WOLF CREEK GENERATING STATION QUADRENNIAL SIMULATOR CERTIFICATION REPORT

Wolf Creek Nuclear Operating Corporation

January, 1997

NRC FORM 474 U.S. NUCLEAR REGULATORY COMMISSION
(8-95)

SIMULATION FACILITY CERTIFICATION

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
Wolf Creek Generating Station	50----482
LICENSEE	DATE
Wolf Creek Nuclear Operating Corporation	1/8/97

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:

Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, KS 66839-0411

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 attached Wolf Creek Generating Station Simulator Certification Report.

X SIMULATION FACILITY PERFORMANCE TESTING SCHEDULE ATTACHED. (For the conduct of approximately 25% of performance test 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 attached Wolf Creek Generating Station Simulator Certification Report.

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.)

See attached Wolf Creek Generating Station Simulator Certification Report.

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 that the information in this document and attachments is true and correct.

SIGNATURE - AUTHORIZED REPRESENTATIVE	TITLE	DATE
Clay C. Warren	Chief Operating Officer	1/8/97

In accordance with 10 CFR 55.5, Communicaitons, 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, KC 20555-0001

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

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Wolf Creek Nuclear Operating Corporation

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I. EXECUTIVE SUMMARY

Wolf Creek Generation Station's simulation facility complies with 10 CFR 55.45 and meets the guidance contained in the standard ANSI/ANS-3.5-1993 as endorsed by NRC Regulatory Guide 1.149, Revision 2 with the exceptions noted within this report.

The Wolf Creek simulator was initially certified on January 10, 1989. The last quadrennial certification report was submitted to the USNRC on December 17, 1992. The four year cycle and certification testing program is based upon the anniversary date of initial certification.

The Wolf Creek simulator has performed very well over this certification period. Availability for training has been essentially 100%. Significant improvements have been made in simulator fidelity.

- In 1993, the plant power rating was re-rated from an output of 3411 MWt to 3565 MWt. This required a substantial number of simulator modifications. However, after this re-rating effort was complete, the simulator once again very closely matched the plant.
- In 1994, major simulator control room remodeling resulted in an environment that is very much like that found in the plant control room. This remodeling included installing a Shift Supervisor's office and a simulator lighting system that nearly exactly matches that found in the plant.
- In 1996, the most-significant improvements included the re-modeling of the simulator's emergency diesel generators to the 'relay-level' and the addition a radiation monitoring system simulator.

Other major enhancements which are either in-progress or planned include the addition of a fire protection system simulator, simulation re-host to a PC computer platform and, subsequently, upgrade of the core neutronics and thermal-hydraulic models, the reactor coolant system (RCS), the steam generator models and the containment models.

At the writing of the report, the most-significant challenges to simulator vs. plant fidelity involve:

- RCS response to very large LOCAs (>10,000 gpm) is not supported.
- Tcold not at Tsat for S/G pressure when on natural circulation (deviates by <10°F) and
- Response to the loss of non-class IE instrument AC buses is not as complete as desired.

It is important to note that in each of these cases, valid simulator training is possible. The response of the simulator, however, is not as close or complete as is desired. Due to the complex nature of these issues, plans are to work to address them after the re-host of the computer platform. The current simulator computer system does not posses the capacity to accommodate the changes that will be required.

The simulation facility is tied directly to the INPO accredited initial and requalification operator training programs. It is for this reason that the simulator testing program is to include validation of simulator training and examination scenarios.

Wolf Creek administrative instructions (AIs) prescribing the Simulator Certification Program described herein will be revised by February 28, 1997.

II. DEFINITIONS

A. Simulator Certification Cycle

The four-year cycle by which quadrennial simulator certification reports are submitted. The beginning of each cycle is established by the anniversary of the initial simulator certification date.

B. Simulator Certification Year

The certification testing program is based upon the anniversary date of initial certification. The beginning of each cycle is established by the anniversary of the initial simulator certification date.

C. Initial Simulator Certification Date

The Wolf Creek simulator was initially certified on January 10, 1989.

D. Reference Unit

The Wolf Creek simulator is a plant-specific simulator. The reference unit is Wolf Creek Generating Station Unit #1.

E. Qualitative Acceptance Criteria

Qualitative acceptance criteria is as follows:

1. The same as the most-current reference criteria for the following procedure types:
   a. startup test procedures.
   b. surveillance test procedures
   c. plant system operating procedures
2. Observable changes in the parameters correspond in the direction to those expected for a best estimate of normal unit operation.
3. Simulator shall not fail to cause an alarm* or automatic action if the reference unit would have caused and alarm or automatic action under identical circumstances.
4. Simulator shall not cause and alarm* or automatic action if the reference unit would not cause an alarm or automatic action under identical circumstances

*Such alarms include those which are expected to occur by design and those for which occurrence is anticipated by the procedures included in II.E.1, above.

F. Quantitative Acceptance Criteria

In making comparisons between the simulator computed values and the plant data, an additional deviation may be allowed up to the documented value of the plant instrument error. The simulator instrument error shall be no greater than that of the comparable meter, recorder, and related instrument system of the plant.

Quantitative acceptance criteria is as follows:

1. Under steady state, normal operating conditions, the following recorded and computed parameters shall match plant data within 1% of the plant unit instrument loop range:
   a. RCS average temperature (T_{avg})
   b. RCS loop T_{hot}
   c. RCS loop T_{cold}
   d. Generator load (MWe)
   e. Core thermal power (MWt)
   f. Nuclear instrumentation power (% of rated power)
   g. RCS system pressure (psig)
   h. PZR level (%)

2. Under steady state, normal operating conditions, the following recorded and computed parameters shall match plant data within 2% of the plant unit instrument loop range:
   a. Steam generator feedwater flow
   b. RCS loop flow
   c. Steam generator level
   d. Letdown flow
   e. Charging flow
   f. Steam flow
   g. Turbine first stage pressure

3. Under steady state, normal operating conditions, recorded and computed parameters not itemized above shall match plant data within 10% of the plant unit instrument loop range.

G. Real Time Acceptance Criteria

No noticeable differences that impact training shall exist between the simulator and the reference unit in the following respects:

a. time base relationships,
b. sequences,
c. durations,
d. rates, and
e. accelerations.

H. Simulator Modification Request (SMR)

A documentation package which documents hardware and software modification requests, related analysis and implementation decision.

I. Simulator Modification Package (SMP)

A documentation package which documents modifications to the simulator which alter the way the simulator looks or responds.

III. SIMULATOR PERFORMANCE AND IMPROVEMENTS SINCE THE LAST REPORT

Simulator availability for training is essentially 100%. Improvements in simulator hardware have been successful in reducing hardware failures to a minimum. The simulator executive and models are very reliable.

Over the last four years, over 450 Simulator Modification Packages have been processed and closed. Most of these packages have corrected or enhanced simulator models, implemented plant modifications, improved simulator control room or panel fidelity or improved simulator reliability.

Attachment A details the modifications which have most-significantly improved simulator fidelity or reliability.

IV. SIMULATOR CERTIFICATION PROGRAM

A. Scope of Certified Simulation

Certified simulation includes those simulator models and simulated control panels needed to provide the controls, instrumentation, alarms, and other human-system interfaces used by licensed operators in the reference unit to conduct required normal evolutions and respond to required malfunctions.

Desk top simulators are included to the extent that they are used to train licensed operators or licensed operator candidates on the required evolutions and malfunctions. Since the configuration of desktop simulators will be administratively controlled to contain only plant system models which have been tested on the main WCGS simulator, no additional testing of desk top simulator performance is necessary.

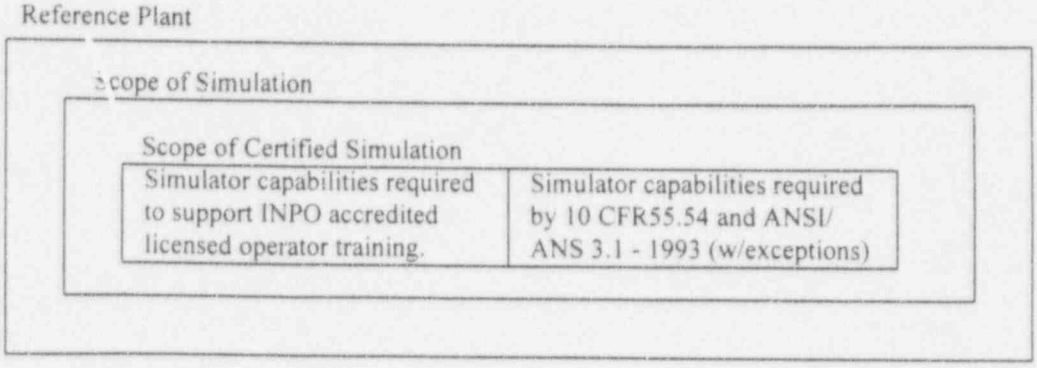
Required evolutions and malfunctions are as indicated in Attachment B and Attachment C, respectively.

The fire-protection panel (KC008) and other part-task or limited scope simulators intended for specialized training or familiarization are excluded.

B. Scope of Simulator Certification Program

The Simulator Certification Program applies to those simulator modification and testing activities performed on simulator models and control panels which are within the Scope of Certified Simulation.

The Scope of Simulation includes aspects of the reference plant which are outside the Scope of Certified Simulation. Although simulation may be provided, the same processes and controls associated with the Simulator Certification Program need not be applied outside the Scope of Certified Simulation.



C. Simulator Configuration Management

1. Control of Simulator Software and Hardware Configuration

The configuration of the software and hardware used for training is controlled by administrative instructions.

2. Simulator Fidelity Review Board

The Simulator Fidelity Review Board (SFRB) acts as a steering group for simulator maintenance activities and provides a technical review of simulator performance tests. Open Simulator Modification Packages are periodically reviewed to assure that training impact and priority assessments are as needed to support the INPO accredited licensed operator initial and requalification training and examination programs. The SFRB also reviews selected Simulator Modification Packages to determine if they are relevant to the scope of certified simulation.

3. Simulator Design Database

The simulator design data base is comprised of the actual data that form the baseline for the current simulator hardware and software configuration. This database includes data from which the simulator is designed. This data include:

a. Data collected directly from the plant.
b. Plant design documents and procedures.
c. Data generated through engineering analysis with a sound theoretical basis.
d. Data collected from plants which are similar in design and operation to the Wolf Creek plant.
e. Data, such as subject matter expert estimates, that do not come from any of the above sources.

Data included in this database are available many different places. When such data are used to make simulator modifications, the source is referenced by, or included in, the Simulator Modification Package.

Modifications made to the plant are reviewed for determination of the need for simulator modification within 12 months. Plant modifications determined to be relevant to the scope of certified simulation will be implemented on the simulator within 24 months of their plant in-service dates.

4. Simulator Modification Request Database

A database is maintained of all requests for simulator modifications. If the requested modification is implemented, this database also provides a reference to the implementing Simulator Modification Package.

5. Simulator Modification Package Database

A database is maintained of all simulator modifications.

6. Plant Change Package Database

A database is maintained of all plant modifications which have been determined to impact the scope of simulation. This database also provides references to implementing Simulator Modification Requests and Simulator Modification Packages.

7. Work Controls

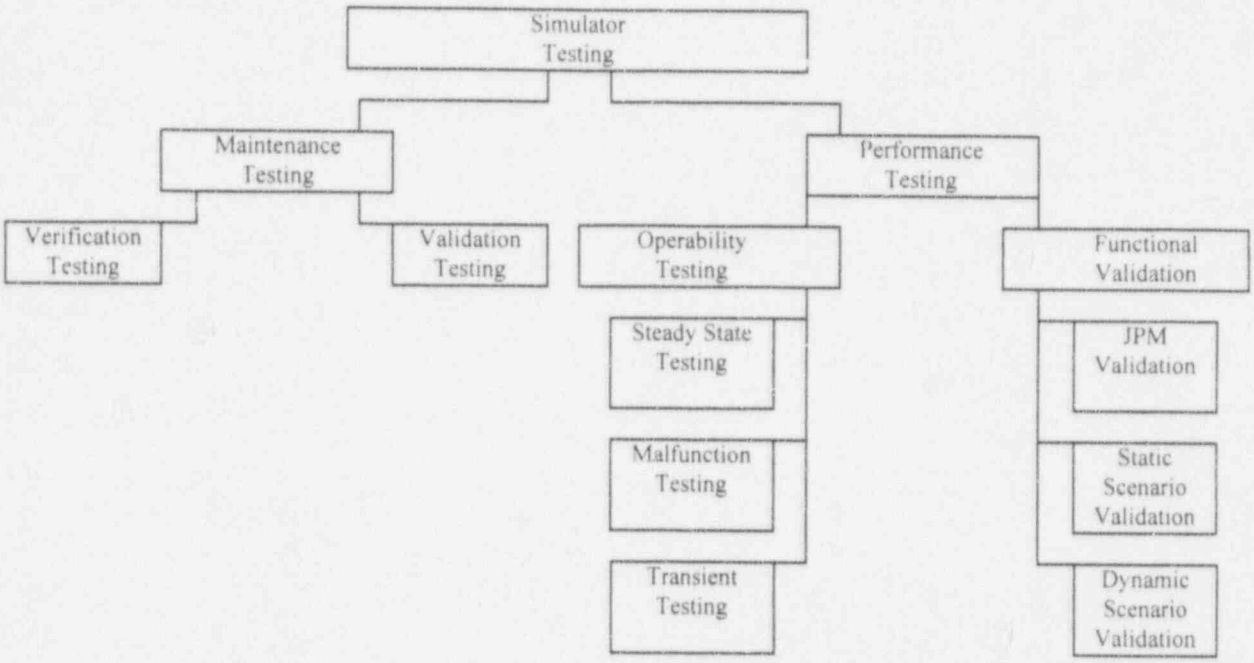
All simulator modifications are made under the administrative control of the instruction which prescribes Simulator Modification Package processing.

8. Records

Records which document the modification and testing of the simulator are retained for at least four years. Such records are not considered QA Records as defined in Wolf Creek administrative procedures.

D. Simulator Testing Program

Simulator testing is divided into two major types: Maintenance Testing and Performance Testing. Maintenance testing is integral to the simulator modification process. Performance testing is user-based testing that confirms the maintenance of fidelity. Each is subdivided into two groups as shown below:



1. Maintenance Testing

a. Verification Testing

Verification testing confirms that a simulator modification meets work standards and design specifications. Work standards include concerns such as program structure requirements, database content, documentation. Design specifications are as specified or referenced in the Simulator Modification Package. This testing is usually done by the individual simulator specialist or a peer and is documented as necessary in the Simulator Modification Package.

b. Validation Testing

Validation testing confirms that, following a simulator modification, the simulator accurately replicates the plant. This testing is performed by a Subject Matter Expert (SME) and is documented as necessary in the Simulator Modification Package.

The extent to which validation testing is required depends upon the extent to which the simulator has been modified. As a minimum, acceptance testing will ensure that real time, quantitative and qualitative acceptable criteria are met.

2. Performance Testing

a. Operability Testing

Operability testing of the simulator is performed once every certification year. These operability tests are intended to ensure that no noticeable differences exist between the simulator control room and simulated systems when evaluated against the control room and systems of the plant. The degree of fidelity required is as stated in this report.

1. Steady State Testing

Steady state testing verifies that the steady state response of the simulator meets the quantitative acceptance criteria when compared to the steady state response of the plant at three different power levels for which plant data are available. The exact power level for these tests will depend on the availability of plant data. The intent is to conduct these tests at power levels at which the plant is typically stabilized during power ascension; for example, a power level hold to obtain chemistry results or to perform a thermal calorimetric calculation. (e.g. 30%, 50%, 100%). Since initial condition (IC) snapshots are written by performing a continuous operation over the power range, existing snapshots are used to accomplish these tests.

In addition to the above testing, stability testing is performed to verify that the parameters identified in section 4.1.3.1 of ANSI/ANS-3.5-1993 do not vary by more than 2% of the range of the instrument during a continuous 60 minute period of operation a rated power.

2. Malfunction Testing

Malfunction testing verifies the simulator capability for insertion and, as appropriate, termination of the malfunction events specified in Attachment C. This testing considers all simulator features that affect or alter the normal operation of the simulated instrumentation or components within the model as needed to produce the required malfunction events. As indicated by Attachment D, these malfunctions events are tested at least once every four years, approximately 25% per year, to ensure continued acceptability of the simulator for the planned training and examination application as required by 10 CFR 55.45 and 55.59.

3. Transient Testing

Transient testing verifies that observable changes in simulator parameters correspond in the direction to those expected for a best estimate of plant response for the events and parameters specified in Attachment E.

b. Functional Validation

Functional validation of the simulator is performed to ensure that the features used to create simulated conditions have resulted in a simulator response that meets the applicable portions of the qualitative acceptance criteria. This validation is performed by Subject Matter Experts (SMEs) that have received instruction on performing simulator functional validations. Documentation of this validation is made a part of the exercise guide documentation. Modifications to the validated exercise guides requires appropriate revalidation and documentation.

1. Job Performance Measure (JPM) Validation

2. Static Scenario Validation

3. Dynamic Scenario Validation

V. EXCEPTIONS TO ANSI/ANS-3.5-1993

The following exceptions are taken to ANSI/ANS-3.5-1993 as endorsed by NRC Regulatory Guide 1.149, Revision 2.

A. ANSI/ANS-3.5-1993 (Section 3.1.3, Normal Evolutions) indicates that the simulator should be capable of "*(7) Startup...with less than full reactor coolant flow*". Since this evolution is not permitted by Wolf Creek operating procedures, it should not be necessary to require the simulator to support it.

B. ANSI/ANS-3.5-1993 (Section 3.1.4, Malfunctions) lists malfunctions that should be included: "*(12) Control rod failures, including... drifting rods....*" Since this particular control rod failure is not a characteristic of the Westinghouse control rod design, it should not be necessary to require the simulator to support it.

C. ANSI/ANS-3.5-1993 (Section 4.1.3.1) specifies that parameters not individually listed shall be within 10% of the benchmark for Steady State Tests. Since there are thousands of such parameters, a list of the most important ones is being used to focus the testing resources. The selection of these parameters considers the data available on the reference plant heat balances plus the list of parameters in another part of ANSI/ANS-3.5-1993 (Appendix B)

D. ANSI/ANS-3.5-1993 (Section 4.1.3, Appendix B) specifies parameters for Steady State and Transient Tests. Some of the required parameters are "Total" flows. In some situations, "Individual" flows shall be substituted because they are indicated on the control panels or the plant computer systems. Individual flows also show more information since many transients are not symmetric on the various loops.

E. ANSI/ANS-3.5-1993 (Section 4.1.3.3, Normal Evolutions) states that, when evaluating the simulator reponse to normal evolutions, the accepance criteria shall be *"(1) the same as the reference unit startup test procedure acceptance criteria."* Over the years, many plant modifications have been made. This reduces the applicability of the startup test procedures (most were performed over 11 years ago). It is not appropriate to utilize criteria which may be outdated. Other acceptance criteria specified in section 4.1.3.3 is adequate to ensure the capability to perform normal evolutions is maintained.

F. ANSI/ANS-3.5-1993 (Section 4.4.2) states that Operability Tests shall be conducted each calendar year. The Simulation Facility Operability Testing shall be based on the certification year. Although each "year" is twelve months, it is preferable that all time periods be based on one date, the Initial Simulator Certification Date.

G. ANSI/ANS-3.5-1993 (Section 5.1.2, Simulator Design Data Base Update) states *"any new data shall be reviewed and the simulator design data base appropriately revised once per calendar year"*. Updating of the Wolf Creek simulator and its design data base is an on-going process.

H. ANSI/ANS-3.5-1993 (Section 4.1.3.2, Steady State Stability) requires that certain simulator parameters are *"stable and do not vary by more than 2% of the inital values during a continuous 60 minute period..."*. This criteria presents problems as written. For example, if an initial value should be near zero, then the allowed tolerance would also be very low. To simplify and clarify this testing, this criteria will require that parameters be "stable and do not vary by more than 2% of the range of the instrument."

I. ANSI/ANS-3.5-1993 (Appendix B) lists the "Transient Performance Tests" and required that they be run *"from an initial condition of approximately 100% power, steady state...(unless otherwise noted)."* Test "e", Trip of any Single Reactor Coolant Pump, would cause an immediate reactor trip if performed at 100% power. Therefore, this particular test will be performed at the maximum power level which does not result in immediate reactor trip.

VI. IDENTIFICATION OF UNCORRECTED PERFORMANCE TEST FAILURES AND SCHEDULE FOR CORRECTION

As required by 10CRF55.45(b)(5)(ii), the following identifies uncorrected simulator performance test failures and provides a schedule for correction.

A. Steady State Testing

<u>SMP #96-076 -- 3rd Stage Extraction/MSR Flow Values Too High</u>
During 54% and 75% Steady State Simulator Certification Tests, it was observed that the simulator values for 3rd stage extraction flow exceeded the recorded plant values by approximately 11% and 9%, respectively. As the simulator power level approaches 100% power, the flow values approach those found in the plant. Also, these flows are quite turbulent in the plant and simulator. Therefore, exact values are are difficult to compare. Little, if any, training impact occurs. This item is scheduled for completion by 12/31/97.

B. Malfunction Testing

Attachment F provides the results of the malfunction testing performed over the last 4 years. In the last quarter of 1993, the decision was made to test all options of all malfunctions including any ramp functions. Prior to this time, the Simulator Certification Program required only two options of each malfunction be tested. This increase in test program scope likely resulted in more malfunction deficiencies being identified. The status 'FAIL' indicates that some aspect of one or more malfunction options was not as described in the malfunction description. This status does not necessarily indicate that the malfunction is totally useless for training purposes. Malfunction discrepancies are annotated on the malfunction description so that simulator instructors are aware of the operational status of the malfunction.

1. SMP #96-070 -- Incomplete Response to Loss of PN07/PN08/PN09/PN10 (Malf EPS-8)
This item deals with the simulator response to a loss of four non-Class IE electrical instrumentation buses. There is no off-normal (OFN) procedure which directs operator action to the loss of one of these buses. The simulator response to the loss of the safety-related NN buses is much more complete. Within the last year, the Operations and Engineering departments researched this area and published documents which described the expected plant response to the loss of these buses. The simulator response demonstrates the loss of most of the major components power from these buses. The details of any known problems have been annotated in the malfunction description and so they may be accommodated by the instructors. The current simulator computer system is not currently capable of supporting the changes required to the level of detail now available. This item is scheduled to be implemented after the simulator computer is re-hosted to the PC platform. Therefore, this item is scheduled to be corrected by 12/31/98.

2. SMP #95-035 -- Aux & Turb Bldg Options for MALF AIR-1 Impact Entire Air System
Malf AIR-1 is used to cause instrument system failures. However, instrument air system leaks or breaks in the Turbine and Auxiliary Bldgs should be prevented from dragging down the entire instrument air system down because of installed flow restricting orifices. These flow restricting orfices are not modeled. This has been annotated in the malfunction description. This item is scheduled to be corrected by 6/30/97.

3. SMP #95-082 -- CCW Service Loop Flo[illegible] Always Correct for Plant Conditions
When malfunction CCW-16 is activated, unexpected CCW to RCS flow oscillations are observed on flow indicators. These oscillations begin when the malfunction is activated and continue even after CCW pumps are secured. This has been annotated in the malfunction description. This item is scheduled to be corrected by 12/31/97.

4. SMP #95-126 -- BTRS System Response to Malf CVC-7 Is Not as Expected
Temperature Element BG TE-381 or BG TE-382 Failure, the simulator response was not as expected and not as described by the malfunction description. The malfunction description has been annotated to reflect this condition. There is another option to this malfuction which works properly. This item is scheduled to be corrected by 12/31/98.

5. SMP #96-087 -- Occassional Simulator Halts When Malf. CRF4, Rod Drop, Is Active

The "stationery gripper" option of this malfunction routinely causes a simulator hang. A known 'work-around' is available to simulator instructors. If the instructors activate this malfunction without viewing it first, it functions as designed. This has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

8. SMP #96-113 -- NIS Rate Response to Rod Malfs CRF-4 & CRF-12 Is Too Sensitive
Input received from the Wolf Creek Fuels Group indicates that the simulator excore nuclear instrumentation may be too sensitive to control rod alignment perturbations. This is being evaluated and has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

9. SMP #96-124 -- Malf. CVL-2, BG PCV-131 Control Failure, Not Per Malf Description
This malfunction description indicates this feature is intended to represent the failure of an I/P converter. Therefore, then the controller output should respond in the opposite direction of the valve. The contoller output goes to zero immediately when the malfuction becomes active. This has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

10. SMP #96-123 -- Ramp Function for Malf NIS-4, IR Ch. Gamma Comp. Fail
When performing malfunction test for NIS-4, IR Channel Gamma Compensation Failure, the malfunction responded as desired except for the ramp function. Regardless of the ramp time entered, the IR indication went to the selected value immediately. This has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

11. SMP #96-128 -- Ramp Function Ineffective for Malf NIS-8, SR High Voltage Failure
When performing malfunction test for NIS-8, SR High Voltage Failure, the malfunction responded as desired except for the ramp function. Basically, regardless of the ramp time entered, the SR voltage indication went to the selected value immediately. This has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

12. SMP #96-042 -- Ramp Function for Malf RCS-1 Takes Thot Value Low Then High
This malfunction works except when a ramp function is used to cause the RTD indication to fail high. This has been annotated in the malfunction description. This is scheduled to be corrected by 12/31/97.

C. Transient Testing

The results of the transient tests performed over the last four years has yielded satisfactory results. One uncorrected performance test deficiency exists related to pressurizer response to the maximum-sized LOCA coincident with the loss of off-site power. This item has minimal training impact and has been documented on SMP #96-126. This is scheduled to be corrected by 12/31/98.

Signficant Simulator Improvements Since The Last Report

A. Significant Simulation Model Improvements

1. Added CVCS letdown flashing
2. Modeled time delays for supervisory system
3. Improved emergency diesel generators modeling
4. Remodeled Auxiliary Feedwater System
5. Improved response of feedwater regulating valves controllers
6. Added instrument channel response to bistable tripping
7. Remodeled ECCS Accumulators
8. Added Radiation Monitoring System (RMS) Simulator
9. Added fire protection system simulator (in-progress)

B. Implementation of Significant Plant Modifications

1. Power Rerate
2. Control Room Remodeling (See item D, below.)
3. Annunciator MUX Power Supply Modification
4. Instrument Air Compressor Replacement

C. Significant Control Panel Fidelity Improvements

1. Repainted Control Panels
2. Reworked ESFAS and Bistable Status Panels
3. Added Radiation Monitoring System Panel (SP010)
4. Added Fire Protection Panel (KC008)

D. Control Room Fidelity Improvements

1. Instructor booth relocation
2. Control room remodeling
3. Relocated HVAC panel
4. Relocated Nuclear Instrumentation System (NIS) panel
5. Built Auxiliary Shutdown Panel (ASP) Room
6. Relocated ASPs
7. Relocated lift coil disconnect panel
8. Control Room Lighting Rework
9. Site Radio Console Addition
10. Added Control Room Personal Computer Stations
11. Added plant computer alarm printers

E. Simulator Computer System Hardware Improvements

1. Replaced simulator hard drives
2. Replaced power supplies to analog chassis

ANSI/ANS-3.5-1993 Required Normal Evolutions

Evolution			Procedures / Comments
(1)	Heatup - cold shutdown to hot standby.		
(2)	Unit startup from hot standby to rated power.		
(3)	Turbine/generator startup and generator synchronization.		
(4)	Operator conducted surveillance testing on safety related equipment or systems.		
(5)	Operations at hot standby		
(6)	Load changes		
(7)	Operations with less than full reactor coolant flow		
	(a)	Startup.	*- exception taken -*
	(b)	Shutdown.	
	(c)	Power operations	
(8)	Unit shutdown from rated power to hot standby and cooldown to cold shutdown conditions		
(9)	Unit performance testing (through the use of permanently installed instrumentation) such as:		
	(a)	heat balance.	
	(b)	determination of shutdown margin, and	
	(c)	measurement of reactivity coefficients and control rod worth, through the use of permanently installed instrumentation.	

ANSI/ANS-3.5-1993 Required "Malfunction" Events

(1)	Loss of Coolant:		
	(a)	significant steam generator tube leaks.	MAL RCS2, RCS5
	(b)(1)	inside primary containment.	MAL RCS6
	(b)(2)	outside primary containment.	MAL RHR4
	(c)(1)	large LOCAs demonstrating multi-phase flow.	MAL RCS6
	(c)(2)	small LOCAs demonstrating multi-phase flow.	MAL RCS6
	(d)(1)	failure of safety valve.	MAL PRS6
	(d)(2)	failure of relief valve.	MAL PRS4, PRS10, PRS12
(2)	Loss of instrument air to the extent that the who system or isolable portions can lose pressure and affect the plant's static or dynamic performance.		MAL AIR1
(3)	Degraded electrical power to the station including:		
	(a)	Loss of offsite power.	MAL EPS1
	(b)	Loss of emergency power.	MAL EPS5, EPS6
	(c)	Loss of emergency generators.	MAL DGS1
	(d)	Loss of power to the unit's electrical distribution buses.	MAL EPS4
	(e)	Loss of power to the individual instrumentation AC buses that provide power to control room instrumentation or unit control functions affecting the unit's response.	MAL EPS8
	(f)	Loss of power to the individual instrumentation DC buses that provide power to control room instrumentation or unit control functions affecting the unit's response.	MAL EPS7
(4)	Loss of forced core coolant flow due to single or multiple pump failure.		MAL RCS3, RCS4
(5)	Loss of condenser vacuum, including loss of condenser level control.		MAL CND1, CND2
(6)	Loss of service water or cooling to individual components.		MAL WAT2, WAT3
(7)	Loss of shutdown cooling.		MAL RHR1
(8)	Loss of component cooling system, or cooling to individual components.		MAL CCW4, CCW5, CCW6, CCW13
(9)	Loss of normal feedwater, or normal feedwater system failure.		MAL FWM1, FWM2, FWM3, FWM8, FWM9
(10)	Loss of all feedwater, both normal and emergency.		MAL AFW1, AFW2, FWM1
(11)	Loss of a protective system channel.		MAL EPS8, PCS3, PCS4, PCS8, PCS10
(12)	Control rod failure, including:		
	(a)	stuck rods.	MAL CRF12
	(b)	uncoupled rods.	*- Capability not available -*
	(c)	drifting rods.	*- exception taken -*
	(d)	rod drops.	MAL CRF4
	(e)	misaligned rods.	MAL CRF4
(13)	Inability to drive control rods.		MAL CRF1
(14)	Fuel cladding failure resulting in high activity in reactor coolant or off gas, and the associated high radiation alarms.		PLP RCS1
(15)	Turbine trip.		MAL TUR1
(16)	Generator trip.		SET JGENTRX=T
(17)	Failure in automatic control systems that affect reactivity and core heat removal.		MAL CRF6, MSS7, MSS9

ANSI/ANS-3.5-1993 Required "Malfunction" Events

(18)	Failure of reactor coolant:	
	(a) pressure control systems.	MAL PRS1, PRS3, PRS7, PRS13
	(b) volume control systems.	MAL CVC1, PRS2
(19)	Reactor trip.	MAL PCS1
(20)	Line breaks.	
	(a)(1) main steam lines inside CTMT.	MAL MSS3
	(a)(2) main steam lines outside CTMT.	MAL MSS4
	(b)(1) main feedwater lines inside CTMT.	MAL FWM8
	(b)(2) main feedwater lines outside CTMT.	MAL FWM9
(21)	Nuclear instrumentation failures	
	(a) source range.	MAL NIS1
	(b) intermediate range.	MAL NIS2
	(c) power range.	MAL NIS3
(22)	Miscellaneous process control failures	
	(a) process instrumentation failures.	MAL FWM2, FWM4, MSS1, PRS1, PRS2
	(b) alarm failures.	LOA BAT4, BAT5, BAT6, BAT7, BAT8, BAT9, BAT10, BAT11, BAT12, BAT13, BAT14, BAT15, BAT16, BAT17
	(c) control system failures.	MAL FWM3, MSS13
(23)	Passive failures of components in systems, such as:	
	(a) engineered safety features	MAL CCW8, CCW20, CVC3, ECC1, RHR7
	(b) emergency feedwater systems	*- take exception -*
	(c) control system failures.	MAL FWM17, PRS13
(24)	Failure of automatic reactor trip system	MAL PCS8, PCS9

Simulator "Malfunction" Test Schedule

Cycle A (1997)	ANSI 3.5 Event	Cycle B (1998)	ANSI 3.5 Event	Cycle C (1999)	ANSI 3.5 Event	Cycle D (2000)	ANSI 3.5 Event
AFW-1	10	CCW-6	8	AIR-1	2	AFW-2	10
CC[illegible]	8	CRF-6	17	CCW-20	23(a)	CCW-4	8
CCW-13	8	EPS-4	3(d)	CVC-3	23(a)	CCW-8	23(a)
CND-2	5	EPS-8	3(e) 11	DGS-1	3(c)	CND-1	5
CRF-1	13	FWM-3	9 22(c)	EPS-1	3(a)	CRF-4	12(d) 12(e)
CVC-1	18(b)	FWM-17		EPS-5	3(b)	CRF-12	12(a)
EPS-7	3(f)	MSS-3	20(a)(1)	FWM-4	22(a)	ECC-1	23(a)
FWM-2	9 22(a)	MSS-7	17	FWM-8	9 20(b)(1)	EPS-6	3(b)
NIS-1	21(a)	NIS-2	21(b)	MSS-4	20(a)(2)	FWM-1	9 10
PCS-3	11	PCS-4	11	NIS-3	21(c)	FWM-9	9 20(b)(2)
PCS-10	11	PCS-8	11	PCS-1	19	MSS-1	22(a)
PRS-2	18(b) 22(a)	PRS-3	18(a)	PCS-9		MSS-9	17
PRS-6	1(d)(1)	PRS-7	18(a)	PRS-4	1(d)(2)	MSS-13	22(c)
PRS-10	1(d)(2)	RCS-3	4	PRS-12	1(d)(2)	PRS-1	18(a) 22(a)
PRS-13	18(a)	WAT-3	6	RHR-7	23(a)	RCS-6	1(b)(1) 1(c)(1) 1(c)(2)
RCS-2	1(a)	RCS-4	4	RCS-5	1(a)	WAT-2	6
RHR-1	7	RHR-4	1(b)(2)	TUR-1	15	SET JGENTRX=T	16
PLP RCS1	14	LOA BAT-4	22(b)	LOA BAT-5	22(b)	LOA BAT-6	22(b)6
LOA BAT-7	22(b)	LOA BAT-8	22(b)	LOA BAT-9	22(b)	LOA BAT-10	22(b)
LOA BAT-11	22(b)	LOA BAT-12	22(b)	LOA BAT-13	22(b)	LOA BAT-14	22(b)
LOA BAT-15	22(b)	LOA BAT-16	22(b)	LOA BAT-17	22(b)		

CYCLE A	1997
CYCLE B	1998
CYCLE C	1999
CYCLE D	2000

Note: The simulator features listed above are malfunctions unless preceeded by PLP (Plant Parameter) or LOA (Local Operator Action).

ANSI/ANS-3.5-1993 Required Transient Events

(1)	Manual reactor trip.	
(2)	Simultaneous trip of all feedwater pumps.	
(3)	Simultaneous closure of all Main Steam Isolation Valves.	
(4)	Simultaneous trip of all reactor coolant pumps	
(5)	Trip of any single reactor coolant pump.	*Exception taken.* add the following: "...from maximum power level which does not result in immediate reactor trip".
(6)	Main turbine trip from maximum power level which does not result in immediate reactor trip.	
(7)	Maximum rate power ramp from 100% down to approximately 75% and buck up to 100%.	
(8)	Maximum size reactor coolant system rupture combined with a loss of all offsite power.	
(9)	Maximum size unisolable main steam line rupture.	
(10)	Slow primary system depressurization to saturated condition using pressurizer relief or safety valve stuck open (Inhibit activation of high pressure Emergency Core Cooling System)	
(11)	Load rejection	To be defined as: Load rejection (setback) resulting from trip of a single Circulating Water Pump.

Wolf Creek Generating Station Simulator
Malfunction Certification Test Status
1993

Malf No.	Tested by	Date	Status	SMP No.	Date Closed	Comments
AFW-1	Guyer	5/14/93	Pass			
CCW-1	Guyer	5/14/93	Pass			
CCW-5	Falkenstein	9/10/93	Pass			
CCW-9	Guyer	5/14/93	Pass			
CCW-13	Guyer/Moses	6/17/93	Pass			
CCW-18	Guyer	5/17/93	Pass			
CND-2	Guyer	5/17/93	Pass			
CRF-1	Falk/Schmidt	11/11/93	Pass			
CRF-5	Callaway	9/10/93	Pass			
CRF-9	Callaway	9/10/93	Pass			
CVC-1	Callaway	9/10/93	Pass			
CVC-5	Callaway	9/10/93	**Fail**	93-133	2/23/94	
CVC-9	Callaway	9/10/93	Pass			
CVC-13	Callaway	9/10/93	Pass			
CVC-17	Callaway	9/10/93	Pass			
CVL-3	Mosebey	9/16/93	Pass			
CVM-3	Mosebey	9/16/93	Pass			
ECC-2	Mosebey	9/16/93	Pass			
EPS-3	Reeves	9/16/93	**Fail**	93-137	10/29/94	
EPS-7	Falkenstein	10/18/93	Pass			
FWM-2	Reeves	9/16/93	Pass			
FWM-6	Piteo	9/23/93	Pass			
FWM-10	Piteo	9/23/93	Pass			
FWM-14	Piteo	9/23/93	Pass			
MSS-2	Piteo	9/23/93	Pass			
MSS-6	Falkenstein	9/27/93	Pass			
MSS-10	Falkenstein	9/27/93	Pass			
NIS-1	Falkenstein	9/27/93	Pass			
NIS-5	Falkenstein	9/27/93	**Fail**	93-094	6/22/94	
NIS-9	Falkenstein	9/27/93	**Fail**	93-142	2/23/94	
PCS-3	Falkenstein	9/30/93	Pass			
PCS-7	Falkenstein	9/30/93	Pass			
PCS-10	Falkenstein	9/27/93	Pass			
PRS-2	Falkenstein	9/30/93	Pass			
PRS-6	Falkenstein	9/30/93	Pass			
PRS-10	Falkenstein	10/4/93	Pass			
PRS-13	Falkenstein	9/30/93	Pass			
RCS-2	Falkenstein	10/4/93	Pass			
RCS-7	Falkenstein	10/18/93	**Fail**	93-153	1/25/94	**DELETED**
RCS-12	Callaway	10/11/93	Pass			
RHR-2	Falkenstein	10/18/93	Pass			
RMS-1	Callaway	10/11/93	Pass			
TUR-2	Callaway	10/11/93	Pass			
TUR-10	Callaway	10/11/93	Pass			**DELETED**
WAT-2	Falkenstein	10/18/93	Pass			
WAT-6	Falkenstein	10/18/93	Pass			

Wolf Creek Generating Station Simulator
Malfunction Certification Test Status
1994

Malf No.	Tested by	Date	Status	SMP No.	Date Closed	Comments
AFW-3	Falk./Even.	1/26/94	**Fail**	93-124	6/29/94	Options #1 thru #8 failed. Passed 6/30/94.
CCW-6	Falk./Even.	1/26/94	Pass			
CCW-10	Falk./Even.	1/26/94	Pass			
CCW-14	Falk./Even.	2/1/94	Pass			
CCW-19	Falk./Even.	2/1/94	**Fail**	95-062	4/2/96	Option 'A' does not work.
CND-3	Falk./Even.	2/1/94	Pass			Revised malf. description. (12/7/94)
CRF-2	Falk./Even.	2/1/94	Pass	94-140		RDMG status points on NPIS to be fixed.
CRF-6	Falk./Even.	2/1/94	Pass			
CRF-10	Falk./Even.	2/1/94	Pass			
CVC-2	Guyer/Schmi	2/7/94	Pass			
CVC-6	Guyer/Schmi	2/7/94	**Fail**	94-019	12/18/96	No seal flow change when LO iso.
CVC-14	Guyer/Schmi	2/7/94	Pass			
CVC-18	Guyer/Schmi	12/29/93	**Fail**	94-001	2/7/94	Passed 2/7/94
CVL-4	Guyer/Schmi	2/7/94	Pass			
CVM-4	Guyer/Schmi	2/7/94	Pass			
ECC-3	Falk./Even.	2/9/94	Pass			
EPS-4	Falk./Even.	2/9/94	Pass			
EPS-8	**Schm/Reeves**	**10/20/94**	**Fail**	**96-070**		**PN07/PN08/PN09/PN10 response**
FWM-3	Even./Schmi	2/28/94	Pass			
FWM-11	Even./Schmi	2/28/94	**Fail**	94-033	11/8/95	Options 5B & 4C failed.
FWM-15	Schm./Reeves	10/20/94	Pass			
FWM-17	Schm./Reeves	10/20/94	Pass			
MSS-3	Schm./Reeves	10/20/94	Pass			
MSS-7	Schm./Reeves	10/20/94	Pass			
MSS-11	Schm./Reeves	10/20/94	**Fail**	94-114	4/7/95	Ramp time function not working
NIS-2	Schm./Reeves	10/20/94	Pass			
NIS-6	Schm./Reeves	10/20/94	Pass			
PCS-4	Schm./Reeves	10/20/94	Pass			
PCS-8	Schm./Reeves	10/20/94	Pass			
PRS-3	Schm./Reeves	10/20/94	Pass			
PRS-7	Schm./Reeves	10/20/94	Pass			
PRS-11	Schm./Reeves	10/20/94	**Fail**	94-146	11/1/96	Wrong RCS response to PZR ref. leg break
RCS-3	Schm./Reeves	10/20/94	Pass			
RCS-8	Schm./Webb	10/21/94	Pass			
RHR-3	Schm./Webb	10/21/94	Pass			
RHR-6	Callaway/Rvs	4/7/93	Pass			New malfunction.
RMS-2	Schm./Reeves	10/26/94	Pass			
TUR-3	Schm./Webb	10/21/94	Pass			
TUR-7	Schm./Webb	10/21/94	Pass			
TUR-11	Schm./Reeves	10/26/94	Pass			
WAT-3	Schm./Webb	10/21/94	Pass			
WAT-7	Schm./Webb	10/21/94	Pass			

Wolf Creek Generating Station Simulator
Malfunction Certification Test Status
1995

Malf No.	Tested by	Date	Status	SMP No.	Date Closed	Comments
AIR-1	**Mitch/Reeves**	**3/30/95**	**Failed**	**95-035**		**Options 1 & 3 failed.**
CCW-3	(deleted)	n/a	n/a	n/a	n/a	
CCW-7	Reeves/Knapp	12/7/95	Failed	93-061	12/19/96	Seal wtr. inj. temp. increases unexpectedly.
CCW-11	(deleted)	n/a	n/a	n/a	n/a	
CCW-16	**Reeves/Knapp**	**12/7/95**	**Failed**	**95-082**		**Unexpected CCW to RCS flow oscillations**
CCW-20	Reeves/Knapp	12/8/95	Failed	95-127	1/4/96	RHR HXGR leak goes to incorrect sump.
CND-5	Falk/Reeves	10/30/95	Passed			
CRF-3	Reeves	12/5/95	Passed			* Very useful malfunction *
CRF-7	Reeves/Webb	12/5/95	Passed			
CRF-11	Reeves	12/5/95	Passed			
CVC-3	Reeves/Knapp	12/8/95	Passed			
CVC-7	**Reeves**	**12/7/95**	**Failed**	**95-126**		**Incorrect BTRS system response**
CVC-11	Evens/Reeves	2/13/95	Passed			Reference: SMR# 95-014
CVC-15	Falk/Reeves	2/16/95	Passed			Reference: SMP# 95-020
CVL-1	Reeves/Webb	12/5/95	Passed			
CVM-1	Reeves/Webb	12/5/95	Passed			
DGS-1	Reeves	12/6/95	Passed			
EPS-1	Palmer/Reeves	3/14/95	Passed			Reference: SMP# 95-023
EPS-5	Reeves/Webb	12/5/95	Passed			
EPS-9	Reeves	12/6/95	Passed			
FWM-4	Falk/Reeves	10/30/95	Passed			
FWM-8	Reeves/Knapp	12/7/95	Passed			
FWM-12	Reeves	12/6/95	Passed			
FWM-16	Reeves	12/6/95	Passed			
MSS-4	Reeves/Knapp	12/7/95	Passed			
MSS-8	Falk/Reeves	10/30/95	Passed			
MSS-12	Falk/Reeves	10/30/95	Passed			
NIS-3	Palmer/Reeves	10/31/95	Passed			Reference: SMP #95-118
NIS-7	Reeves/Knapp	12/6/95	Passed			
PCS-1	Reeves	12/5/95	Passed			
PCS-5	Reeves	12/5/95	Passed			
PCS-9	Reeves	12/5/95	Passed			
PRS-4	Reeves/Knapp	12/6/95	Passed			
PRS-8	Reeves	12/6/95	Passed			
PRS-12	Falk/Reeves	10/30/95	Passed			
RCS-4	Reeves	12/6/95	Passed			
RCS-9	Falk/Reeves	10/30/95	Passed			
RCS-14	Mitch/Reeves	3/30/95	Passed			Reference: SMP #93-032
RHR-4	Reeves/Knapp	12/8/95	Passed			
RHR-7	Reeves	12/8/95	Passed			
RMS-3	Falk/Reeves	10/30/95	Passed			
TUR-4	Reeves	12/7/95	Passed			
TUR-8	Reeves	12/6/95	Passed			
TUR-12	Falk/Reeves	10/30/95	Passed			
RHR-6	Reeves	12/8/95	Passed			Normally in Cycle B.

Wolf Creek Generating Station Simulator
Malfunction Certification Test Status
1996

Malf No.	Tested by	Date	Status	SMP No.	Date Closed	Comments
AFW-2	Falkenstein	2/19/96	Passed			
AIR-2	Falkenstein	2/19/96	Failed	96-038	3/28/96	Passed SMP retesting.
CCW-4	Reeves	9/22/96	Passed			
CCW-8	Reeves	9/29/96	Passed			
CCW-12	Reeves	9/29/96	Passed			
CCW-17	Reeves	9/29/96	Passed			
CND-1	Reeves	9/22/96	Passed			
CND-6	Ray/Reeves	2/22/96	Passed			
CRF-4	**Reeves**	**9/22/96**	**Failed**	**96-087**		**Causes simulator to 'halt'.**
CRF-8	Reeves	9/22/96	Passed			Retested on 10/5/96.
CRF-12	**Reeves**	**9/22/96**	**Failed**	**96-113**		**Too responsive in some cases**
CVC-4	Reeves	9/22/96	Passed			
CVC-8	Reeves	9/22/96	Passed			
CVC-12	Reeves	9/22/96	Passed			
CVC-16	Reeves	9/28/96	Passed			
CVL-2	**Reeves**	**9/28/96**	**Failed**	**96-124**		**PCV-131 response not per malf.**
CVM-2	Ray/Reeves	2/22/96	Passed			
ECC-1	Reeves	9/28/96	Passed			
EPS-2	Reeves	9/29/96	Passed			
EPS-6	Reeves	3/18/96	Passed			Ref: SMP: 94-054
FWM-1	Ray/Reeves	2/22/96	Passed			
FWM-5	Reeves	9/29/96	Passed			
FWM-9	Reeves	9/29/96	Passed			
FWM-13	Reeves	9/29/96	Passed			
MSS-1	Reeves	6/7/96	Passed			Ref: SMPs # 96-045 & 96-110
MSS-5	Reeves	9/29/96	Passed			
MSS-9	Reeves	9/29/96	Passed			
MSS-13	Reeves	9/29/96	Passed			
NIS-4	**Reeves**	**9/28/96**	**Passed**	**96-123**		**Ramp function ineffective**
NIS-8	**Reeves**	**9/29/96**	**Passed**	**96-128**		**Ramp function ineffective**
PCS-2	M. Westman	2/21/96	Passed			
PCS-6	M. Westman	2/21/96	Passed			
PRS-1	Ray/Reeves	2/22/96	Passed			
PRS-9	Reeves	9/29/96	Passed			
RCS-1	**Reeves**	**9/22/96**	**Failed**	**96-042**		**Bad ramp function for Thot.**
RCS-5	Reeves	9/29/96	Passed			
RCS-6	Reeves	9/29/96	Passed			
RHR-1	Reeves	9/29/96	Passed			
RHR-5	Reeves	9/29/96	Passed			
TUR-1	Reeves	9/29/96	Passed			
TUR-5	Reeves	9/29/96	Passed			Reference: SMP 95-007.
TUR-9	Reeves	9/29/96	Passed			
WAT-8	Reeves	9/29/96	Passed			

SIMULATOR "MALFUNCTIONS" INDEX

(Required features are shown in **BOLD**)

MALF ID	DESCRIPTION
AFW-1	**Aux. F.W. pump trip**
AFW-2	**Turbine-driven Auxiliary Feedwater Pump Failure**
AFW-3	Aux. feedwater valve failure
AIR-1	**Loss of instrument air to specific air header**
AIR-2	SG air valves accumulator failure
CCW-1	Letdown HX tube leak
CCW-4	**Loss of CCW to letdown HX**
CCW-5	**Loss of CCW to RHR HX**
CCW-6	**CCW pump trip**
CCW-7	Seal water HX tube leak
CCW-8	**RHR HX tube leak**
CCW-9	RCP thermal barrier leak
CCW-10	CCW HX temp. control failure
CCW-12	Excess letdown HX tube leak
CCW-13	**Service loop header leak to aux. bldg.**
CCW-14	CCW misc. R.W. cooling header leak to R.W. bldg.
CCW-16	RCF coolers header leak to CTMT
CCW-17	CCW HX leak to ESW
CCW-18	Leak in CCW safety loop
CCW-19	SFP cooling HX leak
CCW-20	**RHR HX outlet leak to RHR sump**
CND-1	**Loss of condenser vacuum**
CND-2	**Hotwell level transmitter fails**
CND-3	Circulating water tube leak in condenser
CND-5	Vacuum pump trip
CND-6	Condensate pump trip
CRF-1	**Rods fail to move**
CRF-2	Rod drive MG set trip
CRF-3	Improper bank overlap
CRF-4	**Dropped rod**
CRF-5	Rod ejection
CRF-6	**Uncontrolled rod motion**
CRF-7	Auto rod speed controller failure
CRF-8	T-REF failure (rod control)
CRF-9	DRPI loss of voltage
CRF-10	DRPI open or shorted coil
CRF-11	Rod position step counter failure
CRF-12	**Stuck rod**
CVC-1	**VCT level channel 112 & 185 failure**
CVC-2	Charging line break - next to FT-121
CVC-3	**Charging pumps suction header break**
CVC-4	Charging hdr. vlv. -HCV-182- I/P controller fail.
CVC-5	Failure of PDP speed control
CVC-6	RCP seal failure
CVC-7	BTRS temp. element TE-381 or TE-382 failure
CVC-8	BTRS chiller pump failure
CVC-9	VCT level channel 149 failure
CVC-11	Charging line leak inside CTMT
CVC-12	BTRS failure of demin. bypass -HCV-387
CVC-13	Loss of charging pump
CVC-14	BTRS temp. controller - TE-386- failure

SIMULATOR "MALFUNCTIONS" INDEX

(Required features are shown in **BOLD**)

MALF ID	DESCRIPTION
CVC-15	CVCS miscellaneous valve failure
CVC-16	Miniflow valve 8110 fails to close/open on high/low flow
CVC-17	Miniflow valve 8111 fails to close/open on high/low flow
CVC-18	Excess letdown leak to PRT
CVL-1	VCT divert valve -LCV112A- control failure
CVL-2	PCV-131 control failure
CVL-3	Letdown line leak inside CTMT
CVL-4	Letdown relief valve BG 8117 failure
CVM-1	Boric acid flow transmitter - FT110- failure
CVM-2	Boric acid transfer pump trip
CVM-3	Reactor make-up water transfer pump trip
CVM-4	Plugged boric acid filter
DGS-1	**Diesel generator failure**
ECC-1	**RWST leak**
ECC-2	Safety injection pump trip
ECC-3	CTMT spray pump trip
ECC-4	Containment Leak
EPS-1	**Loss of site power**
EPS-2	**Main generator voltage regulator oscillation**
EPS-3	Switchyard bus trip
EPS-4	**Service bus trip**
EPS-5	**ESF bus trip**
EPS-6	**ESF bus fault**
EPS-7	**Loss of a D.C. distribution bus**
EPS-8	**Loss of a 120 VAC instrument bus**
EPS-9	Load rejection
FWM-1	**Main feedwater pump trip**
FWM-2	**SG level channel failure**
FWM-3	**SG feedwater control valve failure**
FWM-4	**Feedwater flow transmitter failure**
FWM-5	Feedwater pump turbine speed control failure
FWM-6	Heater drain pump trip
FWM-8	**Feedwater line break inside CTMT**
FWM-9	**Feedwater line break outside CTMT**
FWM-10	Feedwater pump speed control oscillates
FWM-11	Feedwater heater tube leak
FWM-12	Failure of a FWIV to close
FWM-13	Main feed pump loss of speed signal
FWM-14	Motor driven feed pump trip
FWM-15	Unstable SG level controller
FWM-16	Feed header pressure transmitter failure
FWM-17	**FRV Valve Positioner Failure**
MSS-1	**Steam pressure detector failure**
MSS-2	Failure of an MSIV to close
MSS-3	**Steam line break inside CTMT**
MSS-4	**Steam line break outside CTMT**
MSS-5	Failure of main steam safety valves
MSS-6	SG steam isolation valve closes
MSS-7	**SG relief valve failure**
MSS-8	Steam dump cooldown valves control failure
MSS-9	**Steam dump control failure**

SIMULATOR "MALFUNCTIONS" INDEX

(Required features are shown in **BOLD**)

MALF ID	DESCRIPTION
MSS-10	Stuck steam dump valve
MSS-11	Main steam header steam leak
MSS-12	Steam generator steam flow transmitter failure
MSS-13	**Main steam header pressure transmitter failure**
NIS-1	**Source range channel failure**
NIS-2	**Intermediate range channel failure**
NIS-3	**Power range channel failure**
NIS-4	I.R. channel gamma compensation failure
NIS-5	Failure of S.R. high voltage to disconnect
NIS-6	Noisy source range channel
NIS-7	Power range detector failure
NIS-8	S.R. channel hign voltage failure
NIS-9	BDMS inadvertent doubling
PCS-1	**Inadvertent Rx trip**
PCS-2	First stage pressure transmitter failure
PCS-3	**Safeguards sequencer "A" failure**
PCS-4	**Safeguards sequencer "B" failure**
PCS-5	Inadvertent SI actuation
PCS-6	Inadvertent containment isolation 'Phase A'
PCS-7	Failure of auctioneered low Tavg
PCS-8	**Protective system failure (Rx fails to trip)**
PCS-9	**Stuck Rx trip break**
PCS-10	**Failure of Containment Isolation Phase A**
PRS-1	**PZR pressure channel failure**
PRS-2	**PZR level channel failure**
PRS-3	**PZR spray valve failure**
PRS-4	**PZR PORV control system failure**
PRS-6	**PZR safety valve failure**
PRS-7	**PZR pressure master controller failure**
PRS-8	PZR level controller failure
PRS-9	PZR steam space leak
PRS-10	**PZR PORV leak**
PRS-11	PZR level detector reference leg rupture
PRS-12	**PORV stuck open**
PRS-13	**Pressurizer spray valve failure**
RCS-1	Faulty primary RTD
RCS-2	**SG tube leak**
RCS-3	**RCP trip**
RCS-4	**RCP lock rotor**
RCS-5	**Steam generator tube leak**
RCS-6	**RCS leak**
RCS-8	RCS loop flow transmitter failure
RCS-9	Rx vessel flange leak
RCS-12	RTD wide range cold and hot leg failure
RCS-14	Failure of RCS W.R. pressure transmitter
RHR-1	**RHR pump trip**
RHR-2	RHR HX flow control valve failure
RHR-3	RHR HX bypass valve control failure
RHR-4	**RHR HX bypass line leak**
RHR-5	RWST level channels failure (RHR suct. fails to switch)
RHR-6	RHR low pressure letdown header leak

SIMULATOR "MALFUNCTIONS" INDEX

(Required features are shown in **BOLD**)

MALF ID	DESCRIPTION
RHR-7	**RHR injection line break**
RMS-1	Radiation monitor process flow failure
RMS-2	Area radiation monitor actuation
RMS-3	Process radiation monitor actuation
TUR-1	**Inadvertent turbine trip**
TUR-2	Turbine vibration
TUR-3	EHC throttle pressure sensor failure
TUR-4	Loss of EHC acceleration error signal
TUR-5	EHC - Generator current failure
TUR-7	Stator water cooling trouble
TUR-8	Turbine trip failure
TUR-9	Turbine intercept valve trip
TUR-11	MSR drain tank drain valve failure
TUR-12	Main turbine EHC pump trip
WAT-2	**Service water pump trip**
WAT-3	**Loss of ESW pump**
WAT-6	Circulating water pump trip
WAT-7	ESW leak inside CTMT
WAT-8	Circulating water pipe leak