isolate the Inlet Isolation Valves to each RCP to verify back flow occurs. The RCP Bearing Oil Coolers are tested individually.

5.2.8 TCV-144, Controller Failure Test

TC-144 Automatic Signal is failed to the fully closed value, isolating CCW to the Letdown Heat Exchanger. Temperatures, alarms, and valve position for the Demineralizer Diversion Valve are verified to be correct. The Valve Controller is placed in manual and opened to reestablish CCW flow to the Letdown Heat Exchanger and it is verified that temperatures decrease and the diversion valve returns to normal position.

5.3.1 AFW Pumps Trip Test

This test commences with a Main Feedwater Pump in service and a malfunction inserted for "A" AFW Pump. The Main Feedwater Pump is tripped and it is verified that "A" AFW Pump will not start and "B" AFW Pump does start automatically. The malfunction is inserted for "B" AFW Pump and the trip is verified. The Turbine Driven AFW Pump is started and the malfunction for this pump is inserted and the trip verified. The malfunctions are then cleared and normal start for the AFW Pumps is verified. Correct alarms, flow, and level indications are verified for the actions.

The final section of this test reestablishes initial

conditions, inserts the malfunction for "A" Pump, actuates Safety Injection, and verifies correct alarms and response for the pumps.

5.3.3 Turbine Driven AFW Pump Steam Supply Break Test

The malfunction is entered for "A" Steam Line with the "A" Steam Line supplying the Steam Driven AFW Pump. Correct plant response is verified until the steam line isolates and the Steam Driven AFW Pump Discharge Pressure goes to zero.

The test is repeated for each steam line with the Steam Driven Pump being supplied from the line with the break.

5.3.4 AFW Line Rupture Outside CV Test

The malfunction is first entered for the AFW Line to "A" S/G. Correct response of the S/G flows and levels is verified. The Feedwater to "A" S/G is then isolated and the same parameters are verified to be correct. The same test is performed for "B" and "C" S/G lines after reinitializing for each test.

5.3.5 AFW Line Rupture Inside CV Test

The malfunction is first entered for the AFW Line to "A" S/G. Correct response of the S/G flows and levels is verified. AFW Discharge Pressure and Containment Sump Level is also verified to respond correctly. The Feedwater to "A" S/G is then isolated and the same parameters are verified to be correct. The same test is performed for "B" and "C" S/G lines after reinitializing for each test.

5.3.6 Motor Driven AFW Pump Isolation Valves Failure Test

A malfunction is entered to close the AFW Isolation Valve to "A" S/G. Safety Injection is then manually initiated and AFW System Operation is monitored to verify that the valve remains closed and cannot be opened manually. S/G levels and AFW flows are verified to be correct. An attempt is made to close the AFW isolation valve to "B" S/G and then Safety Injection is reset and it is verified that the "B" valve will close. The AFW valve to "C" S/G is failed open by entering a malfunction and it is verified that it cannot be closed with the malfunction entered.

The simulator is reinitialized and a malfunction is entered to close the AFW isolation valve to "B" S/G.

The Reactor is tripped to establish S/G Lo Level and the same verifications are made for applicable flows, levels, and valves. In this test the AFW valve to "A" S/G is failed 100% open and it is verified that it will not close with the malfunction entered.

5.3.7 Feedwater Bypass Valve Failure Test

With the turbine at 1800 rpm and S/G levels being maintained by the Bypass Valve malfunctions are entered to fail "A" Bypass Valve closed, "B" Bypass Valve closed, and "C" Bypass Valve open. Verifications are made after entering each malfunction for correct indication of Feedwater Flow, S/G levels, and controller indication. It is also verified that the controller cannot position the valve with the malfunction entered and that LOA CFW will close the isolation valve for S/G "C" Bypass Valve.

The simulator is reinitialized to 100% BOL and "A" Feedwater Bypass Valve is failed fully open. Correct response of valve controllers, alarms, flows, levels, and Main Feedwater Regulating Valve is verified.

5.3.8 Turbine Driven AFW Flow Control Valve Failure Test

The Steam Driven Auxiliary Feedwater Pump is placed in service and the malfunction is entered to fail the Flow Control Valve fully closed and then fully open. After each failure, correct response is verified for flows, pressures, indicating lights, and S/G level. In each case, the controller is placed in manual and it is verified that valve position cannot be changed with the malfunction entered.

5.3.9 Condensate Pump Trip Test

The malfunction is entered to trip Condensate Pump A with one MFW Pump running. Correct plant response is verified including automatic start of "B" Condensate Pump and that the running MFW Pump does not trip. The simulator is reinitialized with two MFW Pumps running and "B" Condensate Pump is tripped by entering the malfunction. Correct plant response is verified including trip of "B" MFW Pump, Reactor Trip, flows, pressures, levels, and alarms.

5.3.10 Feedwater Isolation Valve Failure Test

The Feedwater Isolation Valve for S/G C is failed to full closed by entering the malfunction. Correct response is verified for indicating lights and flows to the S/G's. An attempt is made to open the failed valve and then the Bypass Valve is opened and correct indications verified. Feedwater flows, S/G levels, alarms, and Reactor Protection System Status Lights are verified correct through Reactor Trip and start of AFW Pumps.

The simulator is reinitialized and the three Feedwater Isolation Valves are failed open. A manual safety injection is initiated and it is verified that the valves remain open and cannot be closed by their control switches.

5.3.12 Heater Drain Pump Trip Test

The malfunction to trip Heater Drain "A" is entered and results in a trip of the Heater Drain Pump. Realistic integrated plant response is verified. It is also verified that a low-low level in the Heater Drain Tank will trip both pumps, a low discharge pressure will trip the associated Heater Drain Pump, and that a high Heater Drain Tank level is required to start either Heater Drain Pump. LOA CFW for LCV-1530A Bypass Valve and XMT for PT-1582 are utilized for this test.

5.3.13 High Pressure Feedwater Heater 6 Tube Leak Test

The malfunction is entered and correct response is verified for levels, temperature, pressure, controller actions and alarms associated with heater, MSR Drain Tank and Heater Drain Tank.

5.3.14.1 Low Pressure Feedwater Heater 1A Tube Rupture Test

The malfunction is entered and correct response is verified for heater level, pressure, temperature, controller actions, and alarms. The effect on 2A heater is also verified.

5.3.14.2 Low Pressure Feedwater Heater 3A Tube Rupture Test

The malfunction is entered and correct response is verified for heater level, pressure, temperature, controller actions, and alarms. The effect on 4A heater is also verified.

5.3.16 Main Feedwater Pump Recirculation Valve Failure Test

The failed closed malfunction is entered with the "A" Main Feedwater Pump in service and the recirculation valve open. Correct flow response and valve position is verified. The automatic start of "B" Main Feedwater Pump and both Motor Driven Auxiliary Pumps is verified and the same test is repeated for "B" pump.

With the reactor at 100% power, the failed open malfunction is entered for "A" pump. Correct response is verified for flow to Steam Generators and recirculation flow. The Isolation Valve is closed by LOA. The simulator is reinitialized and the test repeated for "B" pump.

5.3.17 Feedwater Control Valve Failure Test

The malfunction is entered to fail open "A" S/G Feedwater Control Valve. The valve is placed in manual and S/G level is stabilized after correct integrated plant response is verified. The malfunction is then cleared.

After the plant has stabilized the malfunction is entered to close "A" S/G Feedwater Control Valve and the valve is placed in automatic to verify the malfunction functional and correct integrated plant response is verified.

5.3.18 Feedwater Break Inside Containment Test

The malfunction is entered and causes a feed line break inside Containment, which results in a Reactor Trip, Turbine Trip, and Safety Injection. Initial parameter response is verified prior to Reactor Trip/Safety Injection. Following Reactor Trip/Safety Injection, simulator response is verified by following the appropriate Emergency Operating Procedures until a stable condition is attained with Reactor Coolant System pressure stable. Plant parameters, alarms, and Reactor Protection System Bistable Status Lights are verified to be correct.

5.3.19 Total Loss of Feedwater Test

The malfunction is inserted and results in a reactor trip, turbine trip, and a Red Path on the Heat Sink Critical Function. Initial parameter response is verified prior to the reactor trip. Following the trip, the simulator's response is verified by completion of the appropriate Emergency Operating Procedures until a stable condition is attained.

5.3.20 Inadvertent Feedwater Isolation Test

With the Simulator at a stable 25% power condition, an Inadvertent Feedwater Isolation signal to the "A" Steam Generator was initiated. The appropriate plant responses including alarms, interlocks, and indications are verified. Additionally, the effect of depressing the Feedwater Isolation Reset Push buttons for the affected and unaffected Steam Generators is verified.

5.3.21 SG High Level Trip Failure Test

This test verifies the ability to fail automatic turbine trip and feedwater isolation on high-high steam generator (SG) level using MALFUNCTION CFW21.

VERIFICATION No. 1: SG 1 High-High Level Condition

With the plant initially at 100% power and with the high-high SG level trip signal failed, the SG 1 feedwater regulating valve is shifted to manual and SG 1 level raised above the set point for high-high level bistable actuation. Following bistable actuation, it is verified that the turbine fails to trip, the main feedwater (MFW) pumps fail to trip, and the feedwater regulating and bypass valves fail to close.

VERIFICATION No. 2: SG 2 High-High Level Condition

With the plant initially at 100% power and with the high-high SG level trip signal failed, the SG 2 controlling level transmitter is failed low using the transmitter override function. In response to the low level signal, automatic SG water level control increases MFW flow. SG 2 level increases and the high-high level bistables on the two unaffected SG level channels trip. Following bistable actuation, it is verified that the turbine fails to trip, the Main Feedwater (MFW) Pumps fail to trip, and the Feedwater Regulating and Bypass Valves fail to close.

VERIFICATION No. 3: SG 3 High-High Level Condition

With the plant initially at 100% power and with the high-high SG level trip signal failed, two of the three SG 3 high-high level bistables are tripped using the Local Operator Action function. Following bistable actuation, it is verified that the turbine fails to trip, the Main Feedwater (MFW) Pumps fail to trip, and the Feedwater Regulating and Bypass Valves fail to close. Safety Injection is then manually actuated and it is verified that the malfunction does not affect SI initiated Feedwater Isolation, including turbine trip

and MFW Pump trip.

5.3.24 Feedwater Break in Main Feedwater Header Test

The malfunction is entered and initial parameter response is verified prior to reactor trip. Following reactor trip correct integrated plant response is verified including annunciator reflash capability.

5.3.26 Feed Line Break in Discharge of Main Feedwater Pump Test

The malfunction is entered for "A" Main Feedwater Pump and integrated plant response is verified. The test is repeated for "B" Main Feedwater Pump.

The simulator is reinitialized to 50% power and a leak of 1×10^5 lbm/hr is entered for "A" MFW Pump. Flow out of the break is verified and then LOA is used to close the "A" MFW Pump Suction Isolation Valve. Verification of flow going to 0 is made and the test repeated for "B" MFW Pump.

5.3.28 Loss of MFW Pump Lube Oil Test

The malfunction is entered for "A" MFW Pump with "B" MFP off. Correct response of the Auxiliary Oil Pump is verified. Automatic start of "B" MFP is verified when "A" MFW Pump trips. Automatic start of both Motor Driven AFW Pumps, Indicating Lights, and Annunciators are verified to be correct. The test is repeated with "B" MFW Pump in service and the malfunction for "B" entered.

5.3.29 Condensate Storage Tank (CST) Leak Test

The malfunction is entered and it is verified that a leak near the bottom of the Condensate Storage Tank results. Alarm functions and integrated plant response are verified including high and low CST level alarms, loss of makeup capability to the Condenser Hot well, ability to makeup to the CST and loss of Auxiliary Feedwater suction capability from the CST.

5.4.2 Condenser Air Inleakage Test

The malfunction is inserted and plant response is verified loss of vacuum, auto start of the standby Condenser Vacuum Pump, Generator Load, Reactor Power, Alarms, Turbine Trip, and Reactor Trip.

5.4.3 Condenser Vacuum Pump Trip Test

The malfunction is entered for "A" Vacuum Pump and it is verified that "B" Vacuum Pump automatically starts when "A" trips and that proper breaker indication and alarms are received. The malfunction is then entered for "B" Vacuum Pump. After verifying correct indications and responses for the breakers, both malfunctions are removed and their Control Switches are placed in "STOP." Verification is made that the pumps will not automatically start on low vacuum with their switches in "STOP."

5.4.4 Vacuum Pump Shaft Break Test

The malfunction is entered for Condenser "A" Vacuum Pump and correct plant response is verified including Condenser Vacuum, Breaker Indication, Generator Load, and automatic start of "B" Condenser Vacuum Pump.

5.4.5 Hot well Level Control Failure Test

The Condensate Reject to Condensate Storage Tank Isolation Valve is opened with local operator function and the malfunction is entered to cause the Controller to lower Hot well level. Correct responses for alarms, actual Hotwell level, and Condensate Storage Tank level are verified. The simulator is reinitialized and the isolation valve for makeup is opened with local operator function. The malfunction is entered to cause the Controller to raise Hotwell level. Correct response for the same parameters are verified.

5.5.1 False CV Spray Actuation Test

The malfunction is inserted for Train A and it is verified that spurious spray actuation occurs. The simulator is reinitialized and the malfunction is entered for Train B along with Malfunction EPS13, Loss of Startup Transformer. Verification of inadvertent spray is made. It is also verified that the train's Component Cooling Water Pump is tripped when that train's Emergency Diesel Generator is supplying its emergency bus, and both a Safety Injection Signal and Containment Spray Signal for that train exist at the same time.

5.5.2 CV Spray Pump Failure Test

The malfunction is entered for "B" Containment Spray Pump and containment spray is manually actuated for both trains. Correct response is verified for the failed pump and for the running pump. The malfunction

is then entered for "A" pump and verification is made that the pump trips and that proper indications and alarms are received. Restart is attempted for both pumps with the malfunction active.

5.5.3 CV Spray Header Leak Test

With train B containment spray pump and associated discharge valves inoperable, a containment spray signal is manually actuated from the main control board. Proper alarm and containment spray system response is verified following the actuation. The leak malfunction is then entered for train A containment spray line and response of the system to the leak is verified. Also, the containment spray pump is stopped in train A for verification of leak stoppage.

5.6.1 Power Cabinet Urgent Failure Test

The malfunction is entered for Power Cabinet 1AC and the urgent failure alarm is confirmed. The Rod Group Selector is positioned to each Shutdown Bank and Control Bank, and rods are driven in to verify that rods powered from 1AC Power Cabinet do not move and that unaffected rods do move. It is then verified that not any rods will move with the Rod Group Selector Switch in Manual or Automatic. The test is repeated for a malfunction entered for each of the other three Power Cabinets.

5.6.2 Failure of Control Rods to Move Test

The malfunction is entered and the urgent failure alarm is verified. Each position on the Rod Group Selector Switch is sequentially selected and rod motion, in and out, is attempted in each position by use of the IN-HOLD-OUT lever. It is also verified that the rods will not move in automatic by reducing the turbine load until an in demand signal is generated.

5.6.3 Control Rod Drop Test

This simulator performance test verifies that a control rod can be dropped into the core using the associated dropped rod malfunction. Realistic integrated plant response following the rod drop and subsequent recovery is verified, except that automatic turbine run back is inhibited to limit observed effects to the rod drop itself.

5.6.4 Stuck Control Rod Test

The malfunction is entered for Control Rod D-8. A power reduction is initiated to cause Control Bank D to insert. When it is verified that D-8 is not moving, the Bank Selector is placed in manual, and D Bank inserted 5 steps then withdrawn 5 steps verifying D-8 will not move. An attempt is made with the Control Bank D Rods, except D-8, lift coils disconnected. The lift coils disconnect switches are closed and the reactor is manually tripped to verify D8 Rod does not trip.

5.6.5 Ejected Control Rod Test

The malfunction is entered and verification is made for correct response of Power and Intermediate Range Nuclear Instrumentation, Rod Position Indicating Lights, Alarms, and Indications of a LOCA.

5.6.6 Uncontrolled Rod Motion

The malfunction for uncontrolled automatic rod insertion is entered and then a malfunction is entered to fail T_{ref} 0.6 Deg F low. As rods continue to step in and T_{avg} decreases. A malfunction is entered to fail rod speed to 24 steps/min. The Rod Group Selector Switch is placed in Manual to stop rod motion. The simulator is reinitialized and the malfunction is entered for uncontrolled rod motion in manual. The IN-HOLD-OUT Switch is placed to IN. Rod insertion is verified with the switch in HOLD and also in OUT. The Rod Group Selector is shifted to verify continued insertion, except in AUTO in which rod motion is verified to stop.

The simulator is reinitialized and the malfunction for manual uncontrolled rod motion reentered. The IN-HOLD-OUT lever is positioned to OUT and it is verified rod out motion continues when the lever is released and continues until the Group Selector Switch is placed in AUTO.

5.6.7 Auto Rod Speed Controller Failure Test

The Rod Speed Signal is failed to 60 steps/min by entering the malfunction and realistic Rod Control System response is verified. It is also verified that placing Rod Control in manual allows normal speed control and that the malfunction remains when placed back in auto.

5.6.8 Rod Control T_{ref} Failure Test

With the plant initially at full power and rod control in automatic, reference temperature derived from first stage turbine pressure (T_{ref}) was failed to 565 Deg F using MALFUNCTION CRF8. Automatic inward rod motion occurred as a result of the failure until T_{avg} was reduced to the new T_{ref} value. Proper lag compensation from the T_{ref} module to the rod control system was also verified.

5.6.10 IRPI Coil Failures Test

The combinations of this malfunction are individually entered for Control Rod H-8 with the simulator initialized before insertion of the malfunction. Except for secondary coil shorted and primary and secondary shorted the rod is dropped and causes a turbine run back to 70%. Correct indications and alarms are verified.

5.6.11 Control Bank Overlap Failure Test

Each of the three overlap failure malfunctions is tested individually to verify that the malfunction will reset the overlap settings. Rod positions and correct alarm response are verified for each malfunction.

5.6.12 Step Counter Failures Test

Each Step Counter is failed in turn. It is verified that the malfunction only affects the Step Counters and does not impact actual rod movement or the Rod Bank position indication available from the ERFIS computer.

5.6.13 Rod Speed Dead band Controller Failure Test

The malfunction is entered and it is verified that rod control operates with a dead band selected by the malfunction.

5.6.16 Loss of Rod Drive MG Sets Test

Proper Control Rod Drive System response is verified following sequential tripping of the two Rod Drive Motor-generator (MG) sets. It is verified that, when the second MG set is tripped, Control Rods drop in but Reactor Trip Breakers do not open and the turbine does not trip.

5.6.17 Loss of Power to Power Cabinets Test

This malfunction is entered for Power Cabinet 2BD and verification is made for correct rods dropped, power decrease, and alarms. The Rod Group Selector is then sequentially positioned to each bank and manual insertion is made to verify correct rods move in.

5.6.18 Bent Control Rod Shaft Test

This malfunction is inserted and verification is made that Rod H-12 will not insert past 160 steps manually, automatically or upon Reactor Trip. The ability to withdraw the rod is verified.

5.7.1 Letdown Isolation Valves Failure Test

The malfunction was entered to cause both letdown isolation valves to fail open. The main control board common control switch for these valves was positioned to CLOSE and it is verified that the valves remain open. With the common control switch returned to AUTO, it is verified that the letdown valves remain open when an automatic closure signal from low pressurizer level is present. This signal is developed by failing pressurizer level transmitter LT-460 to less than 14.4% using its transmitter override.

Additionally, the malfunction is entered to cause both letdown isolation valves to fail closed in independent verifications. Integrated plant response to loss of letdown is completely verified following LCV-CVC-460B closure.

In both cases, appropriate system responses including alarms, levels, pressure, temperatures, interlocks, and control functions are verified.

5.7.2 CVC-LCV-115C Failure Test

This test verifies the ability to fail the Volume Control Tank (VCT) Outlet Valve (CVC-LCV-115C) both fully open and fully closed using MALFUNCTION CVC2 with the plant at 100% power.

With CVC-LCV-115C failed open, it is verified that the valve cannot be shut by either its control switch or via the low VCT level interlock. The low VCT level signal is developed by failing the two level transmitters (LT-112 and LT-115) using their transmitter overrides (LT-112 is failed to 20 percent and LT-115 is failed to 12 inches).

With CVC-LCV-115C failed closed, it is verified that CVC-LCV-115C cannot be opened with its control switch and that the emergency makeup valve (CVC-LCV-115B) automatically opens on interlock. Boration from the refueling water storage tank through CVC-LCV-115B is verified by observing an RCS temperature change.

5.7.3 Letdown Line Leak Inside CV Test

This malfunction is entered for two different leak rates 10 gpm and 165 gpm. In both cases, the appropriate system responses including alarms, levels, pressures, temperatures, and indication are verified. Additionally, the ability of the Radiation Monitoring System to respond to different sizes of leaks in containment is verified.

5.7.4 Letdown Line Leak Outside CV Test

This malfunction was entered with a 60 gpm leak and a 0 second ramp to the Letdown Line outside Containment. Appropriate system responses including flows, levels, pressures, temperatures, and indications are verified.

5.7.5 Charging Pump Trip Test

The malfunction is entered to each running charging pump sequentially. The indications and alarms associated with a charging pump trip are verified. Additionally, integrated plant response to a loss of charging flow is verified on the trip of the "C" Charging Pump.

5.7.6 Primary Water Pump Trip Test

This malfunction is entered when the Primary Water Pump A is supplying the system. Appropriate system responses including alarms, flows, and indications are verified.

5.7.7 PCV-145 Controller Failure Test

This malfunction is entered to the 85% closed variation, with a 0 second ramp. Appropriate system responses including alarms, flows, pressures, temperatures, and indications are verified.

5.7.8 Inadvertent Low Pressurizer Level Bistable Actuation Test

This malfunction is entered when the Pressurizer Heaters are energized, resulting in the automatic tripping of the heaters and the isolation of letdown. Appropriate system responses, including alarms, flows, interlocks, and indications are verified.

5.7.9 LCV-112 Failure Test

This test verifies the ability to fail the letdown divert valve (CVC-LCV-115A) controller (LC-112) high and low using MALFUNCTION CVC9.

VERIFICATION No. 1: LC-112 failed high

With the plant at 100 percent power, the LC-112 automatic control signal is failed high resulting in full diversion of CVC-LCV-115A to the holdup tank (HUT). It is then verified that CVC-LCV-115A can be positioned using the valve's control switch and by taking manual control of LC-112.

VERIFICATION No. 2: LC-112 failed low

With the plant at 100 percent power, VCT level transmitter LT-112 (which provides the LC-112 level signal) is failed high to cause CVC-LCV-115A to fully divert to the HUT. The LC-112 automatic control signal is then failed low causing CVC-LCV-115A to reposition to the VCT. VCT level transmitter LT-115 is then failed high, causing CVC-LCV-115A to position back to the HUT (LT-115 high level overrides the LC-112 signal). It is then verified that CVC-LCV-115A can be positioned using the valve's control switch and by taking manual control of LC-112.

5.7.11 Non-Regenerative Heat Exchanger Tube Leak Test

This malfunction is entered with a 165 gpm leak rate and a 5 second ramp time. Appropriate system responses including alarms, flows, pressures, temperatures, and control/interlock functions are verified. Additionally, the use of Local Operator Actions and Remote Operator Actions to isolate the leak are verified.

5.7.12 Seal Water Heat Exchanger Tube Leak Test

This malfunction is entered with a 200 gpm leak and a 0 second ramp time. Appropriate system responses including alarms, flows, levels, and indications are verified. Additionally, the use of Local Operator Actions to isolate the Seal Water Heat Exchanger are verified.

5.7.13 Plugged Boric Acid Filter Test

This malfunction is entered to the 100% Blockage variation with a 10 second ramp, while a normal Boration is in progress. Appropriate system responses including flows, alarms, interlocks, and indications are verified. Additionally, the use of a Local Operator Action to bypass the Boric Acid Filter and reestablish normal system parameters is verified.

5.7.14 Plugged RCS Filter Test

This malfunction is entered to the 100% plugged option with a 60 second ramp time. Appropriate System Parameters including flows, levels, pressure, and indication are verified. Additionally, the use of a Local Operator Action to bypass the filter and reestablish normal system parameters is verified.

5.7.15 Charging Pump Speed Controller Failure Test

With the plant at 100% power and with the effected charging pump's controller in automatic, the Speed Control Signals to Charging Pump A and Charging Pump B are failed to 0% in separate verifications. The indications and alarms associated with each of these failures should occur as required. It is further verified that the malfunction prevents manual control of charging pump speed.
With the plant at 100% power and with its controller in automatic, the Charging Pump C Speed Control Signal is failed to 100%. Pump speed should increase as indicated by the Speed Signal Meter and Charging Flow Rate. Due to the increased Charging Flow Rate through the Regenerative Heat Exchanger, Charging Temperature, and Letdown Outlet Temperature should decrease. Due to the higher Charging Flow Rate Volume Control Tank (VCT) level and pressurizer level should increase. The alarms, indications, and control actions should occur as required.

5.7.16 Orifice Isolation Valve Failure Test

The malfunction is entered to cause the two 60 gpm Orifice Isolation Valves to fail open. The indications, alarms, and interlock/control functions are verified. Additionally, the is entered causing the three Orifice Isolation Valves to fail closed. Appropriate system responses are verified.

5.7.17 Letdown Leak Before Orifice Isolation Valves Test

This test verifies that MALFUNCTION CVC17 causes a leak in the letdown line between letdown isolation valve CVC-LCV-460B and the regenerative heat exchanger inside containment.

With the plant at 25% power and with a 45 gpm letdown orifice in service, a 500 gpm leak is initiated on the letdown line inside containment. Following leak initiation, indicated letdown flow rate decreases to zero gpm and letdown pressure decreases markedly. Regenerative heat exchanger temperatures change in a manner that verifies proper leak location. Volume Control Tank (VCT) level and pressurizer level decrease at a rate consistent with the leak size. Also, containment pressure and sump levels increase at a rate consistent with the leak size.

When pressurizer level decreases to 14.4%, letdown automatically isolates, isolating the leak. VCT level and pressurizer level stop decreasing and containment sump level stops increasing. The indications, alarms, and control actions associated with a leak at this location are verified.

5.7.18 Auxiliary Spray Valve Failure Test

This malfunction is entered for two separate failures of the Auxiliary Spray Valve, full open and full closed. In both cases appropriate pressurizer system responses are verified.

5.7.19 Normal and Alternate Charging Valves Failure Test

This malfunction is entered to fail the normal charging valve, open and then closed. It is subsequently entered to fail the alternate charging valve open and closed. Appropriate system responses including alarms, flows, pressures, and interlocks, are verified.

5.7.21 CVC-LCV-115B Failure Test

This malfunction is entered to cause two separate failures of LCV-115B (Full open and full closed). In both cases, the ability of the malfunction to inhibit automatic and manual control of LCV-115B and interlock functions are verified.

5.7.22 Boric Acid Pump Trip Test

With a boration in progress, the malfunction is entered to cause a trip of the in service Boric Acid Pump. Proper alarm, flow, and interlock functions are verified. The Standby Boric Acid Pump was then placed

in service by the use of Local Operator Actions, and the Boration reinitiated. This pump is also tripped by the use of the malfunction and appropriate parameter verifications rechecked.

5.7.23 Plugged Seal Water Return Filter Test

With the plant at 100% Power, the Seal Return Filter is completely plugged by the insertion of this malfunction. Seal Water Return Flow from each RCP decreases until the Seal Water Return Line Relief Valve lifted. Seal Water Return Flow then fluctuates as the Relief Valve lifts and reseats. Proper alarms, flows, and levels are verified. Additionally, the use of a Local Operator Action to open the Bypass Valve around the Seal Return Filter and establish normal operating parameters is verified.

5.7.24 Charging Leak Test

This malfunction is entered at five separate locations within the charging system. The charging systems response to these leaks is verified. This verification consisted of proper flow, pressure, temperature, level, and alarm actuation. Additionally, the ability to isolate the leak is verified where appropriate.

5.7.25 Makeup Selector Switch Failure Test

The RCS Makeup Mode Selector Switch is failed by the use of this malfunction. It is then verified that Automatic Boration, Dilution, Alternate Dilution, and Blended Makeup will not initiate. The ability to manually makeup by operation of the individual components is additionally verified.

5.8.1.1 Circulating Water Pump Trip Test

The malfunction is entered and verification is made for initial integrated plant response indicative of a loss of a single Circulating Water Pump.

5.8.1.2 Loss of Circulating Water Pumps Test

The malfunctions are sequentially entered for each Circulating Water Pump. When the third Circulating Water Pump trips, alarm and interlock functions are verified.

5.9.1 Diesel Generator Failures Test

Each of the three Diesel Generators is tested separately to verify the malfunction will cause a shutdown of the diesel if running or a failure to start, manually or automatically if a start is attempted. The simulator is reinitialized for each trip or fail to start test.

5.9.4 Emergency Diesel Generator Load Sequencer Test

The malfunction is entered for Individual Blocks or Separate Trains. The equipment this malfunction prevents from loading is STOPPED, if previously running. A Manual Safeguards Signal is then inserted, which would have started the individual components. Proper component responses are verified.

5.10.2 Loss of Instrument Buses Test

The malfunction for each of the nine 120 VAC instrument buses is entered individually. Verification is made that indicators, recorders, transmitters, and monitors powered from the bus deenergize. Additionally, the LOAs to reenergize instrument buses 6, 7, 8, and 9 are verified.

5.10.3 Loss of 125V DC Buses Test

The malfunction is entered for MCC "A" and integrated plant response is verified. The indications, alarms, and equipment actions or failures are verified. The test is then repeated for MCC "B" and MCC "C" individually.

5.10.4 Loss of 4160V Buses Test

The malfunction is entered for each 4160V bus individually. Verification is made for correct breaker operation, alarms, 4160V equipment lost, Diesel Generator starts and voltage indications. Use of LOAs to reenergize the Electrical Distribution System verifies their function.

5.10.5 E-1 and E-2 Feeder Breaker Trip Test

With the simulator at a stable 100% power condition,

the Feeder Breakers to the 480 Volt Emergency Buses E-1 and E-2 are failed in separate verifications. The appropriate responses including alarms, interlocks, and indications are verified.

5.10.7 Auxiliary Transformer Failure Test

The Auxiliary Transformer normally supplies the majority of the Electrical Distribution System when the plant is at 100% Power. The malfunction is entered and loss of appropriate portion of the Electrical Distribution System verified. Additionally, alarm and breaker Automatic Transfer/Interlocks are verified.

5.10.8 Loss of 480V Buses Test

The malfunction is entered for each 480V bus individually. Verification is made for correct breaker operation, voltage indication, alarm, and 480V equipment lost.

5.10.9 Degraded Grid Voltage Test

The malfunction is entered and the plant connections to the grid are monitored to verify voltage and current respond in correct direction. Generator megavars, frequency and field amps are also verified.

5.10.13 Loss of Start-up Transformer Test

This test verifies proper plant response to a loss of the Start-up Transformer under two different Electrical Distribution System Line-ups. When the plant is in a Hot Shutdown condition, the Start-up Transformer supplies the entire Electrical Distribution System. The malfunction is entered and loss of the Electrical Distribution System verified. The Emergency Diesel Generators started and closed on to their respective buses.

When the plant is at 100% Power, the Start-up Transformer normally supplies only a portion of the Electrical Distribution System. The malfunction is entered and loss of the appropriate portion of the Electrical Distribution System verified. The Associated Emergency Diesel Generator should start and close on to its associated bus.

5.12.2 Turbine Trip on Generator Trip Failure Test

This simulator performance test verifies that this

malfunction can prevent a turbine trip following a main generator ground lockout trip. Proper integrated plant response is verified including operation of the turbine overspeed protection controller.

5.12.3 Generator Output Breaker Failures Test

The malfunction is entered for each breaker individually. The Reactor is manually tripped and it is verified that the breaker with malfunction entered does not trip. Verification is also made that correct indications occur for the turbine, generator, and other associated breaker.

5.12.5 Load Rejection Test

Enter a 25% Load Rejection from a stable 100% BOL condition. The integrated plant response is verified. Additional parameters are verified after initiating event stabilized. No Operator Actions are taken during the course of this test.

5.12.6 Generator Trips Test

This Simulator Performance Test verifies that a Main Generator Trip, from each of the tested options, produces the integrated plant response associated with a loss of the Main Generator from 100% Power. Proper alarm/relay and system indications are verified.

5.13.1 Containment Fan Cooler Trip Test

The malfunction is entered for each Fan Cooler Unit with the unit in operation and verification is made for the associated indications and alarms. Reset of alarm for High Vibration is also verified.

The simulator is initialized to Hot Standby and Safety Injection is manually initiated with the malfunction entered for Fan Cooler Units 1, 2, & 3. Verification is made that these units attempt to start and then immediately trip. Verification is made of correct indications and alarms. The malfunction is then entered for Fan Cooler Unit 4 and the same verifications are made.

5.14.1 Refueling Water Storage Tank RWST Leak Test

Makeup to the RWST capability is tested utilizing local operator function - a 10,000 gpm leak malfunction is entered and integrated plant response is verified

including alarm function, RWST level response, and loss of ECCS pump suction capability.

5.14.4 Phase A Isolation Signal Failure Test

This simulator performance test verifies each train of containment phase A isolation can be failed, either preventing actuation or causing inadvertent actuation of the selected train. The valves associated with each train of containment isolation are verified to be in the proper position following each malfunction entry.

5.14.5 Phase "B" Isolation Signal Failure Test

The malfunctions are entered for each train individually. After entering the malfunction for failure to actuate, Phase B Isolation is initiated by manually actuating both trains of CV spray for A Train malfunction and LOA action to trip Containment hi hi pressure bistables for B Train malfunction. Correct valve position, alarms, and Containment Spray Status Panel lights are verified. After entering the malfunction for inadvertent operation the same verifications are made. In addition, attempt is made to open the valves with and without the Containment Phase B Reset push button depressed to verify correct Valve Control response.

5.15.2.1 DBA Steam Break Outside C.V. Test

The steam line break malfunction is inserted and initial parameter response is verified prior to the Reactor Trip/Safety Injection. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained which can be continued to Cold Shutdown.

5.15.3 MSIV Fails Open Test

The malfunction is entered for MSIV "A" failure to close and Local Operator Action is used to trip a High Steam Flow Bistable in another loop while a steam break malfunction is entered for the third loop. Integrated plant response is verified to be indicative of a Main Steam Isolation Valve failing to close when required. The test is repeated for the malfunction of each of the other Steam Line MSIVs.

5.15.4 Steam Generator PORV Failure Test

Both open and closed failures of the three Steam Generator PORVs are verified by entering malfunctions MSS4A, MSS4B, and MSS4C in both positions. Valve response is verified on the three steam generators, while integrated plant response to a failed open PORV is only verified on "A" Steam Generator since response should be similar for the other two PORV failures.

5.15.5 Steam Dump Controller Modulation Failure Test

The malfunction is entered for the Condenser Steam Dump Controller to fail to the 100% open position. Malfunction RPS1A is then entered for inadvertent Reactor Trip. Parameters are verified to be indicative of the Condenser Steam Dumps failing to modulate as the valves stay 100% open until the Low T_{avg} Bistable is energized at which time the valves close until T_{avg} increases to deenergize the bistable and the valve again opens to 100%.

5.15.6 Steam Dump Failure Test

The malfunction for each Condenser Steam Dump Valve is entered along with a malfunction (MSS5) to fail the Steam Dump Controller to 100% open and malfunction RPS1A for inadvertent trip of Reactor. Integrated plant response indicative of a Condenser Steam Dump Valve failing to a predetermined position is verified. The test is repeated for each of the five valves.

5.15.7 Steam Dump Permissive Failure Test

The malfunction (Mode 1) is entered in addition to the malfunction for inadvertent Reactor Trip. Integrated plant response indicative of a false Low T_{avg} signal being generated to the Steam Dump Control System is verified.

The simulator is reinitialized and the malfunction (Mode 2) is entered with the inadvertent Reactor Trip. Integrated plant response of the Steam Dump Control System failing to receive a Low T_{avg} signal is verified.

Correct response of the Steam Dump Control System is verified.

5.15.9 Main Steam Header Leak Test

The malfunction is entered and results in a Reactor Trip, Turbine Trip, Safety Injection, and Main Steam

Isolation. Initial parameter response is verified prior to the Reactor Trip/Safety Injection. Following the Reactor Trip/Safety Injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.16.2 Source Range Pulse Height Discriminator Failure Test

The Source Range Nuclear Instrument Pulse Height Discriminator is failed, using malfunction NIS2, in both the low and high direction. Correct indications, bistable action, alarms, and trip actions are verified.

5.16.3 SR NI High Volt Cutoff Failure Test

The reactor is initially critical at 10^{-8} amps in the Intermediate Range. Proper automatic re-energizing of both SR NI channels is verified by manually inserting control rods to reduce reactor power to approximately 5 X 10^{-11} amps. With both SR NIs' re-energized, MALFUNCTION NIS2 is inserted to fail the SR NI Channel NI-32 high voltage cutoff circuit.

Control Rods are subsequently withdrawn to raise power above the P-6 interlock and the push buttons that block the SR high flux trip and provide SR detector high volts cutoff are depressed. SR NI Channel NI-31 de-energizes, but Channel NI-32 fails to de-energize due to the malfunction.

Reactor power is then increased until the NI-32 high flux trip bistable actuates at 10^5 CPS. The reactor does not trip when this bistable is tripped, demonstrating that MALFUNCTION NIS2 only affects the NI-32 high voltage cutoff function and not the high flux trip blocking function.

5.16.4 SR NI High Volts Failure Test

This test verifies the ability to fail the Source Range (SR) Nuclear Instrument (NI) detector voltage using MALFUNCTION NIS4.

VERIFICATION No. 1: Detector voltage failed to 1700 volts

With the plant initially shutdown at no-load temperature, SR NI Channel NI-31 detector voltage is failed to 1700 volts. Indicated flux level for this channel decreases from approximately 60 counts per second (CPS) to approximately 8 CPS and the loss of detector voltage alarm is actuated.

VERIFICATION No. 2: Detector voltage failed to 2500 volts

With the plant initially shutdown at no-load temperature and with one bank of shutdown control rods withdrawn, SR NI Channel NI-32 detector voltage is failed to 2500 volts. Indicated flux level for this channel increases from approximately 60 CPS to a full-scale reading of 10^6 CPS, actuating the SR HIGH FLUX AT SHUTDOWN alarm and generating a SR high flux reactor trip.

5.16.6 IR NI Gamma Compensation Failure Test

This test verifies the ability to fail the Intermediate Range (IR) Nuclear Instrument (NI) compensating voltage using MALFUNCTION NIS6.

With the plant initially at 20 percent power, the IR NI Channel NI-35 compensating voltage is failed to add 7 X 10^{-8} amps to the normal channel output (under-compensation). The reactor is then tripped and the IR NI Channels monitored.

The affected channel indicates higher than the non-affected (NI-36) channel during the neutron flux decrease following the reactor trip and then levels off at approximately 7 X 10^{-8} amps. The non-affected channel's output continues to decrease in the normal fashion to minimum indication (10^{-11} amps).

Source Range (SR) NIs does not automatically re-energize, since both IR NI Channels must indicate less than approximately 5 X 10^{-10} amps for this function to occur. Both SR NIs' re-energize when the appropriate manual push buttons are depressed.

5.16.7 PRNI Detector Failure Test

This test verifies the ability to fail a Power Range (PR) Nuclear Instrument (NI) detector using MALFUNCTION NIS7.

With the plant initially at 100 percent power, the PR NI Channel NI-44 lower detector output is failed to 0 micro amps (FA). The sudden drop in NI-44 Channel output (summed value of the upper and lower detectors) results in a PR NI dropped rod (i.e., negative rate) turbine run back and, appropriate PR NI Channel indications and alarms. The turbine run back is monitored through completion (70% power) to verify proper integrated plant response. The ability to remove NI-44 from service is then demonstrated.

To further verify proper modeling of the PR NI Dropped Rod Turbine Run back Circuit, the PR NI Channel NI-41 upper detector is failed to 0FA and it is verified that a second turbine run back does not initiate.

5.16.9 Incore Detector Failure Test

Incore Detector "A" is inserted into the core with a flux map being recorded. The malfunction is entered and it is verified that the recorded flux map during detector withdrawal is approximately 20% of the values recorded during the insertion.

5.16.10 SR NI Fuse Failure Test

This test verifies the ability to fail a Source Range (SR) Nuclear Instrument (NI) instrument power and control power fuses using MALFUNCTION NIS10.

VERIFICATION No. 1: SR NI Instrument Power Fuse Failure

With the plant initially shutdown at no-load temperature and with one bank of Shutdown Control Rods withdrawn, the Instrument Power Fuses of each of the two SR NI Channels (NI-31 and NI-32) are failed in independent verifications. Source range indication for each channel fails to minimum (10^0 CPS) and the alarms and automatic functions associated with the fail-safe nature of the NI bistables occur, including actuation of a SR High Flux Trip.

VERIFICATION No. 2: SR NI Control Power Fuse Failure

With the plant initially shutdown at no-load temperature and with one bank of Shutdown Control Rods withdrawn, the Control Power Fuses of each of the two SR NI Channels (NI-31 and NI-32) are failed in independent verifications. Source range indication for each channel is not lost, but the alarms and automatic functions associated with the fail-safe nature of the NI bistables occur, including actuation of a SR High Flux Trip. The dependence of the High Flux Trip Bypass and the NIS CHANNEL TEST alarm on control power availability are tested.

5.16.11 IR NI Fuse Failures Test

This test verifies the ability to fail Intermediate Range (IR) Nuclear Instrument (NI) instrument power and control power fuses using MALFUNCTION NIS11.

VERIFICATION No. 1: IR NI Instrument Power Fuse Failure

With the plant initially critical at 10^{-8} amps in the IR and with one bank of shutdown control rods withdrawn, the instrument power fuses of each of the two IR NI channels (NI-35 and NI-36) are failed in independent verifications. IR indication for each channel fails to minimum (10^{-11} amps) and the alarms and automatic functions associated with the fail-safe nature of the IR NI bistables occur, including actuation of a IR high flux trip.

VERIFICATION No. 2: IR NI Control Power Fuse Failure

With the plant initially critical at 10^{-8} amps in the IR and with one bank of shutdown control rods withdrawn, the control power fuses of each of the two IR NI channels (NI-35 and NI-36) are failed in independent verifications. IR indication for each channel is not lost, but the alarms and automatic functions associated with the fail-safe nature of the IR NI bistables occur, including actuation of a IR high flux trip. The dependence of the high flux trip bypass and the NIS CHANNEL TEST alarm on control power availability are tested.

5.16.12 PR NI Fuse Failure Test

This test verifies the ability to fail a Power Range (PR) Nuclear Instrument (NI) instrument power and control power fuses using MALFUNCTION NIS12.

VERIFICATION No. 1: PR NI Instrument Power Fuse Failure

With the plant initially at 100 percent power, the instrument power fuses of two of the four PR NI channels (NI-41 and NI-44) are failed in independent verifications. PR indication for each channel fails to minimum and the alarms and automatic functions associated with the fail-safe nature of the PR NI bistables are verified, including rod stops (control rod out-motion inhibit) and actuation of a PR NI dropped rod (negative rate) turbine run back. The effects of the NI-44 failure on the automatic rod control system response are also verified (NI-44 is the only PR NI with input to automatic rod control). Additionally, the ability to remove NI-41 from service is tested, including the ability to bypass the dropped rod run back signal.

VERIFICATION No. 2: PR NI Control Power Fuse Failure

With the plant initially at 100 percent power, the control power fuses of two of the four PR NI channels (NI-42 and NI-43) are failed in independent verifications. PR indication for each channel is not lost and, the alarms and automatic functions associated with the fail-safe nature of the PR NI bistables is verified, including rod stop action and turbine run back. The dependence of the NI dropped rod turbine run back bypass on control power availability is also tested.

5.16.13 Noisy SR NI Channel Test

This test verifies the ability to increase the Source Range (SR) Nuclear Instrument (NI) noise-to-signal ratio using MALFUNCTION NIS13.

With the plant initially shutdown at no-load temperature and with one bank of shutdown control rods withdrawn, the noise-to-signal ratio of SR NI channel NI-31 is increased to 100. Indicated SR NI channel NI-31 count rate on indications behave erratically and NI-31 startup rate shows large positive and negative swings.

5.16.14 Failure of SR NI Block Test

This test verifies the ability to fail a Source Range (SR) Nuclear Instrument (NI) high flux trip block defeat push button using MALFUNCTION NIS14.

The reactor is initially critical at 10^{-8} amps in the Intermediate Range. Proper automatic re-energizing of both SR NI Channels (NI-31 and NI-32) is verified by inserting control rods to reduce reactor power to approximately 5×10^{-11} amps. With both SR NIs' re-energized, MALFUNCTION NIS14 is inserted to fail the TRAIN A (NI-31) SOURCE RANGE LOGIC TRIP DEFEAT push button.

5.16.15 Failure of SR NI to Reenergize Test

This test verifies the ability to fail automatic and manual re-energizing of a Source Range (SR) Nuclear Instrument (NI) channel using MALFUNCTION NIS15.

With the reactor initially critical at 10-8 amps in the Intermediate Range (IR), re-energizing of SR NI channel NI-32 is failed. The reactor is then tripped. As neutron flux decays to less than approximately 5×10^{-11}

amps, the IR bistables that cause automatic re-energizing of the SR actuate normally; SR NI channel NI-31 re-energizes but channel NI-32 does not re-energize due to the malfunction. Actions are taken to manually re-energize NI-32, but these actions are unsuccessful due to the malfunction.

Control Rods are subsequently withdrawn to raise power above the P-6 interlock. First the TRAIN B (NI-32) SOURCE RANGE LOGIC TRIP DEFEAT push button is depressed and then the TRAIN B push button is depressed. Neither NI-31 or NI-32 deenergized, since both push buttons must operate to remove SR NI high voltage.

The NI-32 output is then increased to the high flux trip bistable set point (10^5 CPS) using MALFUNCTION NIS1. The reactor should not trip at this point, since the unaffected (TRAIN B) DEFEAT push button should block the TRAIN B SR high flux trip; the NI-31 output is then increased to the high flux trip bistable set point (10^5 CPS) using MALFUNCTION NIS1. The reactor trips since Train A is not blocked.

5.16.16 NI51/NI52 Loss of High Voltage Power Supply

The malfunction is entered for Full Range Neutron Detector N51 and correct indication and alarms are verified. The malfunction is cleared and it is verified that indications and alarms return to normal. The malfunction is entered again and the reactor is tripped to verify correct response of Source Range Count Rate indication. The test is repeated for Full Range Neutron Detector N52.

5.17.1 Pressurizer Steam Space Leak Test

The malfunction is entered and correct integrated plant response is verified. Correct response is verified for pressurizer level and temperature, containment temperature, and pressure, area radiation monitors, process radiation monitors, and the Chemical and Volume Control System. The malfunction is removed and it is verified that parameters return to normal.

5.17.2 Pressurizer Spray Valve Failure Test

This simulator performance test verifies the proper response of the pressurizer pressure control system to both a failed closed and failed open pressurizer spray valve. The response of the pressurizer pressure controller, pressurizer heaters, non-affected spray valve and associated instrumentation and alarms are

verified in each case. Included in this test is a verification that pressurizer spray flow can be minimized by stopping the reactor coolant pump in the reactor coolant loop with the failed open spray valve.

5.17.3 Pressurizer PORV Failure Test

The malfunction is entered with the 2000 psig interlock functional and it is verified the PORV will cycle open and closed above the interlock pressure.

The simulator is reinitialized and the malfunction is entered without the 2000 psig interlock functional. For this malfunction, initial parameter response is verified prior to the reactor trip/safety injection. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.17.4 Pressurizer Safety Valve Failure Test

Pressurizer Safety Valve 551A fails open and results in a depressurization of the Reactor Coolant System, Turbine Run back, Reactor Trip, Turbine Trip, Safety Injection, and rupture of the Pressurizer Relief Tank Rupture Disk with resultant flow to the Containment. Correct parameter response is verified for the event along with alarm and protective system action. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.17.5 Pressurizer Backup Heater Group Failures Test

The malfunction is entered for both groups of backup heaters and pressurizer spray is activated to reduce pressurizer pressure. The failure of both groups to energize is verified after which the malfunctions are cleared to verify the heaters will energize with the malfunction removed.

Pressurizer level is increased with the malfunction entered for both backup heaters to verify that they will not energize from high level. The malfunctions are removed to verify the heaters will energize on high level with the malfunctions removed. The same verifications are made for the manual selector switches.

5.17.6 Pressurizer Pressure Control Band Shift Test

The malfunction is entered to first cause the controller to control 25 psia high and then to cause the controller to control 25 psia low. Correct pressurizer control actions and indications are verified in each case.

5.17.7 Pressurizer Level Control Band Shift Test

This simulator performance test verifies that a pressurizer control band shift will result when the malfunction is entered. In this test, the no-load Tavg value is failed to 574.5 Deg F. which causes the pressurizer reference level to fail to a minimum value. Pressurizer level control system and associated instrumentation response to this control band shift is verified. Also, this test verifies recovery of the pressurizer level control system to normal after the malfunction is removed.

5.18.1 DBA RCS Hot Leg LOCA Test

The malfunction is entered and results in a reactor trip, turbine trip, safety injection, and containment spray. Correct parameter response is verified during the performance of this test. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.18.3 Reactor Coolant Pump (RCP) Locked Rotor Test

Malfunction RCS3C is entered and causes a locked rotor on Reactor Coolant Pump "C" with subsequent reactor trip and turbine trip. Initial parameter response is verified for this event. Subsequent to the trip, verification is made by using the appropriate Emergency Operating Procedures until a stable, controllable, and safe conditions is attained.

5.18.5 Variable Boron Concentration Function Test

The malfunction is first entered to decrease Reactor Coolant System Boron Concentration and then entered to increase Boron Concentration. In both cases correct integrated plant response is verified including Boron Concentration, T_{avg}, Reactor Power, Pressurizer Level, Charging Pump Speed, and Control Rod response.

5.18.9.1 RCS Small Leak Test

The malfunction is entered and results in pressurizer level cycling as letdown flow secures and initiates. Realistic integrated plant response is verified including Chemical Volume Control Systems Operation, Containment Atmospheric Conditions, Controller Actions, and Annunciators/Alarms received.

5.18.9.2 RCS Small LOCA Test

The malfunction is entered and results in a reactor trip, turbine trip, and safety injection. Initial parameter response is verified prior to the reactor trip/safety injection. Following the reactor trip/safety injection simulator response is verified by completion of the appropriate operating procedures until a stable, controllable, and safe condition is attained.

5.18.12 Reactor Coolant Pump Thermal Barrier Leak Test

The malfunction is entered for Reactor Coolant Pump "A" and correct plant response is verified. Verifications include Thermal Barrier Indications and alarms, Component Cooling Water Surge Tank Level, Automatic Valve actuation, and Safety Injection Status Lights. The test is repeated for RCPB and RCPC.

5.18.13 Reactor Coolant Pump #1 Seal Failure Test

The malfunction is entered for RCP "A" and correct response is verified for the seal leak off indications and alarms. Chemical and Volume Control System Response is also verified to be correct.

5.18.14 Reactor Coolant Pump "A" No. 2 Seal Failure Test

The malfunction is entered and verification is made for correct response for leak off flows, Reactor Coolant Drain Tank level and alarms.

5.18.15 Reactor Coolant Pump #3 Seal Failure Test

The malfunction is entered and verification is made for correct response of standpipe indication and alarm. Increase in Containment Vessel Sump Level is also verified.

5.18.16 Reactor Coolant Pump Vibration Test

With the simulator in a Hot Shutdown condition, the vibration of each Reactor Coolant Pump Shaft is increased in separate verifications. The appropriate alarms and indications are verified including the effect of High RCP Shaft vibration upon the RCP frame. Additionally, the RCPs are tripped to verify proper response during their coast down period.

5.18.17 RCP Seal Package Failure Test

The three malfunctions are entered simultaneously to cause a complete failure of "A" Reactor Coolant Pump seal package. This results in a loss of reactor coolant to Containment, reactor trip, turbine trip, and safety injection actuation. Initial parameters response is verified prior to the reactor trip/safety injection. Continued simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.19.1 Residual Heat Removal Pump Trip Test

With the simulator in a Cold Shutdown condition, the single RHR Pump that is in service is tripped. The appropriate system parameters are verified. The standby RHR Pump is then placed in service and parameters verified to stabilize. After stability is achieved, the remaining in service RHR Pump is tripped and appropriate parameters verified. Additionally, the response of the RCS to a complete loss of RHR while solid is verified.

5.19.2 Residual Heat Removal, HCV-758 Failure Test

The malfunction to fail HCV-758 closed is entered with the RCS in Cold Shutdown on RHR. Correct response of RHR, Component Cooling Water, and Reactor Coolant is verified. Local Operator Action is entered to open the Bypass Valve around HCV-758 and correct response is verified.

The simulator is reinitialized to place the RCS in a heat up on RHR in progress and the malfunction is entered to fail HCV-758 open.

The RHR, Component Cooling and Reactor Coolant parameters are verified to respond correctly.

5.19.3 Residual Heat Removal, FCV-605, Failure Test

With a heat up in progress and the RHR System in service, the RHR Heat Exchanger Bypass Flow Control Valve, FCV-605, is failed closed and then open in independent verifications. The appropriate integrated system responses to these failures of FCV-605, are verified for both cases.

5.19.4 Hand Control Valve 142 Failure Test

The malfunction is entered to fail HCV-142 closed and verification is made for correct response of letdown flow, pressure, temperature, and controller action. Reactor Coolant System Pressure is verified to increase.

The simulator is reinitialized to the same condition and the malfunction to fail open. HCV-142 is entered. Correct response of the same parameter is verified and LOA is used to close RHR-760 manual valve. Correct response to closure of RHR-760 is verified.

5.19.5 Residual Heat Removal Leak Test

With a heat-up in progress and the RHR System in service, a 3500 gpm leak is ramped in to each RHR Pump Discharge Line in separate verifications. The integrated system response is verified. Additionally, the use of Local Operator Actions to isolate the leak is verified.

5.19.6 Residual Heat Removal Sump Valve Failure Test

The malfunction is entered for Valve 861A with the RCS in Cold Shutdown on RHR. It is verified that the valve cannot be closed and then the malfunction is entered for Valve 860A. Flow from the RCS to the sump and inability to close Valve 860A is verified. Valve 860A is closed to verify conditions return to normal. The same test is repeated for Valves 861B and 860B.

The simulator is reinitialized to 100% power with RHR aligned for low head safety injection and the same tests are repeated for both sets of valves to verify the flow path from the RWST to the Containment Vessel Sump.

5.19.7 Residual Heat Removal Heat Exchanger Tube Leak Test

The malfunction is entered for RHR Heat Exchanger "A". Correct response is verified for the Reactor Coolant System, the Component Cooling Water System, and the RHR System. LOA RHR-757 is entered to isolate the Heat Exchanger and verification is made that parameters trend in the normal direction. The test is repeated for RHR Heat Exchanger "B".

5.19.8 Residual Heat Removal Relief Valve Failure Test

The malfunction is entered and verification is made for proper response of the Reactor Coolant System and the Pressurizer Relief Tank. Parameters monitored include pressure, temperature, level, and alarms.

5.21.1.1 Reactor Trip Breaker Failure Test

Each Reactor Trip Breaker and Reactor Trip Bypass Breaker is tested individually within this test by entering the appropriate malfunction. Local Operator Actions (LOA) are used to rack in, close, and return the Bypass Breakers to normal.

5.21.1.2 ATWS Test

The malfunctions are entered to prevent the Reactor Trip Breakers from opening. LOA is used to generate a reactor trip signal by overriding 2 of the 3 RCS Loop Flow Transmitters. Verification is made that the reactor is not tripped and manual reactor trip is attempted. Verification is made that the reactor is not tripped. The reactor is then tripped by LOA for tripping the two rod drive MG Set Breakers. Simulator response to this event is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.21.2 AMSAC Failures Test

This test verifies that Malfunction RPS2A causes an inadvertent actuation of AMSAC which will result in a Turbine Trip, Auxiliary Feedwater Startup, and Steam Generator Isolation. This test also verifies that Malfunction RPS2B results in a failure of AMSAC to actuate when Steam Generator levels are less than 11% and Turbine Power is greater than 40%. The AMSAC alarm from deviation between the two first stage pressure transmitters is verified. Normal operation of AMSAC is verified by override of two Steam Generator Level Transmitters to 11%.

5.23.1. Steam Generator Safety Valve Failure Test

The malfunctions are entered simultaneously for the four safety valves on Steam Generator A. This results in an un-isolable steam release to atmosphere, a reactor trip, a turbine trip, and a safety injection actuation. Initial parameter response is verified prior to the reactor trip/safety injection. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.23.2.1 SG Tube Leak Test

The malfunction is entered and integrated plant response is verified. Correct parameter response is verified for the Reactor Coolant System, the Chemical and Volume Control System, Radiation Monitoring System, and the Steam Generator Blow down System. Correct status lights and alarms are also verified.

5.23.2.2 Steam Generator Tube Rupture Test

The malfunction is entered and results in a reactor trip, turbine trip, and safety injection. Initial plant parameter response is verified prior to the reactor trip/safety injection. Following the reactor trip/safety injection, simulator response is verified by completion of the appropriate Emergency Operating Procedures until a stable, controllable, and safe condition is attained.

5.23.3 Steam Generator Level Program Failure Test

The malfunction for failed high is first entered for Steam Generator (S/G)"A". After Feedwater Flow increases to "A" S/G the controller is placed in manual to verify that manual control is operable and then returned to automatic. S/G "A" level increases to cause a turbine trip/reactor trip at 75% power. Parameter indications, alarms, bistable lights, and automatic equipment actions are verified to be correct during the transient and after the trip.
The simulator is reinitialized and the malfunction for failed low is entered for Steam Generator "A". Correct parameter indications, alarms, and bistable status are verified until the reactor/turbine trip on low low level in Steam Generator "A". The test is repeated for both failed high and failed low for Steam Generator "B" and "C" level controllers.

5.24.1 Safety Injection Initiation Failure Test

With the simulator in a stable 25% power condition, various components are placed in their non-safety injection positions. This is to verify their response to an Inadvertent Safety Injection Signal. Once the Inadvertent Safety Injection Signal is activated, the appropriate alarms, components, and indications for Train 'A' are verified. Additionally, the appropriate Train 'B' alarms, components, and indications are verified as not actuating.

The simulator is then reinitialized to 25% power and the same components placed in their non-safety injection positions. The failure to initiate for Train 'A' is activated.

A manual Safety Injection is initiated. The appropriate Train 'A' alarms, components, and indications are verified to have not actuated. Additionally, the appropriate Train 'B' alarms, components, and indications are verified as activated.

5.24.2 Accumulator Liquid Leak Test

The malfunction is entered and correct response is verified for accumulator, pressure, level, and associated alarms. The malfunction is cleared and the accumulator is refilled using the operating procedure. Reset of alarms is verified as the accumulator is refilled.

5.24.3 Accumulator Nitrogen Leak Test

The malfunction is entered and correct response is verified for accumulator pressure and alarm. The malfunction is then removed and the accumulator is pressurized using plant operating procedure. Alarm reflash and clear is verified.

5.24.4 Safety Injection Pump Failure Test

This simulator performance test verifies that a trip of a running safety injection pump results in realistic integrated plant response. The ability to trip the three safety injection pumps is verified including both power supplies for safety injection pump B. Additionally, the use of local operator actions to rack out the tripped safety injection pump breaker to verify proper alarm response and control board indication is performed.

5.24.6 Failure of SI Trains to Reset Test

The failure of the SI timer to cycle out is entered and then a manual SI signal is generated. After two minutes, which is the normal time period for the SI Agastat timer to cycle out and allow SI reset, the response of pumps and valves in both trains to the failure is verified. This verification is performed prior to and after the SI reset pushbutton is depressed. The SI timer failure associated with each train (A and B) is tested separately and verification of proper reset capability of both the affected train and unaffected train is made.

5.25.1 Service Water Pump Trip Test

With the simulator in a stable 100% power condition, the Service Water Pumps are sequentially tripped to cause a total loss of service water. The integrated plant response to a total loss of service water is verified.

5.25.2 Service Water Leak on Containment Vessel Fan Cooler Test

With the plant in a stable 100% power condition, the malfunction to cause a leak on each HVH cooler is entered. Appropriate system responses including alarms, flows, and indications are verified. Additionally, the ability to isolate the leak using system valves controlled from the Main Control Board and reestablish normal system parameters is verified.

5.25.4 Service Water Leak Test

The malfunction is entered for the North Service Water Header. Verification is made for correct indications and alarms on both headers. The North Header is then isolated and verification is made for correct indications and alarms clearing. The simulator is reinitialized and the test repeated for a leak in the South Service Water Header.

5.25.6 Service Water Booster Pump Suction Line Leak Test

With the simulator in a stable 100% power condition, the malfunction to cause a suction line leak to the in service, Service Water Booster Pump is entered. The integrated system response to a leak in the suction line of the in service, Service Water Booster Pump, is

thoroughly verified. Additionally, the use of Local Operator Actions to isolate the leak and reestablish normal plant parameters is verified.

5.25.8 Service Water to Emergency Diesel Generator Temperature Control Valve Failure Test

With the associated Diesel Generator supplying its respective bus, the malfunction is entered to fail closed the Diesel's Temperature Control Valve. The associated Diesel Temperature Alarms are verified along with their interlock functions. Additionally, the use of a Local Operator Action to bypass the closed Temperature Control Valve and reestablish normal operating parameters is verified.

5.26.2 Turbine Trip Failures Test

Both options of the turbine trip failure are tested in conjunction with other malfunctions and plant conditions, which create a local or remote turbine trip signal, including generator trips, circulating water pump trip, reactor trip, manual turbine trip, steam generator high level trip, loss of condenser vacuum trip, loss of electro-hydraulic oil pressure and main turbine lube oil leak. Under each condition the response of the turbine, along with associated plant parameters and alarms, are verified.

5.26.4 Turbine Bearing Failure Test

With the simulator at a stable 100% power condition, the malfunction is entered to cause Turbine Bearing #5 vibration to increase. Once Turbine Bearing #5 vibration reached the alarm set point, the adjacent bearings response is verified. Additionally, when the turbine was tripped and coasting down, the bearings vibration is verified to decrease.

5.26.5 Turbine Governor Valve Failure Test

With the simulator at a stable 100% power condition, the malfunction is entered to cause Governor Valve #1 to fail closed over 60 seconds. Integrated System Response to this failure including the Governor Valve Control Program and indications are verified. Additionally, Governor Valve #2 was failed full open and the appropriate responses verified.

5.26.11 Turbine Lube Oil Pumps Trip Test

This Simulator Performance Test verifies that both the AC and DC Turbine Lube Oil Pumps could be failed either while the pump is in service or prior to receiving an auto start signal. The appropriate system responses including alarms, interlocks, and indications are verified.

5.26.12 Loss of EH Oil Pumps Test

With the plant initially at full power and with EH Pump B running and EH Pump A in standby, EH Pump B is tripped using the malfunction. EH fluid pressure decreases causing actuation of the low EH Oil Pressure Alarm followed by an automatic start of EH Pump A which restores EH Oil Pressure.

EH Pump A is then tripped using the malfunction. Decreasing EH Oil Pressure results in eventual closure of the turbine valves as insufficient EH Pressure is available to hold the valves open. Closure of Turbine Stop Valves initiated a reactor trip and a main generator lockout one minute later.

5.26.13 Turbine Turning Gear Failure Test

This Simulator Performance Test verified the system response to a failure of the Turbine Turning Gear Motor in two different system configurations. The first case where the Turbine is on Turning Gear and the second case where the unit is coasting down to go on Turning Gear. In both cases the appropriate system responses including alarms, interlocks, and indications are verified. Additionally the normal operation of the Turning Gear is verified.

5.26.14 Turbine Main Lube Oil Leak Test

With the turbine at 1800 RPM, the malfunction to cause a 100 gpm leak in the Turbine Main Lube Oil Discharge Line is entered.

Appropriate system responses to this loss of pressure/level including alarms, interlocks, and indications are verified.

5.26.16 Loss of Gland Seal Steam Test

The simulators response to this malfunction is verified

for two different plant configuration. In the first verification, with the simulator at a stable 13% power condition, the Gland Sealing Steam System supplies the Main Turbine Gland Seals. The malfunction is entered to cause a loss of Gland Sealing Steam, and the appropriate system responses verified.

In the second verification, with the simulator at a stable 100% power condition, the Main Turbine supplies its own gland seals. The malfunction is entered to verify that this malfunction would have no effect on the system.

In both verifications appropriate alarms, the interlocks, and indications are verified.

5.26.18 EH Reservoir Leak Test

With the simulator at a stable 9% power condition, and the Main Generator Output Breakers closed, the malfunction to cause a 20 gpm leak from the EH Fluid Reservoir is entered. The EH, Turbine, and Main Generators integrated plant response to this condition including alarms, relay actuation, interlocks, and indications are verified.

5.26.19 Turbine Bearing Lift Oil Pump Trip Test

This malfunction is entered to the same pump in two different system/plant configurations. In the first condition, the Turbine Bearing Lift Oil Pump was in standby (not running) when the malfunction is entered. In the second condition, the Turbine Bearing Lift Oil Pump is in service. In both conditions, the system response including alarms and indications are verified.

5.26.20 Rod Drop Run back Time Delay Failure Test

With the plant initially at 100% power and with the turbine reference run back failed with MALFUNCTION TUR21A, the turbine load limit time delay relay is failed to 3 seconds (normally 9 second). A power range (PR) nuclear instrument (NI) dropped rod run back (5%/5 sec.) signal is then generated by failing one of the PR excore NI detectors low with MALFUNCTION NIS7. A turbine load limit run back occurs as a result, with the duration of the run back being 3 seconds due to the malfunction.
Additionally, the turbine load reference run back time delay relay is failed to 5 seconds (normally 1.5 seconds). A reference run back signal is then generated by tripping two over-temperature delta-T bistables with their local operator action function. The duration of the turbine load reference run back that resulted should be 5 seconds due to the

malfunction.

In both cases, appropriate alarms, bistable actuation, and indications are verified.

5.26.21 Turbine Run back Failures Test

With the simulator at a stable 100% power condition, the turbine is subjected to erroneous run back signals, in both the load limit and Load Reference Run back Circuits. Appropriate integrated system responses including alarms, interlocks, and indications are verified. Additionally, the malfunction to prevent the turbine from running back from a valid load limit or Load Reference Signal is verified.

5.26.22 EH High Pressure Fluid Leak Test

This Simulator Performance Test is performed at various leak rates and initial conditions to thoroughly verify the systems integrated response. Associated alarms, interlocks, and indications are verified.

5.28.1 High RCS Activity Test

This Simulator Performance Test uses the failed fuel malfunction to generate high for RCS activity causing the simulator to respond in a realistic manner, consistent with indications, to fuel cladding failure, which results in high activity in the RCS and subsequent radiation alarms. Additionally, the Radiation Monitoring Systems capability of detecting a Steam Generator tube leak is verified.

5.29.1 Feedwater Flow Transmitter Failure Test

This Simulator Performance Test uses the Simulator Transmitter Override capability to cause the individual Steam Generators Feedwater Flow Transmitter to fail. The individual Steam Generator Flow Transmitters are failed high and low. Appropriate system responses including alarms, flows, bistable actuation, indications, and manual control are verified for the three Steam Generators.

5.29.3 PT-145 Failure Test

With the plant at 100% power, PT-145 is failed to 600 psig. The letdown pressure controller output decreases to zero in response to this high pressure signal, fully opening the letdown pressure control valve. The

ability to take manual control of the letdown pressure controller is then demonstrated.

5.29.4 LT-459A Failure Test

This Simulator Performance Test verifies that a failure of the Pressurizer Level Transmitter, produces the integrated system responses indicative of a spurious high and then low failure of the Pressurizer Level Transmitter. Appropriate alarms, interlocks, and indications are verified.

5.29.5 PT-444 Failure Test

This Simulator Performance Test verifies the simulator's Transmitter Override capability, to cause a failure of the Channel I Pressurizer Pressure Transmitter, to fail high and low. Associated system control/interlock functions including alarm and indications are verified.

5.29.6 Controlling Steam Generator Pressure Transmitter Failure Test

This Simulator Performance Test verifies the responses to a failure of the controlling Steam Generator Pressure Transmitter in both a failed high and low output condition. Included in the verification are Steam and Feedwater Flow, Steam Generator level response, and alarms/indications associated with this failure.

5.29.7 Steam Generator Pressure Transmitter to PORV Failure Test

The simulators transmitter override capability, is used to override an individual Steam Generators Pressure Transmitter, to its respective PORV to 1400 psig. Integrated plant response to this simulated failure of the Pressure Transmitter is verified.

5.30.1 ESF Passive Failures Test

This Simulator Performance Test verifies that Local Operator Actions (LOA's) could result in passive failures of the Emergency Safeguards Equipment. The LOAs are entered to prevent automatic actuation of the individual components. The interlock/control functions of the individual components that should not have occurred, due to the LOA, are verified. Additionally,

the components are verified to be operable in manual control, with the LOA entered.

6.1 Closure of One MSIV at Full Power Test

With the plant at a stable 100% power condition, the malfunction is entered to inadvertently close the MSIV on the A Steam Generator. Appropriate system responses including alarms, flows, levels, pressures, temperatures, and indications are verified.

6.6 Valve Stroke Time Test

This Simulator Performance Test verifies the ability of the simulator to provide acceptable valve stroke times for control room observable valves. These valves are tested as per their associated Operations Surveillance Tests, and within the guidelines of their individual acceptance criteria.

6.7 Physical Fidelity Comparison Test

This simulator performance test is a item by item comparison of the reference plant's control room to the simulator control room.