WATTS BAR NUCLEAR PLANT

STARTUP TEST INSTRUCTION

SU-1.1

UNIT 1

TITLE: STARTUP TEST PROGRAM MASTER SEQUENCE

Authorization to Perform Test

By _____ / _____
Superintendent Date

CURRENT REVISION LEVEL 1

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Supervisor

PORC Review Date 6-12-84

Approved By E. Shum
Superintendent

Date Approved 6-12-84

Last page of this instruction: 37

1C	Document Control Unit, 1520 CST2-C
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1C	Nuclear Safety Review Staff
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1U	Operating Instructions Coord.
	Plant Program Section Supv.
	Plant Services Supervisor
	Plant Training Officer
1U	Plant Training Shift Engineer
	Power Stores Unit Supervisor
1U	Preop Test Supervisor
	Public Safety
	QA Manager, QA and Audit Staff
1C	Reactor Unit Supervisor
	Safety Engineer
1C	Shift Engineer's Office
	Stationary Equipment Group
	Technical Support Center
	Unit 1 Control Room
	Unit 2 Control Room
1U	W Project Manager
	"Master Copy" in Control Room
1U	Reactor Systems Group
1C	Mech. Maint. Shop Office
1C	John Raulston, NEB

OS/6

B001

1/1

8411280191 841120
PDR ADOCK 05000390
A PDR

PUNCHLIST

1. Acceptance criteria for rod swap measurements (SU-3.8B) must come from Westinghouse.

M. K. Jones 15/7/84
Signature Date

TEST DESCRIPTION

This is the controlling document that directs the initial startup testing program for the NSSS and the balance of plant testing through the plant acceptance test.

STARTUP TEST PROGRAM MASTER SEQUENCE

1.0 PURPOSE

1.1 To provide a recommended sequence of operations constituting the initial startup testing program for the Westinghouse Nuclear Steam Supply System (NSSS) from initial core loading through the plant acceptance test. It is intended that this program shall satisfy the test requirements of the FSAR.

1.2 To provide a recommended schedule for the NSSS startup program which has been expanded to include balance of plant testing.

1.3 To provide a list of definitions for abbreviations, symbols, and terms used throughout the startup testing program.

1.4 To provide acceptance criteria for the tests which constitute the startup testing program.

2.0 PREREQUISITES

2.1 Prior to the performance of the startup testing program, the following conditions are expected to exist. Any condition listed below which cannot be met may be waived by the test director after the condition has been throughly reviewed for the requirements of subsequent testing and safe operation of plant equipment, and the condition has been brought to the attention of cognizant Westinghouse personnel.

2.1.1 The NSSS, all components of the turbine steam system, and supporting control and auxiliary systems are fully assembled and operational.

_____ /
Operations Supervisor

2.1.2 All preoperational tests (except those scheduled to be performed as part of the startup testing program) have been satisfactorily completed.

_____ /
Preop Supervisor

2.1.3 Preliminary values for all control and protection equipment, setpoints and limits have been established per Precautions, Limitations, and Setpoints for the Westinghouse NSSS, or as modified by preoperational test results.

_____ /
Instrumentation Supervisor

_____ /
Preop Supervisor

2.1.4 An adequate supply of demineralized water, meeting the requirements of TI-16 for Reactor Coolant System (RCS) makeup water, is available for extensive RCS boron dilution.

Note: Dilution requirements for achieving criticality will be approximately 37,000 gallons. Dilution requirements during rod worth measurements will approximately 50,000 gallons.

_____ / _____
Unit Operator

2.1.5 An adequate supply of concentrated boric acid solution is available for extensive RCS boration.

NOTE: The boric acid tank level must always be maintained above the minimum level requirements of the Technical Specifications. Boration requirements during rod worth measurements will be approximately 2000 gallons.

_____ / _____
Unit Operator

3.0 PRECAUTIONS

3.1 General

3.1.1 All systems shall be operated according to established instructions. In particular, the NSSS shall be operated at all times according to the appropriate General Operating Instructions (GOIs). Required exceptions for testing purposes will be specified in individual test instructions.

3.1.2 The precautions of each test instruction shall be observed during the performance of that test.

3.1.3 The NSSS shall be operated at all times in a manner consistent with the limitations of the Technical Specifications and the Precautions, Limitations, and Setpoints for the Westinghouse NSSS.

3.1.4 With the reactor trip breakers closed, all reactor protection trips and safeguards systems and their associated permissive and blocking functions shall be in their normal operating status except as specified in the individual test instructions.

3.2 Rod Control System

3.2.1 During extensive plant heatup or cooldown, the control rod drive mechanisms shall not remain energized with Rod Cluster Control Assemblies (RCCAs) fully inserted.

3.2.2 When withdrawing or inserting individual RCCAs, the lift coils for other RCCAs in the same bank must be deenergized. If the bank is fully inserted, withdraw the bank five steps prior to deenergizing the lift coils.

NOTE: During tests which require an RCCA out of bank position, the initial bank position will be recorded to ensure that the RCCA will be returned to the proper bank position.

3.2.3 The rod deviation alarm will be activated during tests involving RCCA misalignment and should be anticipated during such tests.

3.2.4 Special test exceptions permit the banks to be inserted below the limits established by Technical Specifications. During these tests, the alarm should be anticipated.

3.3 Nuclear Instrumentation System

3.3.1 Prior to criticality and until sufficient overlap between intermediate and power range channels is demonstrated, the current corresponding to 100% power should be conservatively set at 200 μ amps for each detector section of the power range channels per W-9.5.

3.3.2 During low power physics testing and until the intermediate range detector current for the high level intermediate range trip can be determined, the intermediate range high level trip setpoint shall be set at 1×10^{-4} amperes (100 μ amps) per W-9.5.

3.3.3 Before each escalation to a new power level, reset the high power range trip setpoint to a value no greater than 20% power above the power level anticipated for the escalation per W-9.5 (to a maximum of 109%).

3.4 Critical Testing and Power Escalation

3.4.1 When conducting low power physics tests, the signal to the reactivity computer is taken from the sum of the top and bottom detectors of one power range channel. The channel shall be put in the test mode and the signal connected directly through a picoammeter to the reactivity computer.

During power operation, the signal to the reactivity computer is obtained from the sum of all four power range channels through the isolation amplifiers. Appropriate connections to the reactivity computer should be made in advance in order to permit adequate checkout prior to use.

3.4.2 During tests and any plant operations which involve reactivity additions, the startup rate shall be administratively limited to less than +1 steady decade per minute.

3.4.3 During tests that require abnormal rod configuration, flux patterns will be produced which may exceed normal instrumentation setpoints. These conditions should be anticipated

and appropriate administrative action should be taken to permit test completion consistent with the special test exceptions of Technical Specifications.

3.4.4 Initial power escalation to a new power level shall be performed in increments of 10% or less. Following each escalation, the thermal equilibration time requirements of the turbine and associated equipment shall be observed before actual testing resumes.

4.0 SPECIAL TEST EQUIPMENT

All special test equipment will be called out in the individual startup tests.

5.0 INSTRUCTIONS

NOTE: This is a recommended sequence. The existing plant conditions and status of plant hardware and components is the primary factor in determining which test and operation can be performed at a particular time.

NOTE: The abbreviations, symbols and terms used throughout the various test instructions are given in Table 1.

5.1 Obtain approval from the site director to load the core.

_____ / _____

5.2 Load the core by performing SU-1.2, Initial Core Loading Test Sequence.

_____ / _____

5.3 Preliminary test results on Table 2 have been reviewed by PORC and approval by the plant manager to proceed to SU-1.3.

_____ / _____

5.4 Perform SU-1.3, Post Core Loading Precritical Test Sequence.

_____ / _____

5.5 Preliminary test results on Table 3 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.4.

_____ / _____

5.6 Obtain approval from the site director to proceed to make the reactor critical.

_____ / _____

5.7 Perform SU-1.4, Initial Criticality and Low Power Test Sequence.

_____ / _____

5.8 Preliminary test results on Table 4 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.5

_____ / _____

5.9 Obtain approval from the site director to proceed to the 30% power testing plateau.

_____ / _____

5.10 Perform SU-1.5, 30% Power Test Sequence.

_____ / _____

5.11 Preliminary test results on Table 5 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.6.

_____ / _____

5.12 Obtain approval from the site director to proceed to the 50% power testing plateau.

_____ / _____

5.13 Perform SU-1.6, 50% Power Test Sequence.

_____ / _____

5.14 Preliminary test results on Table 6 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.7.

_____ / _____

5.15 Obtain approval from the site director to proceed to the 75% power testing plateau.

_____ / _____

5.16 Perform SU-1.7, 75% Power Test Sequence.

_____ / _____

5.17 Preliminary test results on Table 7 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.8.

_____ / _____

5.18 Obtain approval from the site director to proceed to the 90% power testing plateau.

_____ / _____

5.19 Perform SU-1.8, 90% Power Test Sequence.

_____ / _____

5.20 Preliminary test results on Table 8 have been reviewed by PORC and approved by the plant manager to proceed to SU-1.9.

_____ / _____

5.21 Obtain approval from the site director to proceed to the 100% power testing plateau.

_____ / _____

5.22 Perform SU-1.9, 100% Power Test Sequence.

_____ / _____

5.23 Startup testing program has been completed and all aspects of testing analysis and results are completed.

_____ / _____

5.24 Remove all hold orders, TACFs, caution orders, etc. installed by this startup program which are no longer required.

_____ / _____

6.0 ACCEPTANCE CRITERIA

There are two categories of acceptance criteria for startup testing involving core measurements; Design Review Criteria and Safety Review Criteria.

Safety Review Criteria are those criteria which shall be met prior to exceeding the testing plateau at which they are required to be analyzed. Design Review Criteria are those criteria which should be met prior to exceeding the testing plateau at which they are required to be analyzed.

At predetermined points during the startup program, analysis and verification is required that the results from previously performed tests be within their acceptance criteria before continuing to the next test plateau. Failure to meet a design review criteria does not, by itself, constitute a safety problem or prevent continuance of power ascension or testing at higher testing plateaus.

6.1 Acceptance criteria for startup tests are in the following sections. The tests are grouped according to the sequence in which they are performed. Not all tests have acceptance criteria.

6.1.1 Safety review criteria is designated by the Greek letter β. Design review criteria is designated by the Greek letter Ω.

6.1.2 SU-1.2

6.1.2.1 SU-2.1

(Ω) 1. Final loaded core configuration is consistent with the Design Report.

_____ /

(Ω) 2. A permanent record of the final core has been completed per TI-28.

_____ /

6.1.2.2 SU-2.2

(Ω) 1. All items specified on checklists in SU-2.2 have been satisfactorily completed during the performance of SU-1.2

_____ /

6.1.2.3 SU-2.3

(Ω) 1. The boron concentration of the samples obtained from the designated sample points must be within the limits of 2000 ppm $\leq C_B \leq$ 2150 ppm.

_____ /

6.1.2.4 SU-2.4

(Ω) 1. Results of the on-site checkout of the special core loading instrumentation shall agree closely with data obtained during the preshipment equipment checkout. The high voltage and discriminator settings should verify the settings established earlier. Any differences must be reviewed and evaluated by the test engineer to ensure proper functioning and calibration of the equipment.

_____ /

(Ω) 2. During the response check, each of the channels shall respond by indicating a positive change in count rate as the neutron level is increased and/or decreased near its associated detector. The statistical reliability factor for the ten count rate observations shall be between 0.5 and 1.4.

_____ /

6.1.3 SU-1.3

6.1.3.1 SU-6.1A

(Ω) 1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

_____ / _____

6.1.3.2 SU-6.1.b.1

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.3.3 SU-6.1.b.2

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.4 SU-1.4

(Ω)

1. The reactivity computer has been checked out per TI-7 and $|\Delta\rho c - \Delta\rho\tau| \leq \{(0.04)x(\rho\tau) \text{ or } 1\ \rho cm\}$ whichever is larger

_____ / _____

6.1.4.1 SU-3.2

(Ω) 1. The reactor is critical with the flux level established at approximately 1×10^{-8} amps on the intermediate range nuclear channels.

_____ / _____

6.1.4.2 SU-3.3

(Ω) 1. The flux level where feedback from nuclear heating is observed has been determined and the upper and lower limits for the zero power testing range has been determined.

_____ / _____

6.1.4.3 SU-3.5

(Ω)1. The ARO critical boron concentration is within the limits of 1321 ± 50 ppm.

_____ / _____

(Ω)2. The CD boron reactivity worth is within the limits of 147 ± 15 ppm.

_____ / _____

6.1.4.4 SU-3.6

(β)1A. The ARO Isothermal Temperature Coefficient is within the limit of -1.4 ± 3.0 pcm/°F

_____ / _____

(β)B. The ARO moderator temperature coefficient (consisting of the ARO ITC - the Doppler contribution of -1.95 pcm/°F) is within the limit of Technical Specifications 3.1.1.3.

_____ / _____

(Ω)2. The CD in isothermal temperature coefficient is within the limit of -4.3 ± 3.0 pcm/°F

_____ / _____

6.1.4.5 TI-41

1. M/D Flux Map; HZP ARO

(Ω)A. The relative assembly power error (P_I) is within the limits of ±10% for $P_I \geq 0.9$, ±15% for $P_I < 0.9$.

_____ / _____

(Ω)B. The quadrant power tilt ratio is $\leq$ 1.02.

_____ / _____

(Ω)C. $F^N_{\Delta H}$ is within the limits of 1.39 ± 0.14.

_____ / _____

2. M/D Flux Map; HZP CD at zero.

(Ω) A. The relative assembly power error (P_I) is within the limits of ± 10% for $P_I \geq 0.9$, ± 15% for $P_I < 0.9$.

_____ / _____

(Ω) B. The quadrant power tilt ratio is ≤ 1.02

_____ / _____

(Ω) C. $F^N_{\Delta H}$ is within the limits of 1.53 ± 0.15.

_____ / _____

6.1.4.6 SU-3.8A

(Ω) 1. CD reactivity worth is within the limits of 1470 ± 147 pcm.

_____ / _____

6.1.4.7 SU-3.8B

(Ω) 1. Westinghouse must supply target values for acceptance criteria.

_____ / _____

6.1.4.8 SU-3.9

(Ω) 1. Natural circulation has been demonstrated.

_____ / _____

6.1.4.9 SU-6.1A

(Ω) 1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

_____ / _____

6.1.4.10 SU-6.1.b.1

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.4.11 SU-6.1.b.2

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.5 SU-1.5

6.1.5.1 TI-41

1. M/D Flux map 30%; Rods at HFP insertion limit.

(Ω)
A. The relative assembly power error (PI) is within the limits of ±10% for $P_I \geq 0.9$, ±15% for $P_I < 0.9$.

_____/_____

(Ω)
B. The Quadrant Power Tilt Ratio is ≤ 1.02.

_____/_____

2. M/D Flux Map 30%; RCCA pseudo ejection.

(β)A. The relative assembly power error (P_I) is within the limits of ± 10% for P_I ± ≥ 0.9, ± 0.1% for $P_I < 0.9$.

_____/_____

(β)B. $F_Q^T = F_Q^N \times 1.05 \times 1.03 \leq 4.10$

_____/_____

6.1.5.2 SU-4.7

(Ω)
1. The following acceptance criteria are to be used to determine successful test completion. Failure to meet these criteria does not constitute a need for stopping the test program. Correction of any deficiencies which preclude meeting these criteria should be accomplished as required consistent with the current plant schedule.

A. Reactor and turbine must not trip.

_____/_____

B. Safety injection is not initiated.

_____/_____

C. Neither the steam generator relief valves nor safety valves shall lift.

_____/_____

D. Neither the pressurizer relief valves nor safety valves shall lift.

_____/_____

E. No manual intervention shall be required to bring plant conditions to steady state.

_____/_____

F. Plant variables (Tavg, Press, Feed Flow, Steam Flow, etc.) do not incur sustained or diverging oscillations.

_____/_____

G. Nuclear power overshoot (undershoot) must be less than 3% for load increase (decrease). (See scope SU-3.4.7, page 10, note 1.

_____/_____

6.1.5.3 SU-6.1A

(Ω)

1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

_____/_____

6.1.5.4 SU-6.1.b.1

(Ω)

1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____/_____

6.1.5.5 SU-6.1.b.2

(Ω)

1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____/_____

6.1.5.6 SU-6.2

(Ω)

1. The normal feeder RCP and main generator breakers opened.

_____/_____

(Ω)2. The turbine tripped.

_____/_____

(Ω)3. The reactor tripped.

_____/_____

(Ω)4. The diesel generators started and energized their respective buses.

_____/_____

(Ω)5. The motor and turbine driven auxiliary feedwater pumps started.

_____/_____

(Ω)6. The reactor was maintained in a safe, stable, shutdown condition.

_____/_____

6.1.5.7 SU-6.3

(Ω)1. The unit was safely tripped from outside the control room and maintained in mode 3 for at least 30 minutes using the regular shift complement in accordance with section 5.4 of SU-6.3.

_____/_____

(Ω)2. The reactor coolant temperature and pressure was reduced to less than 350°F and 425 psig, respectively, using steam generator power reliefs and auxiliary feedwater in accordance with section 5.5 of SU-6.3.

_____/_____

(Ω)3. RHR and ERCW systems were used to cool the primary coolant system at least 50°F to less than 300°F in accordance with section 5.5 of SU-6.3.

_____/_____

(Ω)4. Only AOI-27 and the equipment specified therein were required to perform SU-6.3.

_____/_____

(Ω)5. All actions taken by observation personnel would not impact the safe shutdown of the plant, within the scope of SU-6.3, if not performed.

_____/_____

6.1.6 SU-1.6

6.1.6.1 TI-41

1. M/D Flux Map; 50%

$(\Omega)_A$. The relative assembly power error (P_I) is within the limits of ± 10% for $P_I \geq 0.9$, ± 15% for $P_I < 0.9$.

_____ /

$(\Omega)_B$. The quadrant power tilt ratio is $\leq$ 1.02.

_____ /

2. M/D Flux Map, 50% RCCA Pseudo Drop

$(\beta)_A$. The relative assembly power error (P_I) is within the limits of ± 10% for $P_I \geq 0.9$, ± 0.1% for $P_I < 0.9$.

_____ /

$(\beta)_B$. $F^T_{\Delta H} = F^N_{\Delta H} \times 1.04 \leq 1.68$

_____ /

6.1.6.2 SU-6.1A

(Ω)

1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the sheets.

_____ /

6.1.6.3 SU-6.1.b.1

(Ω)

1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ /

6.1.6.4 SU-6.1.b.2

(Ω)1. Acceptance criteria is in the test itself. All acceptance criteria has been met.

_____ /

6.1.7 SU-1.7

6.1.7.1 TI-41

1. M/D flux map; 75% AFD Calibration

(Ω) A. The relative assembly power error (P_I) is within the limits of ±10% for $P_I > 0.9$, ± 15% for $P_I < 0.9$.

_____ / _____

(Ω) B. The quadrant power tilt ratio is ≤ 1.02.

_____ / _____

6.1.7.2 SU-4.7

(Ω)

1. The following acceptance criteria are to be used to determine successful test completion. Failure to meet these criteria does not constitute a need for stopping the test program. Correction of any deficiencies which preclude meeting these criteria should be accomplished as required consistent with the current plant schedule.

A. Reactor and turbine must not trip.

_____ / _____

B. Safety injection is not initiated.

_____ / _____

C. Neither the steam generator relief valves nor safety valves shall lift.

_____ / _____

D. Neither the pressurizer relief valves nor safety valves shall lift.

_____ / _____

E. No manual intervention shall be required to bring plant conditions to steady state.

_____ / _____

F. Plant variables (Tavg, Press, Feed flow, Steam flow, etc.) do not incur sustained or diverging oscillations.

_____ / _____

G. Nuclear power overshoot (undershoot) must be less than 3% for load increase (decrease).

_____ / _____

6.1.7.3 SU-4.8

(Ω) 1. The following acceptance criteria are to be used to determine successful test completion. Failure to meet there criteria does not constitute a need for stopping the test program.

A. Reactor and turbine must not trip.

_____ / _____

B. Safety injection is not initiated.

_____ / _____

C. Pressurizer safety valves shall not lift.

_____ / _____

D. Steam generator safety valves shall not lift.

_____ / _____

E. No manual intervention shall be required to bring plant conditions to equilibrium values following the transient.

_____ / _____

6.1.7.4 SU-6.1A

(Ω) 1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

_____ / _____

6.1.7.5 SU-6.1.b.1

(Ω) 1. Acceptance criteria is in the test. All acceptance criteria have been met.

_____ / _____

6.1.7.6 SU-6.1.b.2

(Ω) 1. Acceptance criteria is in the test. All acceptance criteria have been met.

_____ / _____

6.1.8 SU-1.8

6.1.8.1 TI-41

1. M/D Flux Map; 90%.

(Ω)
A. The relative assembly power error (PI) is within the limits of ± 10% for $P_I \geq 0.9$, ± 15% for $P_I < 0.9$.

_____ / _____

(Ω)
B. The quadrant power tilt ratio is ≤ 1.02.

_____ / _____

6.1.8.2 SU-6.1A

(Ω) 1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

_____ / _____

6.1.8.3 SU-6.1.b.1

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.8.4 SU-6.1.b.2

(Ω) 1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____ / _____

6.1.9 SU-1.9

6.1.9.1 TI-41

1. M/D Flux Map; HFP

(Ω) A. The relative assembly power error (P_I) is within the limits of ± 10% for $P_I \geq 0.9$, ± 15% for $P_I < 0.9$.

_____ /

(Ω) B. The Quadrant Power Tilt Ratio is ≤ 1.02.

_____ /

(Ω) C. $F^N_{\Delta H} = 1.33 \pm 0.13$

_____ /

6.1.9.2 SU-4.1

(Ω) 1. Power coefficient determination is within the the limits of :

$$\left| C^M \right| = \left| C^P \right| \pm 0.5°F/\%$$

_____ /

6.1.9.3 SU-4.6

(Ω) 1. Steam generator moisture carryover test is a conditional test starting with point #1 conditions.

a. Point #1 - 100% power, nominal warranty steam flow and pressure.

Point #2 - 96% power, same Tavg progam as point #1.

Point #3 - 92% power, same Tavg program as point #1.

Point #4 - 100% power, Tavg program approx 6°F lower than point #1.

Point #5 - 100% power, nominal warranty steam flow and pressure, water level 4% below point #1.

b. If the moisture carryover measurement is less than 0.1% at point #1, point #3 may be eliminated. If the moisture carryover measurement is less than 0.25% at point #1, point #5 may be eliminated. If the moisture carryover measurement is greater than 0.25% at point #1, point #4 may be eliminated. The points may be tested in any order following the initial moisture carryover measurement at point #1.

_____ / _____

c. The measured steam generator moisture carryover is less than or equal to 0.25%.

_____ / _____

6.1.9.4 SU-4.7

(Ω) 1. The following acceptance criteria are to be used to determine successful test completion. Failure to meet these criteria does not constitute a need for stopping the test program. Correction of any deficiencies which preclude meeting these criteria should be accomplished as required consistent with the current plant schedule.

A. Reactor and turbine must not be tripped.

_____ / _____

B. Safety injection is not initiated.

_____ / _____

C. Neither the steam generator relief valves nor safety valves shall lift.

_____ / _____

D. Neither the pressurizer relief valves nor safety valves shall lift.

_____ / _____

E. No manual intervention shall be required to bring the plant conditions to steady state.

_____ / _____

F. Plant variables (Tavg, Press, Feed flow, Steam flow, etc.) do not incur sustained or diverging oscillations.

_____/_____

G. Nuclear power overshoot (undershoot) must be less than 3% for load increase (decrease).

_____/_____

6.1.9.5 SU-4.8

(Ω) 1. The following acceptance criteria are to be used to determine successful test completion. Failure to meet these critria does not constitute a need for stopping the test program.

A. Reactor and turbine must not trip.

_____/_____

B. Safety injection is not initiated.

_____/_____

C. Pressurizer safety valves shall not lift.

_____/_____

D. Steam generator safety valves shall not lift.

_____/_____

E. No manual intervention shall be required to bring plant conditions to equilibrium valves following the transient.

_____/_____

6.1.9.6 SU-4.9B

(Ω) 1. The following acceptance criteria are to be used to determine successful test completion. Criteria must be met to consider the test satisfactory and allow the program to proceed.

A. Pressurizer safety valves shall not lift.

_____/_____

B. Steam generator safety valves shall not lift.

_____ / _____

C. Safety injection is not initiated.

_____ / _____

D. Nuclear flux must drop to 15% within 2 seconds after opening of the reactor trip breakers.

_____ / _____

E. All rods must release and drop.

_____ / _____

F. The turbine shall not trip.

_____ / _____

(Ω)2. The overall hot leg RTD response time must be no greater than 6 seconds.

_____ / _____

The overall hot leg RTD response time includes response of the RTD itself, and is defined for the purpose of this test as the interval of time measured between the point where the neutron flux has decreased by 50% of its initial value to the point where the hot leg temperature signal (as measured by the RTD output) has decreased by a value equivalent to 33-1/3% of the initial loop ΔT value in degrees Fahrenheit. Initial values are those recorded at the time the reactor trip breakers open.

(Ω)3. The following are expected minimum values during test accomplishment, but are not required for test acceptance.

A. Pressurizer level - minimum value 25% of level span.

_____ / _____

B. Pressurizer pressure - minimum value 2000 psig.

_____ / _____

(Ω)4. The following conditions shall be observed during the test, but are not required for test acceptance.

A. Pressurizer pressure is not expected to increase above its initial value.

_____ / _____

B. Feedwater flow should go to full shutoff prior to no load Tavg being reached.

_____ / _____

C. Tavg should steady out at or above no load Tavg without manual intervention on feed flow.

_____ / _____

D. Steam dump valves should modulate closed.

_____ / _____

E. Initially steam generator level may drop out of range.

_____ / _____

6.1.9.7 SU-5.1

(Ω)1. The reliability of the NSSS has been demonstrated by operating the plant at 95% to 100% of rated thermal output for 300 hours without a load reduction or plant trip resulting from an NSSS malfunction.

_____ / _____

(Ω)2. The NSSS is capable of developing the warranted output as calculated in the performance measurement portion (5.2) of SU-5.1.

_____ / _____

(Ω)3. Critical boron concentration ARO, HFP, Eq. Xenon is within the limits of 877 ± 50 ppm.

_____ / _____

6.1.9.8 SU-6.1A

(Ω)1. The plant manager shall be informed of any unusual radiation survey data and all data which exceeds the criteria stated on the data sheets.

23 _____ / _____

6.1.9.9 SU-6.1.b.1

(Ω)1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____/_____

6.1.9.10 SU-6.1.b.2

(Ω)1. Acceptance criteria is in the test itself. All acceptance criteria have been met.

_____/_____

TABLE 1

Definition of Abbreviations, Symbols, and Terms

A. ABBREVIATIONS

Abbreviation	Definition
AFD	Axial Flux Difference
BA	Concentrated Boric Acid
C	Control (banks of RCCAs) as CA, CB, CC, CD
CB	Boron Concentration
CRDM	Control Rod Drive Mechanism
CVCS	Chemical and Volume Control System
DRPI	Digital Rod Position Indication
ICRR	Inverse Count Rate Ration
IR	Intermediate Range nuclear channel
FW	Feedwater
mv	Millivolts (10^{-3} volts)
NIS	Nuclear Instrumentation System
NSSS	Nuclear Steam Supply System
P	Pressure
pcm	Percent mille - Reactivity unit equal to 1×10^{-5}
PR	Power Range nuclear channel
PRZ	Pressurizer
RCC	Rod Cluster Control
RCCA	Rod Cluster Control Assembly (rod)
RCP	Reactor Cooland Pump
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RMW	Reactor Makeup (demineralized) Water
ARPI	Analog Rod Position Indication
RTD	Resistance Temperature Detector
SIS	Safety Injection System
SD	Shutdown (banks or RCCAs) as SDA, SDB, etc.
SG	Steam Generator
SR	Source Range nuclear channel
Step	Smallest possible increment of RCCA motion
T	Temperature

TABLE 1

B. SYMBOLS

Symbols	Definition
Q	Core thermal powr level (% of full power)
ΔQ	Change in core thermal power level
q_T	Thermal power in top half of core
q_B	Thermal power in bottom half of core
I	Detector current, power range detector
I_T	Detector current in top detector
I_B	Detector current in bottom detector
$(AO)_{IN}$	Incore Axial Offset, $(q_T - q_B)/(q_T + q_B)$
T/C	Incore Thermocouple
M/D	Incore Moveable Detector
F/L	Full Length (RCCA)
Ω	Greek letter Omega (Nuclear Design Criteria)
β	Greek letter Beta (Nuclear Safety Criteria)
C_B	Boron Concentration
ρ	Reactivity
k	Core multiplication constant
$\Delta\rho$	Reactivity change $(\ln \frac{\text{final } k}{\text{initial } k})$
τ	Reactor period
α_{ISO}	Isothermal temperature coefficient
α_M	Moderator temperature coefficient
α_F	Fuel temperature coefficient
Φ	Neutron flux
μa	Micro-amps (10^{-6} amperes)

TABLE 1

B. SYMBOLS

Symbols	Definition
T_c	Reactor vessel inlet temperature
T_h	Reactor vessel outlet temperature
T_{avg}	Reactor coolant average temperature 1/2 $(T_h + T_c)$
T_{ref}	Programmed T_{avg}
ΔT	$(T_h - T_c)$
F_q^N	Nuclear Heat Flux Hot Channel Factor, defined as the maximum local fuel rod linear power density divided by the average fuel rod linear power density, assuming nominal fuel pellet and rod parameters.
F_q^E	Engineering uncertainity (1.03), 3%
F_q^U	Measurement uncertainty (1.05), 5%
F_q^T	$F_q^T = F_q^N \times F_q^U \times F_q^E$
$F_q(Z)$	Axial Nuclear Heat Flux Hot Channel Factor, defined as the maximum local fuel rod power density in plane Z divided by the average fuel rod linear power density.
$F_{\Delta H}^N$	Nuclear Enthalpy Rise Hot Channel Factor, defined as the ratio of the integral of linear power along the rod with the highest integrated power to the average rod power, assuming nominal fuel pellet and rod parameters.
$\Delta\rho_c$	Reactivity Computer Results (pcm)
$\Delta\rho\tau$	Reactivity from a stable reactor period (pcm)

C. TERMS

Term	Definition
Stable Temperature	RCS temperature (T_{avg}) drift $\leq$ 3°F/hr
Stable Power	Drift $\leq$ 5%/hr
Stable RCS C_B	Spread of measured RCS boron concentration values, taken at intervals of 15-20 min, $\leq$ 6 ppm from average.

TABLE 1

C. TERMS

Term	Definition
Stable Xenon	Reactivity drift from Xenon change $\leq$ 5 pcm/hr
Stable Reactor	Reactivity drift $\leq$ 5 pcm/hr
Critical	Core reactivity of 0 $\pm$ 1 pcm
Calorimetrics	Determination of core thermal power from secondary side heat balance measurements across the steam generators.

TABLE 2

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the post core loading precritical test sequence as listed below have been completed.

SU-1.2, Initial Core Loading Test Sequence
SU-2.1, Initial Core Loading
SU-2.2, Core Loading Periodic Checklist
SU-2.3, Reactor System Sampling for Core Loading
SU-2.4, Core Loading Instrumentation and Neutron Source Requirements

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 3

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the low power testing plateau as listed below have been completed.

All tests called out in SU-1.3, Post Core Loading Precritical Test Sequence with the exception of:

W-1.6, Reactor Coolant System Flow Measurement
W-1.8, Reactor Coolant System Flow Coastdown

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 4

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the 30% power testing plateau as listed below have been completed.

W-1.6, Reactor Coolant System Flow Measurement of SU-1.3
SU-3.2, Initial Criticality
SU-3.3, Core Power Range for Physics Testing
SU-3.5, Boron Endpoint Determination (ARO)
SU-3.6, Isothermal Temperature Coefficient (ARO)
TI-41, Incore Flux Mapping (ARO)
SU-3.8A, RCCA Bank Worth Measurements at Zero Power (CD)
SU-3.9, Natural Circulation
TI-7, Reactivity Computer Setup
SU-6.1A, Baseline Radiation Survey of SU-1.4
SU-6.1.b.1, Plant Measurements-Operational Baseline Data (Primary) - Chemical and Radiochemical of SU-1.4
SU-6.1.b.2, Plant Measurements-Operational Baseline Data (Secondary) - Chemical and Radiochemical of SU-1.4

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 5

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the 50% power testing plateau as listed below have been completed.

SU-4.5, Thermal Power Measurement and Statepoint Data of SU-1.5
SU-6.1A, Baseline Radiation Survey of SU-1.5
SU-6.1.b.1, Plant Measurements-Operational Baseline Data (Primary) - Chemical and Radiochemical of SU-1.5
SU-6.1.b.2, Plant Measurements-Operational Baseline Data (Secondary) - Chemical and Radiochemical of SU-1.5
SU-6.2, Loss of Offsite Power
SU-6.3, Shutdown from Outside Control Room

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 6

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the 75% power testing plateau as listed below have been completed.

SU-3.5,	Boron Endpoint Determination (All Bank Positions) of SU-1.4
SU-3.6,	Isothermal Temperature Coefficient (CD at Zero) of SU-1.4
TI-41,	Incore Flux Mapping (CD at Zero) of SU-1.4
SU-3.8B,	Rod Worth Measurement Using Rod Swap (All banks with exception of CD)
SU-4.5	Thermal Power Measurement and State Point Data of SU-1.6.
SU-6.1A,	Baseline Radiation Survey of SU-1.6
SU-6.1.b.1,	Plant Measurements-Operational Baseline Data (Primary) - Chemical and Radiochemical of SU-1.6
SU-6.1.b.2,	Plant Measurements-Operational Baseline Data (Secondary) - Chemical and Radiochemical of SU-1.6

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 7

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the 90% power testing plateau as listed below have been completed.

W-1.8,	Reactor Coolant System Flow Coastdown of SU-1.3
SU-4.5,	Thermal Power Measurement and Statepoint Data of SU-1.7
SU-4.7,	Load Swing Test of SU-1.5
SU-6.1A,	Baseline Radiation Survey of SU-1.7
SU-6.1.b.1,	Plant Measurements-Operational Baseline Data (Primary) - Chemical and Radiochemical of SU-1.7
SU-6.1.b.2,	Plant Measurements-Operational Baseline Data (Secondary) - Chemical and Radiochemical of SU-1.7
T1-41,	Flux Mapping (M/D Flux Map 50%) of SU-1.6

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

TABLE 8

PRELIMINARY TEST RESULTS

Those startup tests required to be performed and analyzed prior to ascending to the 100% power testing plateau as listed below have been completed.

SU-4.7,	Load Swing Test of SU-1.7
SU-4.8,	Large Load Reduction Test of SU-1.7
TI-41,	Flux Mapping (M/D Flux Map 50% RCCA Pseudo Drop) of SU-1.6
SU-4.5,	Thermal Power Measurement and State Point Data of SU-1.8
SU-6.1A,	Baseline Radiation Survey of SU-1.8
SU-6.1.b.1,	Plant Measurements - Operational Baseline Data (Primary) - Chemical and Radiochemical of SU-1.8
SU-6.1.b.2,	Plant Measurements - Operational Baseline Data (Secondary) - Chemical and Radiochemical of SU-1.8.

Remarks and Outstanding Deficiencies

Test Engineer _____ / _____

Reactor Unit Supv. _____ / _____

Engineering Section Supv. _____ / _____

PORC Review _____ / _____

Approved _____ / _____
Plant Manager

STARTUP TESTING SEQUENCE

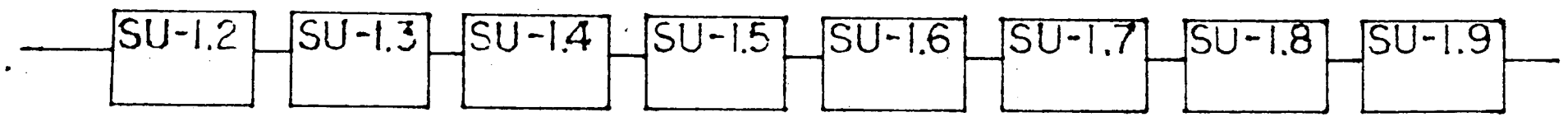

FIGURE 1.

APPENDIX A

REFERENCES

1. Final Safety Analysis Report (FSAR)
2. Technical Specification
3. NSSS Startup Manual
4. Precautions, Limitations, and Setpoints for the Westinghouse NSSS
5. Nuclear Design Report, WCAP-9983
6. AI-6.3, Startup Test Program
7. GOIs
8. Startup Tests
   - SU-1.2, Initial Core Loading Test Sequence
   - SU-1.3, Post Core Loading Precritical Test Sequence
   - SU-1.4, Initial Criticality and Low Power Test Sequence
   - SU-1.5, 30% Power Test Sequence
   - SU-1.6, 50% Power Test Sequence
   - SU-1.7, 75% Power Test Sequence
   - SU-1.8, 90% Power Test Sequence
   - SU-1.9, 100% Power Test Sequence
   - SU-2.2, Core Loading Periodic Checklist
   - SU-2.3, Reactor System Sampling for Core Loading
   - SU-2.4, Core Loading Instrumentation and Neutron Source Requirements
   - SU-3.2, Initial Criticality
   - SU-3.3, Core Power Range for Physics Testing
   - SU-3.5, Boron Endpoint Determination
   - SU-3.6, Isothermal Temperature Coefficient
   - SU-3.8A, RCCA or Bank Worth Measurements at Low Power
   - SU-3.8B, RCCA Bank Worth Measurements Using Rod Swap
   - SU-4.1, Power Coefficient Determination
   - SU-4.6, Steam Generator Mositure Carryover Measurement
   - SU-4.7, Load Swing Tests
   - SU-4.8, Large Load Reduction Test
   - SU-4.9B, Plant Trip from 100% Power (Load Rejection)
   - SU-5.1, NSSS Acceptance Test
   - SU-6.1A, Plant Measurements - Radiation Baseline Data
   - SU-6.1.b.1, Plant Measurements - Operational & Baseline Data (Primary) - Chemical & Radiochemical
   - SU-6.1.b.2, Plant Measurements - Operational & Baseline Data (Secondary) - Chemical & Radiochemical
   - SU-6.2, Loss of Offsite Power
   - SU-6.3, Shutdown from Outside the Control Room.
9. TIs
   - TI-7, Reactivity Computer Setup
   - TI-28, Physical Verification of Core Load Prior to Vessel Closure
   - TI-16, Sampling Methods
   - TI-41, Incore Flux Mapping
10. AOI-27, Main Control Room Inaccessibility
11. Preop Tests
   - W-1.6, Reactor Coolant System Flow Measurement
   - W-1.8, Reactor Coolant System Flow Coastdown
   - W-9.5, Operational Alignment of Nuclear Instrumentation